J.K.K. MUNIRAJAH COLLEGE OF TECHNOLOGY

(AUTONOMOUS)

Approved by AICTE, New Delhi and Affiliated to Anna University, Chennai.

Accredited by NAAC with "A" grade

T.N. Palayam (Po), Gobi (Tk), Erode (Dt) – 638 506

1.1.1 The institution ensures effective curriculum delivery through a well-planned system and Documentation process

ACADEMIC YEAR 2023-2024

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INSTITUTION ACADEMIC CALENDAR FOR THE ODD SEMESTER 2023 - 2024

DATE	DAY	PARTICULARS
01-Jul-23	Saturday	
02-Jul-23	Sunday	Holiday
03-Jul-23	Monday	
04-Jul-23	Tuesday	
05-Jul-23	Wednesday	
06-Jul-23	Thursday	
07-Jul-23	Friday	BLOOD DONATION CAMP - Conducted by NSS Unit
08-Jul-23	Saturday	
09-Jul-23	Sunday	Holiday
10-Jul-23	Monday	
11-Jul-23	Tuesday	BLOOD DONATION CAMP - Conducted by NSS Unit
12-Jul-23	Wednesday	
13-Jul-23	Thursday	
14-Jul-23	Friday	
15-Jul-23	Saturday	Holiday
16-Jul-23	Sunday	Holiday
17-Jul-23	Monday	
18-Jul-23	Tuesday	
19-Jul-23	Wednesday	
20-Jul-23	Thursday	CLUB INAUGURAL FUNCTION - Conducted by ECO-SDG Club
21-Jul-23	Thursday	
22-Jul-23	Saturday	
23-Jul-23	Sunday	Holiday
24-Jul-23	Monday	
25-Jul-23	Tuesday	
26-Jul-23	Wednesday	
27-Jul-23	Thursday	Commencement of ODD SEMESTER Classes for UG (B.E/B.TECH - III & IV YEAR - SEM - V,VII)
28-Jul-23	Friday	
29-Jul-23	Saturday	Holiday - Muharram
30-Jul-23	Sunday	Holiday
31-Jul-23	Monday	
01-Aug-23	Tuesday	INTERNAL ASSESSMENT – I UG - B.E / B.TECH - I Year - II SEM
02-Aug-23	Wednesday	INTERNAL ASSESSMENT – I UG - B.E / B.TECH - I Year - II SEM
03-Aug-23	Thursday	Holiday - Aadi Perukku
04-Aug-23	Friday	INTERNAL ASSESSMENT – I UG - B.E / B.TECH - I Year - II SEM
05-Aug-23	Saturday	OUTCOME BASED EDUCATION - Conducted by Faculty Welfare Club
06-Aug-23	Sunday	Holiday
07-Aug-23	Monday	
08-Aug-23	Tuesday	CLIMATE QUEST - Conducted by JKKM Community Radio Station
09-Aug-23	Wednesday	PLASTIC FREE CAMPUS - Conducted by ECO-SDG Club
10-Aug-23	Thursday	ERODE BOOK FESTIVAL
11-Aug-23	Friday	ANTI-DRUG AWARENESS RALLY - Conducted by NSS Unit / THE ABUSE OF OLDER PEOPLE RALLY - Conducted by ECO-SDG club
12-Aug-23	Saturday	Holiday
13-Aug-23	Sunday	Holiday
14-Aug-23	Monday	Holiday
15-Aug-23	Tuesday	Holiday - Independence Day
16-Aug-23	Wednesday	
17-Aug-23	Thursday	CHALLENGE WALKING OF 10000 STEPS IN 90 MINUTES - Conducted by ECO-SDG Club
18-Aug-23	Friday	SLOW CYCLING COMPETITION - Conducted by ECO-SDG Club
19-Aug-23	Saturday	
20-Aug-23	Sunday	Holiday
21-Aug-23	Monday	
22-Aug-23	Tuesday	DRAWING COMPETITION - Conducted by ECO-SDG Club
23-Aug-23	Wednesday	
24-Aug-23	Thursday	
25-Aug-23	Friday	YOGA COMPETITION - Conducted by ECO-SDG Club
26-Aug-23	Saturday	
27-Aug-23	Sunday	Holiday

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DATE	DAY	PARTICULARS
28-Aug-23	Monday	
29-Aug-23	Tuesday	
30-Aug-23	Wednesday	TREE PLANTATION - Conducted by ECO-SDG Club
31-Aug-23	Thursday	
01-Sep-23	Friday	
02-Sep-23	Saturday	
03-Sep-23	Sunday	Holiday
04-Sep-23	Monday	IV Semester MCA Project Viva Examination for April/May 2023
05-Sep-23	Tuesday	
06-Sep-23	Wednesday	Holiday - Krishna Jayanthi
07-Sep-23	Thursday	
08-Sep-23	Friday	
09-Sep-23	Saturday	
10-Sep-23	Sunday	Holiday
11-Sep-23	Monday	Commencement of ODD SEMESTER Classes for PG (MBA & M.E & MCA - SEM - I)
12-Sep-23	Tuesday	ONE DAY WORKSHOP - Conducted by ECE Department
13-Sep-23	Wednesday	
14-Sep-23	Thursday	MOTIVATIONAL SPEECH - Conducted by Women Empowerment Cell
15-Sep-23	Friday	
16-Sep-23	Saturday	
17-Sep-23	Sunday	Holiday
18-Sep-23	Monday	
19-Sep-23	Tuesday	
20-Sep-23	Wednesday	Commencement of ODD SEMESTER Classes for UG (B.E/B.TECH - SEM - III)

DATE	DAY	PARTICULARS
21-Sep-23	Thursday	INTERNAL ASSESSMENT – I UG (B.E / B.TECH - III & IV Year - V, VII SEM)
22-Sep-23	Friday	INTERNAL ASSESSMENT – I UG (B.E / B.TECH - III & IV Year - V, VII SEM)
23-Sep-23	Saturday	INTERNAL ASSESSMENT – I UG (B.E / B.TECH - III & IV Year - V, VII SEM)
24-Sep-23	Sunday	Holiday
25-Sep-23	Monday	MOTIVATIONAL PROGRAMME - Conducted by Automobile Engineering Department
26-Sep-23	Tuesday	ONE DAY WORKSHOP - Conducted by Mechanical Engineering Department / ENTREPRENEURSHIP DEVELOPMENT CELL - Inaugural Function
27-Sep-23	Wednesday	
28-Sep-23	Thursday	Holiday - Milad-Un-Nabi
29-Sep-23	Friday	
30-Sep-23	Saturday	
01-Oct-23	Sunday	Holiday
02-Oct-23	Monday	Holiday - Gandhi Jayanthi
03-Oct-23	Tuesday	
04-Oct-23	Wednesday	
05-Oct-23	Thursday	
06-Oct-23	Friday	ONE DAY WORKSHOP - Conducted by CSE & IT Department
07-Oct-23	Saturday	
08-Oct-23	Sunday	Holiday
09-Oct-23	Monday	IV Semester M.E Project Viva Examination for April/May 2023
10-Oct-23	Tuesday	POSTER MAKING COMPETITION - Conducted by Electoral Literacy Club
11-Oct-23	Wednesday	
12-Oct-23	Thursday	INTERNAL ASSESSMENT – II UG (B.E / B.TECH - IV Year - VII SEM) / INTERNAL ASSESSMENT – I PG (MCA - II Year - III SEM)
13-Oct-23	Friday	INTERNAL ASSESSMENT – II UG (B.E / B.TECH - IV Year - VII SEM) / INTERNAL ASSESSMENT – I PG (MCA - II Year - III SEM)
14-Oct-23	Saturday	INTERNAL ASSESSMENT – II UG (B.E / B.TECH - IV Year - VII SEM) / INTERNAL ASSESSMENT – I PG (MCA - II Year - III SEM)

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DATE	DAY	PARTICULARS
15-Oct-23	Sunday	Holiday
16-Oct-23	Monday	
17-Oct-23	Tuesday	Importance of Networking for Entrepreneurs - Conducted by IT Department
18-Oct-23	Wednesday	
19-Oct-23	Thursday	
20-Oct-23	Friday	
21-Oct-23	Saturday	Holiday
22-Oct-23	Sunday	Holiday
23-Oct-23	Monday	Holiday - Pooja
24-Oct-23	Tuesday	Holiday - Pooja
25-Oct-23	Wednesday	
26-Oct-23	Thursday	
27-Oct-23	Friday	
28-Oct-23	Saturday	
29-Oct-23	Sunday	Holiday
30-Oct-23	Monday	
31-Oct-23	Tuesday	
01-Nov-23	Wednesday	
02-Nov-23	Thursday	
03-Nov-23	Friday	
04-Nov-23	Saturday	PATENT DRAFTING - Conducted by FACULTY WELFARE CLUB
05-Nov-23	Sunday	Holiday
06-Nov-23	Monday	
07-Nov-23	Tuesday	
08-Nov-23	Wednesday	
09-Nov-23	Thursday	
10-Nov-23	Friday	Holiday- DIWALI
11-Nov-23	Saturday	Holiday- DIWALI
12-Nov-23	Sunday	Holiday
13-Nov-23	Monday	Holiday- DIWALI
14-Nov-23	Tuesday	
15-Nov-23	Wednesday	INTERNAL ASSESSMENT – II UG (B.E / B.TECH - III Year - V SEM) / INTERNAL ASSESSMENT – III UG (B.E / B.TECH - IV Year - VII SEM)
16-Nov-23	Thursday	INTERNAL ASSESSMENT – II UG (B.E / B.TECH - III Year - V SEM) / INTERNAL ASSESSMENT – III UG (B.E / B.TECH - IV Year - VII SEM) / INTERNAL ASSESSMENT – I UG & PG - I Year - I SEM / INTERNAL ASSESSMENT - I UG & PG (B.E/B.TECH / M.E / MBA) - II YEAR - III SEM
17-Nov-23	Friday	INTERNAL ASSESSMENT – II UG (B.E / B.TECH - III Year - V SEM) / INTERNAL ASSESSMENT – III UG (B.E / B.TECH - IV Year - VII SEM) / INTERNAL ASSESSMENT – I UG & PG - I Year - I SEM / INTERNAL ASSESSMENT - I UG & PG (B.E/B.TECH / M.E / MBA) - II YEAR - III SEM
18-Nov-23	Saturday	INTERNAL ASSESSMENT – I UG & PG - I Year - I SEM / INTERNAL ASSESSMENT - I UG & PG (B.E/B.TECH / M.E / MBA) - II YEAR - III SEM
19-Nov-23	Sunday	Holiday
20-Nov-23	Monday	
21-Nov-23	Tuesday	
22-Nov-23	Wednesday	
23-Nov-23	Thursday	
24-Nov-23	Friday	
25-Nov-23	Saturday	
26-Nov-23	Sunday	Holiday
27-Nov-23	Monday	
28-Nov-23	Tuesday	
29-Nov-23	Wednesday	

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DATE	DAY	PARTICULARS
30-Nov-23	Thursday	INTERNAL ASSESSMENT – II PG (MCA - II Year - III SEM)
01-Dec-23	Friday	INTERNAL ASSESSMENT – II PG (MCA - II Year - III SEM)
02-Dec-23	Saturday	INTERNAL ASSESSMENT – II PG (MCA - II Year - III SEM)
03-Dec-23	Sunday	Holiday
04-Dec-23	Monday	
05-Dec-23	Tuesday	
06-Dec-23	Wednesday	
07-Dec-23	Thursday	
08-Dec-23	Friday	
09-Dec-23	Saturday	Holiday
10-Dec-23	Sunday	Holiday
11-Dec-23	Monday	
12-Dec-23	Tuesday	
13-Dec-23	Wednesday	
14-Dec-23	Thursday	
15-Dec-23	Friday	
16-Dec-23	Saturday	LETTER WRITING COMPETITION - Conducted by NSS Unit & ELC Club
17-Dec-23	Sunday	Holiday
18-Dec-23	Monday	
19-Dec-23	Tuesday	
20-Dec-23	Wednesday	
21-Dec-23	Thursday	
22-Dec-23	Friday	

DATE	DAY	PARTICULARS
23-Dec-23	Saturday	
24-Dec-23	Sunday	Holiday
25-Dec-23	Monday	Holiday - Christmas
26-Dec-23	Tuesday	
27-Dec-23	Wednesday	SINGING COMPETITION - Conducted by Electoral Literacy Club
28-Dec-23	Thursday	INTERNAL ASSESSMENT – II UG & PG - I Year - I SEM / INTERNAL ASSESSMENT - II UG & PG (B.E/B.TECH / M.E / MBA) - II YEAR - III SEM
29-Dec-23	Friday	INTERNAL ASSESSMENT – II UG & PG - I Year - I SEM / INTERNAL ASSESSMENT - II UG & PG (B.E/B.TECH / M.E / MBA) - II YEAR - III SEM
30-Dec-23	Saturday	INTERNAL ASSESSMENT – II UG & PG - I Year - I SEM / INTERNAL ASSESSMENT - II UG & PG (B.E/B.TECH / M.E / MBA) - II YEAR - III SEM
31-Dec-23	Sunday	Holiday
01-Jan-24	Monday	Holiday - New Year
02-Jan-24	Tuesday	
03-Jan-24	Wednesday	
04-Jan-24	Thursday	
05-Jan-24	Friday	
06-Jan-24	Saturday	
07-Jan-24	Sunday	Holiday
08-Jan-24	Monday	
09-Jan-24	Tuesday	
10-Jan-24	Wednesday	
11-Jan-24	Thursday	ON CAMPUS DRIVE - Conducted by Training and Placement Cell
12-Jan-24	Friday	
13-Jan-24	Saturday	Holiday - Pongal
14-Jan-24	Sunday	Holiday

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DATE	DAY	PARTICULARS
15-Jan-24	Monday	Holiday - Pongal
16-Jan-24	Tuesday	Holiday - Pongal
17-Jan-24	Wednesday	Holiday - Pongal
18-Jan-24	Thursday	
19-Jan-24	Friday	
20-Jan-24	Saturday	
21-Jan-24	Sunday	Holiday
22-Jan-24	Monday	
23-Jan-24	Tuesday	

DATE	DAY	PARTICULARS
24-Jan-24	Wednesday	
25-Jan-24	Thursday	Holiday - Thaipoosam
26-Jan-24	Friday	Holiday - Republic day
27-Jan-24	Saturday	
28-Jan-24	Sunday	Holiday
29-Jan-24	Monday	BLOOD DONATION CAMP - Conducted by EEE department
30-Jan-24	Tuesday	
31-Jan-24	Wednesday	

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INSTITUTION ACADEMIC CALENDAR FOR THE EVEN SEMESTER 2023 - 2024

DATE	DAY	PARTICULARS
01-Feb-24	Thursday	Commencement of EVEN SEMESTER classes for UG (B.E & B.Tech - VI & VIII SEM)
02-Feb-24	Friday	
03-Feb-24	Saturday	
04-Feb-24	Sunday	Holiday
05-Feb-24	Monday	
06-Feb-24	Tuesday	
07-Feb-24	Wednesday	Protecting Innovations in the Technical World - Seminar Conducted by CSE & IT Department
08-Feb-24	Thursday	
09-Feb-24	Friday	
10-Feb-24	Saturday	
11-Feb-24	Sunday	Holiday
12-Feb-24	Monday	
13-Feb-24	Tuesday	WORLD RADIO DAY - Conducted by JKKM Community Radio Station
14-Feb-24	Wednesday	
15-Feb-24	Thursday	
16-Feb-24	Friday	
17-Feb-24	Saturday	Holiday
18-Feb-24	Sunday	Holiday
19-Feb-24	Monday	
20-Feb-24	Tuesday	
21-Feb-24	Wednesday	
22-Feb-24	Thursday	
23-Feb-24	Friday	
24-Feb-24	Saturday	
25-Feb-24	Sunday	Holiday
26-Feb-24	Monday	
27-Feb-24	Tuesday	
28-Feb-24	Wednesday	
29-Feb-24	Thursday	
01-Mar-24	Friday	
02-Mar-24	Saturday	
03-Mar-24	Sunday	Holiday
04-Mar-24	Monday	
05-Mar-24	Tuesday	
06-Mar-24	Wednesday	
07-Mar-24	Thursday	INTERNAL ASSESSMENT – I (UG IV & III Year - B.E & B.TECH)
08-Mar-24	Friday	INTERNAL ASSESSMENT – I (UG IV & III Year - B.E & B.TECH) / WOMEN'S DAY CELEBRATION - Conducted by Women's Empowerment Cell
09-Mar-24	Saturday	INTERNAL ASSESSMENT – I (UG IV & III Year - B.E & B.TECH)
10-Mar-24	Sunday	Holiday
11-Mar-24	Monday	
12-Mar-24	Tuesday	
13-Mar-24	Wednesday	Commencement of EVEN SEMESTER classes for UG & PG (B.E & B.Tech - II & IV SEM / MCA - IV SEM / MBA - II & IV SEM / M.E - II & IV SEM)
14-Mar-24	Thursday	
15-Mar-24	Friday	
16-Mar-24	Saturday	Holiday
17-Mar-24	Sunday	Holiday

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DATE	DAY	PARTICULARS
18-Mar-24	Monday	CAREER GUIDANCE TRAINING AND PLACEMENT - Conducted by Training & Placement Cell
19-Mar-24	Tuesday	
20-Mar-24	Wednesday	TRENDS AND OPPORTUNITIES OF RAPID PROTOTYPING TECHNOLOGIES - Conducted by AUTO, MECH & EEE Department
21-Mar-24	Thursday	
22-Mar-24	Friday	
23-Mar-24	Saturday	
24-Mar-24	Sunday	Holiday
25-Mar-24	Monday	Commencement of EVEN SEMESTER classes for PG (MCA - II SEM)
26-Mar-24	Tuesday	Holiday - Local Festival
27-Mar-24	Wednesday	
28-Mar-24	Thursday	RECENT TRENDS IN GREEN POWER TECHNOLOGY - Conducted by AUTO, MECH & EEE Department
29-Mar-24	Friday	Holiday - Good Friday
30-Mar-24	Saturday	Holiday
31-Mar-24	Sunday	Holiday
01-Apr-24	Monday	
02-Apr-24	Tuesday	
03-Apr-24	Wednesday	
04-Apr-24	Thursday	INTERNAL ASSESSMENT – II (UG IV Year - B.E & B.TECH)
05-Apr-24	Friday	INTERNAL ASSESSMENT – II (UG IV Year - B.E & B.TECH)
06-Apr-24	Saturday	INTERNAL ASSESSMENT – II (UG IV Year - B.E & B.TECH)
07-Apr-24	Sunday	Holiday
08-Apr-24	Monday	
09-Apr-24	Tuesday	Holiday - Ugadi
10-Apr-24	Wednesday	Government funding and policy for Research and Development - Seminar Conducted by CSE & IT Department
11-Apr-24	Thursday	Holiday - Ramzan
12-Apr-24	Friday	
13-Apr-24	Saturday	
14-Apr-24	Sunday	Holiday
15-Apr-24	Monday	
16-Apr-24	Tuesday	
17-Apr-24	Wednesday	
18-Apr-24	Thursday	
19-Apr-24	Friday	Holiday - Election
20-Apr-24	Saturday	Holiday
21-Apr-24	Sunday	Holiday
22-Apr-24	Monday	
23-Apr-24	Tuesday	
24-Apr-24	Wednesday	
25-Apr-24	Thursday	INTERNAL ASSESSMENT – III (UG IV Year - B.E & B.TECH) / INTERNAL ASSESSMENT – II (UG III Year - B.E & B.TECH) INTERNAL ASSESSMENT – I (UG & PG I & II Year)
26-Apr-24	Friday	INTERNAL ASSESSMENT – III (UG IV Year - B.E & B.TECH) / INTERNAL ASSESSMENT – II (UG III Year - B.E & B.TECH). INTERNAL ASSESSMENT – I (UG & PG I & II Year)
27-Apr-24	Saturday	INTERNAL ASSESSMENT – III (UG IV Year - B.E & B.TECH) / INTERNAL ASSESSMENT – II (UG III Year - B.E & B.TECH) INTERNAL ASSESSMENT – I (UG & PG I & II Year)
28-Apr-24	Sunday	Holiday

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29-Apr-24	Monday	ON CAMPUS DRIVE - Conducted by Training & Placement Cell
30-Apr-24	Tuesday	ON CAMPUS DRIVE - Conducted by Training & Placement Cell
01-May-24	Wednesday	Holiday - May Day
02-May-24	Thursday	
03-May-24	Friday	
04-May-24	Saturday	Holiday
05-May-24	Sunday	Holiday
06-May-24	Monday	
07-May-24	Tuesday	
08-May-24	Wednesday	
09-May-24	Thursday	
10-May-24	Friday	
11-May-24	Saturday	ONLINE WORKSHOP - Conducted by Training & Placement Cell
12-May-24	Sunday	Holiday
13-May-24	Monday	
14-May-24	Tuesday	
15-May-24	Wednesday	Commencement of Theory Examination for UG & PG APRIL / MAY 2024
16-May-24	Thursday	
17-May-24	Friday	
18-May-24	Saturday	Holiday
19-May-24	Sunday	Holiday
20-May-24	Monday	
21-May-24	Tuesday	
22-May-24	Wednesday	
23-May-24	Thursday	
24-May-24	Friday	

DATE	DAY	PARTICULARS
25-May-24	Saturday	
26-May-24	Sunday	Holiday
27-May-24	Monday	
28-May-24	Tuesday	
29-May-24	Wednesday	
30-May-24	Thursday	
31-May-24	Friday	
01-Jun-24	Saturday	Holiday
02-Jun-24	Sunday	Holiday
03-Jun-24	Monday	
04-Jun-24	Tuesday	
05-Jun-24	Wednesday	WORLD ENVIRONMENT DAY - Conducted by EEE Department
06-Jun-24	Thursday	INTERNAL ASSESSMENT – II (UG & PG I & II Year) / Commencement of Theory Examination for UG & PG APRIL / MAY 2024
07-Jun-24	Friday	INTERNAL ASSESSMENT – II (UG & PG I & II Year)
08-Jun-24	Saturday	INTERNAL ASSESSMENT – II (UG & PG I & II Year)
09-Jun-24	Sunday	Holiday
10-Jun-24	Monday	
11-Jun-24	Tuesday	
12-Jun-24	Wednesday	
13-Jun-24	Thursday	

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DATE	DAY	PARTICULARS
14-Jun-24	Friday	
15-Jun-24	Saturday	
16-Jun-24	Sunday	Holiday
17-Jun-24	Monday	Holiday - Bakrid
18-Jun-24	Tuesday	
19-Jun-24	Wednesday	
20-Jun-24	Thursday	MASS YOGA REVELATION SESSION- Conducted by NSS Unit
21-Jun-24	Friday	INTERNATIONAL YOGA DAY - Conducted by JKKM Community Radio Station & NSS Unit
22-Jun-24	Saturday	
23-Jun-24	Sunday	Holiday
24-Jun-24	Monday	
25-Jun-24	Tuesday	
26-Jun-24	Wednesday	
27-Jun-24	Thursday	
28-Jun-24	Friday	
29-Jun-24	Saturday	Holiday
30-Jun-24	Sunday	Holiday
01-Jul-24	Monday	
02-Jul-24	Tuesday	
03-Jul-24	Wednesday	
04-Jul-24	Thursday	
05-Jul-24	Friday	
06-Jul-24	Saturday	
07-Jul-24	Sunday	Holiday

DATE	DAY	PARTICULARS
08-Jul-24	Monday	
09-Jul-24	Tuesday	
10-Jul-24	Wednesday	
11-Jul-24	Thursday	
12-Jul-24	Friday	
13-Jul-24	Saturday	
14-Jul-24	Sunday	Holiday
15-Jul-24	Monday	
16-Jul-24	Tuesday	
17-Jul-24	Wednesday	Holiday - Muharram
18-Jul-24	Thursday	
19-Jul-24	Friday	
20-Jul-24	Saturday	
21-Jul-24	Sunday	Holiday
22-Jul-24	Monday	
23-Jul-24	Tuesday	
24-Jul-24	Wednesday	
25-Jul-24	Thursday	
26-Jul-24	Friday	
27-Jul-24	Saturday	
28-Jul-24	Sunday	Holiday
29-Jul-24	Monday	
30-Jul-24	Tuesday	
31-Jul-24	Wednesday	MBA Project viva for April/May 2024

Principal
J.K.K.Munirajah College of Technology
(Autonomous)
T.N.Palayam, Gobi (Tk),
Erode (Dt) - 638 506.

Date: 02.09.2023

CENTRE FOR ACADEMIC COURSES

ANNA UNIVERSITY: : CHENNAI – 600 025

ACADEMIC SCHEDULE FOR NON-AUTONOMOUS AFFILIATED COLLEGES

September 2023 – January 2024 (Odd Semester – Semester I)

PG (FT/PT) Degree Programmes

Sl. No.	Programme	Semester	Commencement of Classes	Last working day	Commencement of Practical Examinations	Commencement of End Semester Examinations
1.	M.E. / M. Tech. / M. Arch.(FT)	I	11.09.2023	30.12.2023	05.01.2024	22.01.2024
2.	M.B.A. (Full-Time & Part-Time)					
3.	M.B.A. (5 Yrs-Integrated)					

RE-OPENING DAY FOR THE NEXT SEMESTER: 28.02.2024 (Wednesday)

NOTE:

1. The Theory and Practical Examination schedules will be published in due course. (Practical Examinations will be conducted before the theory examinations).
2. If necessary, loss of classes due to various curricular / co-curricular activities of the department / college may be compensated by conducting classes on Saturdays.

02/09/2023

DIRECTOR
ACADEMIC COURSES

PRINCIPAL
JKK MUNIRAJAH COLLEGE
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DAC - SB

Date: 02.09.2023

DIRECTOR ACADEMIC COURSES ANNA UNIVERSITY CHENNAI-600 025

CENTRE FOR ACADEMIC COURSES

ANNA UNIVERSITY: : CHENNAI – 600 025

ACADEMIC SCHEDULE FOR NON-AUTONOMOUS AFFILIATED COLLEGES

September 2023 – January 2024 (SEMESTER I)

UG (FT) Degree Programmes

Sl. No.	Programme	Semester	Commencement of Induction Programme	Commencement of Classes	Last working day	Commencement of Practical Examinations	Commencement of End Semester Examinations
1.	B.E. / B.Tech. (Full Time)	I	11.09.2023	25.09.2023	04.01.2024	05.01.2024	22.01.2024
2.	B.Arch.(Full Time)						

RE-OPENING DAY FOR THE NEXT SEMESTER: 06.03.2024 (Wednesday)

NOTE:

1. The Theory and Practical Examination schedules will be published in due course. (Practical Examinations will be conducted before the theory examinations).
2. If necessary, loss of classes due to various curricular / co-curricular activities of the department / college may be compensated by conducting classes on Saturdays.

**** In order to ensure minimum no. of working days, the following Saturdays are declared as working days.**

Sl. No.	Working Days (Saturdays)	Time Table of the Week Day to be Followed
1.	30.09.2023	Thursday
2.	14.10.2023	Monday
3.	28.10.2023	Monday
4.	04.11.2023	Tuesday

Sl. No.	Working Days (Saturdays)	Time Table of the Week Day to be Followed
5.	25.11.2023	Monday
6.	09.12.2023	Monday
7.	23.12.2023	Tuesday

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02/09/2023
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ACADEMIC COURSES

DAC - SB

Date: 02.09.2023

CENTRE FOR ACADEMIC COURSES

ANNA UNIVERSITY: : CHENNAI – 600 025

ACADEMIC SCHEDULE FOR NON-AUTONOMOUS AFFILIATED COLLEGES

September 2023 – January 2024 (ODD SEMESTER –Semester I)

M.C.A. (FT) Degree Programme

Sl. No	Programme	Semester	Commencement of Regular MCA Classes (Students undergoing Bridge Courses)		Continuation of Classes (for both Regular and Students undergoing Bridge Courses)	Last working day	Commencement of Practical Examinations	Commencement of End Semester Examinations
			From	To				
1.	M.C.A (FT)	I	11.09.2023	27.09.2023	29.09.2023	04.01.2024	05.01.2024	22.01.2024

RE-OPENING DAY FOR THE NEXT SEMESTER: 06.03.2024 (Wednesday)

1. Theory and Practical Examination schedules will be published in due course. (Practical Examinations will be conducted before the theory examinations).
2. If necessary, loss of classes due to various curricular / co-curricular activities of the department / college may be compensated by conducting classes on Saturdays.

** In order to ensure minimum no. of working days, the following Saturdays are declared as working days.

Sl. No.	Working Days (Saturdays)	Time Table of the Week Day to be Followed
1.	30.09.2023	Monday
2.	07.10.2023	Monday
3.	14.10.2023	Tuesday
4.	28.10.2023	Monday
5.	04.11.2023	Monday

Sl. No.	Working Days (Saturdays)	Time Table of the Week Day to be Followed
6.	18.11.2023	Monday
7.	25.11.2023	Tuesday
8.	09.12.2023	Wednesday
9.	23.12.2023	Thursday
10.	30.12.2023	Wednesday

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Date: 13.07.2023

CENTRE FOR ACADEMIC COURSES

ANNA UNIVERSITY: : CHENNAI – 600 025

ACADEMIC SCHEDULE FOR NON-AUTONOMOUS AFFILIATED COLLEGES

August 2023 – December 2023 (Semester III)

M.C.A. (FT) Degree Programme

Sl. No	Programme	Semester	Commencement of Regular MCA Classes (Students undergoing Bridge Courses)		Continuation of Classes (for both Regular and Students undergoing Bridge Courses)	Last working day	Commencement of Practical Examinations	Commencement of End Semester Examinations
			From	To				
1.	M.C.A (FT)	III	07.08.2023	24.08.2023	25.08.2023	06.12.2023**	08.12.2023	18.12.2023

RE-OPENING DAY FOR THE NEXT SEMESTER: 22.01.2024 (Monday)

1. Theory and Practical Examination schedules will be published in due course. (Practical Examinations will be conducted before the theory examinations).
2. If necessary, loss of classes due to various curricular / co-curricular activities of the department / college may be compensated by conducting classes on Saturdays.

**** In order to ensure minimum no. of working days, the following Saturdays are declared as working days.**

Sl. No.	Working Days (Saturdays)	Time Table of the Week Day to be Followed
1.	26.08.2023	Thursday
2.	09.09.2023	Tuesday
3.	23.09.2023	Thursday
4.	07.10.2023	Monday

Sl. No.	Working Days (Saturdays)	Time Table of the Week Day to be Followed
5.	21.10.2023	Monday
6.	04.11.2023	Tuesday
7.	18.11.2023	Wednesday

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13/7/2023
DIRECTOR
ACADEMIC COURSES

DAC - SB

Date: 02.09.2023

CENTRE FOR ACADEMIC COURSES

ANNA UNIVERSITY: : CHENNAI – 600 025

ACADEMIC SCHEDULE FOR NON-AUTONOMOUS AFFILIATED COLLEGES

September 2023 – January 2024 (Odd Semester – Semester III)

UG / PG (FT/PT) Degree Programmes

Sl. No.	Programme	Semester	Commencement of Classes	Last working day	Commencement of Practical Examinations	Commencement of End Semester Examinations
1.	B.E. / B . Tech. / B. Arch. (FT)	III	20.09.2023	04.01.2024	05.01.2024	22.01.2024
2.	B.E. / B. Tech. (PT)					
3.	M.E. / M. Tech. / M. Arch.(FT)					
4.	M.B.A. (Full-Time & Part-Time)					
5.	M.B.A. (5 Yrs-Integrated)					

RE-OPENING DAY FOR THE NEXT SEMESTER: 13.03.2024 (Wednesday)

NOTE:

1. The Theory and Practical Examination schedules will be published in due course. (Practical Examinations will be conducted before the theory examinations).
2. If necessary, loss of classes due to various curricular / co-curricular activities of the department / college may be compensated by conducting classes on Saturdays.

**** In order to ensure minimum no. of working days, the following Saturdays are declared as working days.**

Sl. No.	Working Days (Saturdays)	Time Table of the Week Day to be Followed
1.	30.09.2023	Thursday
2.	14.10.2023	Monday

Sl. No.	Working Days (Saturdays)	Time Table of the Week Day to be Followed
3.	04.11.2023	Monday
4.	09.12.2023	Tuesday

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02/09/2023
DIRECTOR
ACADEMIC COURSES

DAC - SB

Date: 13.07.2023

CENTRE FOR ACADEMIC COURSES

ANNA UNIVERSITY: : CHENNAI – 600 025

ACADEMIC SCHEDULE FOR NON-AUTONOMOUS AFFILIATED COLLEGES

July 2023 – November 2023 (ODD SEMESTER – Except Semester III)

UG / PG Programmes

Sl. No.	Programme	Semester	Commencement of Classes	Last working day	Commencement of Practical Examinations	Commencement of End Semester Examinations
1.	B.E. / B.Tech.(Full-Time)	V, VII	27.07.2023	17.11.2023	20.11.2023	29.11.2023
2.	B.E. / B.Tech.(Part-Time)	V, VII				
3.	B.Arch.(Full-Time)	V, VII, IX				
4.	M.B.A.(5 years Integrated)	V, VII, IX				

RE - OPENING DAY FOR THE NEXT SEMESTER: 22.01.2024 (Monday)

NOTE:

1. The Theory and Practical Examination schedules will be published in due course (Practical Examinations will be conducted before the theory examinations).
2. If necessary, loss of classes due to various curricular / co-curricular activities of the department / college may be compensated by conducting classes on Saturdays.

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13/7/2023
DIRECTOR
ACADEMIC COURSES

DAC - SB

Date: 12.01.2024

CENTRE FOR ACADEMIC COURSES

ANNA UNIVERSITY: : CHENNAI – 600 025

ACADEMIC SCHEDULE FOR NON-AUTONOMOUS AFFILIATED COLLEGES

February 2024 – May 2024 (Even Semester)

UG (FT/PT) & PG (FT) Degree Programmes

Sl. No.	Programme	Semester	Commencement of Classes	Last working day	Commencement of Practical Examinations	Commencement of End Semester Examinations
1.	B.E. / B.Tech.(Full-Time)	VI, VIII	01.02.2024	03.05.2024**	06.05.2024	15.05.2024
2.	B.Arch. (Full-Time)	VI, VIII, X				
3.	B.E. / B.Tech. (Part-Time)	VI				
4.	M.B.A. (5 years Integrated) (FT)	VI, VIII, X				

RE - OPENING DAY FOR THE NEXT SEMESTER: 18.07.2024 (Thursday)

NOTE:

1. The Theory and Practical Examination schedules will be published in due course (Practical Examinations will be conducted before the theory examinations).
2. If necessary, loss of classes due to various curricular / co-curricular activities of the department / college may be compensated by conducting classes on Saturdays.

**** Following Saturdays are declared as working days.**

Sl. No.	Working Days (Saturdays)	Time Table of the Week Day to be Followed
1.	03.02.2024	Friday
2.	10.02.2024	Tuesday
3.	17.02.2024	Thursday
4.	24.02.2024	Wednesday
5.	02.03.2024	Monday
6.	09.03.2024	Tuesday

Sl. No.	Working Days (Saturdays)	Time Table of the Week Day to be Followed
7.	16.03.2024	Wednesday
8.	23.03.2024	Thursday
9.	30.03.2024	Friday
10.	06.04.2024	Monday
11.	20.04.2024	Tuesday
12.	27.04.2024	Wednesday

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12/01/24
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ACADEMIC COURSES

DAC - SB

Date: 12.01.2024

CENTRE FOR ACADEMIC COURSES

ANNA UNIVERSITY: : CHENNAI – 600 025

ACADEMIC SCHEDULE FOR NON-AUTONOMOUS AFFILIATED COLLEGES

March 2024 – June 2024 (Even Semester)

UG (FT / PT) & PG (FT / PT) Degree Programmes

Sl. No	Programme	Semester	Commencement of Classes	Last working day	Commencement of Practical Examinations	Commencement of End Semester Examinations
1.	B.E. / B. Tech. / B. Arch. (Full-Time)	II, IV	13.03.2024	13.06.2024	08.07.2024	15.06.2024
2.	B.E. / B. Tech. (Part-Time)	II, IV				
3.	M.E. / M. Tech. / M. Arch.(FT)	II, IV				
4.	M.B.A. (Full-Time & Part-Time)	II, IV				
5.	M.B.A. (5 years Integrated)	II, IV				
6.	M.C.A. (FT)	IV				

RE-OPENING DAY FOR UG (FT/PT) and M.B.A. (5 years Integrated) NEXT SEMESTER: 18.07.2024 (Thursday)

RE-OPENING DAY FOR M.E. / M. Tech. / M. Arch. / M.B.A.(FT / PT) NEXT SEMESTER : 12.08.2024 (Monday)

1. Theory and Practical Examination schedules will be published in due course. (Practical Examinations will be conducted before the theory examinations).
2. If necessary, loss of classes due to various curricular / co-curricular activities of the department / college may be compensated by conducting classes on Saturdays.

**** Following Saturdays are declared as working days.**

Sl. No.	Working Days (Saturdays)	Time Table of the Week Day to be Followed
1.	16.03.2024	Friday
2.	23.03.2024	Tuesday
3.	30.03.2024	Thursday
4.	06.04.2024	Wednesday
5.	20.04.2024	Monday
6.	27.04.2024	Tuesday

Sl. No.	Working Days (Saturdays)	Time Table of the Week Day to be Followed
7.	04.05.2024	Wednesday
8.	11.05.2024	Thursday
9.	18.05.2024	Friday
10.	25.05.2024	Monday
11.	01.06.2024	Tuesday
12.	08.06.2024	Wednesday

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12/01/24
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ACADEMIC COURSES

DAC - SB

Date: 12.01.2024

CENTRE FOR ACADEMIC COURSES

ANNA UNIVERSITY: : CHENNAI – 600 025

ACADEMIC SCHEDULE FOR NON-AUTONOMOUS AFFILIATED COLLEGES

March 2024 – July 2024 (Even Semester – Semester II)

M.C.A. (FT) Degree Programme

Sl. No	Programme	Semester	Commencement of Regular MCA Classes (Students undergoing Bridge Courses)		Continuation of Classes (for both Regular and Students undergoing Bridge Courses)	Last working day	Commencement of Practical Examinations	Commencement of End Semester Examinations
			From	To				
1.	M.C.A (FT)	II	06.03.2024	22.03.2024	25.03.2024	26.06.2024**	28.06.2024	05.07.2024

RE-OPENING DAY FOR THE NEXT SEMESTER: 25.07.2024 (Thursday)

1. Theory and Practical Examination schedules will be published in due course. (Practical Examinations will be conducted before the theory examinations).
2. If necessary, loss of classes due to various curricular / co-curricular activities of the department / college may be compensated by conducting classes on Saturdays.

**** Following Saturdays are declared as working days.**

Sl. No.	Working Days (Saturdays)	Time Table of the Week Day to be Followed
1.	30.03.2024	Tuesday
2.	06.04.2024	Thursday
3.	20.04.2024	Wednesday
4.	27.04.2024	Monday
5.	04.05.2024	Tuesday
6.	11.05.2024	Wednesday

Sl. No.	Working Days (Saturdays)	Time Table of the Week Day to be Followed
7.	18.05.2024	Thursday
8.	25.05.2024	Friday
9.	01.06.2024	Monday
10.	08.06.2024	Tuesday
11.	15.06.2024	Wednesday
12.	22.06.2024	Thursday

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12/01/24
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ACADEMIC COURSES

DAC - SB

J.K.K. MUNIRAJAH COLLEGE OF TECHNOLOGY
(Approved by AICTE & Affiliated to Anna University, Chennai)
T.N. PALAYAM, GOBI-638506
DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
ACADEMIC YEAR:2023-2024 ODD SEMESTER
ELECTIVE OPTION

SEMESTER:05

S.NO	REGISTER NO	NAME OF THE STUDENT	Professional Elective I								Professional Elective II							
			CCS346	CCS360	CCS355	CCS369	CCW331	CCS349	CCS338	CCS334	CCS375	CCS332	CCS336	CCS370	CCS366	CCS374	CCS342	CCS358
1	731221104001	AADHI SURYA K								✓					✓			
2	731221104004	ARULMURUGAN S								✓					✓			
3	731221104005	BABUSHANKAR S								✓					✓			
4	731221104007	BAMBAVASAN V								✓					✓			
5	731221104008	CHANDRA PRAKASH K								✓					✓			
6	731221104009	DHAKSHINA MOORTHI E								✓					✓			
7	731221104012	DURGA K								✓					✓			
8	731221104013	GUNASEKARAN P								✓					✓			
9	731221104014	GUNASEKARAN S								✓					✓			
10	731221104015	HARIPRABHA V								✓					✓			
11	731221104017	KAMALESH K								✓					✓			
12	731221104021	LALITHA T								✓					✓			
13	731221104022	MADHAN G								✓					✓			
14	731221104025	MOUSIKA S								✓					✓			
15	731221104026	NANDHINI P								✓					✓			
16	731221104027	PANDIYARAJ P								✓					✓			
17	731221104028	PRIYA DHARSHINI S								✓					✓			
18	731221104029	RAVI KUMAR P								✓					✓			
19	731221104031	RUBIKA G								✓					✓			
20	731221104033	SHYAMKUMAR S								✓					✓			

21	731221104034	SENTHILVEL S								✓					✓				
22	731221104035	SUGANYA K								✓					✓				
23	731221104036	SURYA S								✓					✓				
24	731221104037	SUSHMINA M								✓					✓				
25	731221104038	VASANTHKUMAR S								✓					✓				
26	731221104039	VIGNESH M								✓					✓				
27	731221104040	YAMUNA K								✓					✓				
28	731221104301	AMUTHAMALAR R								✓					✓				
29	731221104302	BHARANI DHARAN.M								✓					✓				
30	731221104303	GAYATHRI R								✓					✓				
31	731221104305	NANDINI M								✓					✓				
32	731221104306	SNEHA L								✓					✓				
33	731221104307	SRINIVAS V								✓					✓				
34	731221104308	SUBASHINI P								✓					✓				
35	731221104701	NIKETHA S								✓					✓				

ELECTIVE	COURSE CODE	COURSE NAME	NO OF STUDENTS SELECTED THIS COURSE	REASON FOR SELECTING THE COURSE
PROFESSIONAL ELECTIVE I	CCS334	Big Data Analytics	35	To Learn about advanced tools and technologies
PROFESSIONAL ELECTIVE II	CCS366	Software Testing and Automation	35	To understand how to use Automation Frameworks

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T.N. PALAYAM, GOBI-638506

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

ACADEMIC YEAR:2023-2024 EVEN SEMESTER

ELECTIVE OPTION

SEMESTER:07

S.NO	REGISTER NO	NAME OF THE STUDENT	Professional Elective II							Professional Elective III							
			CS8091	CS8082	CS8092	IT8075	CS8081	IT8074	GE8077	CS8083	CS8079	CS8073	CS8088	CS8071	GE8072	GE8074	GE8071
1	731220104001	ABINAYA G				✓								✓			
2	731220104003	BALU R				✓								✓			
3	731220104004	CHARLES WILLIAM.L				✓								✓			
4	731220104005	DEEPAK.S				✓								✓			
5	731220104006	DEEPIKA.S				✓								✓			
6	731220104007	DHARANISELVI. M				✓								✓			
7	731220104009	JAGATHESWARAN.P				✓								✓			
8	731220104010	KARUNYAA.M				✓								✓			
9	731220104011	KATHIRESAN.K				✓								✓			
10	731220104012	KAVIN.M				✓								✓			
11	731220104014	LOGANATHAN.T				✓								✓			
12	731220104019	NIRMALRAJ.S				✓								✓			
13	731220104021	RAMYA.S				✓								✓			
14	731220104022	ROHITH.R				✓								✓			
15	731220104023	ROSHMA I				✓								✓			
16	731220104024	SIVALINGAM.K				✓								✓			
17	731220104025	SUNDARAGANESAN.K				✓								✓			
18	731220104028	VIGNESH.M				✓								✓			
19	731220104029	VINISHA.T				✓								✓			
20	731220104030	VINITHA.A				✓								✓			
21	731220104031	VINOTHKUMAR.R												✓			
22	731220104301	BOOPALAN.M				✓								✓			
23	731220104302	DHAMODARAN.G				✓								✓			

ELECTIVE	COURSE CODE	COURSE NAME	NO OF STUDENTS SELECTED THIS COURSE	REASON FOR SELECTING THE COURSE
PROFESSIONAL ELECTIVE II	IT8075	Software Project Management	23	It provides structured approach to plan, execute, software project.
PROFESSIONAL ELECTIVE III	CS8071	Advanced Topics on Databases	23	Explore how to design efficient database

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J.K.K. MUNIRAJAH COLLEGE OF TECHNOLOGY(AUTONOMOUS)

(Approved by AICTE & Affiliated to Anna University, Chennai)

T.N. PALAYAM, GOBI-638506

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

ACADEMIC YEAR:2023-2024 EVEN SEMESTER

ELECTIVE OPTION

SEMESTER:06

S.NO	REGISTER NO	NAME OF THE STUDENT	Professional Elective III								Professional Elective IV							
			CCS335	CCS372	CCS336	CCS341	CCS367	CCS365	CCS368	CCS362	CCS344	CCS343	CCS363	CCS351	CB3591	CCS339	CCS354	CCS362
1	731221104001	AADHI SURYA K	✓										✓				✓	
2	731221104004	ARULMURUGAN S	✓										✓				✓	
3	731221104005	BABUSHANKAR S	✓										✓				✓	
4	731221104007	BAMBAVASAN V	✓										✓				✓	
5	731221104008	CHANDRA PRAKASH K	✓										✓				✓	
6	731221104009	DHAKSHINA MOORTHI E	✓										✓				✓	
7	731221104012	DURGA K	✓										✓				✓	
8	731221104013	GUNASEKARAN P	✓										✓				✓	
9	731221104014	GUNASEKARAN S	✓										✓				✓	
10	731221104015	HARIPRABHA V	✓										✓				✓	
11	731221104017	KAMALESH K	✓										✓				✓	
12	731221104021	LALITHA T	✓										✓				✓	
13	731221104022	MADHAN G	✓										✓				✓	
14	731221104025	MOUSIKA S	✓										✓				✓	
15	731221104026	NANDHINI P	✓										✓				✓	
16	731221104027	PANDIYARAJ P	✓										✓				✓	
17	731221104028	PRIYA DHARSHINI S	✓										✓				✓	
18	731221104029	RAVI KUMAR P	✓										✓				✓	
19	731221104031	RUBIKA G	✓										✓				✓	
20	731221104033	SHYAMKUMAR S	✓										✓				✓	
21	731221104034	SENTHILVEL S	✓										✓				✓	

22	731221104035	SUGANYA K	✓										✓				✓	
23	731221104036	SURYA S	✓										✓				✓	
24	731221104037	SUSHMINA M	✓										✓				✓	
25	731221104038	VASANTHKUMAR S	✓										✓				✓	
26	731221104039	VIGNESH M	✓										✓				✓	
27	731221104040	YAMUNA K	✓										✓				✓	
28	731221104301	AMUTHAMALAR R	✓										✓				✓	
29	731221104302	BHARANI DHARAN.M	✓										✓				✓	
30	731221104303	GAYATHRI R	✓										✓				✓	
31	731221104305	NANDINI M	✓										✓				✓	
32	731221104306	SNEHA L	✓										✓				✓	
33	731221104307	SRINIVAS V	✓										✓				✓	
34	731221104308	SUBASHINI P	✓										✓				✓	
35	731221104701	NIKETHA S	✓										✓				✓	

ELECTIVE	COURSE CODE	COURSE NAME	NO OF STUDENTS SELECTED THIS COURSE	REASON FOR SELECTING THE COURSE
PROFESSIONAL ELECTIVE III	CCS335	Cloud Computing	35	to learn how cloud technologies can help organizations
PROFESSIONAL ELECTIVE IV	CCS363	Social Network Security	35	to learn how to protect users privacy and data
PROFESSIONAL ELECTIVE IV	CCS354	Network Security	35	to learn how to safeguard sensitive information

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J.K.K. MUNIRAJAH COLLEGE OF TECHNOLOGY(AUTONOMOUS)

(Approved by AICTE & Affiliated to Anna University, Chennai)

T.N. PALAYAM, GOBI-638506

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

ACADEMIC YEAR:2023-2024 EVEN SEMESTER

ELECTIVE OPTION

SEMESTER:06

S.NO	REGISTER NO	NAME OF THE STUDENT	Professional Elective VI							
			CCS333	CCS352	CCS371	CCS370	CCW332	CCS373	CCS347	CCS353
1	731221104001	AADHI SURYA K		✓						
2	731221104004	ARULMURUGAN S		✓						
3	731221104005	BABUSHANKAR S		✓						
4	731221104007	BAMBAVASAN V		✓						
5	731221104008	CHANDRA PRAKASH K		✓						
6	731221104009	DHAKSHINA MOORTHI E		✓						
7	731221104012	DURGA K		✓						
8	731221104013	GUNASEKARAN P		✓						
9	731221104014	GUNASEKARAN S		✓						
10	731221104015	HARIPRABHA V		✓						
11	731221104017	KAMALESH K		✓						
12	731221104021	LALITHA T		✓						
13	731221104022	MADHAN G		✓						
14	731221104025	MOUSIKA S		✓						
15	731221104026	NANDHINI P		✓						
16	731221104027	PANDIYARAJ P		✓						
17	731221104028	PRIYA DHARSHINI S		✓						
18	731221104029	RAVI KUMAR P		✓						
19	731221104031	RUBIKA G		✓						
20	731221104033	SHYAMKUMAR S		✓						
21	731221104034	SENTHILVEL S		✓						
22	731221104035	SUGANYA K		✓						

23	731221104036	SURYA S		✓						
24	731221104037	SUSHMINA M		✓						
25	731221104038	VASANTHKUMAR S		✓						
26	731221104039	VIGNESH M		✓						
27	731221104040	YAMUNA K		✓						
28	731221104301	AMUTHAMALAR R		✓						
29	731221104302	BHARANI DHARAN.M		✓						
30	731221104303	GAYATHRI R		✓						
31	731221104305	NANDINI M		✓						
32	731221104306	SNEHA L		✓						
33	731221104307	SRINIVAS V		✓						
34	731221104308	SUBASHINI P		✓						
35	731221104701	NIKETHA S		✓						

ELECTIVE	COURSE CODE	COURSE NAME	NO OF STUDENTS SELECTED THIS COURSE	REASON FOR SELECTING THE COURSE
PROFESSIONAL ELECTIVE V	CCS352	Multimedia and Animation	35	This course will teach me the skills needed to bring my stories to life visually.

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T.N. PALAYAM, GOBI-638506

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

ACADEMIC YEAR:2023-2024 EVEN SEMESTER

ELECTIVE OPTION

SEMESTER:08

S.NO	REGISTER NO	NAME OF THE STUDENT	Professional Elective IV							Professional Elective V						
			EC8093	CS8085	IT8073	CS8087	CS8074	CS8086	GE8076	CS8080	CS8078	CS8076	CS8084	CS8001	IT8077	GE8073
1	731220104001	ABINAYA G							✓		✓					
2	731220104003	BALU R							✓		✓					
3	731220104004	CHARLES WILLIAM.L							✓		✓					
4	731220104005	DEEPAK.S							✓		✓					
5	731220104006	DEEPIKA.S							✓		✓					
6	731220104007	DHARANISELVI. M							✓		✓					
7	731220104009	JAGATHESWARAN.P							✓		✓					
8	731220104010	KARUNYAA.M							✓		✓					
9	731220104011	KATHIRESAN.K							✓		✓					
10	731220104012	KAVIN.M							✓		✓					
11	731220104014	LOGANATHAN.T							✓		✓					
12	731220104019	NIRMALRAJ.S							✓		✓					
13	731220104021	RAMYA.S							✓		✓					
14	731220104022	ROHITH.R							✓		✓					
15	731220104023	ROSHMA I							✓		✓					
16	731220104024	SIVALINGAM.K							✓		✓					
17	731220104025	SUNDARAGANESAN.K							✓		✓					
18	731220104028	VIGNESH.M							✓		✓					
19	731220104029	VINISHA.T							✓		✓					
20	731220104030	VINITHA.A							✓		✓					
21	731220104031	VINOTHKUMAR.R							✓		✓					
22	731220104301	BOOPALAN.M							✓		✓					
23	731220104302	DHAMODARAN.G							✓		✓					

ELECTIVE	COURSE CODE	COURSE NAME	NO OF STUDENTS SELECTED THIS COURSE	REASON FOR SELECTING THE COURSE
PROFESSIONAL ELECTIVE IV	GE8076	Professional Ethics in Engineering	23	It Explain how ethics plays a vital role in shaping responsible engineers
PROFESSIONAL ELECTIVE V	CS8078	Green Computing	23	Want to contribute to making technology more eco-friendly

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J.K.K. MUNIRAJAH COLLEGE OF TECHNOLOGY
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T.N. PALAYAM, GOBI-638506
DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

We Propose to opt the following Electives for COMPUTER SCIENCE AND ENGINEERING Students for the ODD Semester of 2023-2024

Semester	Elective Number	Course Code & Name	No of Students	Justification for Choosing
VII	PROFESSIONAL ELECTIVE II	IT8075 & Software Project Management	23	Students will learn how to plan execute software development projects by managing resources.
VII	PROFESSIONAL ELECTIVE III	CS8071 & Advanced Topics on Databases	23	Students will explore advanced query techniques to enhance data management performance.

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

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Semester	Elective Number	Course Code & Name	No of Students	Justification for Choosing
V	PROFESSIONAL ELECTIVE I	CCS334 & Big Data Analytics	35	Students will understand how real time data Processing is used in applications.
V	PROFESSIONAL ELECTIVE II	CCS366 & Software Testing and Automation	35	Students will learn when to use each type of testing & development cycle.

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

We Propose to opt the following Electives for COMPUTER SCIENCE AND ENGINEERING Students for the EVEN Semester of 2023-2024

Semester	Elective Number	Course Code & Name	No of Students	Justification for Choosing
VIII	PROFESSIONAL ELECTIVE IV	GE8076 & Professional Ethics in Engineering	23	Students will learn to evaluate situations using ethical principles.
VIII	PROFESSIONAL ELECTIVE V	CS8078 & Green Computing	23	Students will explore how technology like AI can be used to optimize energy consumption.

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

We Propose to opt the following Electives for COMPUTER SCIENCE AND ENGINEERING Students for the EVEN Semester of 2023-2024

Semester	Elective Number	Course Code & Name	No of Students	Justification for Choosing
VI	PROFESSIONAL ELECTIVE V	CCS352 & Multimedia and Animation	35	Students will understand their responsibility as creators of content.

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

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Semester	Elective Number	Course Code & Name	No of Students	Justification for Choosing
VI	PROFESSIONAL ELECTIVE III	CCS335 & Cloud Computing	35	Students will understand how cloud computing enables on-demand access to computing resources
VI	PROFESSIONAL ELECTIVE IV	CCS363 & Social Network Security	35	Students will explore privacy policies of major social platforms, collects and share user data & how user can manage their privacy setting.
VI	PROFESSIONAL ELECTIVE IV	CCS354 & Network Security	35	Students will learn how to protect computer networks from threads.

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

FACULTY SUBJECT WILLINGNESS LIST

ACADEMIC YEAR 2023-2024

COURSE:B.E/M.E **SEMESTER:EVEN**

S.NO	STAFF NAME	WORK LOAD	YEAR & BRANCH
1	Dr.N.SATHYABALAJI HOD/CSE	CS8078/GREEN COMPUTING	IV-CSE
		GE8076/PROFESSIONAL ETHICS IN ENGINEERING	IV-CSE
		CS8811/PROJECT WORK	IV-CSE
		CP5411/PROJECT WORK	II-ME-CSE
2	Mr.K.S.VINOTHAN AP/CSE	CS8601/MOBILE COMPUTING	III-CSE
		CCS363/SOCIAL NETWORK SECURITY	III-CSE
		CS3491/ARTIFICIAL INTELLIGENCE&MACHINE LEARNING	II-CSE
		CS3491/ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING(AI&ML) LAB	II-CSE
3	Mrs.M.C.SAVITHRI AP/CSE	CS3451/INTRODUCTION TO OPERATING SYSYTEMS(OS)	II-CSE
		CS3461/OPERATING SYSYEMS LABORATORY	II-CSE
		CS3452/THEORY OF COMPUTATION	III-CSE
		MP4251/CLOUD COMPUTING TECHNOLOGIES	I-M.E-CSE
4	Mr.E.ANANTH AP/CSE	GE8076/PROFESSIONAL ETHICS IN ENGINEERING	IV-CSE
		SE4151/ADVANCED SOFTWARE ENGINEERING	I-M.E-CSE
		CCS352/MULTIMEDIA AND ANIMATION	III-CSE
		CCS356 / OBJECT ORIENTED SOFTWARE ENGINEERING	III-CSE
		CCS363/ SOCIAL NETWORK SECURITY	III-CSE

5	Mrs.P.SASIREKA AP/CSE	CS3401/ALGORITHMS(ALG)	II-CSE
		CCS352/MULTIMEDIA AND ANIMATION	III-CSE
		CP4252/MACHINE LEARNING	I-M.E-CSE
		CCS354/NETWORK SECURITY	III-CSE
		SE4151/ADVANCED SOFTWARE ENGINEERING	I-M.E-CSE
		GE8076/PROFESSIONAL ETHICS IN ENGINEERING	IV-CSE
6	Mr.S.SATHEESH AP/CSE	CCS352/MULTIMEDIA AND ANIMATION	III-CSE
		CS3491/ARTIFICIAL INTELLIGENCE&MACHINE LEARNING	II-CSE
		CS8481/DATABASE MANAGEMENT SYSTEM LAB	II-CSE
		CCS363/SOCIAL NETWORK SECURITY	III-CSE
		CP4252/MACHINE LEARNING	I-M.E-CSE
7	Mr.S.DHARANITHARAN AP/CSE	CS8078/GREEN COMPUTING	IV-CSE
		CS3452/THEORY OF COMPUTATION	II-CSE
		CCS335- CLOUD COMPUTING	III-CSE
		CP4096/SOFTWARE QUALITY ASSURANCE	I-M.E-CSE
		CP4252/MACHINE LEARNING	I-M.E-CSE
8	Mrs.P.POORNAPRIYA AP/CSE	CS3401/ALGORITHMS(ALG)	II-CSE
		CS3492/DATABASE MANAGEMENT SYSTEM	II-CSE
		CS3481/DATABASE MANAGEMENT SYSTEMS LABORATORY	II-CSE
		CCS335/CLOUD COMPUTING	III-CSE

9	Mrs.V.NIROSHA AP/CSE	CS3452/THEORY OF COMPUTATIO	II-CSE
		CS3401/ALGORITHMS(ALG)	II-CSE
		CCS354- NETWORK SECURITY	III-CSE
		CP4252/MACHINE LEARNING	I-M.E-CSE
		CP4096/SOFTWARE QUALITY ASSURANCE	I-M.E-CSE
		CCS356 - OBJECT ORIENTED SOFTWARE ENGINEERING	III-CSE
10	Mr.R.GNANASEKAR AP/CSE	CP4292/MULTICORE ARCHITECTURE AND PROGRAMMING	I-M.E-CSE
		CP4252/MACHINE LEARNING	I-M.E-CSE
		CP4212/SOFTWARE ENGINEERING LABORATORY	I-M.E-CSE
		CCS356 - OBJECT ORIENTED SOFTWARE ENGINEERING	III-CSE
		CCS363- SOCIAL NETWORK SECURITY	III-CSE
11	Mrs.L.DHARANI AP/CSE	CCS356 - OBJECT ORIENTED SOFTWARE ENGINEERING	III-CSE
		CCS363- SOCIAL NETWORK SECURITY	III-CSE
		CCS352/MULTIMEDIA AND ANIMATION	III-CSE
		CS3491/ARTIFICIAL INTELLIGENCE&MACHINE LEARNING	II-CSE
12	Mrs.K.SUDARVIZHI AP/CSE	CCS354/NETWORK SECURITY	III-CSE
		CP4251/INTERNET OF THINGS	I-ME-CSE
		CCS363- SOCIAL NETWORK SECURITY	III-CSE
		CP4252/MACHINE LEARNING	I-M.E-CSE

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T.N. PALAYAM, GOBI-638506

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

SUBJECT ALLOCATION FOR EVEN SEMESTER 2023-24

S.NO	STAFF NAME	WORK LOAD	CLASS	EXTRA WORKLOAD	TOTAL
1	Dr.N.SATHYABALAJI	CS8078/GREEN COMPUTING	IV-CSE	HOD,NAAC CORODINATOR,PG PROJECT GUIDE	1+1
		CS8811/PROJECT WORK	IV-CSE		
2	Mr.K.S.VINOTHAN	CS3491/ARTIFICIAL INTELLIGENCE&MACHINE LEARNING	II-CSE	DEPARTMENT PLACEMENT INCHARGE	1
3	Mrs.M.C.SAVITHRI	CS3451/INTRODUCTION TO OPERATING SYSYTEMS(OS)	II-CSE	I-M.E TUTOR,DEPARTMENT AICTE INCHARGE	2+1
		CS3461/OPERATING SYSYEMS LABORATORY	II-CSE		
		MP4253/CLOUD COMPUTING TECHNOLOGIES	I-ME-CSE		
4	Mr.E.ANANTH	CCS356/OBJECT ORIENTED SOFTWARE ENGINEERING	III-CSE	III CSE TUTOR,DEPARTMENT EXAM CELL INCHARGE,CC3 LAB INCHARGE	2
		SE4151/ADVANCED SOFTWARE ENGINEERING	I-ME-CSE		
5	Mrs.P.SASIREKA	CS3401/ALGORITHMS	II-CSE	IV-CSE TUTOR,DEPARTMENT TIMETABLE INCHARGE,CC1 LAB INCHARGE	2
		GE8076/PROFESSIONAL ETHICS IN ENGINEERING	IV-CSE		
6	Mrs.K.SUDARVIZHI	CCS354/NETWORK SECURITY	III-CSE	CO-CURRICULAR ACTIVITIES INCHARGE	2
		CP4251/INTERNET OF THINGS	I-ME-CSE		
7	Mr.S.DHARANITHARAN	CCS335/CLOUD COMPUTING	III-CSE	ALUMNI INCHARGE	2+1
		CP4079/SOFTWARE QUALITY ASSURANCE	I-ME-CSE		
		CP4211/TERM PAPER AND SEMINAR	I-ME-CSE		
8	Mrs.V.NIROSHA	THEORY OF COMPUTATION(TOC)	III-CSE	DEPARTMENT FILE MAINTENANCE INCHARGE	2
		CP4252/MACHINE LEARNING	I-ME-CSE		

9	Mr.R.GNANASEKAR	CP4253/MULTICORE ARCHITECTURE AND PROGRAMMING	I-M.E-CSE	DEPARTMENT PLACEMENT INCHARGE	1+1
		CP4212/SOFTWARE ENGINEERING LABORATORY	I-M.E-CSE		
10	Mrs.P.POORNAPRIYA	CS3492/DATABASE MANAGEMENT SYSTEMS(DBMS)	II-CSE	II CSE TUTOR	1+1
		CS3481/DATABASE MANAGEMENT SYSTEMS LABORATORY	II-CSE		
11	Mrs.L.DHARANI	CCS352/MULTIMEDIA AND ANIMATION	III-CSE	DEPARTMENT LIBRARY INCHARGE	1
12	Mr.S.SATHEESH	CCS363/SOCIAL NETWORK SECURITY	III-CSE	DEPARTMENT ACTIVITIES FILE INCHARGE	1

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
MASTER TIME TABLE FOR EVEN SEMESTER 2023-24

TIME	YEAR	9.30-10.15	10.15-11.00	11.00-11.10	11.10-11.55	11.55-12.40	12.40-1.25	1.25-2.05	2.05-2.40		2.55-3.35	3.35-4.15
Days/ Hr		1	2		3	4		5	6		7	8
MON	II	DBMS	OS	BREAK	TOC	AI&ML	LUNCH	EVS	TOC	BREAK	ALG	DBMS
	III	OOSE	M&A		CC	NS		M&A LAB			ES&IOT	SNS
	IV	PEE	GC		NET LAB	PEE		PROJECT WORK			PROJECT WORK	
TUE	II	DBMS	ALG		AI&ML	OS		OS LAB			OS LAB	OS
	III	M&A	NS		ES&IOT	OOSE		SNS	CC		ES&IOT	NS
	IV	GC	NET LAB		NET LAB	PEE		PROJECT REVIEW			PROJECT REVIEW	
WED	II	NM-ORACLE EBPL			NM-ORACLE EBPL			NM-ORACLE EBPL			NM-ORACLE EBPL	
	III	NM-CYBER SECURITY			NM-CYBER SECURITY			PLACEMENT			SNS LAB	
	IV	GC	NET LAB		NET LAB			PLACEMENT			PROJECT WORK	
THU	II	AI&ML	TOC		EVS	LIB		DBMS LAB			DBMS LAB	AI&ML
	III	NS	OOSE		CC	SNS		M&A	SNS		CC	ES&IOT
	IV	GC	NET LAB		PEE	LIB		PROJECT WORK			PROJECT WORK	
FRI	II	TOC	ALG		OS	OS		ALG	TOC		DBMS	EVS
	III	ES&IOT	M&A		CC	OOSE		NS LAB			CC LAB	
	IV	PEE	GC		NET LAB			NET LAB	PROJECT REVIEW		PROJECT REVIEW	
SAT	II	ALG LAB			AI&ML LAB			DBMS	PLACEMENT		ALG	AI&ML
	III	SNS	OOSE		NS	M&A		OOSE LAB			ES&IOT LAB	
	IV	PLACEMENT			PLACEMENT			PLACEMENT			PLACEMENT	

II YEAR		
S.NO	**SUBJECT TITLE**	**STAFF HANDLING**
1	CS3452/THEORY OF COMPUTATION(TOC)	Mrs.V.NIROSHA
2	CS3491/ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING(AI&ML)	Mr.K.S.VINOTHAN
3	CS3492/DATABASE MANAGEMENT SYSTEMS(DBMS)	Mrs.P.POORNAPRIYA
4	CS3401/ALGORITHMS(ALG)	Mrs.P.SASIREKA
5	CS3451/INTRODUCTION TO OPERATING SYSYTEMS(OS)	Mrs.M.C.SAVITHRI
6	GE3451/ENVIRONMENTAL SCIENCES AND SUSTAINABILITY(ESS)	Mr.PONNUSAMY
7	CS3461/OPERATING SYSYEMS LABORATORY	Mrs.M.C.SAVITHRI
8	CS3481/DATABASE MANAGEMENT SYSTEMS LABORATORY	Mrs.P.POORNAPRIYA

III YEAR		
S.NO	**SUBJECT TITLE**	**STAFF HANDLING**
1	CCS356 - OBJECT ORIENTED SOFTWARE ENGINEERING	Mr.E.ANANTH
2	CS3691-EMBEDDED SYSTEMS AND IOT	Mrs.S.GOMATHI
3	CCS335- CLOUD COMPUTING	Mr.S.DHARANITHARAN
4	CCS363- SOCIAL NETWORK SECURITY	Mr.S.SATHEESH

5	CCS354- NETWORK SECURITY	Mrs.K.SUDARVIZHI
6	CCS352- MULTIMEDIA AND ANIMATION	Mrs.L.DHARANI
IV YEAR		
S.NO	**SUBJECT TITLE**	**STAFF HANDLING**
1	CS8078/GREEN COMPUTING	Dr.N.SATHYABALAJI
2	GE8076/PROFESSIONAL ETHICS IN ENGINEERING(PEE)	Mrs.P.SASIREKA
3	CS8811/PROJECT WORK	Dr.N.SATHYABALAJI

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
ACADEMIC YEAR:2023-24
CLASS: II - B.E (CSE) IV SEMESTER

TIME	9.30-10.15	10.15-11.00	11.00-11.10	11.10-11.55	11.55-12.40	12.40-1.25	1.25-2.05	2.05-2.45	2.45-2.55	2.55-3.35	3.35-4.15
Days/Hr	1	2		3	4		5	6		7	8
MON	DBMS	OS	BREAK	TOC	AI&ML	LUNCH	EVS	TOC	BREAK	ALG	DBMS
TUE	DBMS	ALG		AI&ML	OS		OS LAB			OS LAB	OS
WED	NM-ORACLE EBPL			NM-ORACLE EBPL			NM-ORACLE EBPL			NM-ORACLE EBPL	
THU	AI&ML	TOC		EVS	LIB		DBMS LAB			DBMS LAB	AI&ML
FRI	TOC	ALG		OS			ALG	TOC		DBMS	EVS
SAT	ALG LAB			AI&ML LAB			DBMS	PLACEMENT		ALG	AI&ML

S.NO	SUBJECT TITLE	HOURS	STAFF HANDLING	DEPT
1	CS3452/THEORY OF COMPUTATION(TOC)	5	Mrs.V.NIROSHA	CSE
2	CS3491/ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING(AI&ML)	5	Mr.K.S.VINOTHAN	CSE
3	CS3492/DATABASE MANAGEMENT SYSTEMS(DBMS)	5	Mrs.P.POORNAPRIYA(TUTOR)	CSE
4	CS3401/ALGORITHMS(ALG)	5	Mrs.P.SASIREKA	CSE
5	CS3451/INTRODUCTION TO OPERATING SYSYTEMS(OS)	5	Mrs.M.C.SAVITHRI	CSE
6	GE3451/ENVIRONMENTAL SCIENCES AND SUSTAINABILITY(ESS)	3	Mr.M.PONNUSAMY	S&H
7	CS3461/OPERATING SYSYEMS LABORATORY	3	Mrs.M.C.SAVITHRI	CSE
8	CS3481/DATABASE MANAGEMENT SYSTEMS LABORATORY	3	Mrs.P.POORNAPRIYA	CSE
9	CS3401/ALGORITHMS LAB	2	Mrs.P.SASIREKA	CSE
10	CS3491/ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING LAB	2	Mr.K.S.VINOTHAN	CSE

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J.K.K. MUNIRAJAH COLLEGE OF TECHNOLOGY(AUTONOMOUS)

T.N. PALAYAM, GOBI-638506

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

ACADEMIC YEAR:2023-24

CLASS: III - B.E (CSE) VI SEMESTER

TIME	9.30-10.15	10.15-11.00	11.00-11.10	11.10-11.55	11.55-12.40	12.40-1.25	1.25-2.05	2.05-2.45	2.45-2.55	2.55-3.35	3.35-4.15
Days/Hr	1	2		3	4		5	6		7	8
MON	OOSE	M&A	BREAK	CC	NS	LUNCH	M&A LAB		BREAK	ES&IOT	SNS
TUE	M&A	NS		ES&IOT	OOSE		SNS	CC		ES&IOT	NS
WED	NM-CYBER SECURITY			NM-CYBER SECURITY			PLACEMENT			SNS LAB	
THU	NS	OOSE		CC	SNS		M&A	SNS		CC	ES&IOT
FRI	ES&IOT	M&A		CC	OOSE		NS LAB			CC LAB	
SAT	SNS	OOSE		NS	M&A		OOSE LAB			ES&IOT LAB	

S.NO	SUBJECT TITLE	HOURS	STAFF HANDLING	DEPT
1	CCS356 - OBJECT ORIENTED SOFTWARE ENGINEERING	5+2	Mr.E.ANANTH	CSE
2	CS3691-EMBEDDED SYSTEMS AND IOT	5+2	Mrs.S.GOMATHI	ECE
3	CCS335- CLOUD COMPUTING	5+2	Mr.S.DHARANITHARAN	CSE
4	CCS363- SOCIAL NETWORK SECURITY	5+2	Mr.S.SATHEESH	CSE
5	CCS354- NETWORK SECURITY	5+2	Mrs.K.SUDARVIZHI	CSE
6	CCS352- MULTIMEDIA AND ANIMATION	5+2	Mrs.L.DHARANI	CSE

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J.K.K. MUNIRAJAH COLLEGE OF TECHNOLOGY(AUTONOMOUS)

T.N. PALAYAM, GOBI-638506

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

ACADEMIC YEAR:2023-24

CLASS: IV - B.E (CSE) VII SEMESTER

TIME	9.30-10.15	10.15-11.00	11.00-11.10	11.10-11.55	11.55-12.40	12.40-1.25	1.25-2.05	2.05-2.45	2.45-2.55	2.55-3.35	3.35-4.15
Days/Hr	1	2		3	4		5	6		7	8
MON	PEE	GC	BREAK	NET LAB	PEE	LUNCH	PROJECT WORK		BREAK	PROJECT WORK	
TUE	GC	NET LAB		NET LAB	PEE		PROJECT REVIEW			PROJECT REVIEW	
WED	GC	NET LAB		NET LAB			PLACEMENT			PROJECT WORK	
THU	GC	NET LAB		PEE	LIB		PROJECT WORK			PROJECT WORK	
FRI	PEE	GC		NET LAB			NET LAB	PROJECT REVIEW		PROJECT REVIEW	
SAT	PLACEMENT			PLACEMENT			PLACEMENT			PLACEMENT	

S.No	SUBJECT TITLE	HOURS	STAFF HANDLING	DEPT
1	CS8078/GREEN COMPUTING	5	Dr.N.SATHYABALAJI	CSE
2	GE8076/PROFESSIONAL ETHICS IN ENGINEERING(PEE)	5	Mrs.P.SASIREKA(TUTOR)	CSE
3	CS8811/PROJECT WORK	10	Dr.N.SATHYABALAJI	CSE
4	NET LAB	10	Mrs.P.SASIREKA	CSE

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J.K.K. MUNIRAJAH COLLEGE OF TECHNOLOGY(AUTONOMOUS)

T.N. PALAYAM, GOBI-638506

DEPARTMENT OF MASTER OF COMPUTER SCIENCE AND ENGINEERING

CLASS: I - M.E II SEMESTER

TIME	9.30-10.15	10.15-11.00	11.00-11.10	11.10-11.55	11.55-12.40	12.40-1.25	1.25-2.05	2.05-2.45	2.45-2.55	2.55-3.35	3.35-4.15
Days/Hr	1	2		3	4		5	6		7	8
MON	IOT	MA&P	BREAK	ASE	ML	LUNCH	SQA	TPW&S	BREAK	TPW&S	
TUE	MA&P	CCT		ML	IOT		SE LAB			SE LAB	NET LAB
WED	ASE	MA&P		IOT	ML		CCT	SQA		IOT LAB	
THU	ML	IOT		MA&P	SQA		PLACEMENT			CCT	ASE
FRI	SQA	CCT		ASE	IOT		MA&P LAB			ML LAB	
SAT	CCT	MA&P		ML	ASE		SQA	PLACEMENT		NET LAB	

S.NO	SUBJECT TITLE	HOURS	STAFF HANDLING	DEPT
1	CP4291/INTERNET OF THINGS	7	Mrs.K.SUDARVIZHI	CSE
2	CP4292/MULTICORE ARCHITECTURE AND PROGRAMMING (75 Hrs)	7	Mr.R.GNANASEKAR	CSE
3	CP4252/MACHINE LEARNING	7	Mrs.V.NIROSHA	CSE
4	SE4151/ADVANCED SOFTWARE ENGINEERING	5	Mr.E.ANANTH	CSE
5	MP4251/CLOUD COMPUTING TECHNOLOGIES	5	Mrs.M.C.SAVITHRI(TUTOR)	CSE
6	CP4096/SOFTWARE QUALITY ASSURANCE	5	Mr.S.DHARANITHARAN	CSE
7	CP4211/TERM PAPER WRITING AND SEMINAR	3	Mr.S.DHARANITHARAN	CSE
8	CP4212/SOFTWARE ENGINEERING LABORATORY	4	Mr.R.GNANASEKAR	CSE

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COURSE FILE

SUBJECT CODE AND TITLE : CS3401 / ALGORITHMS

CLASS : II – CSE

SEMESTER : IV

HANDLED BY : P.SASIREKA M.E.,AP/CSE

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING,

J.K.K.MUNIRAJAH COLLEGE OF TECHNOLOGY.

CONTENTS

- INDIVIDUAL TIME TABLE
- SYLLABUS
- LESSON PLAN
- I-V UNITS NOTES
- QUESTION PAPERS
- INTERNAL ASSESSMENT MARKLIST

J.K.K. **MUNIRAJAH** COLLEGE OF TECHNOLOGY T.N. PALAYAM, GOBI-638506

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

NAME OF THE STAFF: Mrs.SASIREKA.P

B.E CSE / IV - SEMESTER

TIME	9.30-10.15	10.15-11.00	11.00-11.10	11.10-11.55	11.55-12.40	12.40-1.25	1.25-2.05	2.05-2.45	2.45-2.55	2.55-3.35	3.35-4.15
DAY/HR	1	2		3	4		5	6		7	8
MON			BREAK			LUNCH			BREAK	ALG	
TUE		ALG									
WED											
THU											
FRI	ALG	ALG					ALG				
SAT										ALG	

Theory	CS3401	5hrs
Total		6 hrs

J.K.K. MUNIRAJAH COLLEGE OF TECHNOLOGY,

T.N.PALAYAM

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

LESSON PLAN

FACULTY NAME	:	**P.SASIREKA**
DESIGNATION	:	**AP/ CSE**
SUBJECT CODE / TITLE	:	**CS 3401 / ALGORITHMS**
BRANCH/SEMEMSTER	:	**CSE / IV**
YEAR	:	**II**

OBJECTIVES:

- To understand and apply the algorithm analysis techniques on searching and sorting algorithms
- To critically analyze the efficiency of graph algorithms
- To understand different algorithm design techniques
- To solve programming problems using state space tree

HOURS	TOPICS TO BE COVERED	DATE	PERIOD	TEACHING METHODOLOGY	TEACHING AID	REMARKS
UNIT I - INTRODUCTION						
1	**Algorithm analysis**: Time and space complexity	15-3-24	2	LECTURE	BOARD & CHALK	
2	Asymptotic Notations and its properties, Best case, Worst case and average case analysis	15-3-24	5	LECTURE	BOARD & CHALK	
3	Recurrence relation:	18-3-24	7	LECTURE	BOARD & CHALK	

	substitution method- Lower bounds , linear search	18-3-24	7	LECTURE	BOARD & CHALK	
4	Binary search and Interpolation Search	19-3-24	2	LECTURE	BOARD & CHALK	
5	**Pattern search:** The naïve string- matching algorithm	22-3-24	2	LECTURE	BOARD & CHALK	
6	Rabin-Karp algorithm	22-3-24	5	LECTURE	BOARD & CHALK	
7	Knuth-Morris-Pratt algorithm	23-3-24	7	LECTURE	BOARD & CHALK	
8	**Sorting:** Insertion sort ,	25-3-24	7	LECTURE	BOARD & CHALK	
9	Heap sort	1-4-24	7	LECTURE	BOARD & CHALK	
UNIT II GRAPH ALGORITHMS						
1	Graph algorithms: Representations of graphs,	2-4-24	2	LECTURE	BOARD & CHALK	
2	Graph traversal: DFS, BFS , applications	5-4-24	2	LECTURE	BOARD & CHALK	
3	Connectivity, strong connectivity,bi connectivity	5-4-24	5	LECTURE	BOARD & CHALK	
4	Minimum spanning tree: Kruskal's and Prim's algorithm	6-4-24	7	LECTURE	BOARD & CHALK	
5	Shortest path: Bellman-Ford algorithm	8-4-24	7	LECTURE	BOARD & CHALK	
6	Dijkstra's algorithm	12-4-24	2	LECTURE	BOARD & CHALK	
7	Floyd-Warshall algorithm	12-4-24	5	LECTURE	BOARD & CHALK	
8	Network flow: Flow networks , Ford-Fulkerson method	13-4-24	7	LECTURE	BOARD & CHALK	
9	Matching:Maximum bipartite matching	15-4-24	7	LECTURE	BOARD & CHALK	
UNIT III ALGORITHM DESIGN TECHNIQUES						

1	**Divide and Conquer methodology**: Finding maximum and minimum	16-4-24	2	LECTURE	BOARD & CHALK	
2	Merge sort , Quick sort	22-4-24	7	LECTURE	BOARD & CHALK	
3	**Dynamic programming:** Elements of dynamic programming	23-4-24	2	LECTURE	BOARD & CHALK	
4	Matrix-chain multiplication	29-4-24	7	LECTURE	BOARD & CHALK	
5	Multi stage graph	30-4-24	2	LECTURE	BOARD & CHALK	
6	Optimal Binary Search Trees	3-5-24	2	LECTURE	BOARD & CHALK	
7	**Greedy Technique**: Elements of the greedy strategy	3-5-24	5	LECTURE	BOARD & CHALK	
8	Activity selection problem	6-5-24	7	LECTURE	BOARD & CHALK	
9	Optimal Merge pattern,Huffman Trees	7-5-24	2	LECTURE	BOARD & CHALK	
UNIT IV STATE SPACE SEARCH ALGORITHMS						
1	**Backtracking**: n-Queens problem	10-5-24	2	LECTURE	BOARD & CHALK	
2	Hamiltonian Circuit Problem	10-5-24	5	LECTURE	BOARD & CHALK	
3	Subset Sum Problem	11-5-24	7	LECTURE	BOARD & CHALK	
4	Graph colouring problem	13-5-24	7	LECTURE	BOARD & CHALK	
5	Branch and Bound	14-5-24	2	LECTURE	BOARD & CHALK	
6	Solving 15-Puzzle problem	17-5-24 17-5-24	2 5	LECTURE	BOARD & CHALK	
7	Assignment problem	20-5-24	7	LECTURE	BOARD & CHALK	
8	Knapsack Problem	21-5-24	2	LECTURE	BOARD & CHALK	

9	Travelling Salesman Problem	24-5-24 24-5-24	2 5	LECTURE	BOARD & CHALK	
UNIT V - NP-COMPLETE AND APPROXIMATION ALGORITHM						
1	Tractable and intractable problems: Polynomial time algorithms	25-4-24	7	LECTURE	BOARD & CHALK	
2	Venn diagram representation ,NP-algorithms	27-4-24	7	LECTURE	BOARD & CHALK	
3	NP-hardness and NP-completeness	28-4-24	2	LECTURE	BOARD & CHALK	
4	Bin Packing problem	31-4-24	2	LECTURE	BOARD & CHALK	
5	Problem reduction:TSP , 3- CNF problem.	31-4-24	2	LECTURE	BOARD & CHALK	
6	**Approximation Algorithms**: TSP	3-6-24	7	LECTURE	BOARD & CHALK	
7	**Randomized Algorithms**: concept and application, primality testing	3-6-24	2	LECTURE	BOARD & CHALK	
8	Randomized quick sort	4-6-24	7	LECTURE	BOARD & CHALK	
9	Finding k^{th} smallest number	4-6-24	2	LECTURE	BOARD & CHALK	

TEXT BOOK

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", 3rd Edition, Prentice Hall of India, 2009.
2. Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran "Computer Algorithms/C++" Orient Blackswan, 2nd Edition, 2019.

REFERENCES

1. Anany Levitin, "Introduction to the Design and Analysis of Algorithms", 3rd Edition, PearsonEducation, 2012.
2. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, "Data Structures and Algorithms", Reprint Edition, Pearson Education, 2006.
3. S. Sridhar, "Design and Analysis of Algorithms", Oxford university press, 2014.

STAFF IN-CHARGE **HOD** **PRINCIPAL**

CS3401	ALGORITHMS	L T P C
		3 0 2 4

COURSE OBJECTIVES:

- To understand and apply the algorithm analysis techniques on searching and sorting algorithms
- To critically analyze the efficiency of graph algorithms
- To understand different algorithm design techniques
- To solve programming problems using state space tree
- To understand the concepts behind NP Completeness, Approximation algorithms and randomized algorithms.

UNIT I INTRODUCTION **9**

Algorithm analysis: Time and space complexity - Asymptotic Notations and its properties Best case,Worst case and average case analysis – Recurrence relation: substitution method - Lower bounds –searching: linear search, binary search and Interpolation Search, Pattern search: The naïve stringmatching algorithm - Rabin-Karp algorithm - Knuth-Morris-Pratt algorithm. Sorting: Insertion sort –heap sort

UNIT II GRAPH ALGORITHMS **9**

Graph algorithms: Representations of graphs - Graph traversal: DFS – BFS - applications - Connectivity,strong connectivity, bi-connectivity - Minimum spanning tree: Kruskal's and Prim's algorithm- Shortestpath: Bellman-Ford algorithm - Dijkstra's algorithm - Floyd-Warshall

algorithm Network flow: Flow networks - Ford-Fulkerson method – Matching: Maximum bipartite matching

UNIT III ALGORITHM DESIGN TECHNIQUES **9**

Divide and Conquer methodology: Finding maximum and minimum - Merge sort - Quick sort Dynamic programming: Elements of dynamic programming — Matrix-chain multiplication - Multi stage graph — Optimal Binary Search Trees. Greedy Technique: Elements of the greedy strategy - Activity-selection problem –- Optimal Merge pattern — Huffman Trees.

UNIT IV STATE SPACE SEARCH ALGORITHMS **9**

Backtracking: n-Queens problem - Hamiltonian Circuit Problem - Subset Sum Problem – Graph colouring problem Branch and Bound: Solving 15-Puzzle problem - Assignment problem – Knapsack Problem - Travelling Salesman Problem

UNIT V NP-COMPLETE AND APPROXIMATION ALGORITHM **9**

Tractable and intractable problems: Polynomial time algorithms – Venn diagram representation - NPalgorithms - NP-hardness and NP-completeness – Bin Packing problem - Problem reduction: TSP – 3-CNF problem. Approximation Algorithms: TSP - Randomized Algorithms: concept and application - primality testing - randomized quick sort - Finding kth smallest number.

45 PERIODS

TEXT BOOKS:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", 3rd Edition, Prentice Hall of India, 2009.

2. Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran "Computer Algorithms/C++" Orient Blackswan, 2nd Edition, 2019.

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2. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, "Data Structures and Algorithms", Reprint Edition, Pearson Education, 2006.

3. S. Sridhar, "Design and Analysis of Algorithms", Oxford university press, 2014.

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Erode (Dt) - 638 506.

UNIT-1

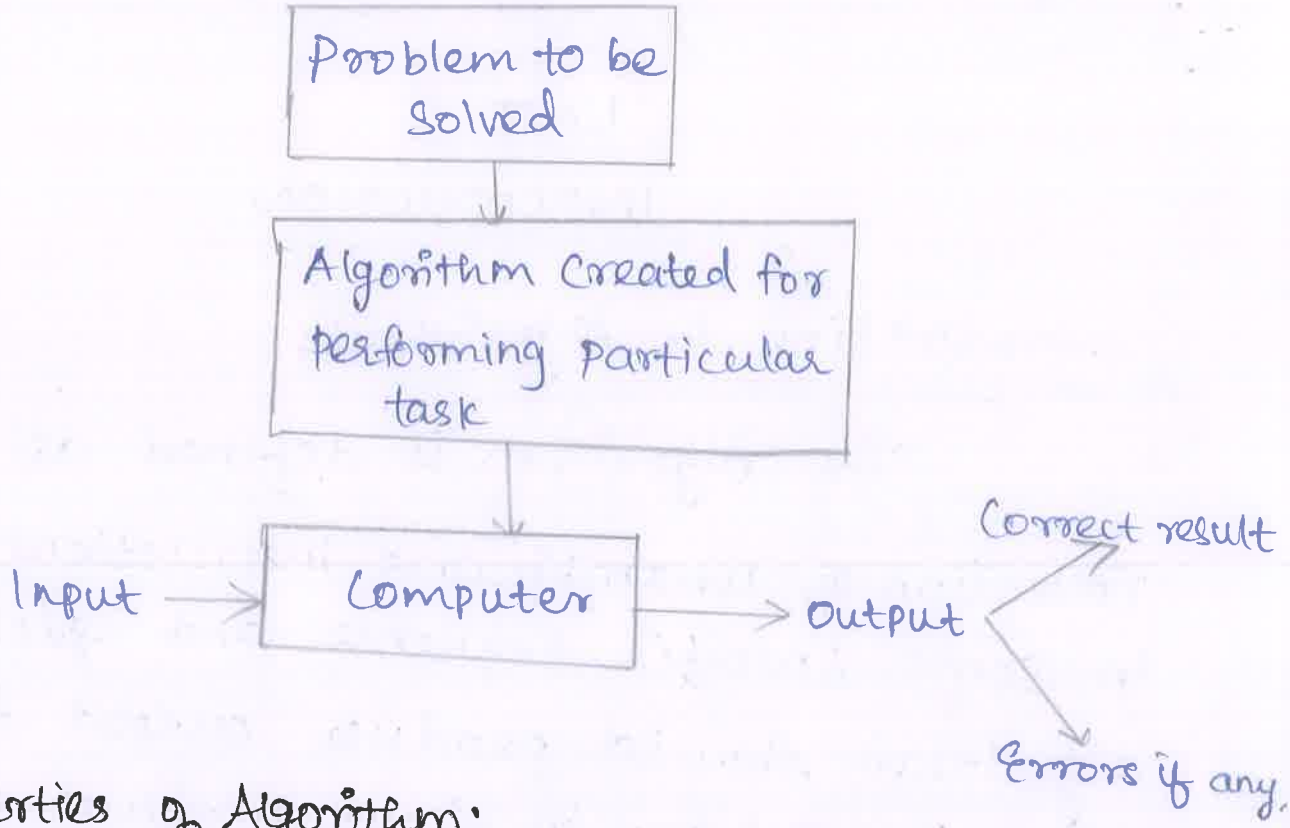
INTRODUCTION

Introduction to Algorithms:

The Algorithm is defined as a Collection of unambiguous instructions occurring in some specific sequence and such an algorithm should produce output for a given set of input in finite amount of time.

Notion of algorithm:

* After understanding the problem statement we have to create an algorithm carefully for the given problem.
* The algorithm is converted into some programming language and then given to some computing device.
* The computer executes this algorithm which is actually submitted in the form of source progra
* During the process of execution it requires certain set of input.



Properties of Algorithm:

* Non ambiguity
* Range of input
* Multiplicity
* Speed
* Finiteness

How to write an Algorithm?

Algorithm is basically a sequence of instructions written in simple language. Algorithm is broadly divided in to two sections.

* Algorithm Heading

It consists of name of algorithm, problem description, input and output.

* Algorithm Body

It consists of logical body of the algorithm by making use of various programming constructs and assignment statements.

Time and space complexity:-

Time complexity:

The Time complexity of an algorithm is the amount of computer time required by an algorithm to run the completion.

It is difficult to compute the time complexity in terms of physically clocked time.

For instance in multiuser system, executing time depends on many factors such as,

* System load
* Number of other programs running
* Instruction set used
* Speed of underlying hardware.

The time complexity is given in terms of frequency count.

Frequency count is a count denoting number of times of execution of statement.

Eg:

```
for (i=0; i<n; i++)
{
  sum = sum+a[i];
}
```

For Calculating Sum of n numbers in an array then we can find its time complexity using frequency count. This frequency count denotes how many times the particular statement is executed.

Statement	Frequency Count
i=0	1
i<n	This statement executes (n+1) times, when the condition is true. when i<n is true, the execution happens to be n times.
i++	n times
Sum=Sum+a[i]	n times
Total	3n + 2

Space Complexity:

The Space complexity can be defined as amount of memory required by an algorithm to run.

They are two factors.

* constant
* instant characteristics.

$$S(p) = C + Sp.$$

Where C is a constant.
Sp is a space dependent upon instant characteristics.

Eg:

```
Algorithm Add (a, b, c)
//problem Description : This algorithm computes the addition
                        of three elements
//Input : a, b and c are of floating type
//Output : the addition is returned.
        return a+b+c.
```

The space requirement for above algorithm is,

$S(P) = C \quad \Theta(|P|) = O.$

If we assume that a, b, and C occupy one word size then total size comes to be 3.

Order of growth:

Measuring the performance of an algorithm in relation with the input size n is called Order of growth.

n	log n	n log n	n^2	2^n
1	0	0	1	2
2	1	2	4	4
4	2	8	16	16
8	3	24	64	256
16	4	64	256	65,536
32	5	160	1024	4,294,967,296

Asymptotic Notations and its Properties:

Asymptotic notations are the mathematical notations used to describe the running time of an algorithm when the input tends towards a particular value or a limiting value.

Various notations such as O, Ω, Θ are called asymptotic notations.

Bigoh Notation:

The bigoh notation is denoted by 'O'. It is a method of representing the upper bound of algorithms running time.

Using bigoh notation we can give longest amount of time taken by the algorithm to complete.

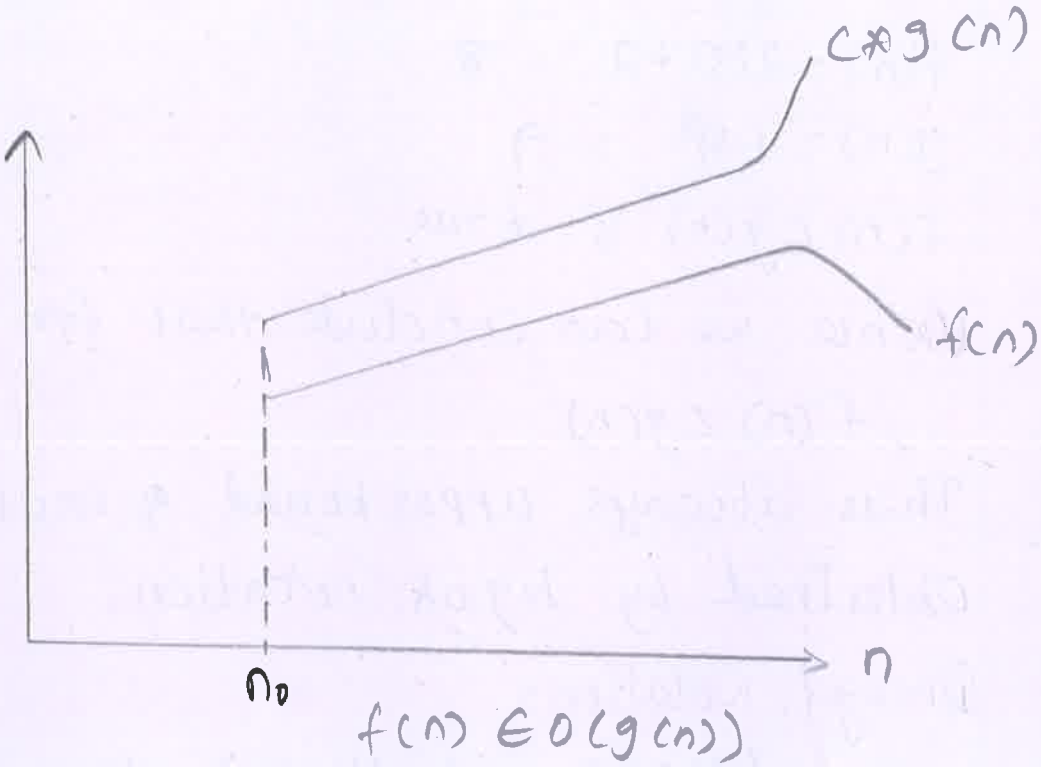
Definition:

Let $f(n)$ and $g(n)$ be two non negative functions.

Let n_0 and constant c are two integers such that n_0 denotes some value of input and $n > n_0$. Similarly c is some constant such that $c > 0$.

$$f(n) \leq c * g(n).$$

Then $f(n)$ is bigoh of $g(n)$. It is also denoted as $f(n) \in O(g(n))$. In other words $f(n)$ is less than $g(n)$ if $g(n)$ is multiple of some constant C.



Example:

Consider function $f(n) = 2n+2$ and $g(n) = n^2$. Then we have to find some constant C, so that $f(n) \leq C * g(n)$. AS $f(n) = 2n+2$ and $g(n) = n^2$ then we find C for $n=1$ then.

$f(n) = 2n+2$

$= 2(1)+2$

$f(n) = 4$

$g(n) = n^2 = (1)^2 = 1.$

$f(n) > g(n).$

If $n=2$ then

$f(n) = 2(2)+2$

$= 6$

$g(n) = 2^2$

$g(n) = 4$

$f(n) > g(n)$

If $n = 3$ then

$f(n) = 2(3) + 2 = 8$

$g(n) = (3)^2 = 9$

$f(n) < g(n)$ is true.

Hence we can conclude that for $n > 2$ we obtain

$f(n) < g(n)$

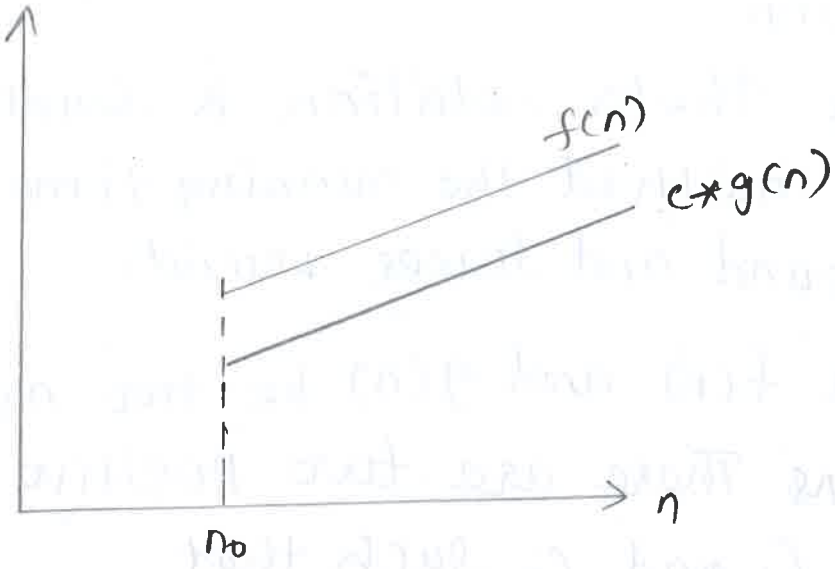
Thus always upperbound of existing time is obtained by bigoh notation.

Omega Notation:

Omega notation is denoted by 'Ω'. This notation is used to represent the lowerbound of algorithm's running time. using omega notation we can denote shortest amount of timetaken by algorithm.

A function $f(n)$ is said to be in $\Omega(g(n))$ if $f(n)$ is bounded below by some positive constant multiple of $g(n)$ such that

$f(n) \geq c * g(n)$ for all $n \geq n_0$



Example:

Consider $f(n) = 2n^2+5$ and $g(n) = 7n$.

if $n=0$, $f(n) = 2(0)^2+5$

$= 5$

$g(n) = 7(0)$

$= 0$ $\quad f(n) > g(n)$

if $n=1$ $\quad f(n) = 2(1)^2+5$

$= 7$

$g(n) = 7(1)$

$= 7$ $\quad f(n) = g(n)$

If $n=3$ then $f(n) = 2(3)^2+5$

$= 18+5$

$= 23$

$g(n) = 7(3)$

$= 21$ $\quad f(n) > g(n)$.

for $n>3$ we get $f(n) > c*g(n)$.

It can be represented as,

$2n^2+5 \in \Omega(n)$

Similarly, $n^3 \in \Omega(n^2)$

Θ Notation:

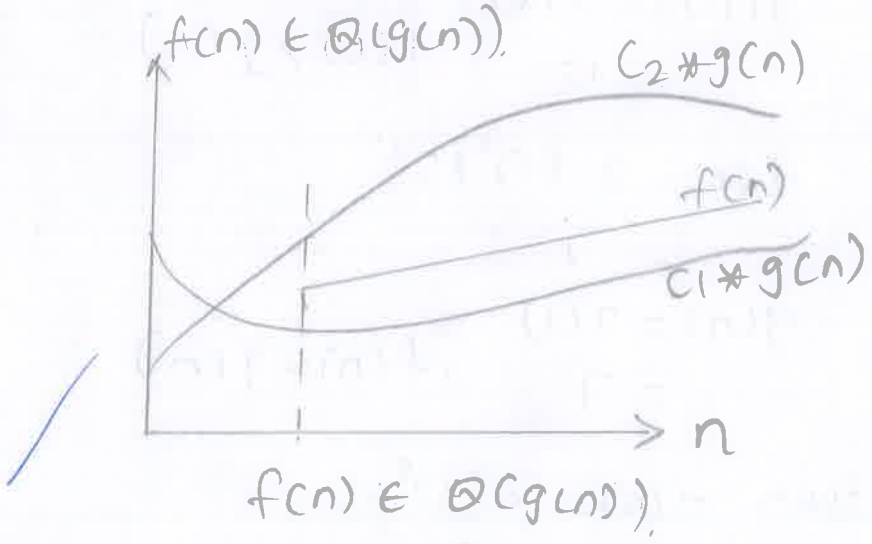
The Theta notation is denoted by Θ. By this method the running time is between upper bound and lower bound.

Let $f(n)$ and $g(n)$ be two non negative functions. There are two positive constants namely C_1 and C_2 such that

$$C_1 * g(n) \leq f(n) \leq C_2 * g(n)$$

we can say that

$$f(n) \in \Theta(g(n)).$$



Eg: If $f(n) = 2n + 8$ and $g(n) = 7n$.

where $n \geq 2$

Similarly $f(n) = 2n + 8$

$g(n) = 7n$

$5n < 2n + 8 < 7n$ for $n \geq 2$

$C_1 = 5$ and $C_2 = 7$ with $n_0 = 2$.

The Theta notation is more precise with bigoh and omega

properties of order of growth:

1. If $f_1(n)$ is order of $g_1(n)$ and $f_2(n)$ is order of $g_2(n)$ then.

$$f_1(n) + f_2(n) \in O(\max(g_1(n), g_2(n))$$

2. polynomials of degree $m \in \Theta(n^m)$.

3. $O(1) < O(\log n) < O(n) < O(n^2) < O(2^n)$.

4. Enponential functions a^n have different orders of growth for different values of a.

Properties of Asymptotic Notations:

* Bigoh notation is used for upperbound values.
* Bigomega notation is used for lower bound values.
* Bigtheta notation is used for average bound values.

1) General properties

i) If $f(n) = O(g(n))$ then $a * f(n) = O(g(n))$

ii) If $f(n) = \Omega(g(n))$ then $a * f(n) = \Omega(g(n))$

iii) If $f(n) = \Theta(g(n))$ then $a * f(n) = \Theta(g(n))$.

2) Reflexive:

If $f(n)$ is given then $f(n) = O(f(n))$

for example- if $f(n) = n^2$ then $f(n) = O(n^2)$.

Similarly, $f(n) = \Omega(f(n))$

$f(n) = \Theta(f(n))$.

3) Symmetry:

$f(n) = \Theta(g(n))$ if any only if $g(n) = \Theta(f(n))$

for example,

If $f(n) = n^3$ and $g(n) = n^3$ then.

$f(n) = \Theta(n^3)$ and $g(n) = \Theta(n^3)$.

Symmetry property is true only for Θ notation.

4) Transitivity:

If $f(n) = O(g(n))$ and if $g(n) = O(h(n))$ then $f(n) = O(h(n))$ is true.

for example if $f(n) = n$, $g(n) = n^2$ and $h(n) = n^3$ then n is $O(n^2)$ $g(n)$ is upper bound for $f(n)$ Similarly n^2 is $O(n^3)$. $h(n)$ is upper bound for $g(n)$. This is called transitive property.

Similarly,

$f(n) = \Theta(g(n))$ and and $g(n) = \Theta(g(n)) \Rightarrow$ $f(n) = \Theta(h(n))$

$f(n) = \Omega(g(n))$ and $g(n) = \Omega(h(n)) \Rightarrow f(n) = \Omega(h(n))$.

5) Transpose Symmetry:

$f(n) = O(g(n))$ if and only if $g(n) = \Omega(f(n))$

Forexample,

$f(n) = n$

$g(n) = n^2$

then n is $O(n^2)$ and n^2 is $\Omega(n)$.

6) If $f(n) = O(g(n))$
and $f(n) = \Omega(g(n))$
then $f(n) = \Theta(g(n))$

7) $\Theta(f(n) + g(n)) = \max(f(n), g(n))$.

Best Case, Worst Case and Average Case Analysis:-

Best Case Time Complexity:

If an algorithm takes minimum amount of time to run to completion for a specific set of input then it is called best case time complexity.

Ex:
While Searching a particular element by using Sequential Search we get the desired element at first place itself, then it is called best case time complexity.

Worst Case Time Complexity:

If an algorithm takes maximum amount of time to run to completion for a specific set of input then it is called worst case time complexity.

Eg:

While searching an element by using linear searching method if desired element is placed at the end of the list then we get worst case time complexity.

Average Case Time Complexity:

The time complexity that we get for certain set of inputs is as a average same. Then for corresponding input such a time complexity is called average case time complexity.

Analysis:

Best Case Analysis:

In above searching algorithm the element key is searched from the list of n elements. If the key element is present at first location in the list (A[0.... n-1]), then algorithm run for a very short time.

The time complexity can be denoted as,

$$T(n) = O(1).$$

Worst Case Analysis:

Worst case time complexity is a time complexity when algorithm runs for a longest time. If the key element is present at nth location the algorithm run for longest time.

If $p=0$, we get

$$T(n) = \frac{0(n+1)}{2} + n(1-0)$$

$$T(n) = n.$$

If $p=1$, we get

$$T(n) = \frac{1(n+1)}{2} + n \cdot (1-1)$$

$$= \frac{n+1}{2}$$

The time complexity can be denoted in terms of bigoh notation as,

$$T(n) = O(n)$$

Best case	Worst case	Average case
$O(1)$	$O(n)$	$O(n)$.

Recurrence Relation:

The recurrence equation is an equation that defines a sequence recursively. It is normally in the following form.

$$T(n) = T(n-1) + n \quad \text{for } n > 0 \quad \text{—(1)}$$

$$T(0) = 0. \quad \text{—(2)}$$

The (1) equation is called recurrence relation and (2) equation is called initial condition.

$$T(n) = n.$$

In Bigoh notation the time complexity can be denoted as,

$$T(n) = O(n).$$

Average Case Analysis:

This type of complexity gives information about the behaviour of an algorithm on specific or random input.

Let,

* p be a probability of getting successful search.
* n is the total number of elements in the list.
* The first match of the element will occur at i^{th} location.
* The probability of getting unsuccessful search is $(1-p)$.

$T(n)$ = probability of successful search + probability of unsuccessful search.

$$T(n) = \left(1\frac{p}{n} + 2\frac{p}{n} + \cdots + i\frac{p}{n}\right) + n.(1-p)$$

$$= \frac{p}{n}(1+2+\cdots+i) + n.(1-p)$$

$$= \frac{p}{n}\,\frac{n(n+1)}{2} + n.(1-p)$$

$$T(n) = p\frac{(n+1)}{2} + n.(1-p).$$

Solving Recurrence Equations:

The recurrencerelation can be solved by following methods.

1. Substitution method
2. Tree method
3. Master's method.

Substitution method:

The Substitution method is a kind of method in which a guess for the solution is made.

There are two types of substitution.

1. Forward Substitution.
2. Backward Substitution

Forward Substitution method:

This method makes use of an initial condition in the initial term and value for the next term is generated. This process is continued until some formula is guessed.

Eg: Consider a recurrence relation,

$$T(n) = T(n-1) + n$$

with initial condition $T(0) = 0$.

let,

$T(n) = T(n-1) + n$

If $n=1$ then

$T(1) = T(0) + 1 = 0 + 1 = 1$.

If $n=2$ then

$T(2) = T(1) + 2 = 1 + 2 = 3$

If $n=3$ then

$T(3) = T(2) + 3 = 3 + 3 = 6$.

By observing above generated equations we can derive a formula,

$$T(n) = \frac{n(n+1)}{2} = \frac{n^2}{2} + \frac{n}{2}.$$

We can also denote $T(n)$ interms of big oh notation as follows,

$$T(n) = O(n^2).$$

Backward Substitution Method:

In this method backward values are substituted recursively.

For example,

Consider a recurrence relation,

$$T(n) = T(n-1) + n \quad \text{— (1)}$$

with initial Condition $T(0) = 0$.

$$T(n-1) = T(n-1-1) + (n-1) \quad \text{— (2)}$$

Substituting equation (2) in (1).

$$T(n) = T(n-2) + (n-1) + n \quad \text{— (3)}$$

Let,

$T(n-2) = T(n-2-1) + (n-2)$ ——— (4)

Substituting eqn (4) in (3)

$T(n) = T(n-3) + (n-2) + (n-1) + n.$

$= T(n-k) + (n-k+1) + (n-k+2) + \cdots + n.$

If $k=n$ then

$T(n) = T(0) + 1 + 2 + \cdots n$

$T(n) = 0 + 1 + 2 - - - - - + n$ $\quad \because T(0) = 0$

$T(n) = \frac{n(n+1)}{2} = \frac{n^2}{2} + \frac{n}{2}.$

We can denote $T(n)$ in terms of big oh notation as

$T(n) \in O(n^2).$

Example:

Solve the following recurrence relation

$T(n) = T(n-1) + 1$ with $T(0) = 0$ as initial condition.

Also find big oh notation.

Soln:

Let, $T(n) = T(n-1) + 1.$

By Backward substitution,

$T(n-1) = T(n-2) + 1$

$T(n) = T(n-1) + 1$

$= (T(n-2) + 1) + 1$

$T(n) = T(n-2) + 2$

$T(n-2) = T(n-2-1) + 1$

$= T(n-3) + 1$

$T(n) = T(n-2) + 2$ becomes

$= (T(n-3) + 1) + 2$

$T(n) = T(n-3) + 3$

⋮

$T(n) = T(n-k) + k$

If $k = n$ then equation (1) becomes.

$T(n) = T(0) + n$

$= 0 + n$

$T(n) = n.$

We can denote $T(n)$ in terms of big oh notation as $T(n) = O(n)$.

Tree method:

The recurrence relation can also be Solved using tree method. In this method a recursion tree is built in which each node represents the cost of a single subproblem in the form of recursive function invocations.

Then we sum up the cost at each level to determine the overall cost.

Example:

Solve the given recurrence relation using recursion Tree.

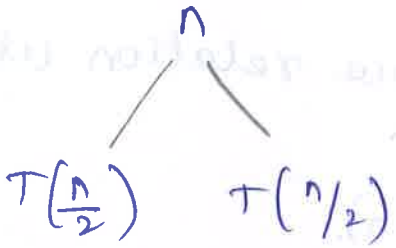
$$T(n) = 2T\left(\frac{n}{2}\right) + n, \quad T(1) = O(1).$$

Soln:

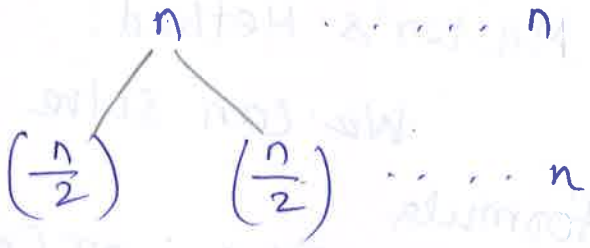
STEP 1:

$T(n)$

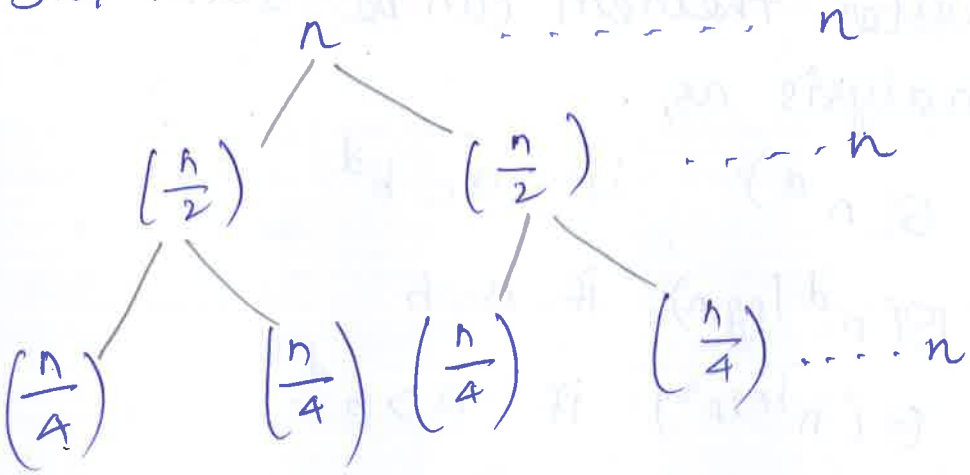
STEP 2:



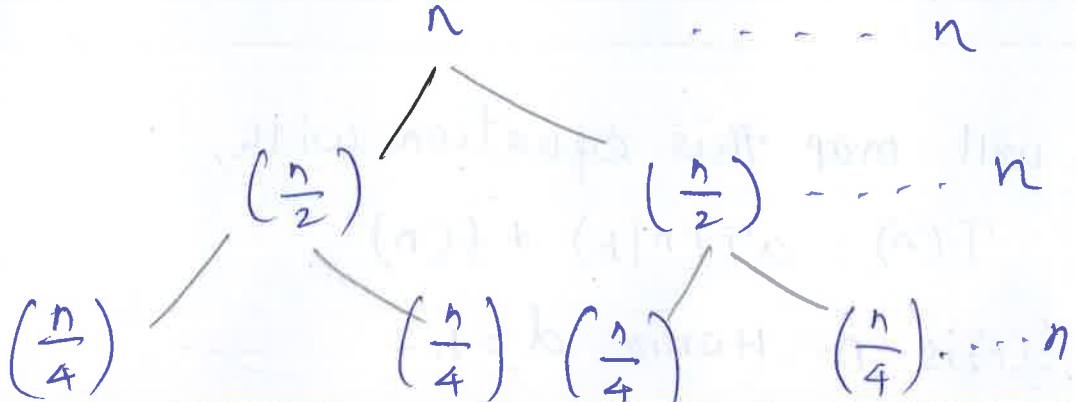
STEP 3:

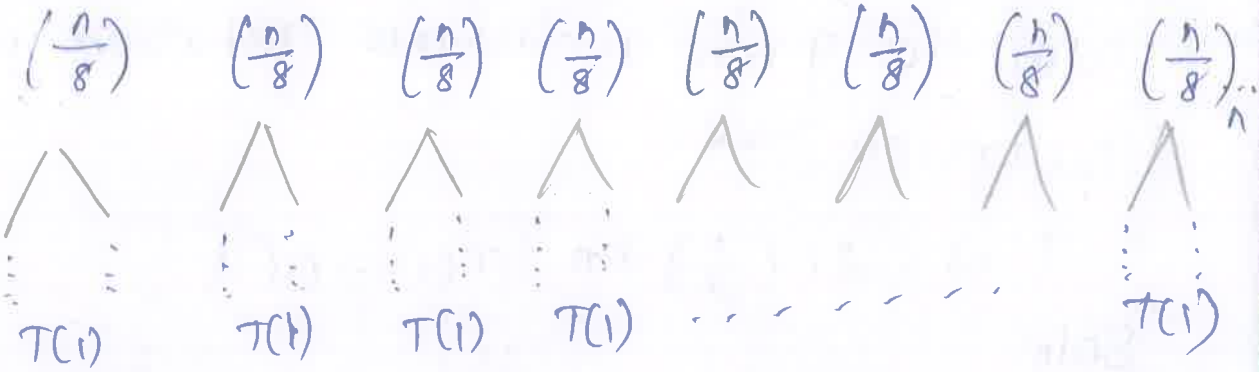


STEP 4:



After certain steps we will get,





Total Cost = $n \log n\, T(1)$. Hence we get the overall cost as $O(n \log n)$.

Master's Method:

We can solve recurrence relation using a formula.

$$T(n) = aT(n/b) + f(n).$$

Then the Master theorem can be stated for efficiency analysis as,

1. $T(n) = \Theta(n^d)$ if $a < b^d$
2. $T(n) = \Theta(n^d \log n)$ if $a = b$
3. $T(n) = \Theta(n^{\log_b a})$ if $a > b^d$.

Solve the following recurrence relation.

$T(n) = 4T(n/2) + n.$

Soln:

We will map this equation with,

$$T(n) = aT(n/b) + f(n)$$

Now $f(n)$ is n. Hence $d = 1$.

$a = 4$ and $b = 2$ and

$a > b^d$ i.e. $4 > 2^1$

$$T(n) = \Theta(n^{\log_b a})$$
$$= \Theta(n^{\log_2 4})$$
$$= \Theta(n^2) \quad \because \log_2 4 = 2$$

Hence, time complexity is $\Theta(n^2)$.

Searching:

* Searching is a technique in which the location of desired element is obtained.
* The searching technique is based on Searchkey. This key is compared with array elements
* If the key and the current element matches than position of that element is returned.

Linear Search:

* Linear searching is a searching technique in which every element is compared with key linearly from first to last element of list.
* the time complexity of this algorithm is $O(n)$. The time complexity will increase linearly with these value of n.
* For higher value of n the linear search is not the satisfactory solution.

* Linear Search is also called as Sequential Search.
* Linear Search is a technique in which the given list of element is scanned from beginning.
* The key element is compared with every element in the list
* If the match is found, the searching is stopped, otherwise it will be continued to the end of the list.
* The time complexity of this algorithm is O(n).
* The time complexity will increase linearly with the value of n.

3	2	18	33	21	5	99	42

key = 33.

Soln:
* The key value is 33.
* 33 is compared with first element in the list. The value is not same [33≠3]
* The element is not found. So compare next element in the list [33=2]. The element is not found.
* Compare next element in the list [18=33] The element is not found. So move next Place.

* Next, compare with next element [33 = 33] the element is found. So the search is successful.

Routine:

```
int linear (int a[], int n, int key)
{
int i;
for (i=0; i<n; i++)
 if (a[i] == key)
  return a[i];
}.
```

Advantages:

* It is simple to implement.
* It does not require specific ordering.

Disadvantages:

* It is less efficient.
* Inefficient for large size.

Binary Search:

Binary search is a searching technique in which the elements are arranged in a sorted order and each time mid element is compared with the key element recursively

The binary search algorithm begins by comparing the element that is present at the middle of the list.

If there is a match then the search ends and location of the middle element is returned.

If the searchelement is less than the middle element then first part of the list is searched, Otherwise second part of the list is searched.

This process continues until the search element is equal to the middle element or the list contains only one element that is not equal to the search element.

Example:

Search 99 from the list -40, 11, 33, 37, 42, 45, 99, 100 using binary search.

Soln:

-40	11	33	37	42	45	99	100

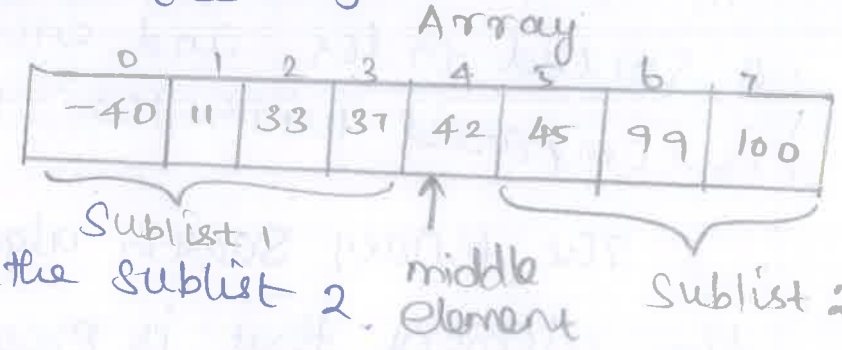
STEP 1; Now the key element which is to be searched is 99. ∴ key = 99.

STEP 2: Find the middle element of the array. compare it with the key.

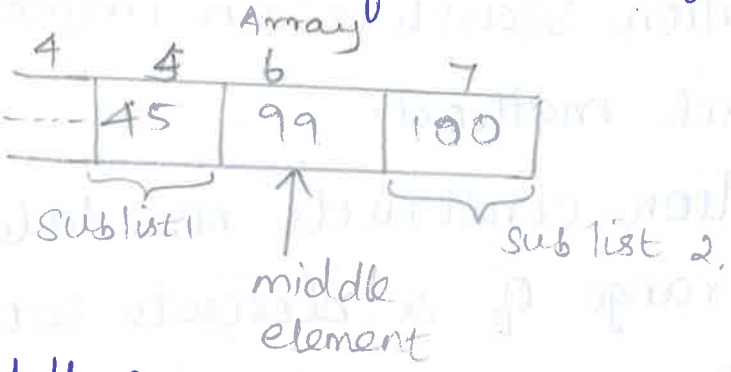
if middle ? key

42 ? 99

if 42 < 99 search the sublist 2.



Again divide it, find mid of sublist 2.



If middle? key

if 99? 99. (99=99)

So match is found at 7th position of the array. array[6].

Thus by the binary search method we can find the element 99 present in the given list at array [6]th location.

Advantages:

* It is an efficient technique.

Disadvantages:

* It requires specific ordering before applying the method.
* It is complex to implement.

Time Complexity:

Best case:

The best case time complexity is O(1).

Worst and average case:

The array is divided in $\frac{n}{2}$ sublists each time. The time complexity is $T(n) = T(n/2) + 1$.

Interpolation search:

* Interpolation search is an improvement over Binary search method.
* Interpolation constructs new data points within the range of a discrete set of known data points.
* Binary search always goes the middle element to check.

STEPS:

1) The list of elements must be sorted and uniformly distributed.
2) Initialize low = 0 and high = n-1
3) Calculate mid using following formula.

$$mid = low + \left[\frac{(high - low) * (key - A[low])}{A[high] - A[low]} \right]$$

4) If A[mid] == key then the element is found at index mid.
5) If key > A[mid], then initialize low = mid + 1
6) Else initialize high = mid - 1.

Example:

10, 12, 14, 16, 18, 20, 22, 24 using interpolation Search.

STEP 1: Consider an array of numbers as

0	1	2	3	4	5	6	7
10	12	14	16	18	20	22	24

STEP 2: Here n = 8, key = 22. That means search = 22.

low = 0, high = 7.

0	1	2	3	4	5	6	7
10	12	14	16	18	20	22	24.

low high

STEP 3: Now we will calculate mid using the formula,

$$mid = low + \left[\frac{(high - low) * (key - A[low])}{A[high] - A[low]} \right]$$

$$= 0 + \left[\frac{(7-0) * (22-10)}{24-10} \right]$$

$$= 0 + \frac{7 * 12}{14}$$

$$mid = 6$$

STEP 4: Check if A[mid] = key element

We find A[mid] = A[6] = 22. key element is found.

Time complexity:

Best case: The best case time complexity is when we could search the element just in one comparison. Hence it is O(1).

Average case: For sorted and uniformly distributed data the interpolation search is $O(\log_2(\log_2 n))$ where n is total number of elements in array.

Worst Case: If the data is sorted but quite randomized, the time complexity of interpolation search will be much worse than binary search. It will be O(n).

Pattern Search:

Concept of String matching:

* String matching algorithms are normally used in text processing.
* Normally text processing is done in compilation of program.
* String matching means finding one or more generally all needed the occurrences of a string in the text. These occurrences are called as Pattern. Sometimes string matching algorithms are called as pattern matching algorithms.

Let,

Text T is denoted by $t_0 \ldots t_{n-1}$ and pattern P is denoted by $P_0 \ldots P_{m-1}$

$t_0 \ldots t_i \ldots t_{i+j} \ldots t_{i+m-1} \ldots t_{n-1}$ ← text

$P_0 \ldots P_j \ldots P_{m-1}$ ← Pattern.

Matched pattern found in text.

String matching Algorithms:

1) The Naive method
2) Rabin-karp method.

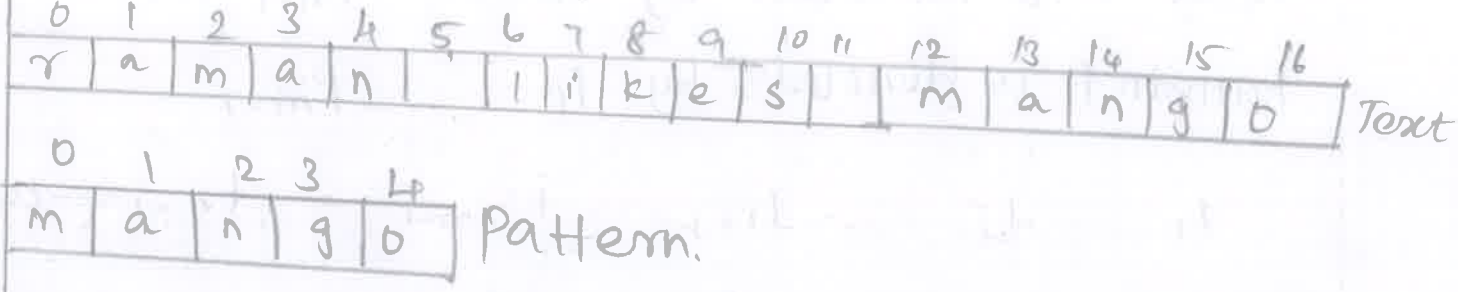
Naive String matching Algorithm:

This is the simplest method which works using Brute force approach.

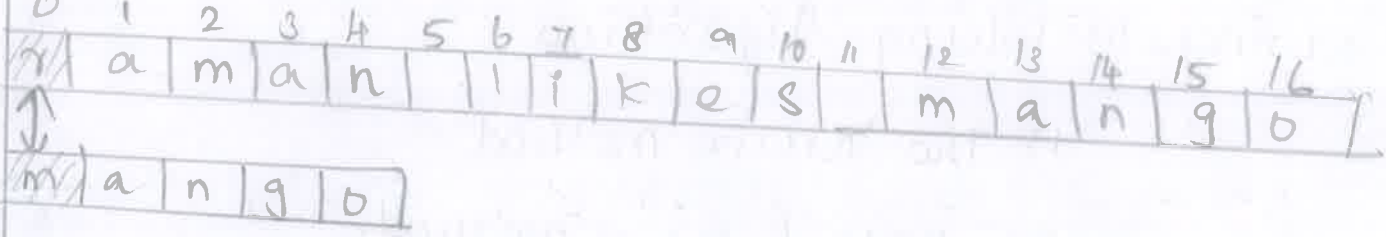
The Bruteforce is a straightforward approach of solving the problem. This method has just do it approach.

This algorithm performs a checking at all positions in the text between 0 to n-m, whether an occurrence of the pattern starts there or not.

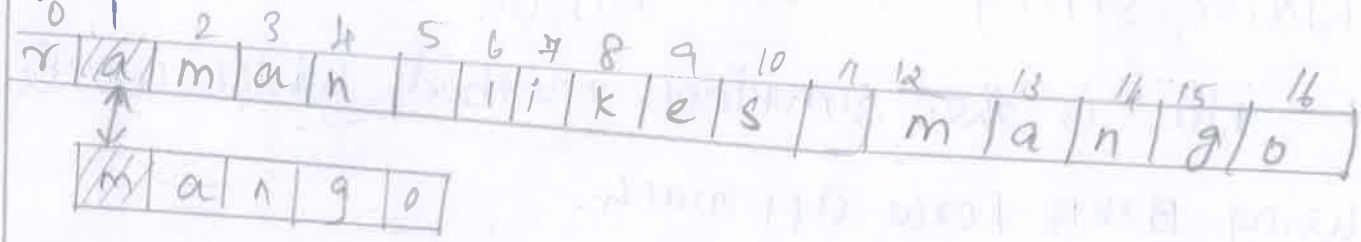
Consider the text and pattern as given below.



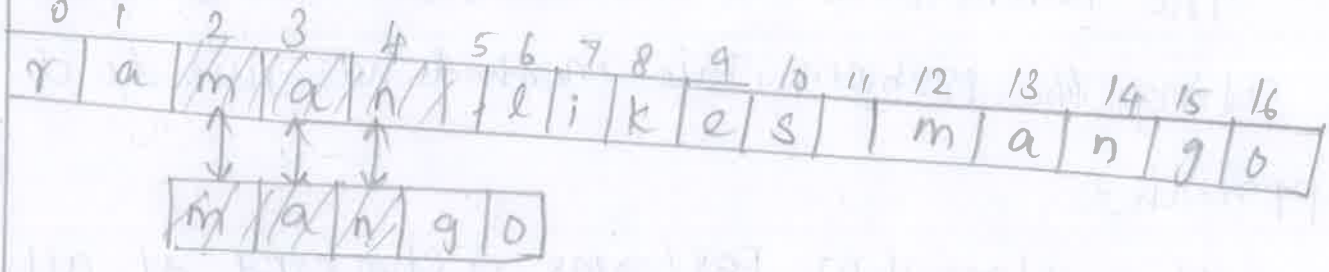
We will start finding match pattern from 0th location in Text. If the match is not found the shift to the right by 1 position.



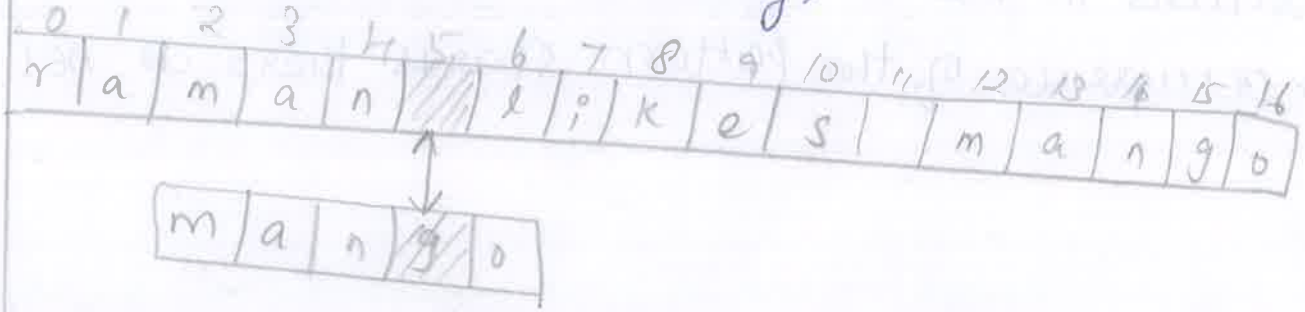
No match is found. ∴ Shift to the right by 1 position.



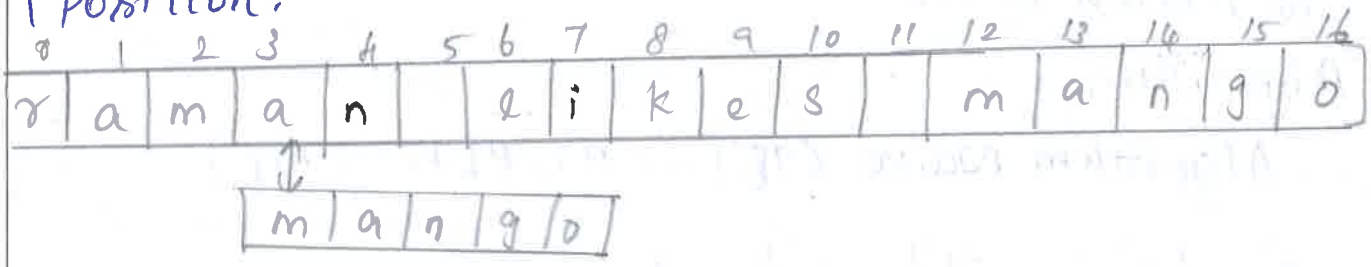
There is no match.



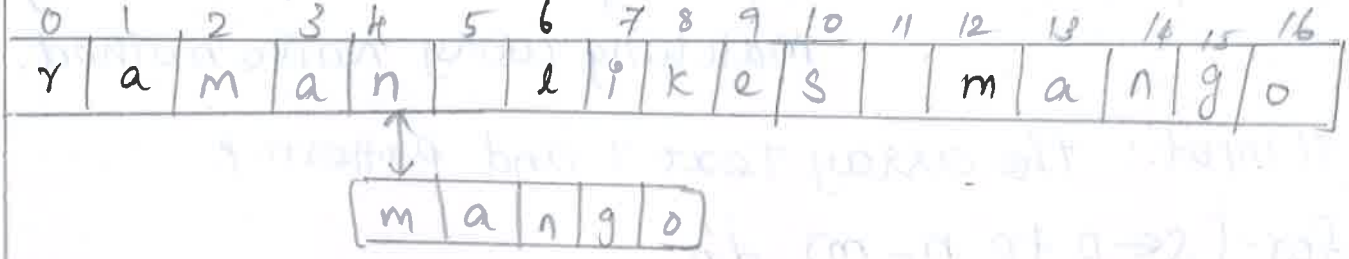
Three symbols are matching.



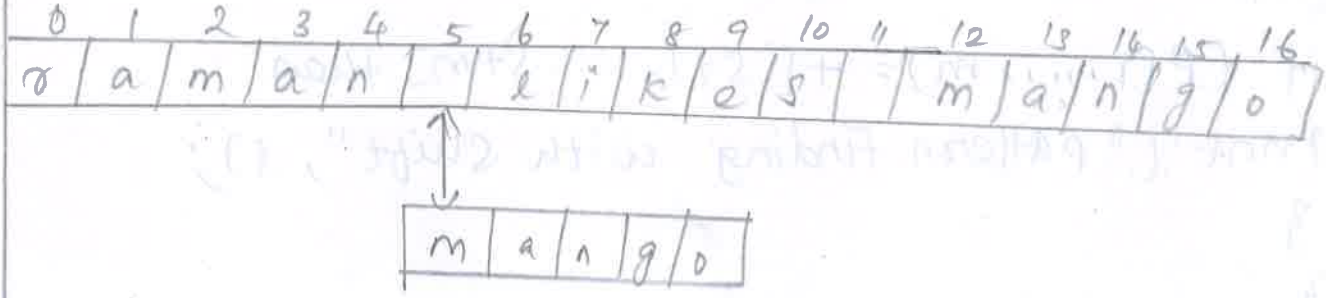
There is no match. ∴ Shift to the right by 1 position.



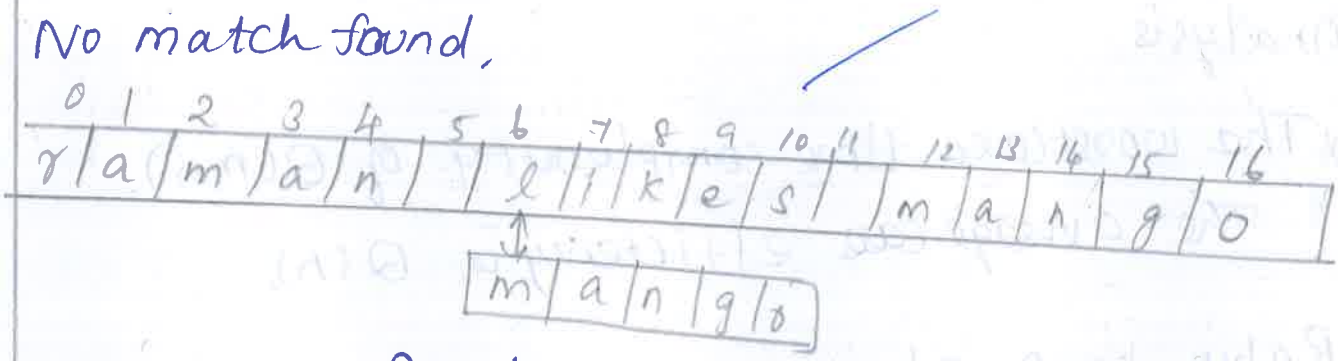
No match found,



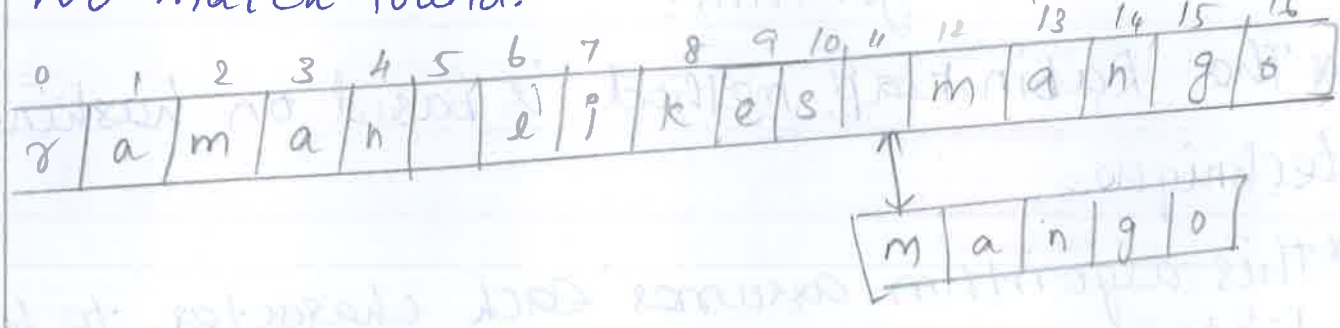
No match found.



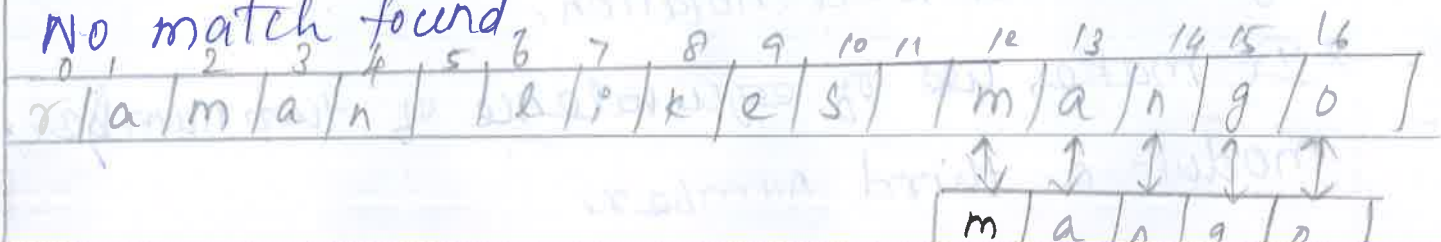
No match found,



No match found.



No match found,



The match is found.
The match is found from position 12 to 16.

Algorithm:

```
Algorithm Naive (T[1....n], P[1.... m])
{
//Problem Description : This algorithm finds the String
                        matching using Naive method.
// Input : the array Text T and pattern P.
for (S←0 to n-m) do
{
if (P[1.....m] = T[S+1.....S+m] then
Print ("pattern finding with shift", S);
}
}.
```

Analysis:

* The worst case time complexity of $\Theta(mn)$.
* The average case efficiency is $\Theta(n)$.

Rabin-karp Algorithm:

* The Rabin karp method is based on hashing technique.
* This algorithm assumes each character to be a digit in radix-d notation.
* It makes use of equivalence of two numbers modulo a third number.

* Let $P[1 \ldots m]$ be a pattern then p denotes its corresponding decimal value. The $d = 10$ for decimal number, $d = 2$ for binary number.
* Similarly let $T[1 \ldots n]$ be a text then t_s denotes the decimal value of the substring $T[s+1, \ldots s+m]$ for $s = 0, 1, \ldots n-m$.
* $t_{s+1} = d(t_s - d^{m-1} T[s+1] + T[s+m+1])$ where $d = 10$.

Example:

Using the Rabin-karp algorithm for Text $T = 3141592653589793$, find for pattern $P = 26$ with modulo $q = 11$.

Soln:

3	1	4	1	5	9	2	6	5	3	5	8	9	7	9	3

Text

2	6

pattern

$26 \bmod 11 = 4$.

We will now obtain mod 11 value for each text.

STEP 1:

To compute pattern

$t_{s+1} = d(t_s - d^{m-1} T(s+1)) + T(s+m+1)$

$p \bmod q = 4$, $m = 2$

$t_0 = 3\ 1$

$31 \bmod 11 = 9$ [4 ≠ 9 match not found, so]

$t_1 = 10(31 - 10^{2-1} * T(0+1)) + T(0+2+1)$

$= 10(31 - 10^1 * T(1) + T(3)$

$= 10(31 - 10 * (3) + 4)$

$t_1 = 14$

14 is not matched with the pattern 26.

$14 \bmod 11 = 3.$

$t_2 = 10(14 - 10^1 T(2) + T(1+2+1)$

$= 10(14 - 10 * 1) + T(4)$

$= 10(4) + 1$

$t_2 = 41$

$41 \bmod 11 = 8$

Now check the hash value, value is 4. No match.

$t_3 = 10(41 - 10^{2-1} * T(2+1) + T(2+2+1)$

$= 10(41 - 40) + 5$

$= 15$

$15 \bmod 11 = 4$ ← spurious hit

So next iteration.

$t_4 = 10(15 - 10^1 + T(3+1)) + T(3+2+1)$

$= 10(15 - 10) + T(6)$

$= 10(5) + 9$

$= 59$

$59 \bmod 11 = 4$ ← spurious hit

$t_5 = 10(59 - 10 * T(4+1) + T(4+2+1))$

$= 10(59 - 10 * T(5)) + T(7)$

$= 10(59 - 50) + 2$

$= 92$

$92 \bmod 11 = 4$ ← Spurious hit

$t_6 = 10(92 - 10^1 * T(5+1)] + T(5+2+1)$

$= 10(92 - 90) + T(8)$

$= 10(2) + 6$

$= 26$ ⟺ valid hit

$26 \bmod 11 = 4$

$t_7 = 10(26 - 10^1 \times T(6+1) + T(6+2+1)$

$= 10(26 - 10 \times (2)) + 5$

$= 10(6) + 5$

$= 65$

$65 \bmod 11 = 10.$

$t_8 = 10(65 - 10^1 \times T(7+1) + T(7+2+1)$

$= 10(65 - 60) + 3$

$= 50 + 3 = 53$

$53 \bmod 11 = 9.$

$t_9 = 10(53 - 10^1 \cdot T(8+1) + T(8+2+1)$

$= 10(53 - 10.(5)) + 5$

$= 10(3) + 5$

$= 35$

$35 \bmod 11 = 2.$

Spurious hit count = 3

valid hit at index 7.

Knuth- Morris- pratt Algorithm:

This algorithm is named after the scientists Knuth, Morris and Pratt.

It avoids the repeated comparison of characters.

The basic idea behind this algorithm is to build a prefix-table. Sometimes this array is also called array or failure function table.

This prefix table is built using the prefix and suffix information of pattern.

Example:

Step1: We will construct prefix-table or failure function table for given pattern as follows.

0	1	2	3	4	5	6	7
a	b	c	d	a	b	c	y
0	0	0	0	1	2	3	0

prefix-table.

Step2: Now Start matching Search for pattern against the text with the help of the prefix-table.

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
a	b	c	x	a	b	c	d	a	b	x	a	b	c	d	a	b	c	d	a	b	c	y
		^	x																			
a	b	c	d	a	b	c	y															

Pattern[3] is not matching with Text[3]. Hence we find position using formula:

⇒ text-index-of-unmatched character − Prefix-table [Pattern-index-1].

⇒ 3 − Prefix-table [3−1]

⇒ 3 − 0

⇒ 3.

That means shift pattern starting at index 3.

STEP 3:

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
a	b	c	x	a	b	c	d	a	b	x	a	b	c	d	a	b	c	d	a	b	c	y
			x																			
			a	b	c	d	a	b	c	y												

Pattern[0] is not matching with Text[3]. Hence simply shift pattern by one position.

STEP 4:

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
a	b	c	x	a	b	c	d	a	b	x	a	b	c	d	a	b	c	d	a	b	c	y
				^	^	^	^	^	^	x												
				a	b	c	d	a	b	c												

Text[10] is not matching with Pattern[6].

∴ text-index-of-unmatched-character — Prefix-table [pattern-index-of-unmatched character — 1].

⇒ 10 — Prefix-table [5]

⇒ 10 - 2 = 8.

That means shift pattern starting at index 8.

STEP 5:-

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
a	b	c	x	a	b	c	d	a	b	x	a	b	c	d	a	b	c	d	a	b	c	y
								n	n	y												
								a	b	c	d	a	b	c	y							

Text[10] is not matching with Pattern[2].

new position = 10 - prefix-table [1]

= 10 - 10

= 10.

That means shift pattern at starting index 10.

STEP 6:-

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
a	b	c	x	a	b	c	d	a	b	x	a	b	c	d	a	b	c	d	a	b	c	y
										x												
										a	b	c	d	a	b	c	y					

Text[10] is not matching with pattern[0].

Hence Shift pattern by one position.

STEP 7:

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
a	b	c	x	a	b	c	d	a	b	x	a	b	c	d	a	b	c	d	a	b	c	y
											∧	∧	∧	∧	∧	∧	∧	x				
											a	b	c	d	a	b	c	y.				

Text [18] is not matching with pattern [7].

New position = 18 − Prefix_table [6]

= 18 − 3

= 15.

That means shift pattern at starting position 15.

STEP 8:

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
a	b	c	x	a	b	c	d	a	b	x	a	b	c	d	a	b	c	d	a	b	c	y
															∧	∧	∧	∧	∧	∧	∧	∧
															a	b	c	d	a	b	c	y.

Hence we found a match for pattern at starting position Text [15].

∴ The match is found.

Sorting:

* Sorting is a technique by which the elements are arranged in some Particular order. Sorting order is of two types: Ascending order Descending order.

* Sorting is useful for arranging the data in desired order. After sorting the required element can be located easily.

* Searching technique is essential for locating the position of the required element from the heap of data.

Insertion Sort:

In this method the elements are inserted at their appropriate place. Hence it is the name as insertion sort.

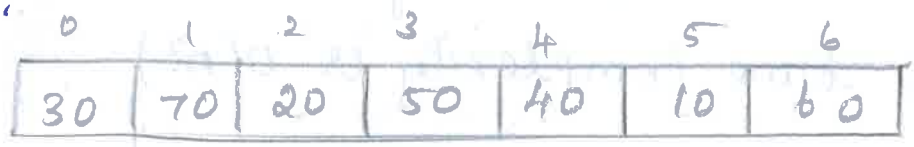
Algorithm:

```
algorithm insert-sort (A[0.....n-1])
for i<-1 to n-1 do
{
temp<-A[i]
j<-i-1
while (j>=0) AND (A[j] > temp) do
{
A[j+1]<-A[j]
j<-j-1
```

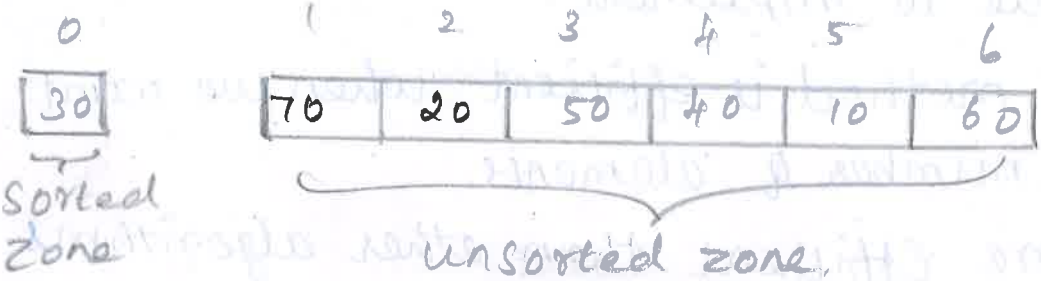
Example:

Consider a list of elements as, 30, 70, 20, 50, 40, 10, 60.

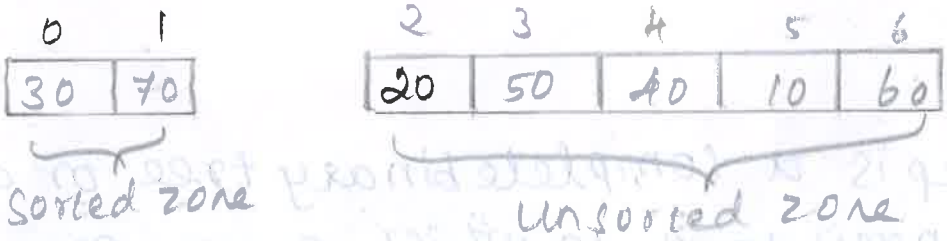
Soln:



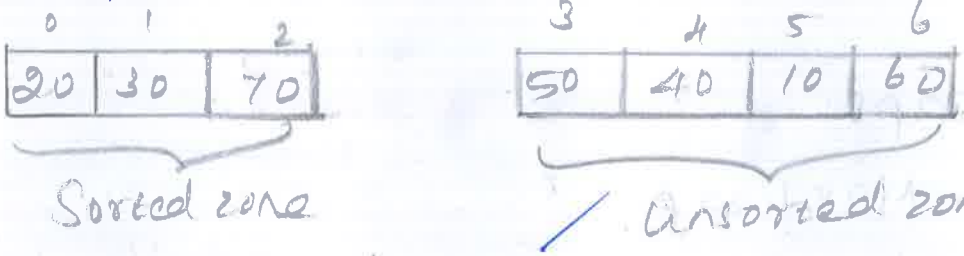
The process starts with first element,

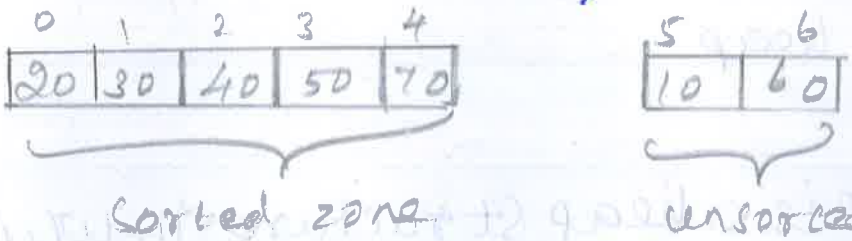


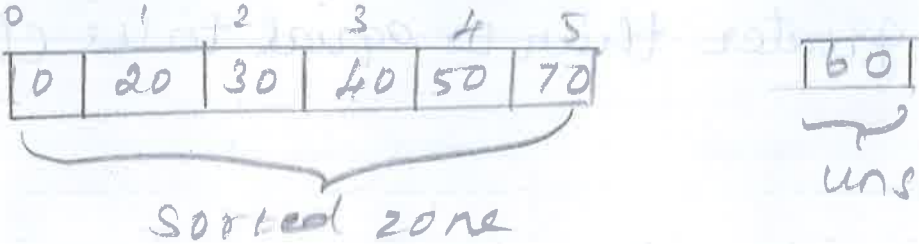
Compare 70 with 30 and insert it at its position.

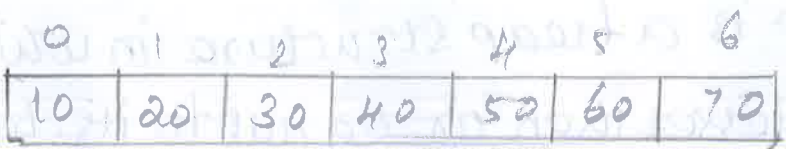


Compare 20 with the elements in sorted zone and insert it in that zone at appropriate position.









→ Sorted list of

Analysis:

* Best case time complexity of insertion sort is $O(n)$.
* Average case time complexity is $O(n^2)$.
* Worst case time complexity is $O(n^2)$

Advantages:

* Simple to implement.
* This method is efficient when we want to sort small number of elements.
* More efficient than other algorithms such as Selection sort or Bubble sort.

HEAP SORT:

A heap is a complete binary tree or almost complete binary tree in which every parent node be greater than or lesser than its child nodes.

Types of Heaps:

1. Max heap
2. Min heap

Max heap:

Max heap is a heap structure in which each node is greater than or equal to its child nodes.

Min heap:

Min heap is a heap structure in which value of each node is lesser than or equal to its child nodes.

STAGES:

1. Heap construction:-
   First construct a heap for given numbers.

2. Deletion of maximum key:
   Delete root key always for (n-1) times to remaining heap. Hence we will get the elements in decreasing order.

Steps:

Step 1: Construct max heap from given set of elements.

Step 2: Swap the root key with the last node key of the heap.

Step 3: Delete the last node and store this key at the end of the array in which heap is stored.

Step 4: Heapify the remaining heap structure.

Step 5: Repeat step 2 to 4 until the last remaining node.

Step 6: Delete the last node and store it in the array of heap.

Step 7: Print all the elements of the array. This will display the elements in sorted order.

Example:

Sort the elements of a given array in ascending order using heap sort. The elements are 48, 0, -1, 82, 108, 72, 54.

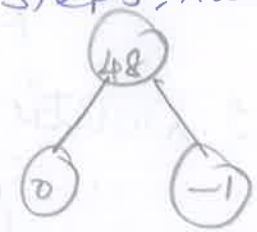
STAGE 1: Construct Heap

We will construct max heap as follows.

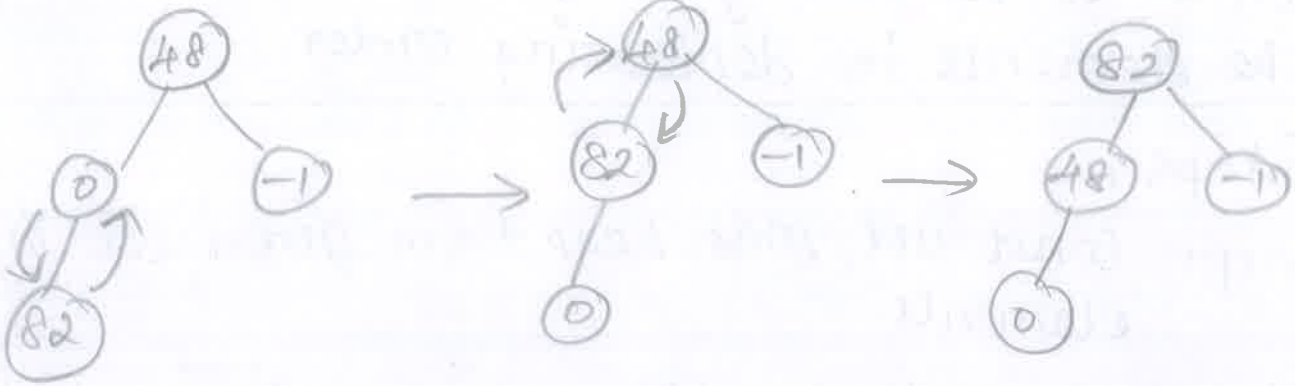
STEP 1: Insert 48

STEP 2: Insert 0

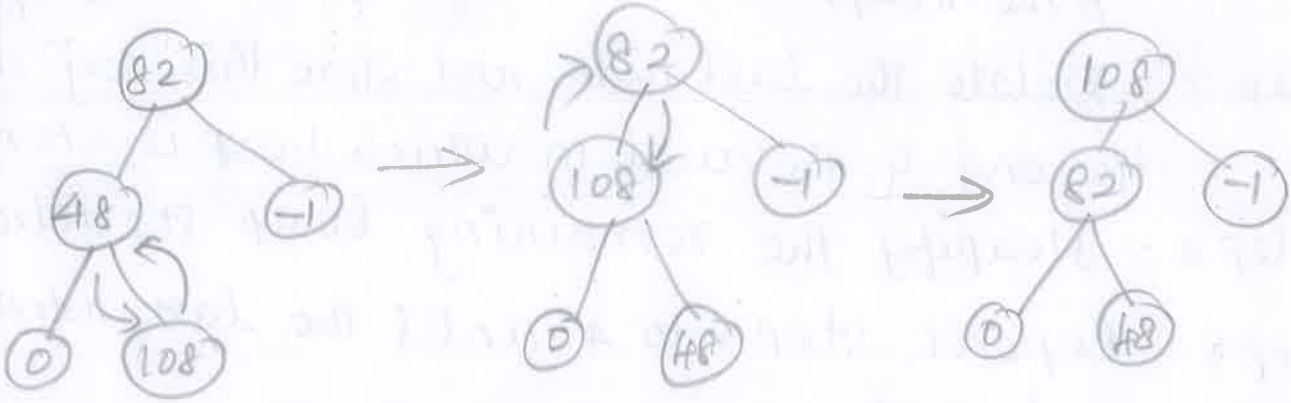
STEP 3: Insert -1



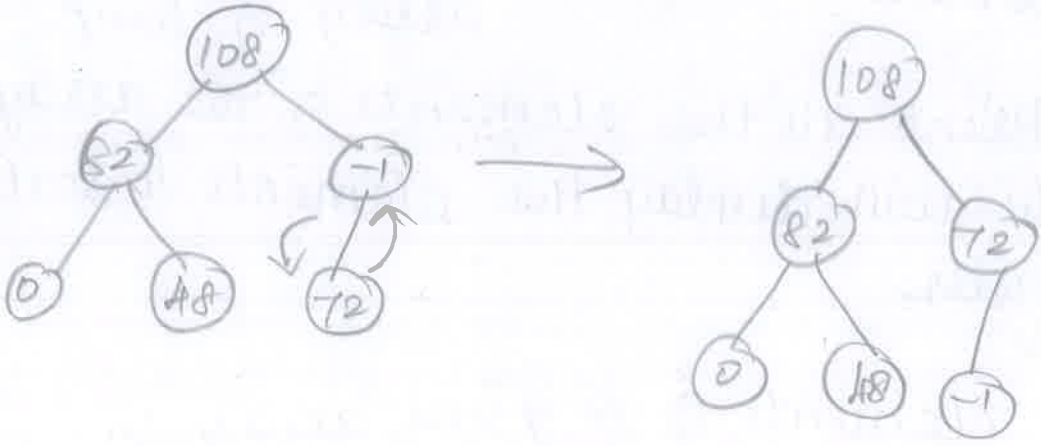
STEP 4: Insert 82



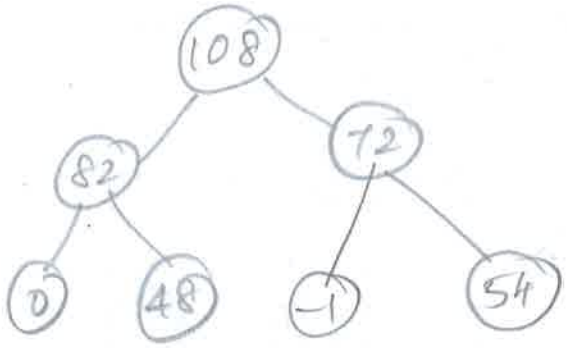
Step 5: Insert 108.



Step 6: Insert 72.



Step 7: insert 54

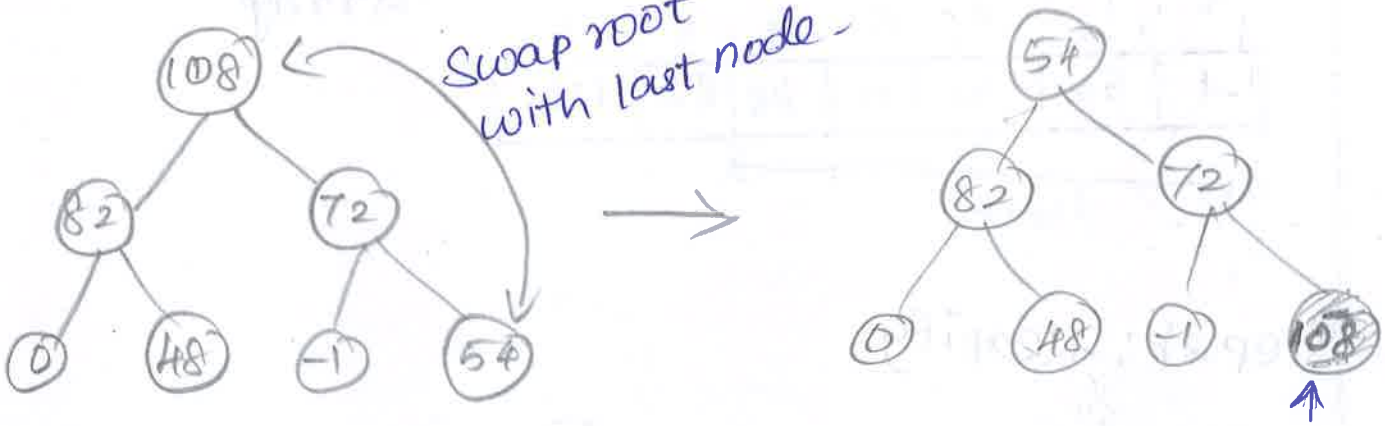


0	1	2	3	4	5	6
108	82	72	0	48	-1	54

Heap elements stored in array.

STAGE 2: Delete root node and heapify repeatedly

Step 1a: Delete root

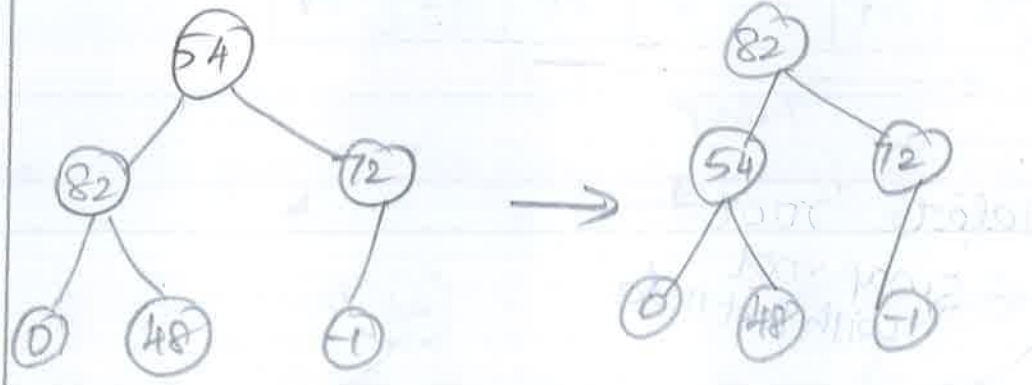


Delete it and insert it at the end of array.

0	1	2	3	4	5	6
54	82	72	0	48	-1	108

Heap

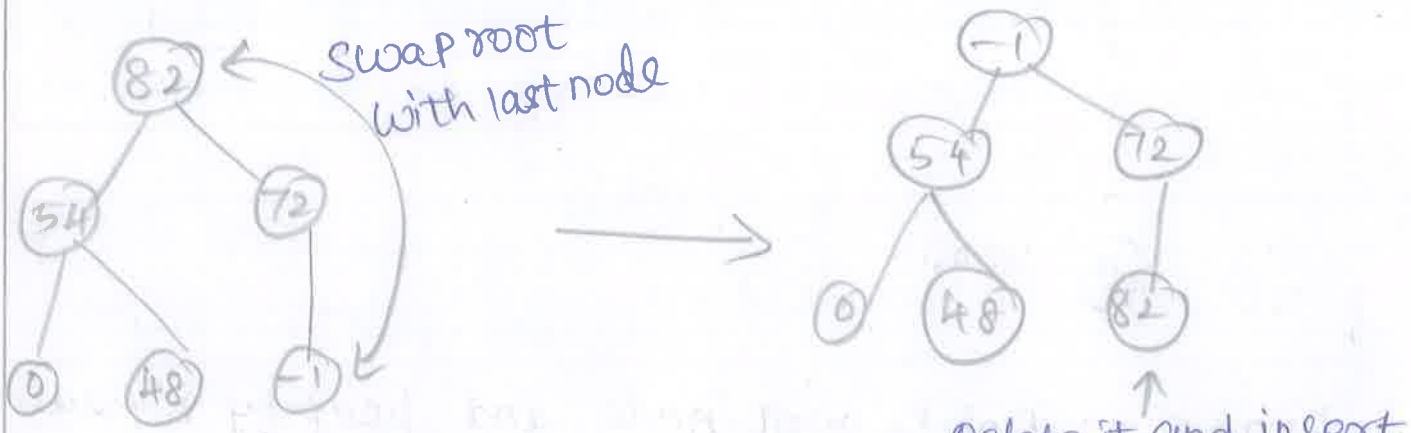
Step 1b: Heapify

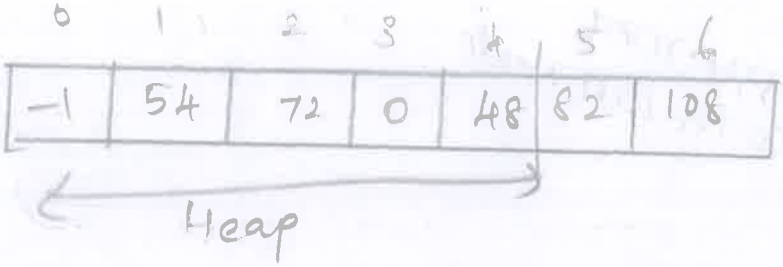


0	1	2	3	4	5	6
82	54	72	0	48	-1	108

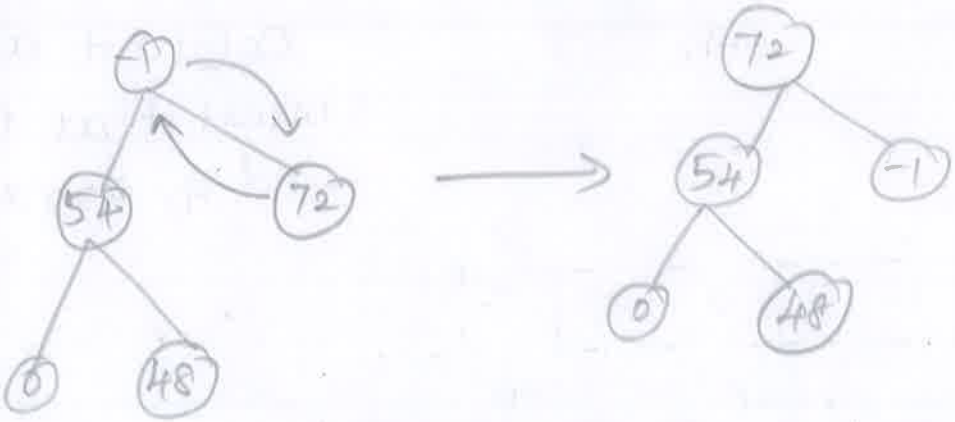
Heap

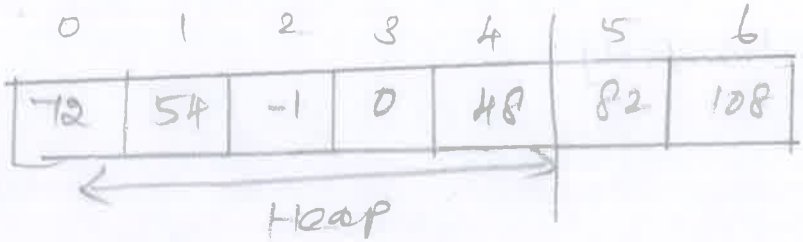
Step 2a: Delete Root



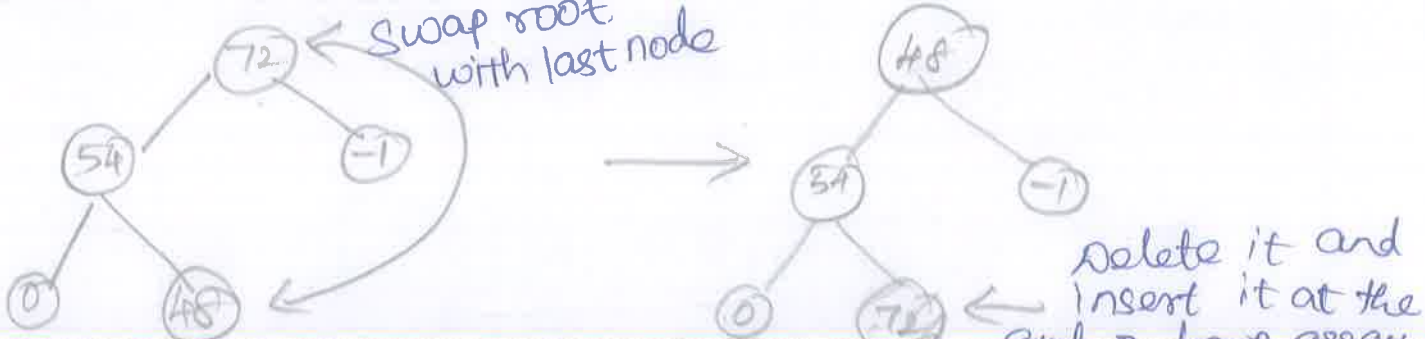


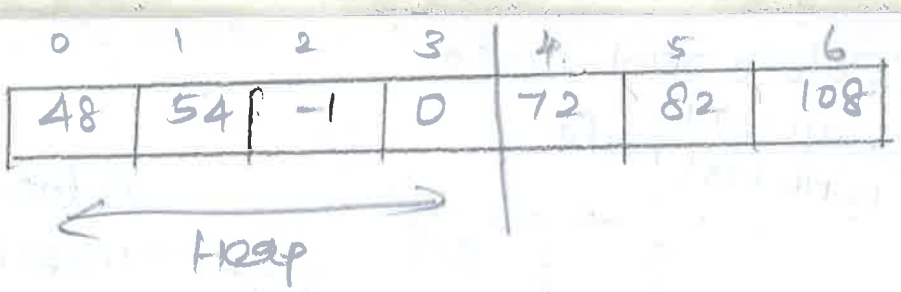
Step 2b: Heapify



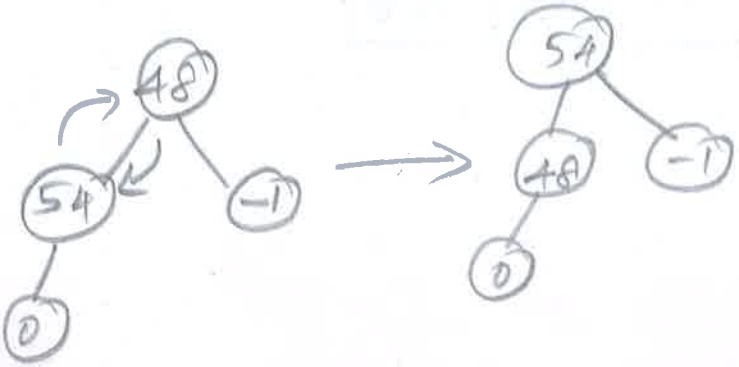


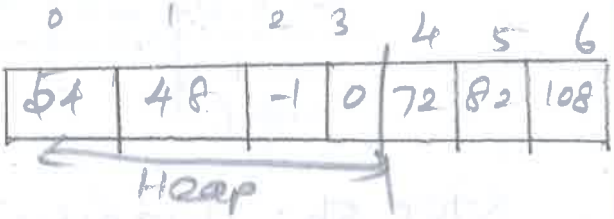
Step 3a: Delete root



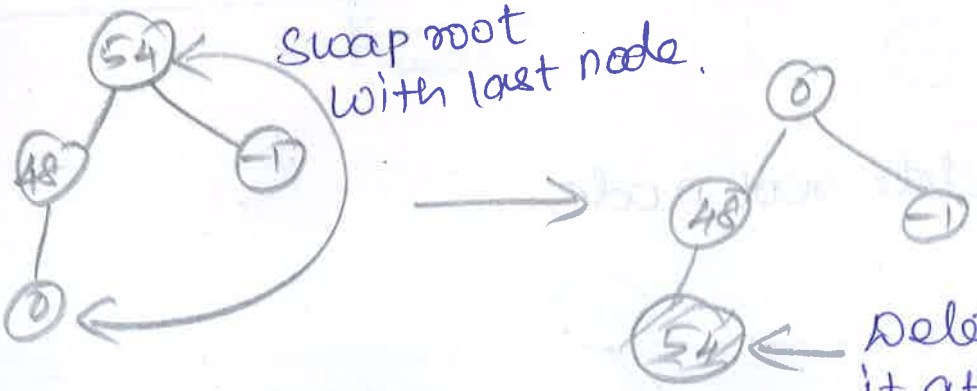


Step 3b - Heapify

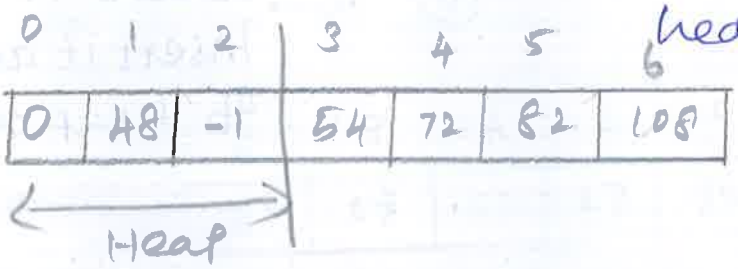




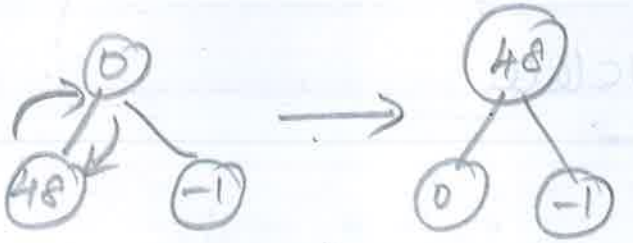
Step 4a: Delete Root node

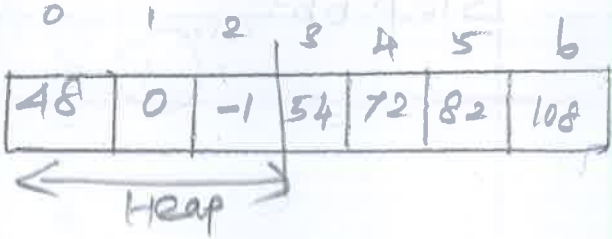


Delete it and insert it at the end of heap array.

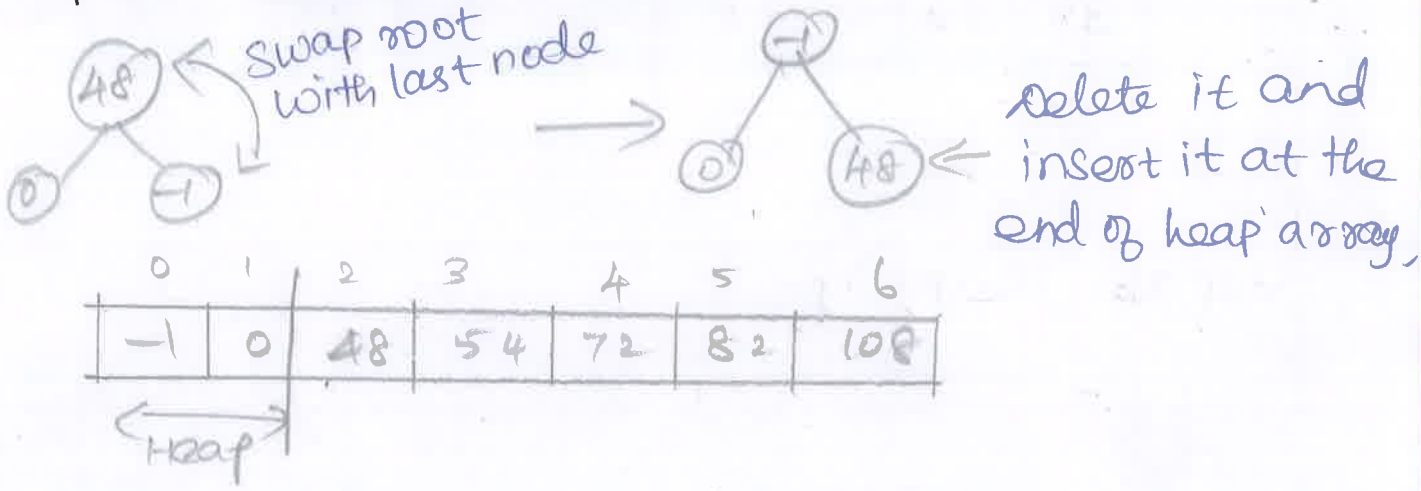


Step 4b: Heapify

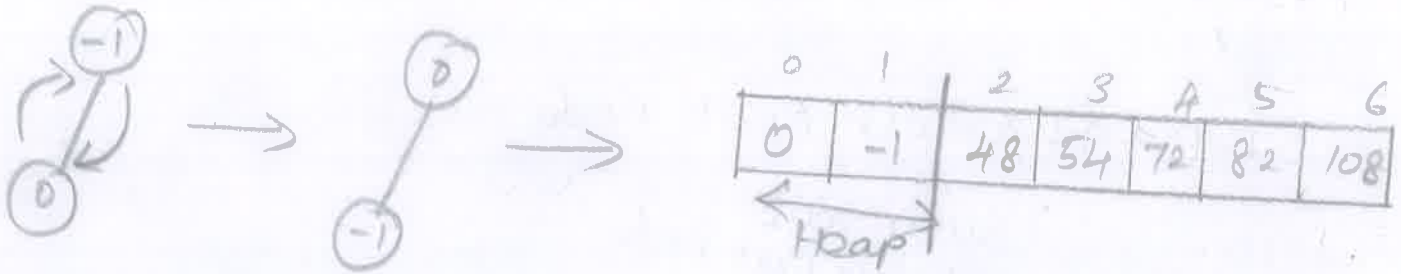




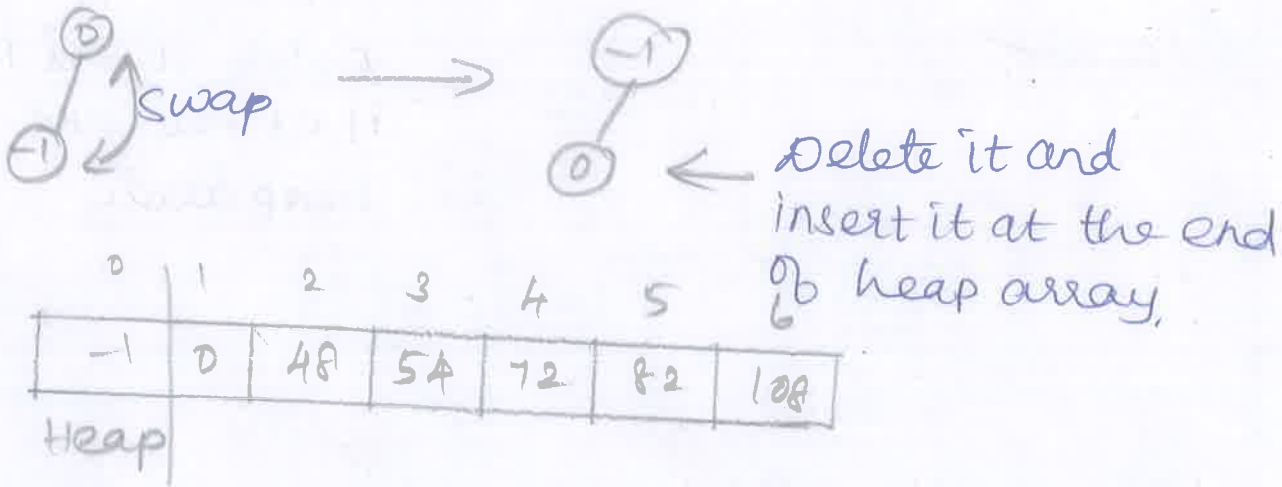
Step 5a: Delete root node



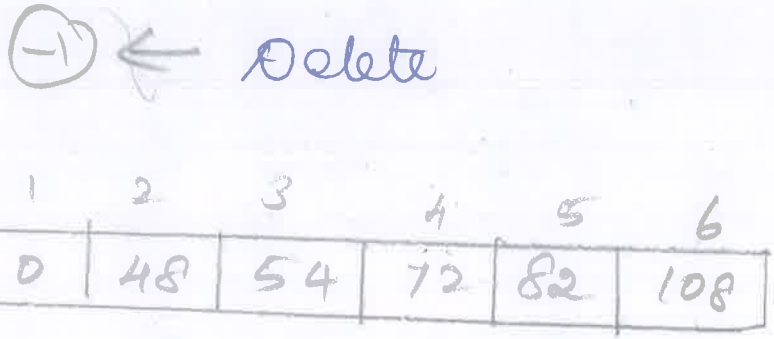
Step 5b: Heapify



Step 6a: Delete root node



Step 6b:



This is the final sorted array.

Important Questions:

2 MARKS:

1. Define Algorithm.
2. Define the notion of algorithm with diagram.
3. Define Time and space complexity.
4. What is meant by recurrence equation?
5. Establish the relation between O and Ω.
6. What do you mean by order of growth.
7. What is the best, worst and average case time complexities of linear search algorithm.
8. What is time space trade off?
9. Define Bigoh, Omega and Theta notation.
10. What is meant by Substitution method.
11. What is meant by linear search and Binary Search.
12. Define interpolation Search.
13. What is meant by pattern matching.
14. Define sorting and its types.
15. What are the different stages in heapsort.

Algorithm:

```
algorithm heapsort (int arr[], int n)
{
for i = n/2 - 1 to i >= 0 do
heapify (arr, n, i);
for (i = n-1 to i >= 0 do
{
swap_elements (&arr[0], &arr[i]);
heapify (arr, i, 0);
}
}.
```

Time complexity:

The time complexity of heapsort for best case, worst case and average case is $O(n \log n)$.

Space complexity:

The Space complexity of heapsort is $O(1)$.

PART-B

1. Discuss all the asymptotic notations in detail and explain bigoh, Theta and Omega notation.
2. What is meant by Recurrence relation, with an example.
3. Analyze the best, worst and average case analysis for linear Search.
4. Explain how analysis of linear Search is done with a suitable illustration.
5. Explain in detail about naive string matching algorithms.
6. Explain in detail about Rabin-Karp algorithm with an example.
7. Explain in detail about Knuth-morris pratt algorithm.
8. Explain in detail about Heapsort?

References:

1) Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, "Data Structures and Algorithms", Pearson education, 2006.
2) www.w3schools.com/Algorithms-CS3401.
3) www.geeks for geeks.com/Algorithms.

UNIT-II

GRAPH ALGORITHMS

Graph:

* A graph is a collection of two sets V and E where V is a finite non-empty set of vertices and E is a finite non-empty set of edges.
* Vertices are nothing but the nodes in the graph.
* Two adjacent vertices are joined by edges.
* Any graph is denoted as $G = \{V, E\}$.

Types of Graph:

Basically graphs are of two types.

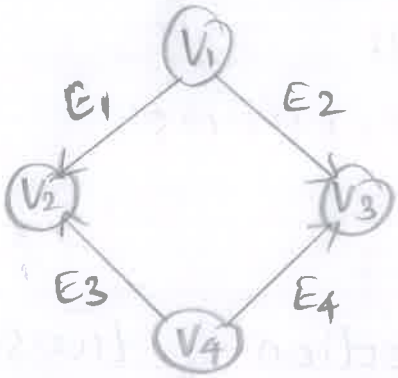
1. Directed graphs
2. Undirected graphs.

Directed graphs:

In the directed graph the directions are shown on the edges.

In this type of graph, the edge E_1 is in between the vertices V_1 and V_2.

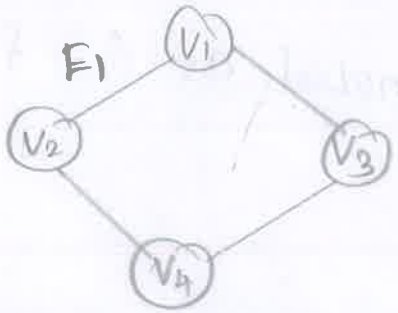
The V_1 is called head and the V_2 is called the tail.



We can say E_1 is the set of (V_1, V_2) and not of (V_2, V_1)

Undirected graph:

In an undirected graph, the edges are not ordered. In this type of graph the edge E_1 is set of (V_1, V_2) or (V_2, V_1).



Properties of graph:

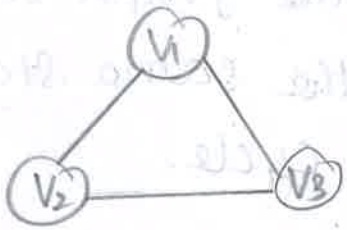
* Complete graph
* Sub graph
* Connected graph
* Weighted graph
* path
* Cycle
* Component
* In-degree and Out-degree
* Self loop
* Isolated vertex.

Complete graph:

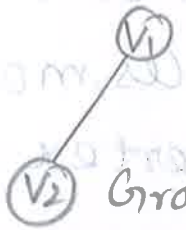
If an undirected graph of n vertices consists of $\frac{n(n-1)}{2}$ number of edges then that graph is called a Complete graph.

Subgraph:

A subgraph G' of graph G is a graph such that the set of vertices and set of edges of G' are proper subset of the set of edges of G.



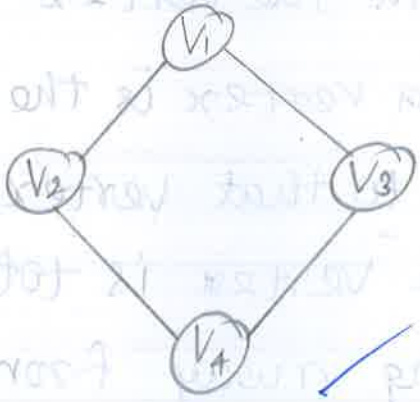
Graph G



Graph G'

Connected graph:

An undirected graph is said to be Connected if for every pair of distinct vertices v_i and v_j in V(G) there is an edge v_i to v_j in G.



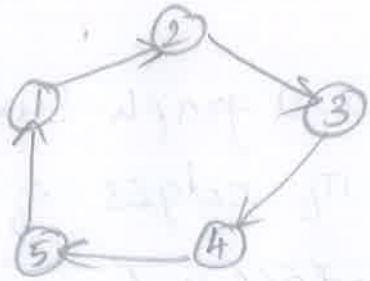
* $V_1 - V_2$
* $V_2 - V_1$
* $V_3 - V_1$
* $V_4 - V_3 - V_1$
* $V_1 - V_3$
* $V_2 - V_1 - V_3$
* $V_3 - V_1 - V_2$
* $V_4 - V_2$
* $V_1 - V_4$
* $V_2 - V_4$
* $V_3 - V_4$
* $V_4 - V_3$.

Weighted graph:

A weighted graph is a graph which consists of weights along its edges.

Path;

A path is denoted using sequences of vertices and there exists an edge from one vertex to the next vertex.



path of G is 1-2-3-4-5.

Cycle:

A closed walk through the graph with repeated vertices, mostly having the same starting and ending vertex is called a cycle.

Component:

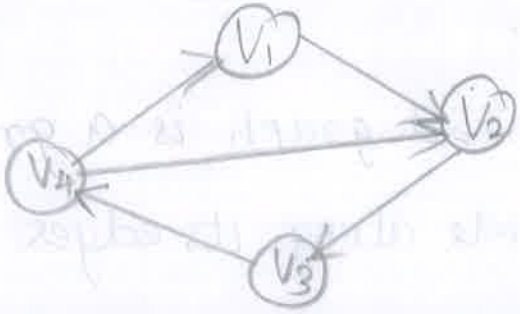
The maximal connected subgraph of a graph is called component of a graph.

In-degree and Out-degree:

The degree of vertex is the number of edges associated with the vertex.

In degree of a vertex is the number of edges that incident to that vertex.

Outdegree of the vertex is total number of edges that are going away from the vertex.



Self loop:

Self loop is an edge that connects the same vertex.

Isolated Vertex:

In a graph the vertex with degree 0 is called isolated vertex.

Representations of Graphs:

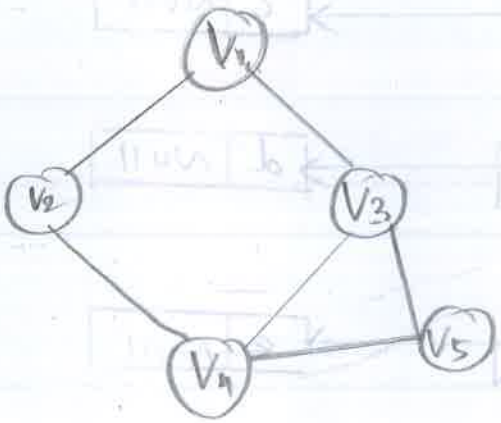
A graph can be represented by two ways.

1. Adjacency matrix
2. Adjacency list

Adjacency matrix:

In this representation 2 dimensional array is used to represent the graph.

Consider a graph G of n vertices and the matrix M. If there is an edge present between vertices V_i and V_j then M[i][j]=1 else M[i][j]=0.

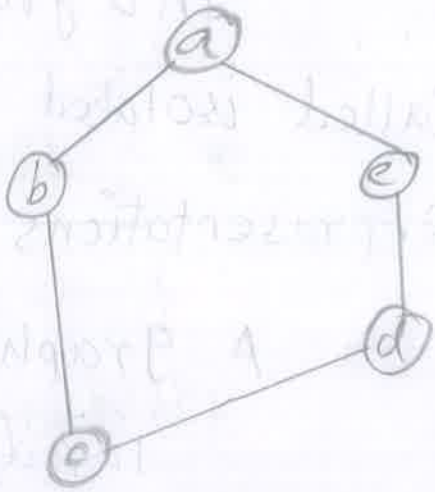


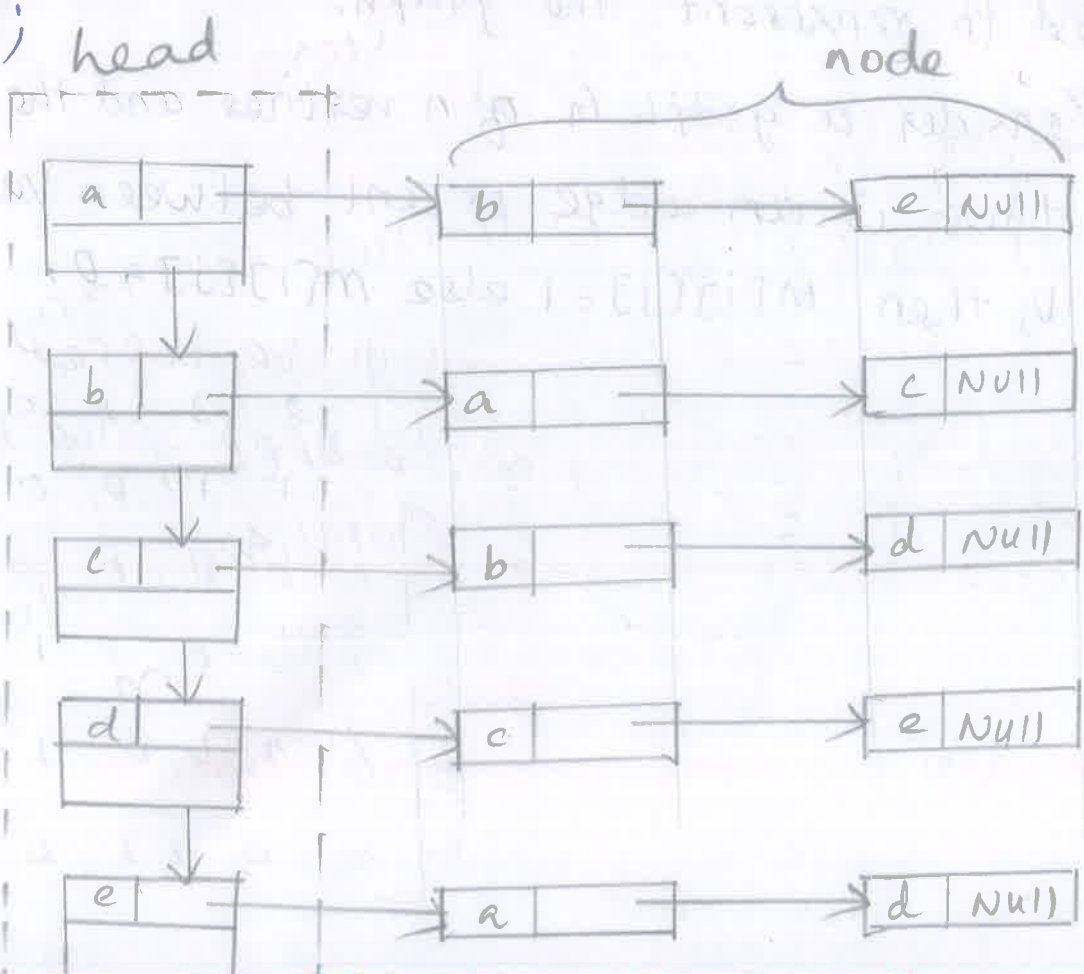
	1	2	3	4	5
1	0	1	1	0	0
2	1	0	0	1	0
3	1	0	0	1	1
4	0	1	1	0	1
5	0	0	1	1	0

Adjacency List:

In this representation a linked list is used to represent a graph.

```
typedef struct head
{
char data;
Struct head *down;
Struct head *next;
};
typedef Struct node
{
 Int vor;
 Struct node *link;
};
```





Graph Traversal:

Traversal is a technique of visiting each node of a graph and exploring it.

There are two types of traversals used in graph.

1. Depth First Search (DFS)
2. Breadth First Search (BFS).

Depth First Search Traversal:

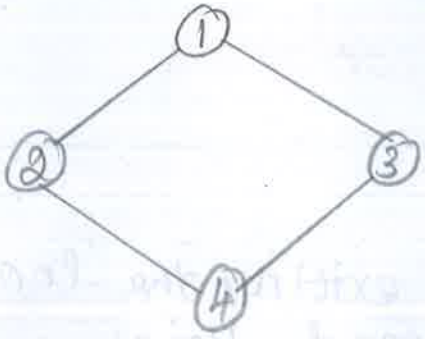
* In depth first search traversal we start from one vertex and traverse the path as deeply as we can go. When there is no vertex further, we traverse back and search for unvisited vertex.

* An array is maintained for storing the visited vertex.

* In DFS the basic data structure for storing the adjacent nodes is stack.

* We have used a recursive call to DFS function.

* When a recursive call is invoked actually push operation gets performed. When we exit from the loop pop operation gets will be performed.



Step 1:

Start with vertex 1, Print it so '1', gets printed. Mark 1 as visited.

visited

0	0
1	1
2	0
3	0
4	0

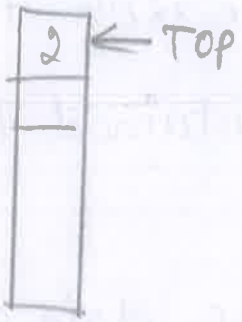
Step 2:

Find adjacent vertex to 1, say 2, if it is not visited, Call DFS(2), 2 will get inserted in the Stack, mark is as visited.

visited

0	0
1	1
2	1
3	0
4	0

Stack



After exiting the loop, value 2 will be popped print '2'.

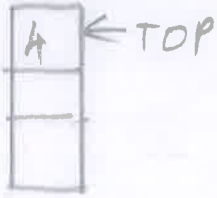
Step 3:

Find adjacent to '2', vertex 4. if it is not visited call DFS(4), 4 will get pushed on to the stack, mark it as visited.

visited

0	0
1	1
2	1
3	0
4	1

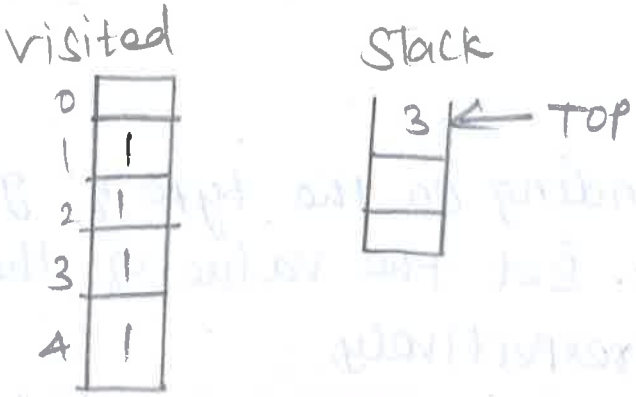
Stack



After exiting the loop, value 4 will be popped. Print 4

Step 4:

Find adjacent to '4', vertex 3 if it is not visited call DFS(3). 3 will be pushed on to the stack mark it as visited.



After exiting the loop, value 3 will be popped print '3'. all the nodes are covered.

the output of DFS will be, 1 2 4 3.

1	2	4	3.

Analysis:

* The time complexity of DFS is O(V+E) where V is the number of vertices and E is the number of edges.
* The space complexity of DFS is O(V).

Breadth First Search Traversal:

In BFS we start from some vertex and find all the adjacent vertices of it.

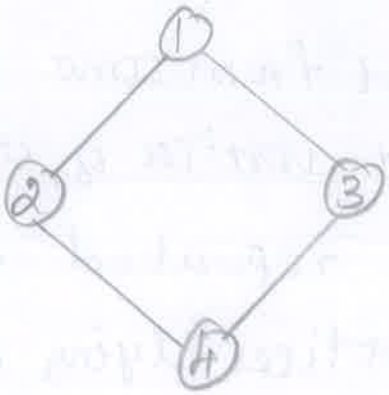
This process will be repeated for all the vertices so that the vertices lying on same breadth gets printed.

* For avoiding re repetition of vertices, we maintain array of visited nodes.
* A queue datastructure is used to store adjacent vertices.

Algorithm:-

1. Create a graph. Depending on the type of graph, directed or undirected. Set the value of the flag as either 0 or 1 respectively.
2. Read the vertex from which you want to traverse the graph say Vi
3. Initialize the visited array to 1 at the index of Vi
4. Insert the visited vertex Vi in the queue.
5. Visit the vertex which is at the front of the queue. Delete it from the queue and place its adjacent nodes in the queue.
6. Repeat the Step 5, till the queue is not empty.
7. Stop.

Example:

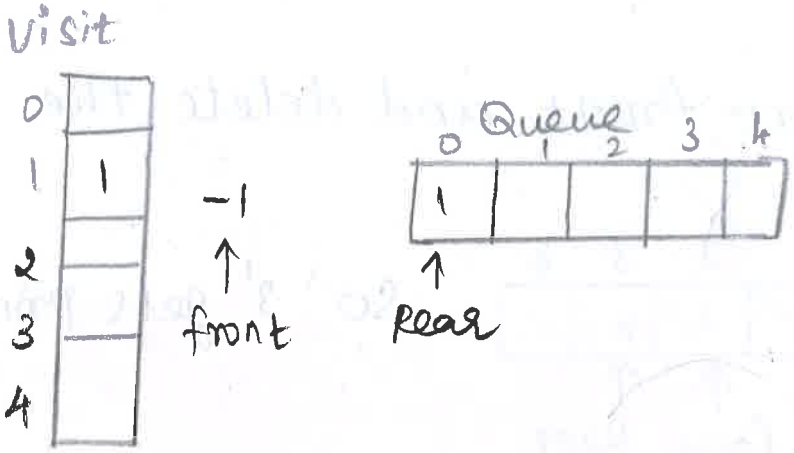


In BFS the queue is maintained for storing the adjacent nodes and an array visited is maintained for keeping the track of visited nodes.

Once a particular node is visited it should not be revisited again.

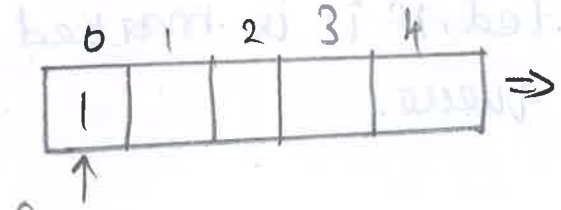
Step 1:

Start with vertex 1.



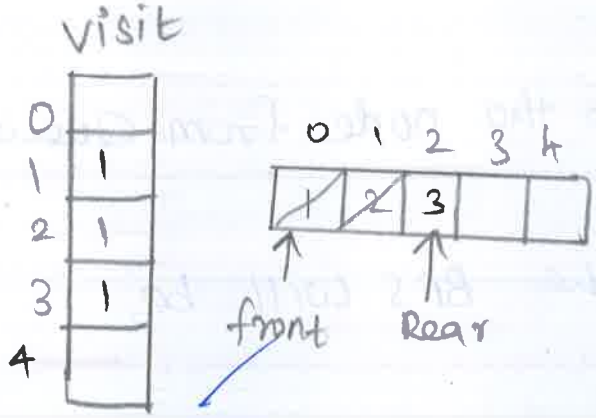
⇒ Inserted vertex 1 in the queue and marked the index 1 of visited array by 1.

Step 2:



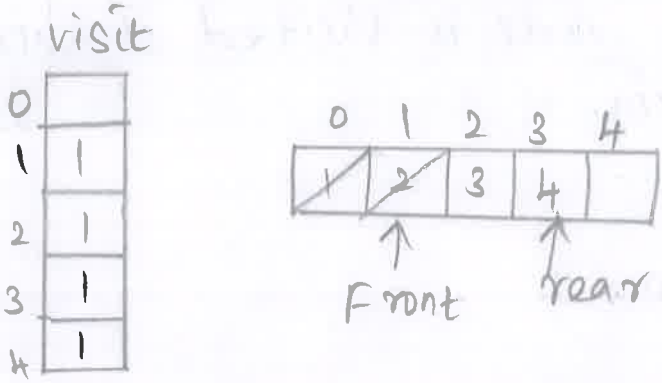
⇒ Delete '1' and print it so '1' gets printed.

Step 3: Find adjacent vertices of vertex 1 and mark them as visited, insert those in Queue.

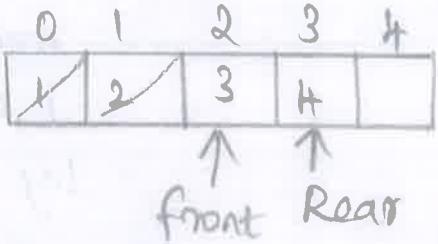


Increment front by 1 delete '2' from Queue and print it so '2' gets printed.

Step 4: Find adjacent to '2' and insert those nodes in Queue as well as mark them as visited.

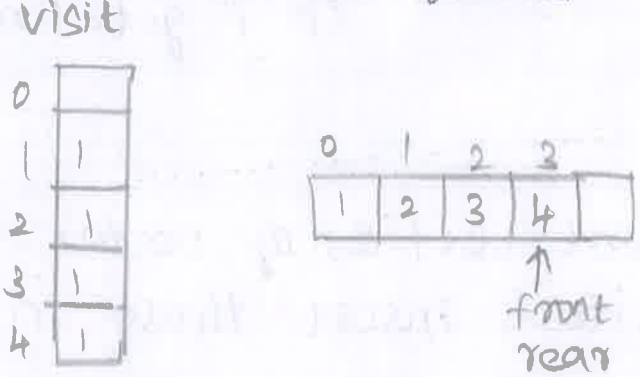


Step 5: Increment front and delete the node print it.



So '3' gets printed.

Step 6: Find adjacent to '3' is 4 check whether it is marked as visited. If it is marked as visited. do not insert in the queue.



So '4' gets printed
Since front = rear
Stop the procedure.

Increment front, delete the node from Queue and print it.

∴ the output for the BFS will be,

Applications of BFS:

1. For finding the connected components in the graph.
2. For checking if any cycle exits in the given graph.
3. To obtain shortest path between two vertices

Applications of DFS:

1. DFS is used for checking connectivity of a graph.
2. DFS is used for checking acyclicity of graph.
3. DFS is used to find articulation point. A vertex of connected graph is said to be its articulation point of its removal with all its incident edges breaks the graph into disjoint pieces.

Difference between BFS and DFS:

Depth first Traversal (DFS)	Breadth first Traversal (BFS)
1. The traversal is done with the help of stack data structure.	1. This traversal is done with the help of queue data structure.
2. It works using two ordering.	2. It works using one ordering.
3. The DFS sequence is composed of tree edges and back edges	3. The DFS sequence is composed of tree edges and cross edges.
4. The efficiency of the adjacency matrix graph is $\Theta(V^2)$	4. The efficiency of the adjacency matrix graph is $\Theta(V^2)$.

Applications of graphs:

1. In computer networking such as local Area Network (LAN), wide Area Networking (WAN), Internetworking.
2. In telephone cabling graph theory is effectively used.
3. In Job scheduling algorithms.

Connectivity, strong Connectivity and Bi-connectivity:

Connectivity:

Connectivity in an undirected graph means that every vertex can reach every other vertex via some path.

If the graph is not connected then the connected components of graph can be obtained.

Strongly Connected Components:

A directed graph is strongly connected if there is a directed path from any vertex to every other vertex.

Biconnectivity:

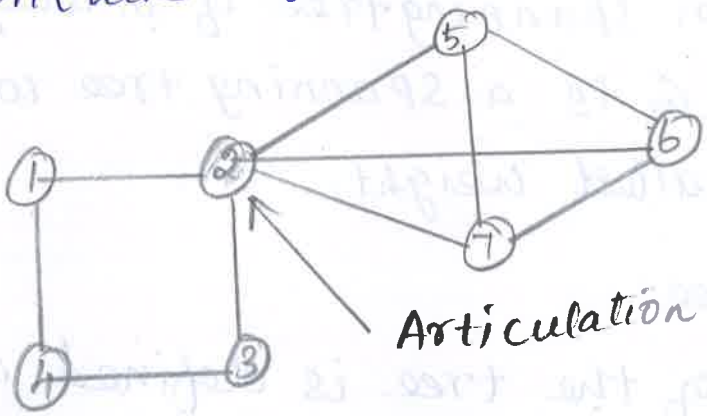
A bi-connected graph $G=(V, E)$ is a connected graph which has no articulation points.

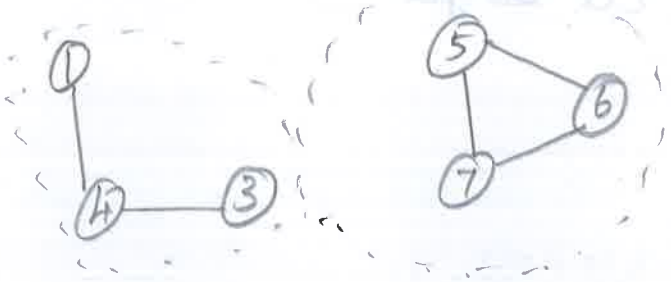
Articulation point:

Let $G = (V, E_0)$ be a connected undirected graph, then an articulation point of graph G is a vertex whose removal disconnects graph G. This articulation point is a kind of cut-vertex.

Example:

A graph G is said to be bi-connected if it contains no articulation points.





⇒ Two disjoint graphs

* Two different bi-connected components should not have any common edges.

Two different biconnected components can have common vertex.

The common vertex which is attaching two (or more) biconnected components must be an articulation point of G.

Minimum Spanning Tree:

Spanning Tree:

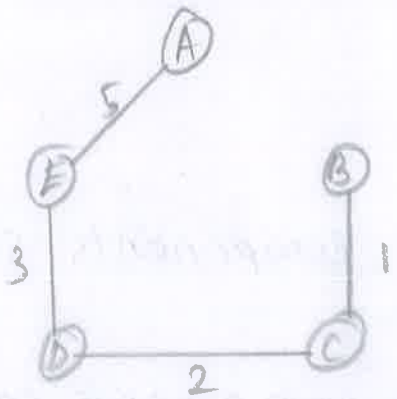
A spanning tree of a graph G is a subgraph which is basically a tree and it contains all the vertices of G containing no circuit.

Minimum Spanning tree:

A minimum spanning tree of a weighted connected graph G is a spanning tree with minimum or smallest weight.

Weight of the Tree:

A weight of the tree is defined as the sum of weights of all its edges.



Wt (T1) = 11.

Applications of Spanning Trees:

* Spanning trees are very important in designing efficient routing algorithms
* Spanning trees have wide applications in many areas such as network design.

Prim's Algorithm :-

We will consider all the vertices first. Then we will select an edge with minimum weight. The algorithm proceeds by selecting adjacent edges with minimum weight. It should not forming circuit.

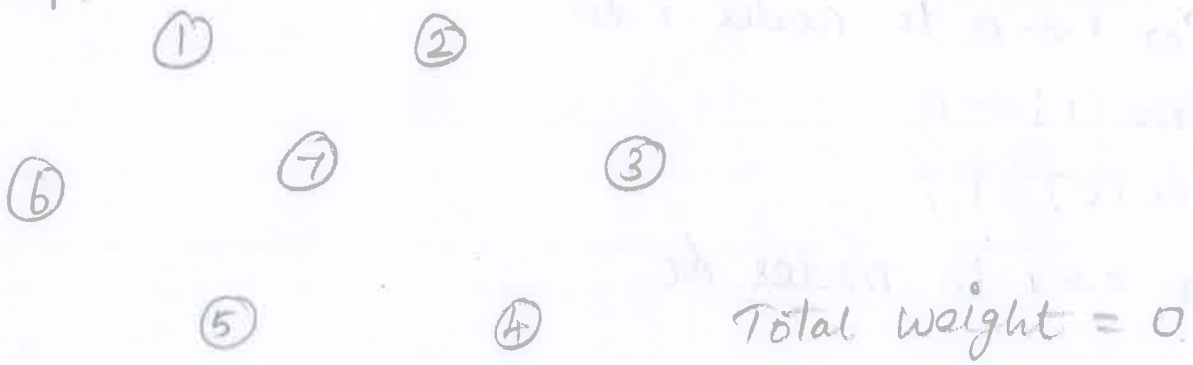
Algorithm:

```
prim ( G[0.... size-1, 0 ..... size-1], nodes)
//problem Description: this algorithm is for implementing
  prim's algorithm for finding spanning tree.
//Input : weighted graph G and total number of nodes.
//Output: Spanning tree gets printed with total path length
        total = 0;
//Initialize the selected vertices list
 for i←0 to nodes-1 do
 tree[i]←0
tree[0]=1;
for k←1 to nodes do.
{
 min_dist←∞
for i←0 to nodes-1 do
{
for j←0 to nodes-1 do
{
if (G[i,j] AND ((tree[i] AND !tree[j]) OR
```

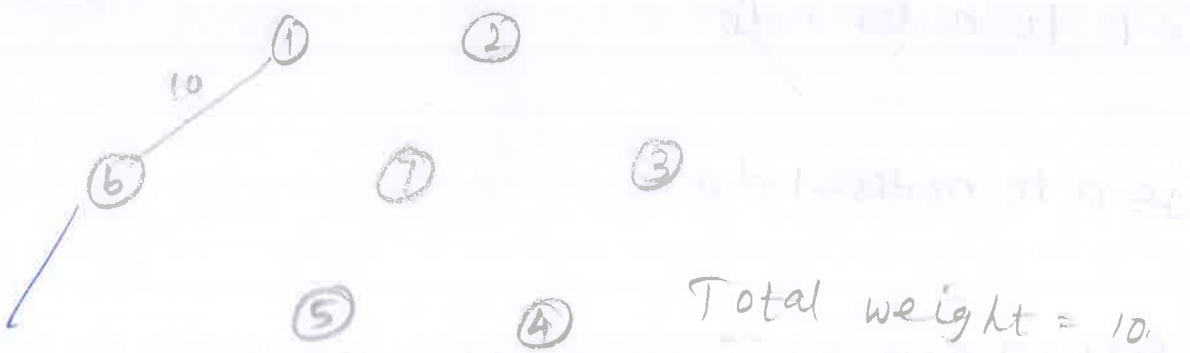
```
( ! tree[j] AND tree[jj] ))) then
{
if (G[i,j] < min_dist) then
{
min_dist ← G[ij]
v1 ← i
v2 ← j
}}
}}
write (v1, v2, min_dist);
tree [v1] ← tree[v2] ← 1
total ← total + min_dist
}
write ("Total path length is", total);
```

Example:

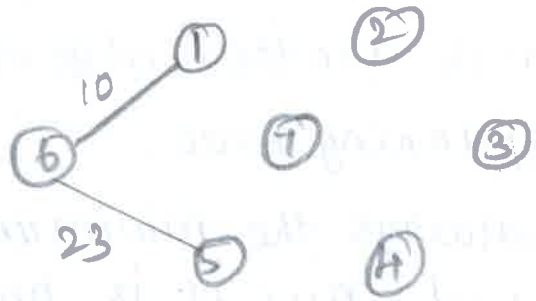
Step 1:



Step 2:

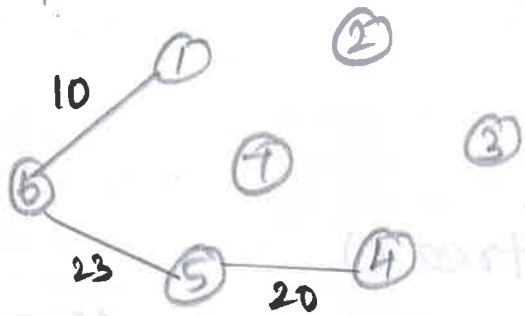


Step 3:



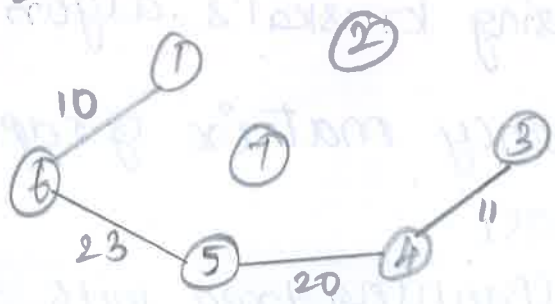
Total weight = 33

Step 4:



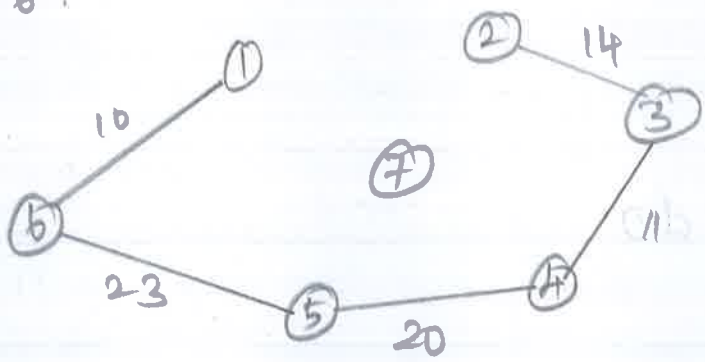
Total weight = 53

Step 5:



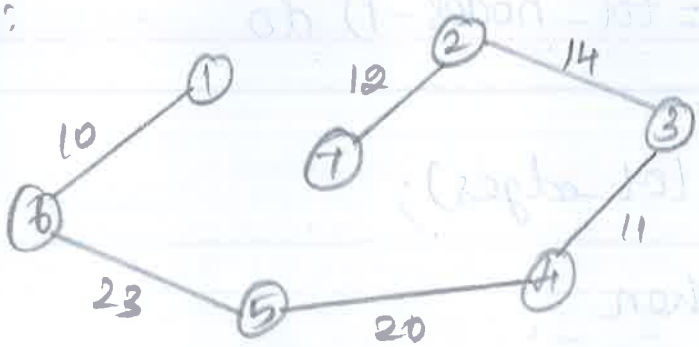
Total weight = 64

Step 6:



Total weight = 78

Step 7:



Total weight = 90.

Time complexity of prim's algorithm is $\theta(V^2)$.

Kruskal's algorithm:

Kruskal's algorithm is another algorithm of obtaining minimum spanning Tree.

In this algorithm always the minimum cost edge has to be selected. But it is not necessary that selected optimum edge is adjacent.

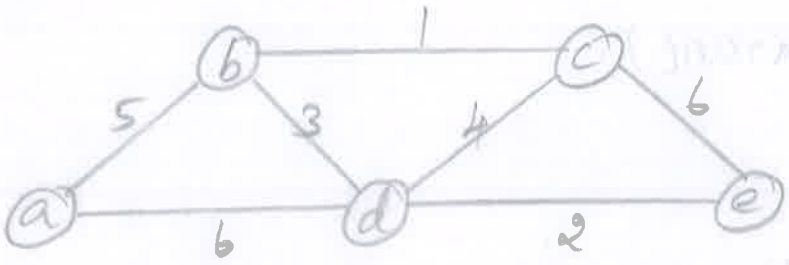
Algorithm:

```
Algorithm spanning_tree ()
//problem Description: This algorithm finds the minimum
  Spanning tree using kruskal's algorithm.
// Input : The adjacency matrix graph G
        Containing cost.
//output : prints the spanning tree with the total cost
count ← 0
k ← 0
sum ← 0
for i ← 0 to nodes do
parent [i] ← i
while (count != tot_nodes - 1) do
{
pos ← minimum (tot_edges);
if (pos = -1) then
break;
```

```
V1 ← G[pos].V1
V2 ← G[pos].V2
i ← Find(V1.parent)
j ← Find(V2.parent)
if (i != j) then
{
tree[k][0] ← V1
tree[k][1] ← V2
k++
count++;
Sum += G[pos].cost
Union(i,j, parent);
}
G[pos].cost INFINITY
}
if (count = tot_nodes-1) then
{
for i ← 0 to tot_nodes-1
{
write(tree[i][0], tree[i][1])
}
write("Cost of spanning tree is", sum);
}
```

Example:

Apply kruskal's algorithm to find a minimum spanning tree of the following graph.



Soln:

STEP 1:

Total weight = 0

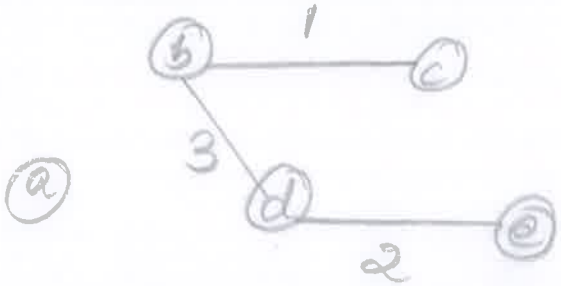
STEP 2:

Total weight = 1

STEP 3:

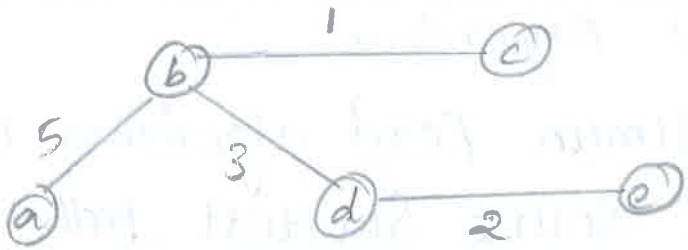
Total weight = 3

STEP 4:



Total weight = 6

STEP 5:



Total weight = 11.

Analysis:

The efficiency of kruskal's algorithm is $O(|E| \log |E|)$ where E is total number of edges in the graph.

Difference between Prims algorithm and kruskal's algorithm:

Prims algorithm	kruskal's algorithm
1. Prims algorithm initialized with nodes.	1. kruskal's algorithm initializes with edges.
2. The next node is always selected from previously selected node.	2. The minimum weight edge is selected independent of earlier selection.
3. In Prims algorithm graph must be connected.	3. kruskal's algorithm can work with dislonnected graph.
4. The time complexity of Prim's algorithm is V^2	4. the time complexity of kruskal's algorithm is $O(\log V)$.

Shortest Path Algorithms:

Bellman-Ford Algorithm:

The Bellman-Ford algorithm works for finding Single Source Shortest Path. It works for negative edges weights.

This is a single source shortestPath algorithm.

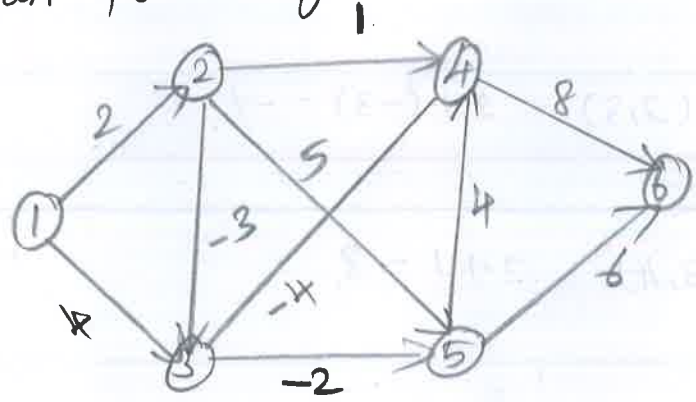
Algorithm:

```
algorithm Bellman Ford (Vertices, edges, Source)
{
//Problem Description: This algorithm finds the shortest
    Path using Bellman Ford method.
for (each vertex V)
{
if (V is source) then
V distance ← 0
else
V.distance ← infinity
V.Prede ← NULL
}
for(i ← 1 to total_vertices - 1)
{
for (each eadge uv)
{
u ← uv.Source
v ← uv.destination
```

```
if (v.distance > u.distance + uv.weight) then
{
v.distance ← u.distance + uv.weight
v.prede ← u.
 }
}
for (each edge uv)
{
u ← uv.source
v ← uv.destination
if (v.distance > u.distance + uv.weight) then
{
write ("Graph has negative edges")
return false
}
}
}.
```

Example:

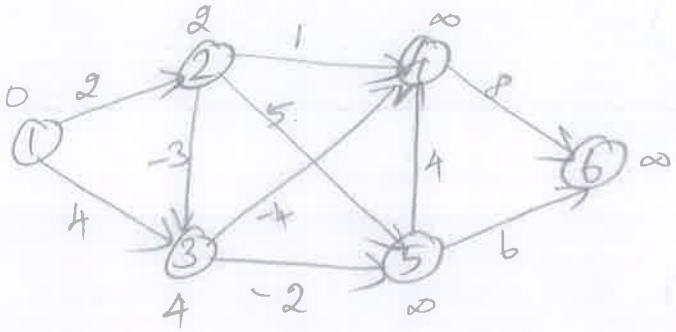
Find shortest path from node 1 to every other node in the graph as given below using bellman ford algorithm.



Soln:

We have a Source vertex 1. Only the direct edges to other vertices are consider. The distances to remaining vertices are ∞.

STEP1: The vertex 2 gives minimum distance so choose vertex 2.



It can be represented as,

1	2	3	4	5	6
0	2	4	∞	∞	∞

STEP 2: Now we will consider 2 as parent node and find distance to all other vertices.

1	2	3	4	5	6
0	2	4	∞	∞	∞
0	2	-1	3	7	∞

For vertex 3

dist(1,2) + dist(2,3) = 2 + (-3) = -1.

For vertex 4

dist(1,2) + dist(3,4) = 2 + 1 = 3.

For vertex 5

dist(1,2) + dist(2,5) = 2 + 5 = 7.

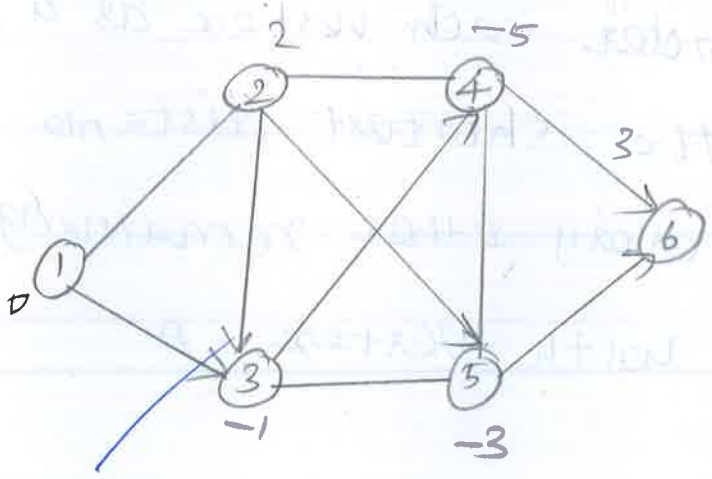
STEP 3: Now consider 3 as parent node.

1	2	3	4	5	6
0	2	4	∞	∞	∞
0	2	-1	3	7	∞
0	2	-1	-5	-3	∞

The distance to vertex 4 and vertex 5 get updated, by considering node 3 as parent node.

STEP 4: Consider node 4 as parent node, shortest distance are them,

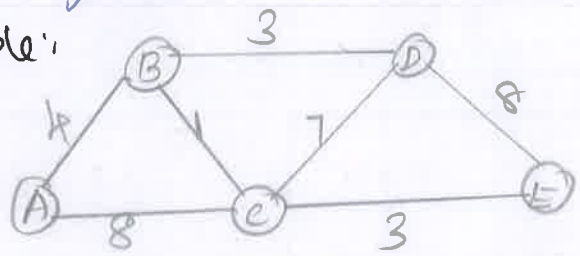
1	2	3	4	5	6
0	2	4	∞	∞	∞
0	2	-1	3	7	∞
0	2	-1	-5	-3	∞
0	2	-1	-5	-3	3



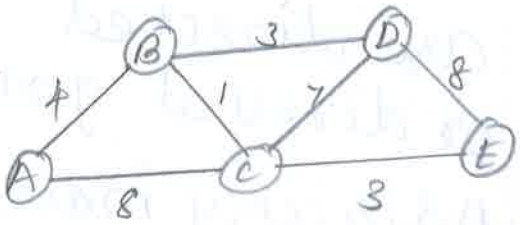
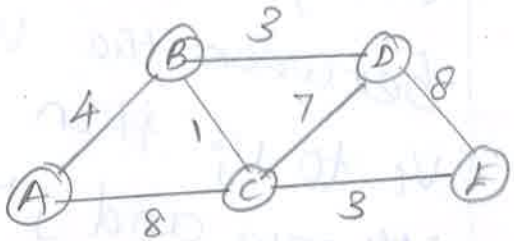
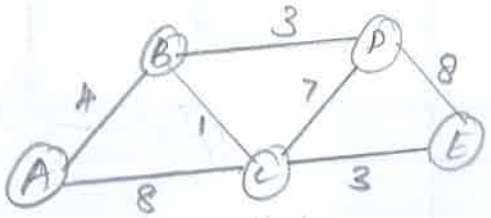
Dijkstra's Algorithm:

* Dijkstra's algorithm is a popular algorithm for finding shortest path.
* This algorithm is called single source shortest path algorithm.
* In this algorithm, for a given vertex called source the shortest path to all other vertices is obtained.
* This algorithm applicable to graphs with non negative weights only.
* Dijkstra's algorithm finds shortest paths to graph's vertices in order of their distance from a given source.

Example:



We will consider each vertex as a source and will find the shortest distance from this vertex to every other remaining vertex. Let us start with vertex A.

Source vertex	Distance with other vertices	Path shown in graph.
A	A-B , path = 4 A-C , path = 8 A-D , path = ∞ A-E , path = ∞	
B	B-C, path = 4+1 = 5 B-D, path = 4+3 = 7 B-E , path = ∞	
C	C-D, path = 5+7 = 12 C-E, path = 5+3 = 8	
D	D-E, path = 7+8 = 15.	

Shortest distance obtained from A to E and that is A-B-C-E with path length: 4+1+3 = 8. similarly other shortest paths can be obtained by choosing appropriate source and destination.

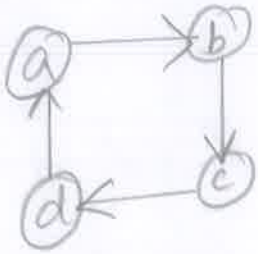
Warshall's Algorithm:

Digraph:

The graph in which all the edges are directed then it is called digraph or directed graph.

Adjacency matrix:

It is a representation of a graph by using matrix. If there exists an edge between the vertices V_i and V_j directing from V_i to V_j then entry in adjacency matrix in i^{th} row and j^{th} column is 1.



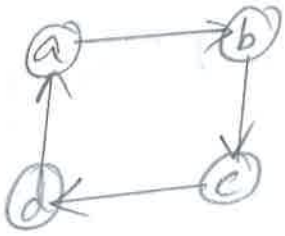
Digraph

	a	b	c	d
a	0	1	0	0
b	0	0	1	0
c	0	0	0	1
d	1	0	0	0

Adjacency matrix

Transitive closure:

Transitive closure is basically a boolean matrix in which the existance of directed paths of arbitrary lengths between vertices is mentioned.



Graph

	a	b	c	d	
a	1	1	1	1	
b	1	1	1	1	path b-c-d
c	1	1	1	1	
d	1	1	1	1	d-a-b-c-d

Transitive closure.

Warshall's algorithm:

Warshall's algorithm constructs the transitive closure of given digraph with n vertices through a series of n-by-n Boolean matrices. The computations in warshall's algorithm are give by following sequence

$$R^{(0)}, \ldots R^{(k-1)} \ldots R^{(k)} \ldots R^{(n)}$$

Example:

Obtain the transitive closure of the given digraph using warshall's algorithm.

Soln:

Adjacency matrix for given graph is,

$$R^{(0)} = \begin{array}{c} \\ a \\ b \\ c \end{array} \begin{array}{c} \begin{array}{ccc} a & b & c \end{array} \\ \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 1 & 0 & 0 \end{bmatrix} \end{array}$$

$$R^k_{[i,j]} = R^{(k-1)}_{[i,j]} \text{ or } [R^{k-1}_{[i,k]} \text{ and } R^{k-1}_{[k,j]}]$$

To find $R^{(1)}$:-

Take first vertex as intermediate vertex, No change in first row and first column.

$$R^{(0)} = \begin{array}{c} \\ a \\ b \\ c \end{array} \begin{array}{c} \begin{array}{ccc} a & b & c \end{array} \\ \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 1 & 0 & 0 \end{bmatrix} \end{array}$$

$$R^{(1)}_{[b,b]} = R^0_{[b,b]} \text{ or } [R^0_{[b,a]} \text{ and } R^0_{[a,b]}]$$

$$= 0 \text{ or } [0 \text{ and } 1]$$

$$= 0 \text{ or } 0$$

$$= 0.$$

$$R^{(1)} = \begin{array}{c} \\ a \\ b \\ c \end{array} \begin{array}{c} \begin{array}{ccc} a & b & c \end{array} \\ \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 1 & 1 & 0 \end{bmatrix} \end{array}$$

$$R^{(1)}_{[c,b]} = R^0_{[c,b]} \text{ or } [R^0_{[c,a]} \text{ and } R^0_{[a,b]}]$$

$$= 0 \text{ or } [1 \text{ and } 1]$$

$$= 0 \text{ or } 1$$

$$= 1.$$

$$R^1_{[c,c]} = R^0_{[c,c]} \text{ or } [R^0_{[c,a]} \text{ and } R^0_{[a,c]}]$$

$$= 0 \text{ or } [1 \text{ and } 0]$$

$$= 0 \text{ or } 0$$

$$= 0.$$

To find R^2:

There is no change in second row and Column.

$$R^{(1)} = \begin{array}{c} \\ a \\ b \\ c \end{array} \begin{array}{c} \begin{array}{ccc} a & b & c \end{array} \\ \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 1 & 1 & 0 \end{bmatrix} \end{array}$$

$$R^{(2)} = \begin{array}{c} \\ a \\ b \\ c \end{array} \begin{array}{c} \begin{array}{ccc} a & b & c \end{array} \\ \begin{bmatrix} \underline{0} & 1 & \underline{1} \\ 0 & 0 & 1 \\ \underline{1} & 1 & \underline{1} \end{bmatrix} \end{array}$$

$R^2[a,a] = R^{[1]}_{a,a}$ or $[R'_{[a,b]}$ and $R'_{[b,a]}]$

$= 0$ or $[1$ and $0]$

$= 0$ or 0

$= 0.$

$R^2[a,c] = R^{[1]}_{[a,c]}$ or $[R'_{[a,b]}$ and $R'_{[b,c]}]$.

$= 0$ or $[1$ and $1]$

$= 0$ or 1

$= 1.$

$R^2[c,c] = R'_{[c,c]}$ or $[R'_{[c,b]}$ and $R'_{[b,c]}]$

$= 0$ or $[1$ and $1]$

$= 0$ or 1

$= 1.$

To find ~~R3~~ :-

Take c as an intermediate vertex. There is no change in that vertex.

$R^{(3)} =$

	a	b	c
a	1	1	1
b	1	1	1
c	1	1	1

$R^3[a,a] = R^2[a,a]$ or $[R^2[a,c]$ and $R^2[c,a]]$

$= 0$ or $[1$ and $1]$

$= 0$ or 1

$= 1.$

$R^3[b,a]$

$= R^2[b,a]$ or $[R^2[b,c]$ and $R^2[c,a]]$

$= 0$ or $[1$ and $1]$

$= 0$ or 1

$= 1.$

$R^3[b,b] = R^2[b,b]$ or $[R^2[b,c]$ and $R^2[c,b]]$

$= 0$ or $[1$ and $1]$

$= 0$ or 1

$= 1.$

This is the transitive closure of a, b, and c.

The time complexity of Warshall's algorithm is $\Theta(n^3)$.

Floyd's algorithm :-

* Floyd's algorithm is for computing shortest path between every pair of vertices of graph.

* The graph may contain negative edges but it should not contain negative cycles.

* Floyd's algorithm computes the distance matrix of a weighted graph with n vertices through a series of n by n matrices.

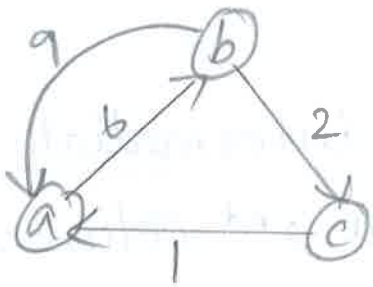
$$D^{(0)}, D^{(1)} \ldots\ldots D^{(k-1)} \ldots D^{(n)}.$$

* Floyd's algorithm is applicable for both directed and undirected graphs.

$$D^{(k)}[i,j] = \min\left[D^{k-1}[i,j], D^{k-1}[i,k] + D^{k-1}[k,j]\right].$$

Example:

Obtain the all-pair shortest path using floyd's algorithm for the following weighted graph.



$$\begin{array}{c} \\ a \\ b \\ c \end{array}\begin{array}{c} \begin{array}{ccc} a & b & c \end{array} \\ \begin{bmatrix} 0 & 6 & \infty \\ 9 & 0 & 2 \\ 1 & \infty & 0 \end{bmatrix} \end{array}$$

Soln:

$$D^{(0)} = \begin{array}{c|ccc} & a & b & c \\ a & 0 & 6 & \infty \\ b & 9 & 0 & 2 \\ c & 1 & \infty & 0 \end{array}$$

To find D^1;

$D^{(1)}$ = a as an intermediate.

$$D^{(1)} = \begin{array}{c|ccc} & a & b & c \\ a & 0 & 6 & \infty \\ b & 9 & 0 & \underline{2} \\ c & 1 & \underline{7} & 0 \end{array}$$

$$D^{(1)}_{[b,c]} = \min\left[D^{(0)}[b,c], D^{0}[b,a] + D^{0}[a,c] \right]$$

$$= \min[2, 9+\infty] = 2.$$

$$D^{(1)}[c,b] = \min\left[D^{(0)}[c,b], D^{0}[c,a] + D^{0}[a,b] \right]$$

$$= \min[\infty, 1+6]$$

$$= \min[\infty, 7]$$

$$= 7.$$

TO find D^2;

Take b as an intermediate. There is no changes in 2nd row and 2nd column.

$$D^{(2)} = \begin{array}{c|ccc} & a & b & c \\ a & 0 & 6 & 8 \\ b & 9 & 0 & 2 \\ c & 1 & 7 & 0 \end{array}$$

$D^2[a,c] = \min[D^1[a,c], D^1[a,b] + D^1[b,c]]$

$= \min[\infty, 6+2]$

$= 8.$

$D^2[c,a] = \min[D^1[c,a], D^1[c,b] + D^1[b,a]]$

$= \min[1, 7+9]$

$= \min[1, 16]$

$= 1.$

To find D^3:

Take c as an intermediate vertex. There is no change in 3rd row and 3rd column.

$$D^3 = \begin{array}{c} \\ a \\ b \\ c \end{array} \begin{array}{c} \begin{array}{ccc} a & b & c \end{array} \\ \begin{bmatrix} 0 & 6 & 8 \\ 3 & 0 & 2 \\ 1 & 7 & 0 \end{bmatrix} \end{array}$$

$D^3[a,b] = \min[D^2[a,b], D^2[a,c] + D^2[c,b]]$

$= \min[6, 8+7]$

$= \min[6, 15]$

$= 6.$

$D^3[b,a] = \min[D^2[b,a], D^2[b,c] + D^2[c,a]]$

$= \min[9, 2+1]$

$= \min[9, 3]$

$= 3.$

The shortest path is

$$\begin{array}{c} \\ a \\ b \\ c \end{array}\begin{array}{c} \begin{array}{ccc} a & b & c \end{array} \\ \begin{bmatrix} 0 & 6 & 8 \\ 3 & 0 & 2 \\ 1 & 7 & 0 \end{bmatrix} \end{array}$$

Thus $D^{(3)}$ represents the shortest paths from all the vertices a, b and c.

Network flow:

Flow Networks:

The flow network can be defined by graph $G = (V, E)$ which is a directed graph with edge $(u, v) \in E$. The edge (u, v) has non-negative capacity denoted by $c(u, v) \geq 0$. If $c(u, v) \notin E$ then $c(u, v) = 0$.

There are two distinguishing nodes in flow network called source and sink.

Properties of flow Networks:

1. Capacity Constraint: for all $u, v \in V$ the flow of edge (u, v) is always less than or equal to the capacity of that edge (u, v). $f(u, v) \leq c(u, v)$.
2. Skew symmetry: For all $u, v \in V$ if $(u, v) = -f$ (v, u) that means reverse edge.

3. Flow conservation: For any vertex V except S, t source and sink respectively,

$$\sum_{v \in V} f(u,v) = 0.$$

The value of flow from u to v can be defined as,

$$|f| = \sum_{v \in V} f(s,v).$$

Ford - Fulkerson method:

This algorithm works for solving maximum-flow Problem. This is an iterative method. The Ford-Fulkerson algorithm makes use of 3 important things.

1. Residual Network
2. Agumenting path
3. Cuts.

Residual Network:

We have a flow network $G = (V, E)$ with Source S and sink t.

Let every edge u, v is having a pair flow/capacity then representation of a graph with residual capacity is called residual network.

$$C_f(u,v) = c(u,v) - f(u,v)$$

Augumenting path:

An agumenting path is a simple path p from S to t in residual network G_f. This is the path which never violates the capacity constraints.

Cuts:

Cut is a collection of arcs such that if they are removed there is no path from s to t.

A cut is said to be minimum in a network whose capacity is minimum over all cuts of the network.

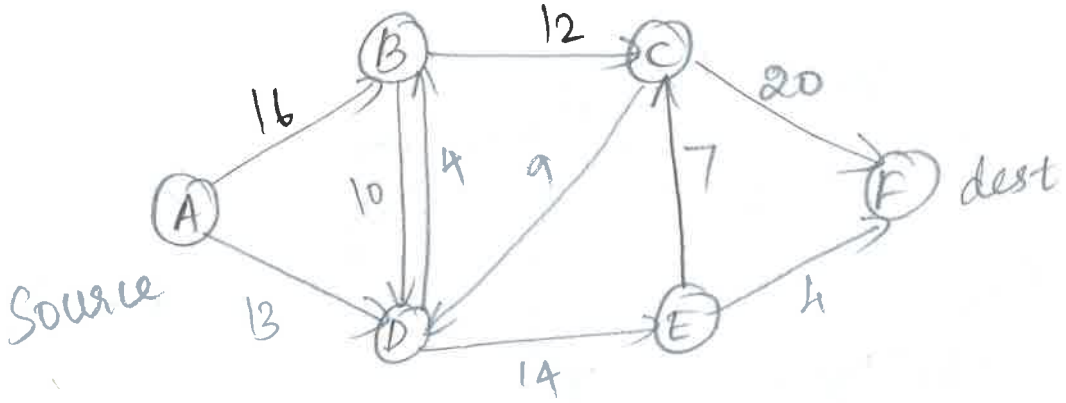
Algorithm:

```
algorithm ford fulkerson (G,S,t)
{
//problem statement: This algorithm obtains a
      graph in maxflow condition

// Here S represents Source and t represents
  Sink node. Let f be the flow initialize flow f to 0.
while there exists an agumenting path P.
 {
 agument flow f for path P
 }
 return f;
 }.
```

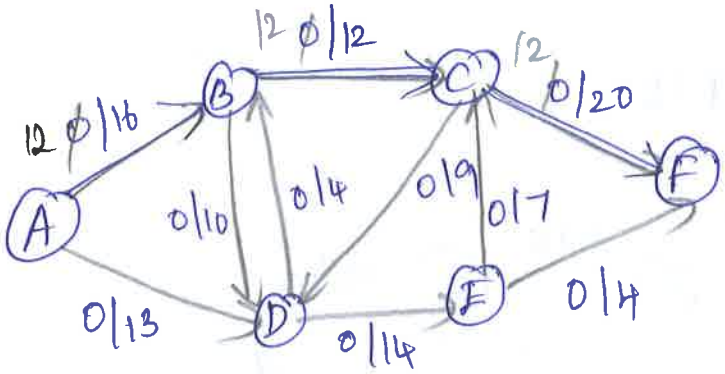
Example:

How do you compute a maximum flow for the following graph using Ford fulkerson method?



Soln :-

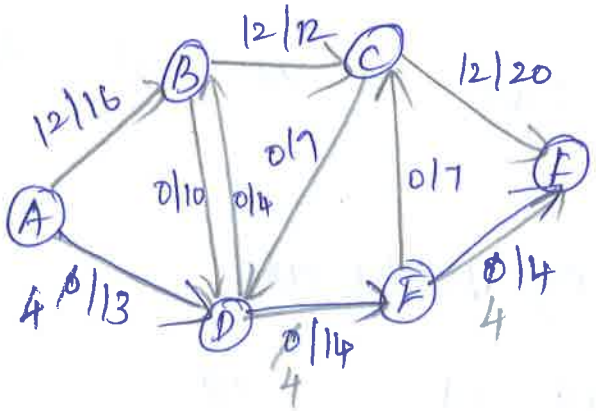
STEP 1 :



Agumenting path	Bottleneck capacity
A→B→C→F	12.

Max flow = 12

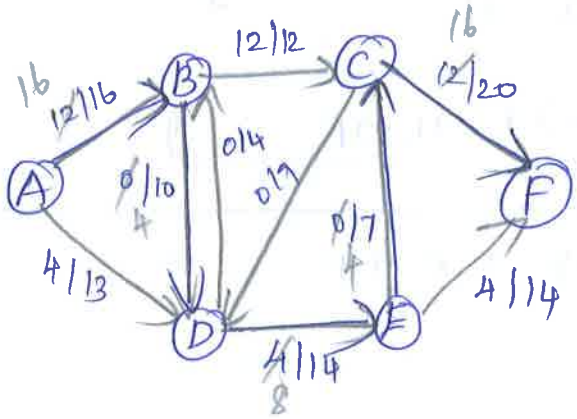
STEP 2 :



A → D → E → F

max flow = 12 + 4 = 16

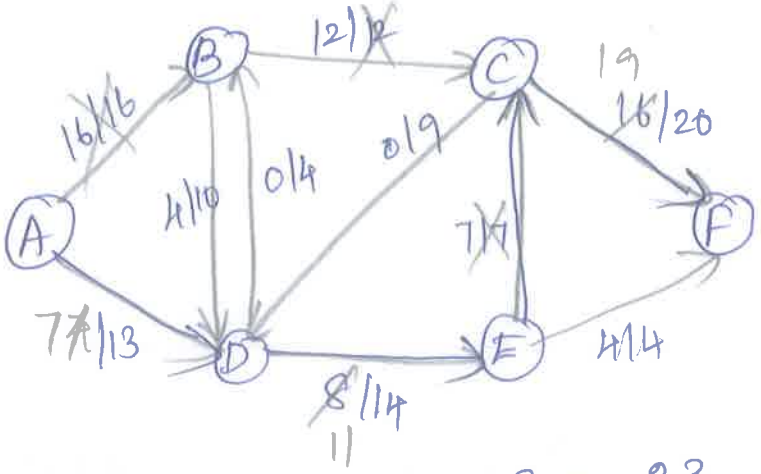
STEP 3 :



A → B → D → E → C → F

max flow = 16 + 4 = 20

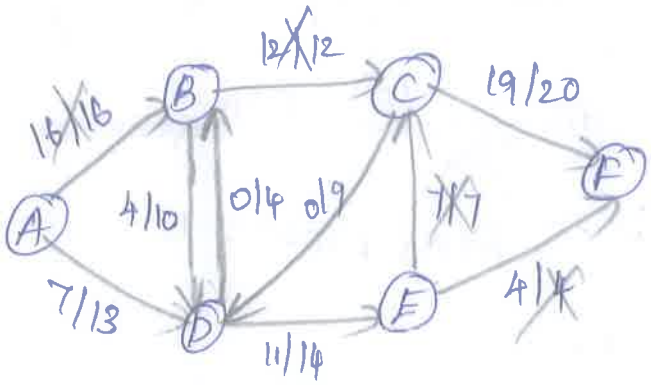
STEP 4:



A → D → E → C → F

Max flow = 20 + 3 = 23.

STEP 5:



Here after there is no path to reach the destination.

The agumenting paths are,

A → B → C → E - 12

A → D → E → F - 4

A → B → D → E → C → F - 4

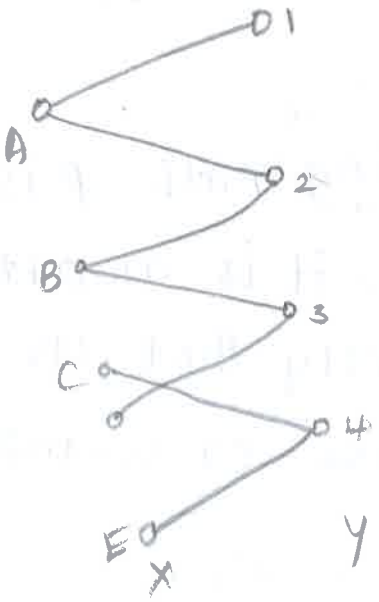
A → D → E → C → F - 3.

Matching: Maximum Bipartite Matching:

Bipartite Graph:

The graph $G=(V, E)$ in which the vertex set V is divided into two disjoint sets X and Y in such a way that every edge $e \in E$ has one end point in X and other end point in Y.

Eg:



Matching:

A matching M is a subset of edges such that each node in V appears in at most one edge in M. In other words matching in a graph is a subset of edges that no two edges share a vertex.

Two colorable graph:

A graph can be colored with only two colors (two colorable graph) such that no edge connects the same color. The Bi-partite graph is 2-colorable.

Free Vertex:

$v \in V$ is a free vertex, if no edge from matching M is incident to v.

Agumenting path:

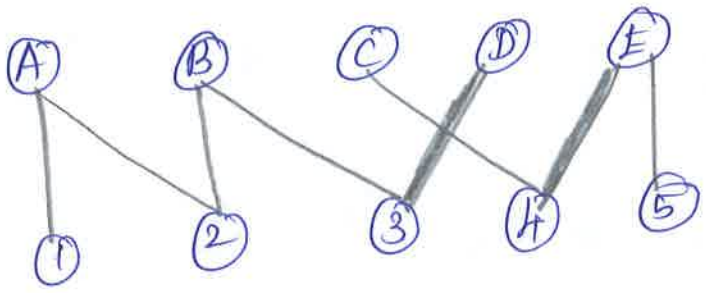
The agumenting path P is a path in graph G, such that it is an alternating path with special property that its start and end vertices are free or unmatched.

Maximum matching or Maximum cardinality matching :-

It is a matching with largest number of matching edges.

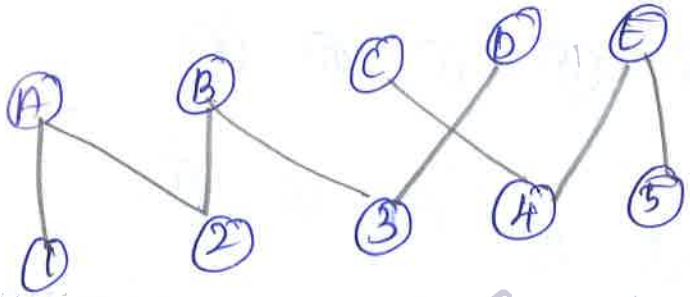
Maximum matching problem is a problem of finding maximum matching in a graph.

STEP 1:



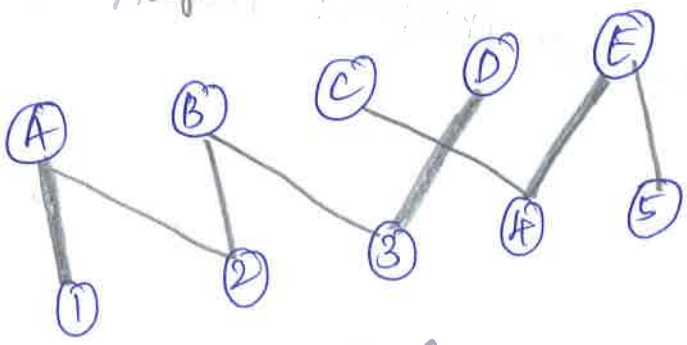
Queue : A, B, C

STEP 2:



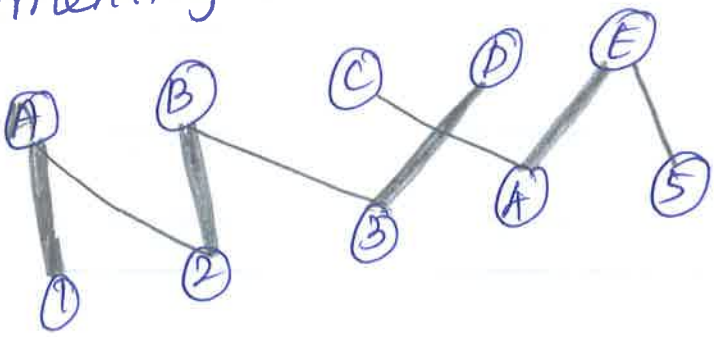
Queue : A B C

Augment from 1.



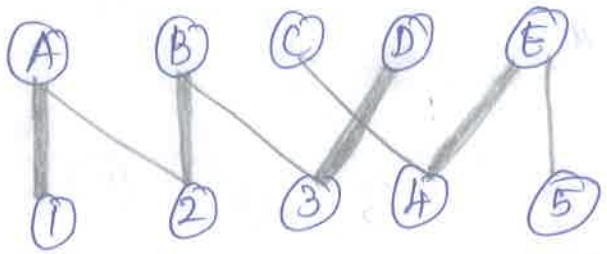
Queue : B C

STEP 3: Augmenting from 2



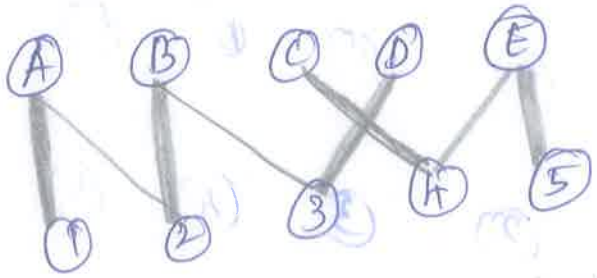
Queue : C 3 D

STEP 4: Augmenting from s.



Queue : C 4 E

STEP 5:



Queue empty ⟹ Maximum matching.

This is also a perfect matching.

PART-A

1. What is digraph?
2. Define weighted graph?
3. What is meant by Minimum Spanning Tree.
4. What are the applications of Spanning Trees.
5. State the time complexity of prims algorithms.
6. What is the purpose of Dijkstra's algorithm.
7. Define the single source shortest path problem.
8. What is Bipartite graph?
9. What is meant by two colorable graph?
10. What is agumenting path?
11. Define Network flow and cut.
12. What is an articulation point in graph.
13. Define adjacency graph.
14. What is meant by Transitive closure.
15. Difference between prims algorithm and kruskal's algorithm.
16. Difference between BFS and DFS.
17. What are the applications of graph
18. What are the different ways to represent a graph.
19. Difference between graph and Tree.
20. What are the types of graph.

PART - B

1. Explain Floyd's algorithm with example.
2. write an algorithm for all pairs shortest path algorithm and what are the time and space complexity of the algorithm.
3. How do you construct a minimum spanning tree using Kruskal's algorithm. Explain?
4. Discuss about the algorithm and pseudocode to find the minimum spanning tree using prims algorithm.
5. Explain and detail about Breadth first search and Depth first search algorithms.

24-Sun

UNIT-III

ALGORITHM DESIGN TECHNIQUE

DIVIDE AND CONQUER METHODOLOGY

Divide and conquer methodology :-

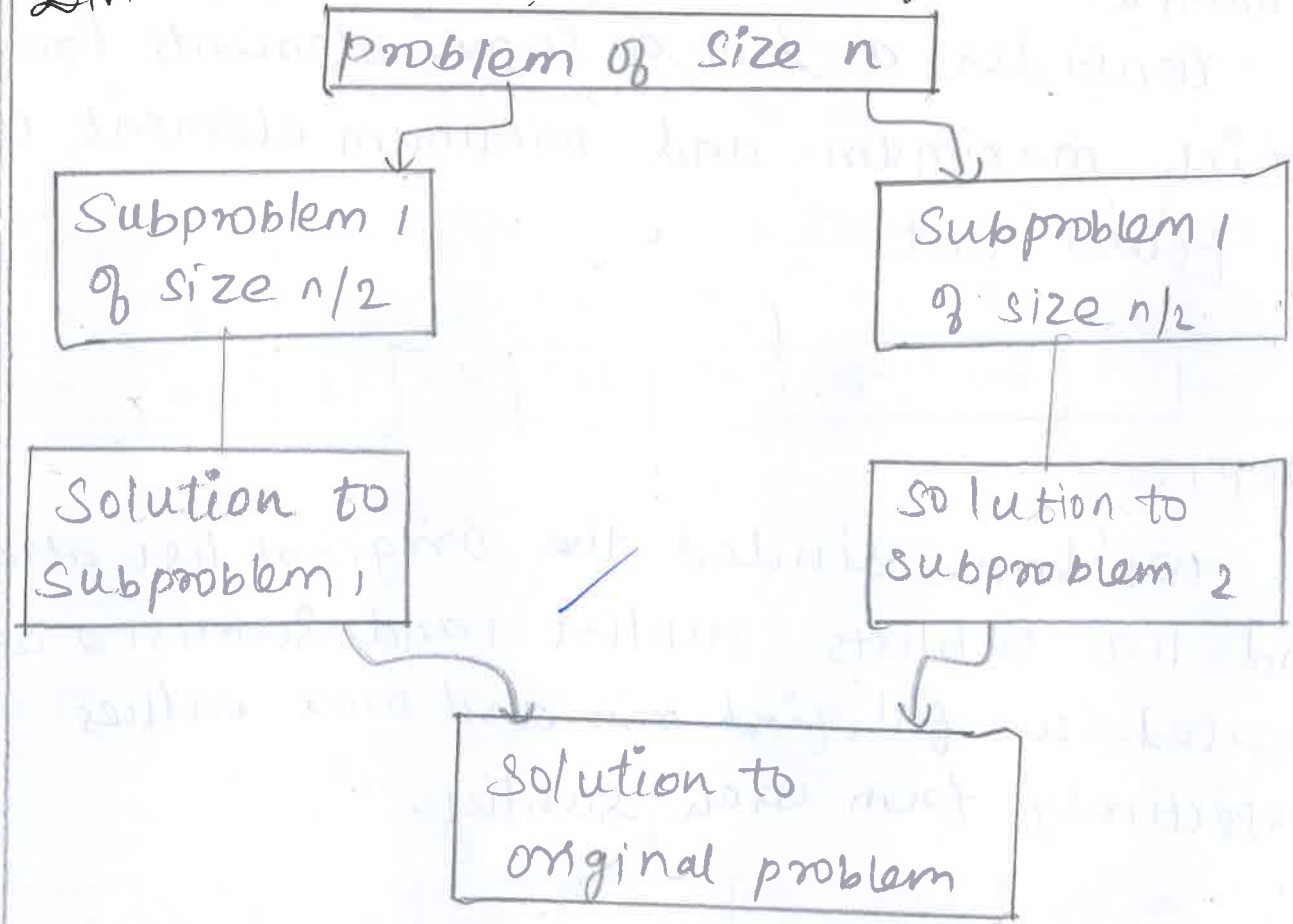
In the divide and conquer technique, a given problem is,

i) Divided into Smaller sub problems,

ii) These subproblems are solved independently.

iii) Combining all the solutions of sub problems into a solution of the whole.

Divide and conquer technique :-



Finding maximum and minimum :-

In this algorithm the list of elements is divided at the mid in order to obtain, two sublists.

From both the sublist maximum and minimum elements are chosen.

Two maxima and minima are compared and from them real maximum and minimum elements are determined. This process is carried out for entire list.

Example:

Consider a list of some elements from which maximum and minimum element can be found out.

1	2	3	4	5	6	7	8	9
50	40	-5	-9	45	90	65	25	75

STEP 1:

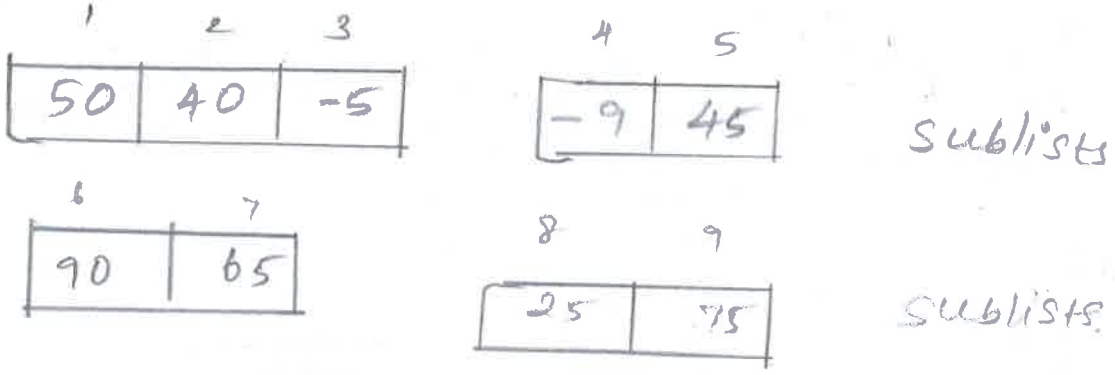
We have divided the original list at mid and two sublists: sublist 1 and Sublist 2 are created. We fill find min and max values respectively from each sublist.

1	2	3	4	5	
50	40	-5	-9	45	Sublist 1

6	7	8	9	
90	65	25	75	Sublist 2

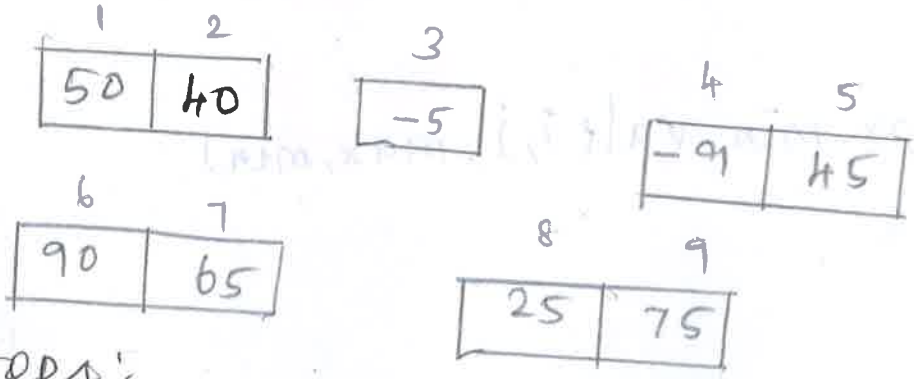
Step2:

Again divide each sublist and create further sublists. Then from each sublist obtain min and max values.



Step3:

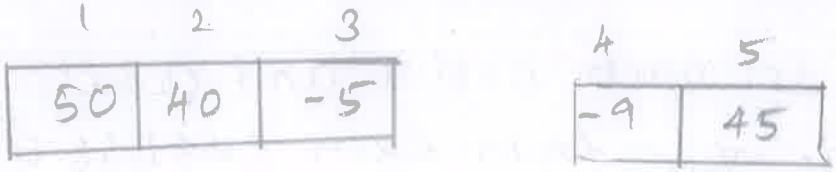
It is possible to divide the list (50, 40, -5) further. Hence we have divided the list into Sublists and min, max values are obtained.



Step4:

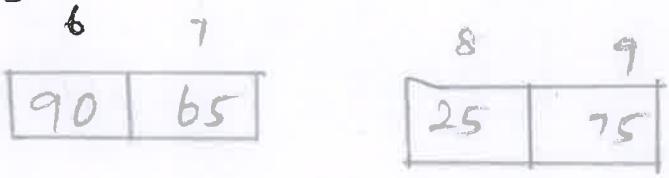
Now further division of the list is not possible. Hence we start combining the solutions of min and max values from each Sublist.

Combine (1, 2) and (3) Min = -5, max = 50

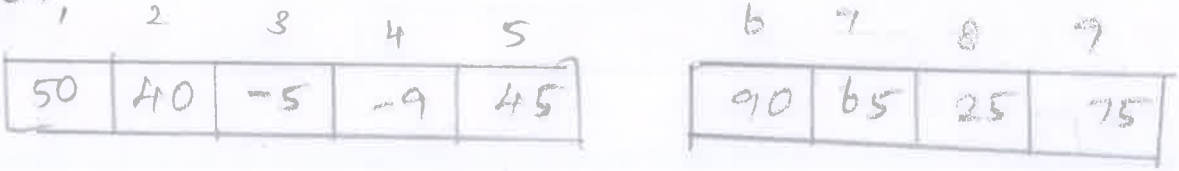


combine (1, ... 3) and (4, 5) min = -9, max = 50.

Step 5:



Step 6:,



Combine the sublists (1 ... 5) and (6 ..... 9). The min and max values are min = -9, max = 90.

Algorithm:

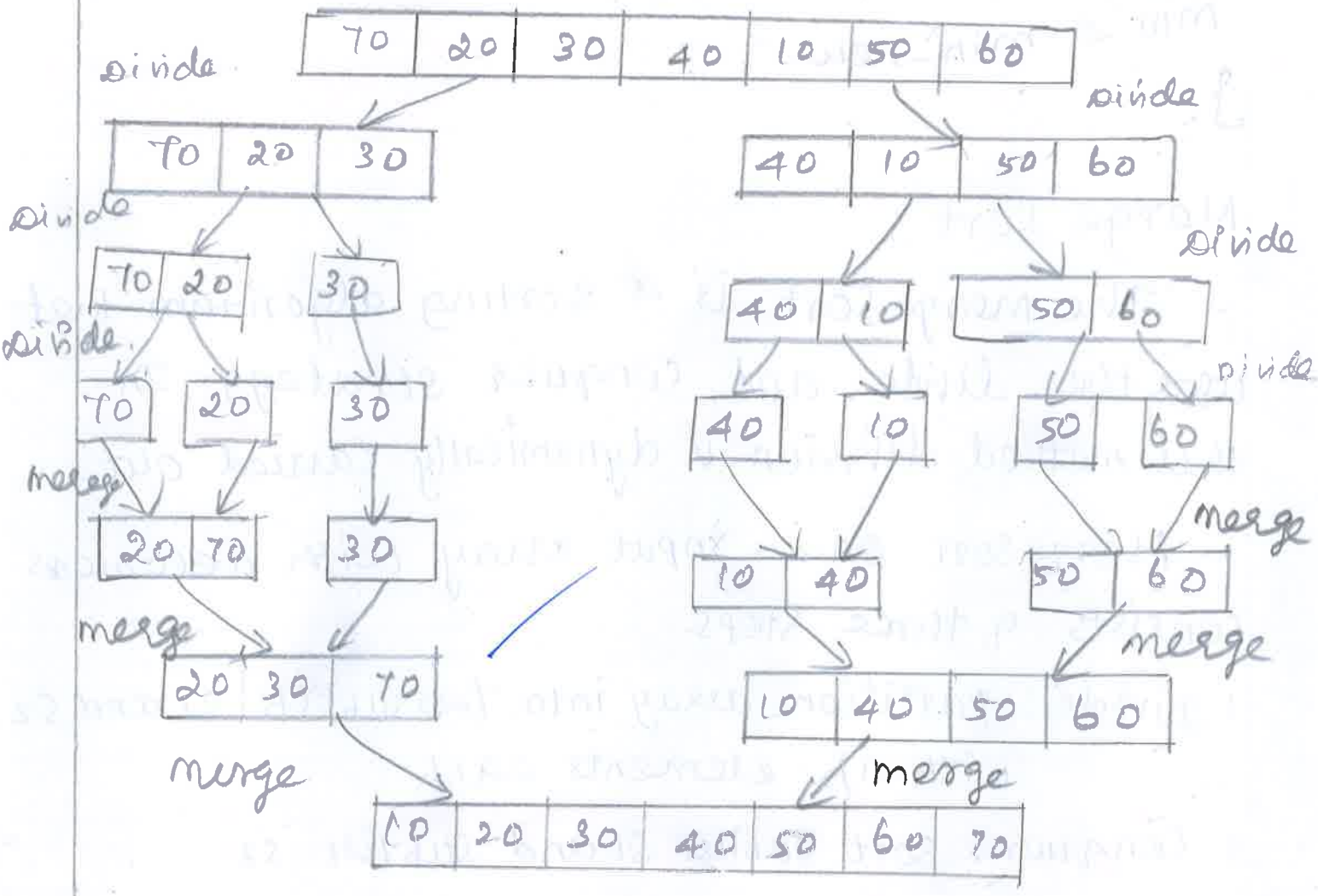
```
algorithm Max_min_vale(i,j, max, min)
if (i==j) then
{
max ⇐ A[i]
min ⇐ A[j]
}
else if (i=j-1) then
{
  if (A[i] < A[j]) then
  {
  max ⇐ A[j]
  min ⇐ A[i]
  }
else
```

En Algorithm :

```
algorithm Mergesort (int A[0---n-1], low, high)
if (low<high) then
{
mid ← (low+high)/2
mergesort (A, low, mid)
Mergesort (A, mid+1, high)
combine (A, low, mid, high)
}.
```

Example:

Consider the elements as 70, 20, 30, 40, 10, 50, 60. Now we will split this list in to two sublists.



```
{
max ← A[i]
min ← A[j]
}
}
else
{
mid ← (i+j)/2
Max_min_val (i, mid, max, min)
Max_min_val (mid+1, j, max_new, min_new)
if (max < max_new) then
max ← max_new
if (min > min_new) then
min ← min_new.
}.
```

Merge Sort :

The MergeSort is a sorting algorithm that uses the divide and conquer strategy. In this method division is dynamically carried out.

MergeSort on an input array with n elements consists of three steps.

1. Divide : partition array into two sublists S1 and S2 with n/2 elements each.
2. Conquer : sort sublist S1 and sub list S2.
3. Combine : Merge S1 and S2 into a unique sorted group.

Quick Sort:

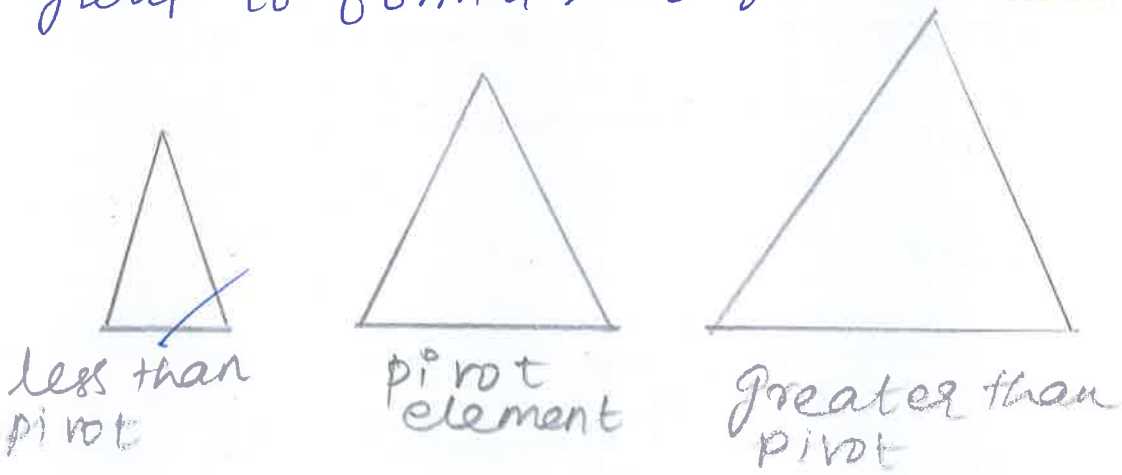
Quick sort is a sorting algorithm that uses the divide and conquer strategy.

Divide: Split the array in to two subarrays that each element in the left sub array is less than or equal the middle element and each element in right sub array is greater than the middle element.

The splitting of the array into two sub arrays is based on pivot element.
All the elements that are less than pivot should be left and all the greater elements are in right sub array.

Conquer: Recursively sort the two sub arrays.

Combine: Combine all the sorted elements in a group to form a list of sorted elements.

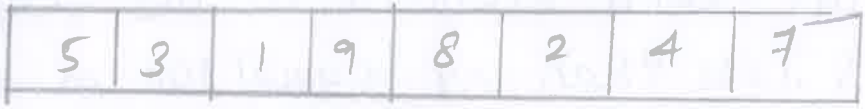


Example,

consider the elements as 5, 3, 1, 9, 8, 2, 4, 7 using quick sort method.

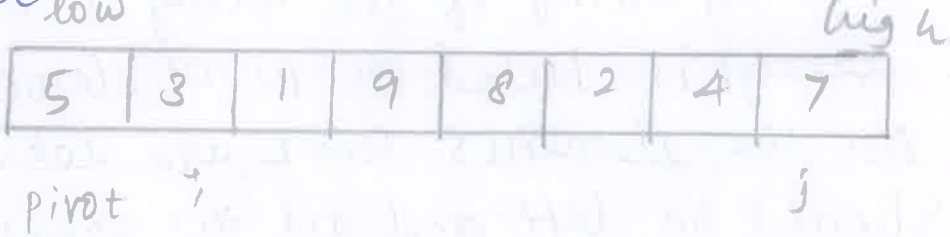
Soln:

Let us store the elements in an array as,



STEP 1:

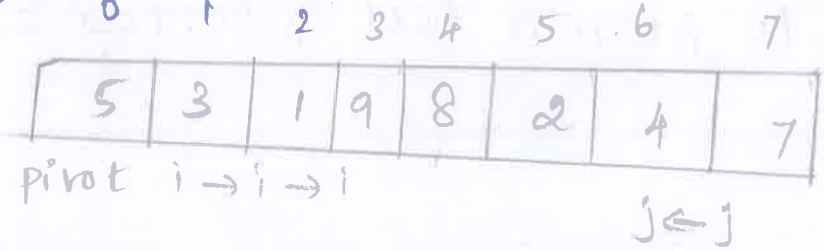
Assume first element of an array as pivot element



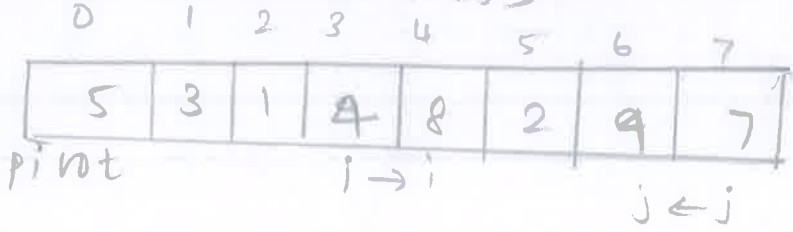
i) If A[pivot] > A[i], then increment i

ii) If A[pivot] < A[j], then decrement j

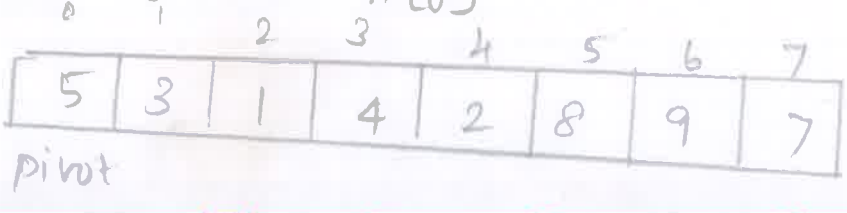
iii) If i and j can not be moved then swap A[i] and A[j].

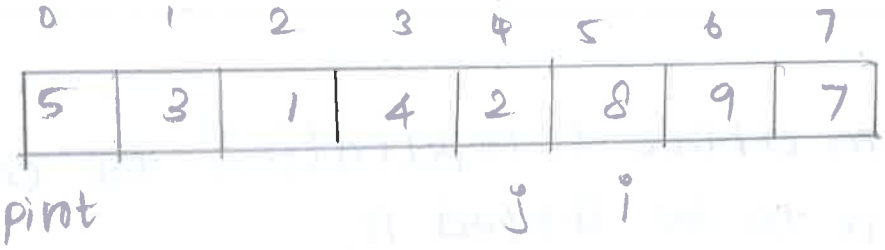


Swap A[i] and A[j]

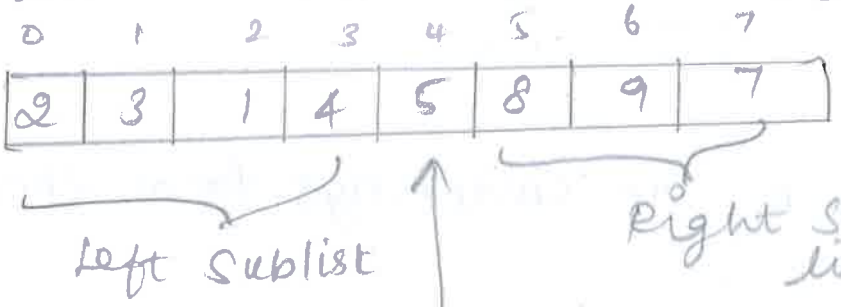


Swap A[i] and A[j]



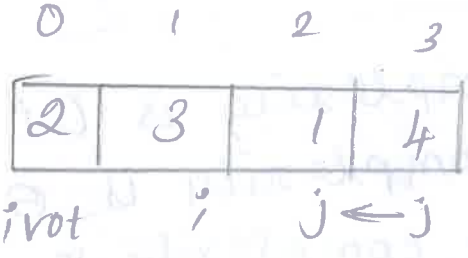


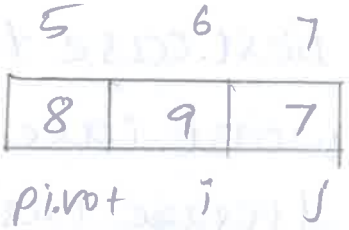
As j<i we will swap A[pivot] and A[j]



pivot has occupied its proper position.

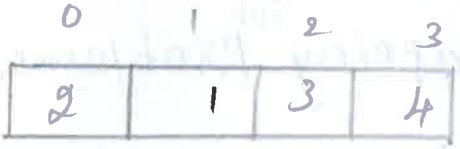
STEP 2:- Now sort the left sublist and right sublist simultaneously.





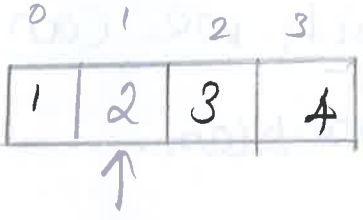
swap A[i] and A[j]

swap A[i] and A[j]

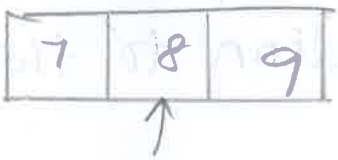


As j<i swap A[pivot] and A[j]

As j<i swap A[pivot] and A[j]



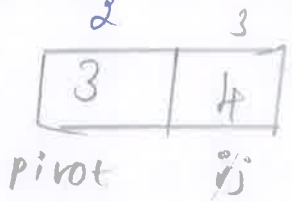
pivot has occupied its proper position.



pivot has occupied

Step 3:

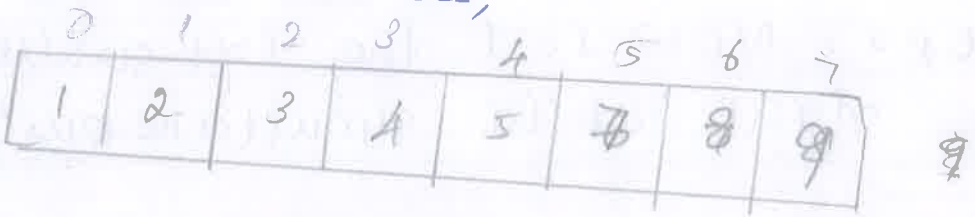
From above computation the only sublist which is to be sorted is,



There is no swappings from above list.

Step 4:

Finally on combining all above sublists we get the sorted list as,



The best case time complexity is $O(n \log_2 n)$
The worst case time complexity is $\Theta(n^2)$
The Average case time complexity is $\Theta(n \log n)$

Dynamic programming:

Dynamic programming is a technique for solving problems with overlapping subproblems.

In this method each subproblem is solved only once. The result of each subproblem is recorded in a table from which we can obtain a solution to the original problem.

ii) Bottom up approach:

This approach is also called as tabulation technique. In this approach all the subproblems that are needed are solved in advance and build up a solution to larger problem.

Optimal Sub-structure:

The optimal solution can be obtained from optimal solution of its sub-problem. Optimal substructure is an approach in which an optimal selection is made from all the possible substructures that can help to select the best structure of the same kind.

Matrix-chain multiplication:

Input: n matrices $A_1, A_2 \cdots A_n$ of dimensions $P_1 \times P_2, P_2 \times P_3 \cdots P_n \times n+1 \cdots$ respectively.

Goal: To compute the matrix product $A_1 A_2 \cdots A_n$.

Problem: Take the minimum number of computations to derive the product.

To solve this problem using dynamic programming method we will perform following steps.

1. Decide the structure of optimal parenthsization.
2. A recursive solution.
3. Computing optimal costs.

Principle of optimality:

The principle of optimality states that in an optimal sequence of choices or decisions, each subsequence must also be optimal.

Elements of dynamic programming:

There are two important elements of dynamic programming.

1) Overlapping sub-problem

The problem is broken down into smaller problems which is called as subproblems.

The overlapping sub-problems are found in a bigger problem which shares the same smaller problem.

There are two ways to handle overlapping sub-problems.

i) Top down approach:

This approach is also known as memorization technique. In this technique the subproblems are solved and the solution is remembered. These solutions are stored in suitable datastructure for using them efficiently.

Example:

Consider

Matrix	Dimension
A1	5 X 4
A2	4 X 6
A3	6 X 2
A4	2 X 7

Compute matrix chain order.

Soln:

Here $P_0 = 5$, $P_1 = 4$, $P_2 = 6$, $P_3 = 2$, $P_4 = 7$.

for all i, $1 \leq i \leq n$.

$m[i, i] = 0$

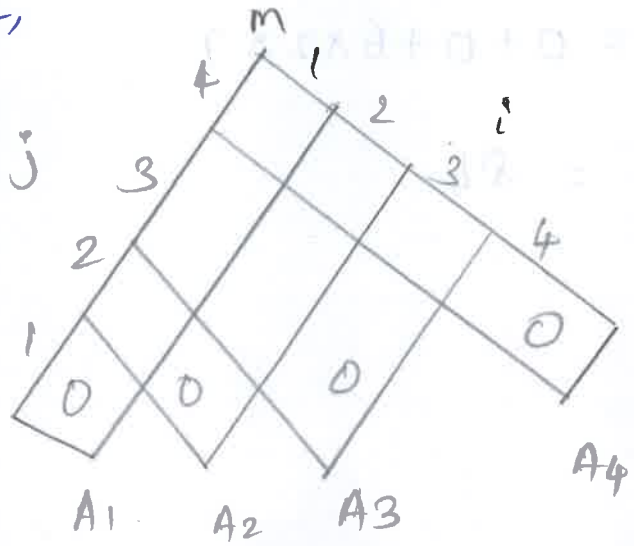
Hence, $m[1, 1] = 0$

$m[2, 2] = 0$

$m[3, 3] = 0$

$m[4, 4] = 0$.

Hence,



Now we will fill up the table horizontally from left to right, assuming $i \le k \le j-1$.

Let $i=1, j=2, k=1$.

$\therefore m[1,2] = m[i,k] + m[k+1,j] + P_{i-1} P_k P_j$

$= m[1,1] + m[2,2] + P_0 P_1 P_2$

$= 0 + 0 + 5 \times 4 \times 6$

$m[1,2] = 120.$

Let $i=2, j=3, k=2$

$\therefore m[2,3] = m[i,k] + m[k+1,j] + P_{i-1} P_k P_j$

$= m[2,2] + m[3,3] P_1 P_2 P_3$

$= 0 + 0 + 4 \times 6 \times 2$

$m[2,3] = 48.$

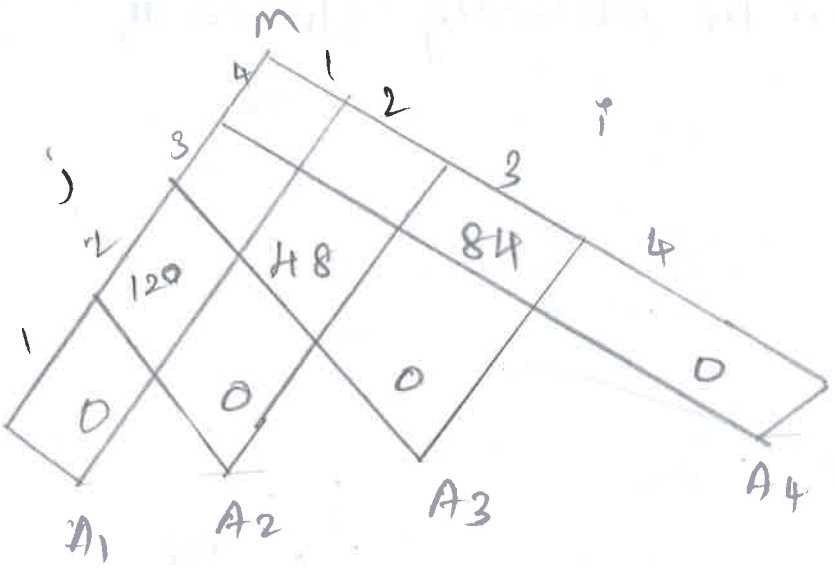
Let $i=3, j=4, k=3$

$m[3,4] = m[i,k] + m[k+1,j] + P_{i-1} P_k P_j$

$= m[3,3] + m[4,4] + P_2 P_3 P_4$

$= 0 + 0 + 6 \times 2 \times 7$

$m[3,4] = 84.$



Let $i=1, j=3, k=1$ or $k=2$.

$$m[1,3] = \min \begin{cases} (m[1,1] + m[2,3] + P_0 P_1 P_3) \rightarrow k=1 \\ (m[1,2] + m[3,3] + P_0 P_2 P_3) \rightarrow k=2 \end{cases}$$

$$= \min \begin{cases} (0 + 48 + 5 \times 4 \times 2) \\ (120 + 0 + 5 \times 6 \times 2) \end{cases}$$

$$= \min \begin{cases} 48 + 40 = 88 & \text{when } k=1. \\ 120 + 60 = 180 \end{cases}$$

$$m[1,3] = 88$$

Let $i=2, j=4, k=2$ or $k=3$.

$$m[2,4] = \min \begin{cases} [m[2,2] + m[3,4] + P_1 P_2 P_4 & k=2 \\ (m[2,3] + m[4,4] + P_1 P_3 P_4 & k=3. \end{cases}$$

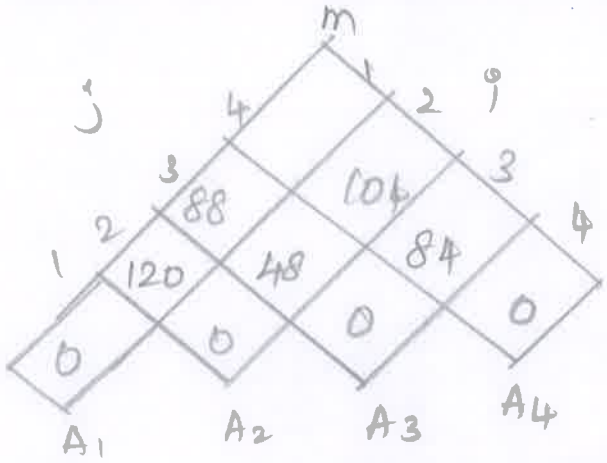
$$= \min \begin{cases} 0 + 84 + 4 \times 6 \times 7 \\ 48 + 0 + 4 \times 2 \times 7 \end{cases}$$

$$\min[2,4] = \min \begin{cases} 84 + 168 \\ 48 + 56 \end{cases}$$

$$= \min \begin{cases} 252 \\ 104 \rightarrow \text{when } k=3 \end{cases}$$

$$\min[2,4] = 104.$$

The table can be partially shown as,



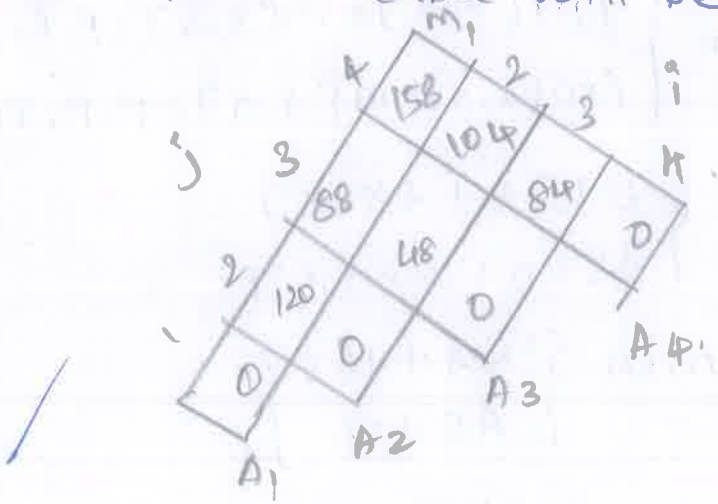
Now, let $i=1, j=4$ then $k=1$ or 2 or 3.

$$m[1,4] = \min \begin{cases} m[1,1] + m[2,4] + P_0P_1P_4 \rightarrow k=1 \\ m[1,2] + m[3,4] + P_0P_2P_4 \rightarrow k=2 \\ m[1,3] + m[4,4] + P_0P_3P_4 \rightarrow k=3 \end{cases}$$

$$= \min \begin{cases} 0 + 104 + 5 \times 4 \times 7 \\ 120 + 84 + 5 \times 6 \times 7 \\ 88 + 0 + 5 \times 2 \times 7. \end{cases}$$

$$= \min \begin{cases} 244 \\ 414 \\ 158 \end{cases} \longrightarrow \text{when } k=3.$$

The matrix table will be



The optimal cost is 158.

Algorithm:

```
algorithm Matrix-chain(P[0....n])
{
// problem Description : This algorithm is to build
   the table m[i,j] and s[i,j]
for (i←1 to n) do
 m[i,j]←0
for (len← 2 to n) do
{
for (i← 2 to (n-len+1) do
{
j←i + len -1
m[i,j] = infinity
for (k←i to j-1) do
{
q← m[i,k]+m[k+1,j]+P[i-1]* P[k]* P[j]
if (q<m[i,j]) then
{
m[i,j]←q
s[i,j]←k
 }}
 } }
return m[1,n]
}.
```

Multi Stage graph:

* A Multistage graph $G=(V,E)$ which is a directed graph.

* In this graph all the vertices are partitioned in to the k stages where $k \geq 2$. In multistage graph problem we have to find the shortest path from source to sink.

* The cost of each path is calculated by using the weight given along that edge.

* The cost of a path from source (denoted by S) to sink (denoted by T) is the sum of the costs of edges on the path.

* In multistage graph problem we have to find the path from S to T.

* There is a set of vertices in each stage. The Multistage graph can be solved using forward and backward approach.

Algorithm:

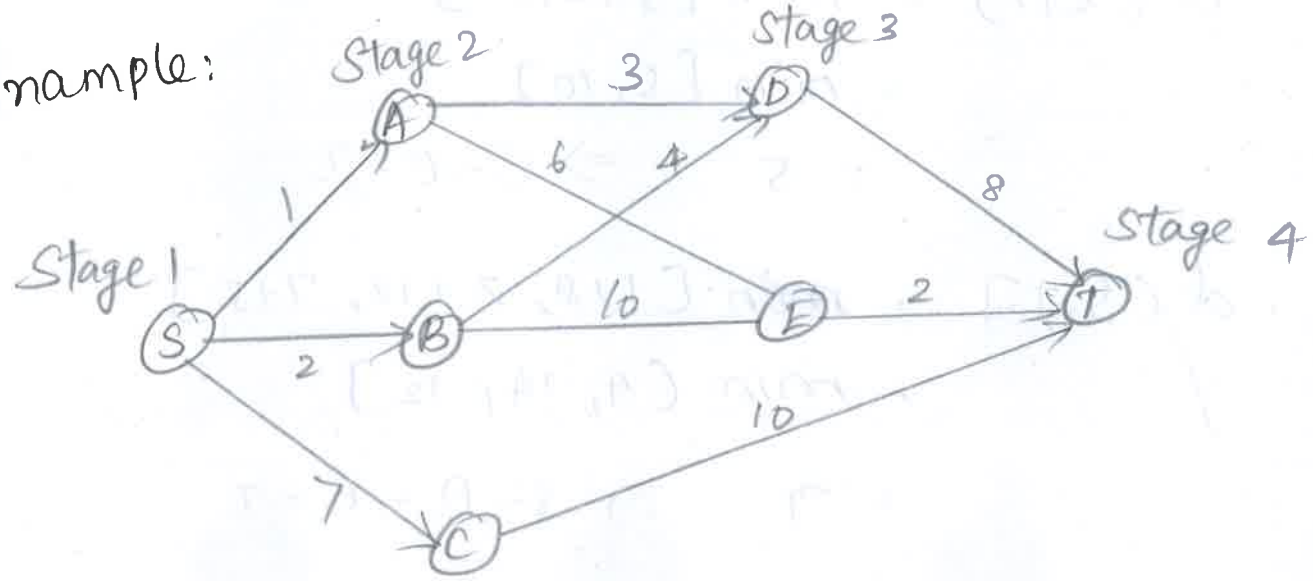
```
algorithm forward_gr(G, stages, n, p)
// problem Description: this algorithm is for
   forward approach of multistage graph.
// Input: The multistage Graph G=(V,E), stages is
          the variable representing number of stages.
```

// n is total number of vertices of G.
// P is an array for restoring path
// output: the path with minimum cost.

```
Cost[i] ← 0
for (i ← n-2 downto 0]
{
 r ← Get_min(i, n)  // r is an edge with min cost
Cost[i] ← c[i][r] + cost[r]
 d[i] ← r
}
// finding minimum cost path
 P[0] ← 0
 P[stages-1] ← n-1
for (i ← 1 to stages-1) do
 P[i] ← d[P[i+1]];
```

Analysis: The algorithm has $\Theta(|V|+|E|)$ time complexity.

Example:



Backward approach:

$d(S,T) = \min\{1+d(A,T), 2+d(B,T), 7+d(C,T)\}$

we will compute $d(A,T), d(B,T), d(C,T)$

$d(A,T) = \min[3+d(D,T), 6+d(E,T)]$

$d(B,T) = \min[4+d(D,T), 10+d(E,T)]$

$d(C,T) = \min[3+d(E,T), d(C,T)]$

Let us compute stage 3,

$d(D,T) = 8$

$d(E,T) = 2$

Now substitute the values,

$d(A,T) = \min[3+8, 6+2]$

$= \min[11,8]$

$= 8 \Rightarrow A-E-T$

$d(B,T) = \min[4+8, 10+2]$

$= \min[12, 12]$

$= 12 \Rightarrow B-D-T$

$d[C,T] = \min[3+2, 10]$

$= \min[5, 10]$

$= 5 \Rightarrow C-E-T$

$d(S,T] = \min[1+8, 2+12, 7+5]$

$= \min(9, 14, 12]$

$= 9 \Rightarrow S-A-E-T$

Optimal Binary Search Trees:

Let $\{a_1, a_2 \ldots\ldots a_n\}$ be a set of identifiers such that $a_1 < a_2 < a_3 \ldots$ Let $P(i)$ be the probability with which we can search for $a_i \rightarrow$ successful search.

Let q_i be the probability of searching an element x such that $a_i < x < a_{i+1}$. where $0 \le i \le n \rightarrow$ unsuccessful search.

Thus $P(i)$ is probability of successful search and $q(i)$ is the probability of unsuccessful search.

Then a tree which is build with optimum cost from $\sum_{i=1}^{n} P(i)$ and $\sum_{i=1}^{n} q(i)$ is called optimal binary search tree.

To obtain the optimal Binary search tree for given key values using dynamic programming approach, we will compute cost of the tree (denoted by (ij) and root of the tree (denoted by r_{ij}).

We will apply following formula for computing each sequence,

$$c(i,j) = \min_{i < k \le j} \{ c(i,k-1) + c(k,j) \} + w(i,j)$$

$$w(i,j) = w[i,j-1] + P[j] + q[j]$$

$$r(i,j) = k$$

Example:

Obtain the optimal Binary search Tree for

$(a_1, a_2, a_3, a_4) = (do, if, int, while)$,

$p(1:4) = (3, 3, 1, 1)$ $q(0:4) = (2, 3, 1, 1, 1)$,

Soln:

Consider $n = 4$.

$p(1:4) = (3, 3, 1, 1)$ → successful search(p)

$q(0:4) = (2, 3, 1, 1, 1)$ → unsuccessful search (q).

$w(i, j) = w(i, j-1) + p(j) + q(j)$

$c(i, j) = \min_{i < k \le j} \{ c(i, k-1) + c(k, j) \} + w(i, j)$

$r(i, j) = k$.

Initial conditions:

$w(i, i) = q_i$

$c(i, i) = 0$

$r(i, i) = 0$.

$i \rightarrow$

$j-i$	0	1	2	3	4
0	$w_{00} = 2$ $c_{00} = 0$ $r_{00} = 0$	$w_{11} = 3$ $c_{11} = 0$ $r_{11} = 0$	$w_{22} = 1$ $c_{22} = 0$ $r_{22} = 0$	$w_{33} = 1$ $c_{33} = 0$ $r_{33} = 0$	$w_{44} = 1$ $c_{44} = 0$ $r_{44} = 0$
1	$w_{01} = 8$ $c_{01} = 8$ $r_{01} = 1$	$w_{12} = 7$ $c_{12} = 7$ $r_{12} = 2$	$w_{23} = 3$ $c_{23} = 3$ $r_{23} = 3$	$w_{34} = 3$ $c_{34} = 3$ $r_{34} = 4$	
2	$w_{02} = 12$ $c_{02} = 19$ $r_{02} = 1$	$w_{13} = 9$ $c_{13} = 12$ $r_{13} = 2$	$w_{24} = 5$ $c_{24} = 8$ $r_{24} = 3$		
3	$w_{03} = 14$ $c_{03} = 25$ $r_{03} = 2$	$w_{14} = 11$ $c_{14} = 19$ $r_{14} = 2$			
4	$w_{04} = 16$ $c_{04} = 32$ $r_{04} = 2$				

STEP 1:

$w_{00} = q_0 = 2$ $\quad w_{11} = q_1 = 3$ $\quad w_{22} = q_2 = 1$

$c_{00} = 0$ $\quad c_{11} = 0$ $\quad c_{22} = 0$

$r_{00} = 0$ $\quad r_{11} = 0$ $\quad r_{22} = 0$

$w_{44} = q_4 = 1$ $\quad w_{33} = q_3 = 1$

$c_{44} = 0$ $\quad c_{33} = 0$

$r_{44} = 0$ $\quad r_{33} = 0.$

STEP 2:

$r(i,j) = k$

$w(0,1) = w[i, j-1] + p[j] + q[j]$

$= w[0,0] + p[1] + q[1]$

$= 2 + 3 + 3$

$= 8$

$$c(0,1) = \min_{i<k\le j} \{ c(i,k-1) + c(k,j) \} + w(i,j)$$

$$= \min_{0<k\le 1} \{ c(0,0) + c(1,1) \} + w(0,1)$$

$0 < 1 \le 1$

$= \min(0+0) + 8$

$= 8.$

$r(0,1) = 1.$

$$w(1,2) = w(1,1) + p(2) + q(2)$$

$$= 3 + 3 + 1$$

$$w(1,2) = 7$$

$$c(1,2) = \min_{1 < k \le 2} \{c(1,1) + c(2,2)\} + w(1,2)$$

$$k = 2.$$

$$= 0 + 0 + 7$$

$$= 7$$

$$r(1,2) = 2.$$

$$w(2,3) = w(2,2) + p(3) + q(3)$$

$$= 1 + 1 + 1$$

$$= 3$$

$$c(2,3) = \min_{2 < k \le 3} \{c(2,2) + c(3,3)\} + w(2,3)$$

$$k = 3$$

$$= \min(0 + 0 + 3)$$

$$= 3$$

$$r(2,3) = 3.$$

$$w(3,4) = w(3,3) + p(4) + q(4)$$

$$= 1 + 1 + 1$$

$$= 3.$$

$$c(3,4) = \min_{3<k\leq 4} \{c(3,3) + c(4,4)\} + w(3,4)$$

$$= 0+0+3$$

$$= 3.$$

$$r(3,4) = 4.$$

$$w(0,2) = w(0,1) + p(2) + q(2)$$

$$= 8+3+1$$

$$= 12.$$

$$c(0,2) = \min_{0<k\leq 2} \{c(0,0) + c(1,2) + w(0,2)\}$$

$k = 1, k = 2$

$$k=1 = \min \begin{cases} c(0,0) + c(1,2) + w(0,2) \\ k=2 \quad c(0,1) + c(2,2) + w(0,2) \end{cases}$$

$$= \begin{cases} 0 + 7 + 12 = 19 \\ 8 + 0 + 12 = 20 \end{cases}$$

$$c(0,2) = 19$$

$r(i,j) = k$ (Take the minimum value based on k)

$$r(0,2) = 1.$$

$$w(1,3) = w(1,2) + p(3) + q(3)$$

$$= 7+1+1 = 9.$$

$$c(1,3) = \min_{1<k\leq 3} \begin{cases} c(1,1) + c(2,3) \\ c(1,2) + c(3,3) \end{cases} + w(1,3)$$

$k=2$

$k=3$

$$\Rightarrow \min \begin{Bmatrix} 0+3 \\ 7+0 \end{Bmatrix} + 9$$

$$\Rightarrow 3+9$$

$c(1,3) \Rightarrow 12$

$r(1,3) \Rightarrow 2.$

$$w(2,4) = w(2,3) + p(4) + q(4)$$
$$= 3+1+1 = 5$$

$$c(2,4) = \min_{2<k\leq 4} \begin{Bmatrix} c(2,2)+c(3,4) \\ c(2,3)+c(4,4) \end{Bmatrix} + w(3,4)$$

$$= \min \begin{Bmatrix} 0+3 \\ 3+0 \end{Bmatrix} + w(3,4)$$

$$= 3+5$$

$$= 8$$

$r(2,4) = 3.$

$$w(0,3) = w(0,2) + p(3) + q(3)$$
$$= 12+1+1 = 14$$

$$c(0,3) = \min_{0<k\leq 3} \begin{matrix} k=1 \\ k=2 \\ k=3 \end{matrix} \begin{Bmatrix} c(0,0)+c(1,3) \\ c(0,1)+c(2,3) \\ c(0,2)+c(3,3) \end{Bmatrix} + w(0,3)$$

$$= \min \begin{matrix} k=1 \\ k=2 \\ k=3 \end{matrix} \begin{Bmatrix} 0+12 = 12 \\ 8+3 = 11 \\ 19+0 = 19 \end{Bmatrix} + 14$$

$$= 11+14 = 25$$

$r(0,3) = 2.$

$w(1,4) = w(1,3) + p(4) + q(4)$

$= 9 + 1 + 1 = 11.$

$c(1,4) = 7 + 12 = 19.$

$r(1,4) = 2.$

$w(0,4) = w(0,3) + q_4 + p_4$

$= 14 + 1 + 1$

$= 16.$

$c(0,4) = 32$

$r(0,4) = 2.$

Algorithm Design Technique:

Greedy Technique:

The greedy method is a straightforward method. This method is popular for obtaining the optimized solutions.

In greedy technique, the solution is constructed through a sequence of steps, each expanding a partially constructed solution.

Applications of greedy method:

i) Knapsack problem
ii) prim's algorithm for minimum spanning tree
iii) Kruskal's algorithm for minimum spanning tree
iv) Finding Shortest path
v) Job sequencing with deadlines
vi) optimal storage on tapes.

Elements of the greedy strategy:

1. Greedy choice property.
2. optimal substructure.

Algorithm:

```
algorithm greedy_act_sel (S, F)
//problem Description: This algorithm selects the
 activities that are compatible to each other.
//Input: The set of starting time and finishing time
//output: Set of selected activities
n ← length [S]
A ← {a}
i ← 1

for m ← 2 to n.
```

{
if (Sm ≥ Fi) then
A ← A ∪ {am}
i ← m
}
return A.

Example:

Write greedy algorithm for activity selection problem. Give its time complexity. For following intervals, select the activities according to your algorithm. $I_1(1-3)$, $I_2(0-2)$, $I_3(3-6)$, $I_4(2-5)$, $I_5(5-8)$, $I_6(3-10)$, $I_7(7-9)$

Soln:

STEP 1:
Sort the given activities in ascending order according to their finishing time.

STEP 2:
Select the first activity from sorted array and add it to solution array.

STEP 3:
For next/subsequent activity if start time of currently selected activity is greater than or equal to finish time of previously selected activity, then add it to solution array.

STEP 4: Select next activity.

STEPS: Repeat Step 3 and Step 4 for all remaining activities.

Time complexity is O(n log n).

Activity	starting time	Finishing Time
I_1	1	3
I_2	0	2
I_3	3	6
I_4	2	5
I_5	5	8
I_6	3	10
I_7	7	9.

Based on the finishing time we will write in ascending order.

activity	starting time	Finishing Time
I_2	0	2
I_1	1	3
I_4	2	5
I_3	3	6
I_5	5	8
I_7	7	9
I_6	3	10.

In the above table,

$I_2 = S_T = 0$

$f_T = 3$

$S_T < f_T$

$0 < 3$ True

Based on the finishing time we take next value.

$I_3 = S_T = 3$

$f_T = 6$

$S_T < f_T$

$3 < 6$ True.

There is no value ⑥ in the starting time. So stop the activity.

The solution is $\{I_2, I_3\}$.

Optimal merge pattern:

The Merge sort is a technique in which two sorted files can be merged together in one sorted file. When two or more files need to be merged in a single file, then the merging of two sorted files must be performed repeatedly.

Merging of sorted files must be done pair-wise.

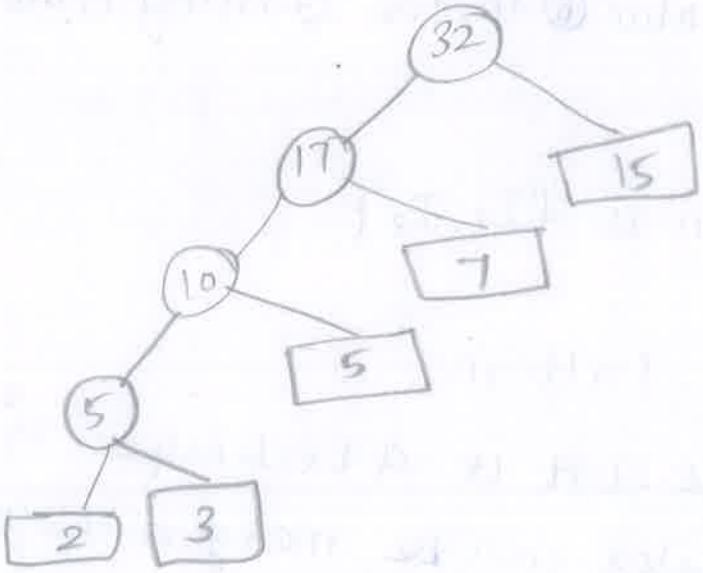
The pairing of files which require optimum computing time to get a single merged file denotes the optimal merge pattern.

Representation of optimal Merge Pattern:

The merge pattern is typically represented by a binary tree, it is also called as two way merge pattern.

Ex:

2, 3, 5, 7, 15 are six files with given lengths then we can build a merge pattern as



The leaf nodes denoted by squares are called external nodes, and remaining nodes are called internal nodes.

The path length from root to corresponding external node is called external path length.

An application of optimal merge pattern is Huffman code.

Huffman Trees:

The huffman trees are constructed for encoding a given text of n characters.

while encoding a given text, each character is associated with some bit sequence. Such a bit sequence is called codeword.

Encoding can be of two types.

1. Fixed length encoding
2. variable length encoding

Fixed length encoding is a kind of encoding in which each character is associated with a bit string of some fixed length.

Variable length encoding is a kind of encoding in which each character is associated with a codeword of different length.

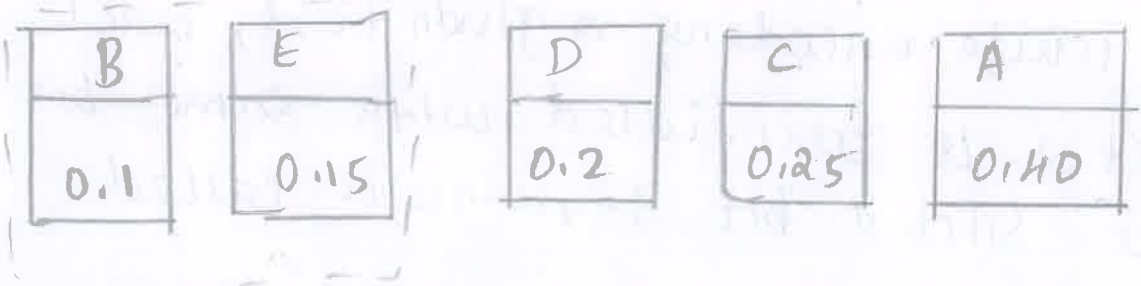
Example:

Consider five character alphabets {A, B, C, D, E} with following occurance probabilities.

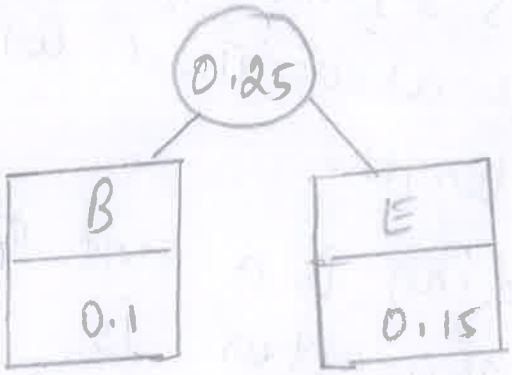
Character	A	B	C	D	E
probability	0.40	0.1	0.25	0.2	0.15

Soln:

Now first arrange the characters in ascending order of their probabilities.

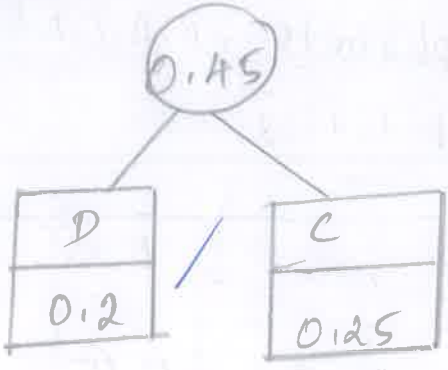


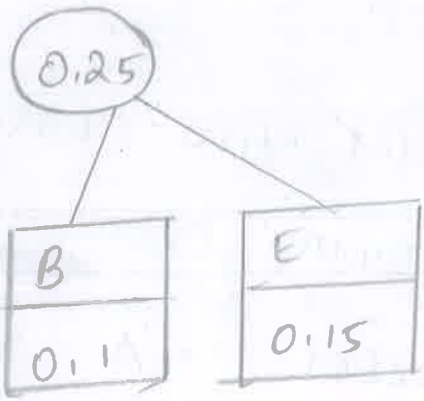
Combine these two nodes and form a single node.



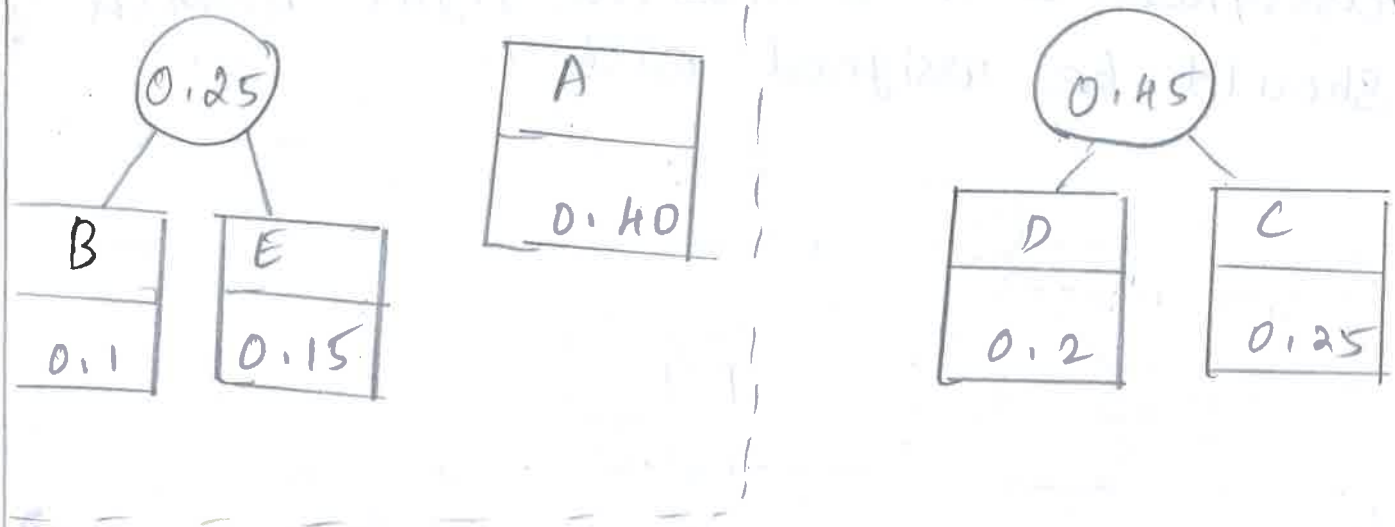
We have got new node with probability 0.25. Then arrange it with other probabilities by maintaining ascending order.

Again we arrange Probabilities with ascending order.

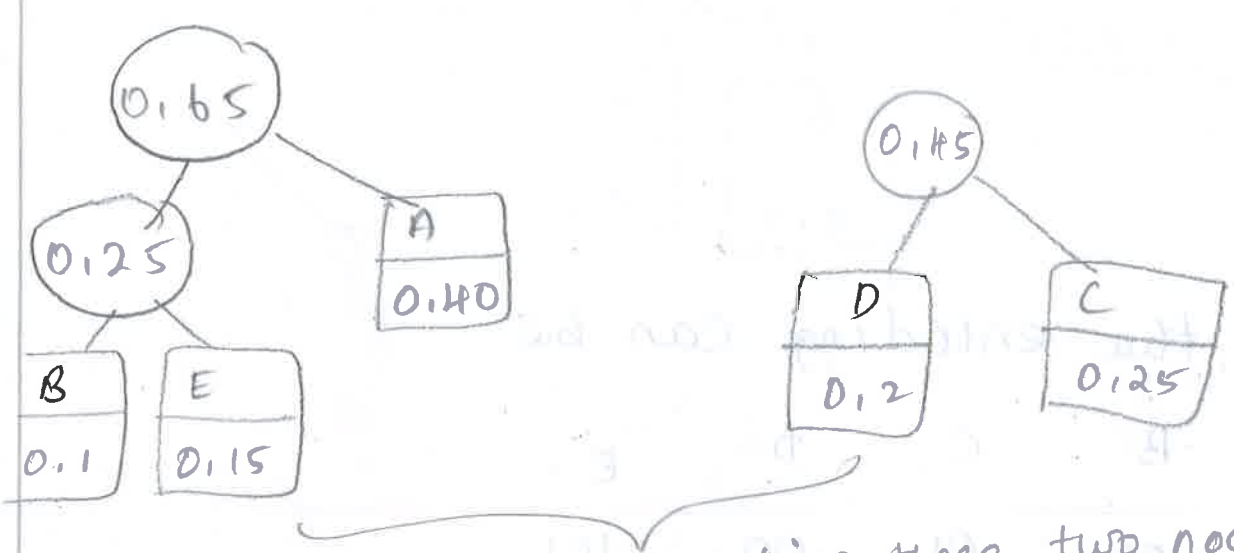




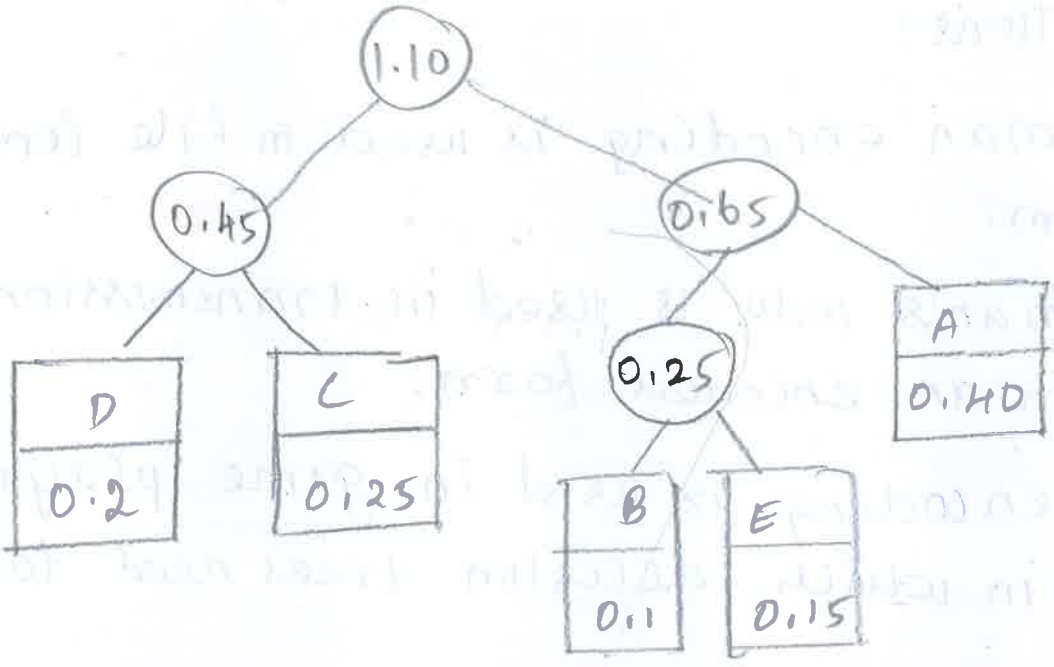
These two are combined to get a new



combine these nodes.

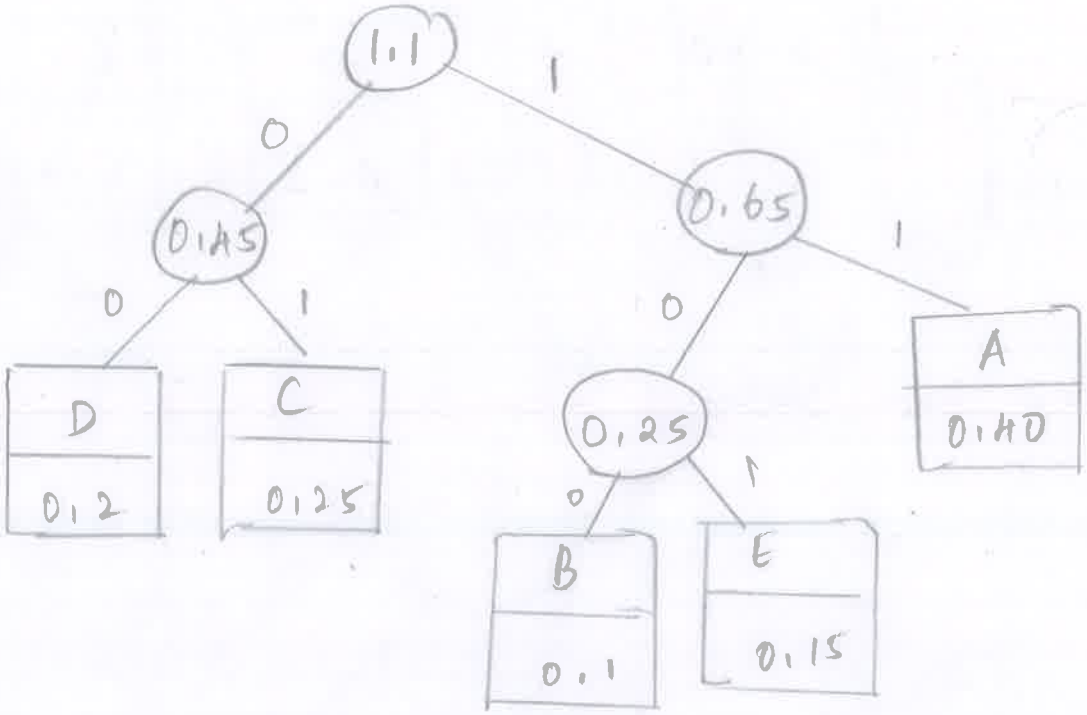


combine these two nodes.



We get a huffman tree. We have to encode the tree. The simple rule to be followed to encode a tree, the left branch should be

assigned with 0 and the right branch should be assigned with 1.



Thus the encoding can be

A	B	C	D	E
11	100	01	00	101.

Applications:

1. Huffman encoding is used in file compression algorithm.
2. Huffman's code is used in transmission of data in an encoded form.
3. This encoding is used in game playing method in which decision trees need to be formed.

PART-A.

1. What is meant by divide and conquer technique.
2. What kind of Problems can be solved using divide and conquer method.
3. Define recurrence relation.
4. What are the steps involved in mergesort.
5. Define Quicksort.
6. Define Dynamic programming.
7. Difference between divide and conquer & dynamic Programming.
8. Define principle of optimality.
9. What is meant by Multistage graph.
10. Define optimal Binary Search Tree.
11. What are the elements of the Greedy Strategy.
12. What is meant by Huffman trees.
13. What are the various encoding techniques in Huffman Trees.

PART-B

1. Explain divide and conquer to apply the technique in binary search algorithm to analysis it.
2. Explain in detail about mergesort give an example
3. What is ot distinguish between Quick sort and Merge sort and arrange the following numbers in increasing order. (18, 29, 68, 32, 43, 37, 87, 24, 47, 50).

4. write an algorithm to construct the optimal Binary Search Tree

5. Let A = {i|119, m|96, c|207, g|283, h|22, f|71, x|92, j|4} be the letters and its frequency of distribution in a text file. Compute a suitable Huffman coding to compress the data effectively.

b. Explain and detail about Huffman Trees.

UNIT-IV

STATE SPACE SEARCH ALGORITHMS

Backtracking:

Backtracking is a general problem solving algorithmic technique in which the algorithm tries to find a solution to a Problem.

In backtracking, the algorithm traverses a tree like search space, where each node represents a partial solution and the branches represent the possible choices or decisions that can be made at each step.

Backtracking is commonly used in problems that require finding all possible solutions, such as generating,

* permutations or combinations
* solving puzzles
* Searching a path in a graph.

Ex: 8 queens Problem.

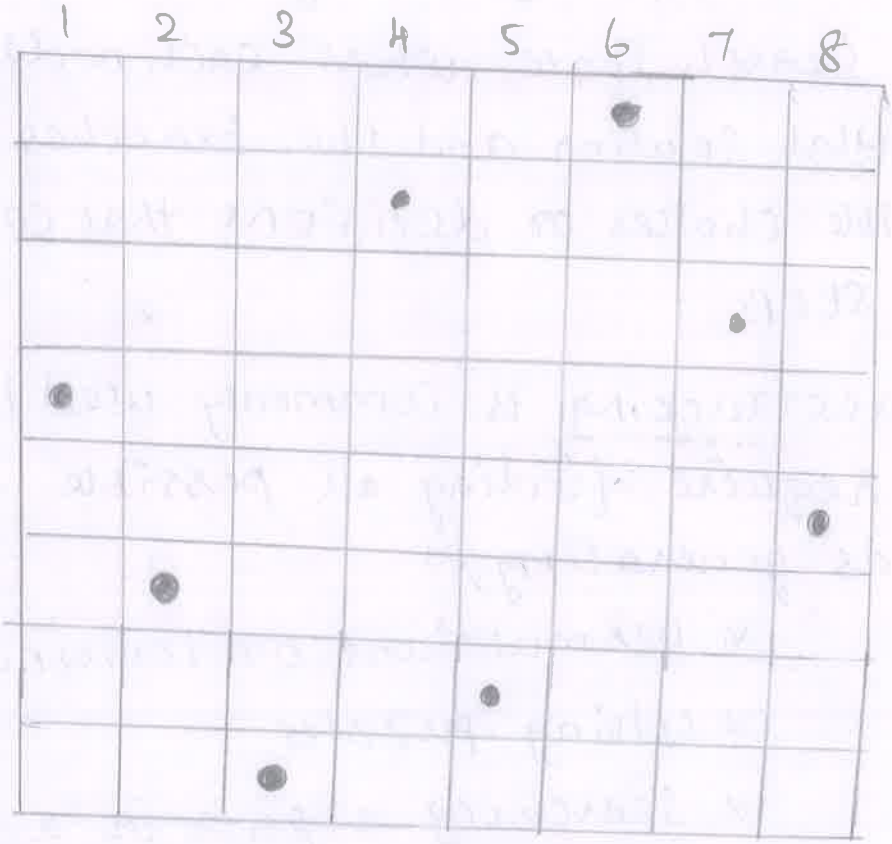
The solution to 8-queens Problem can be obtained using Backtracking method.

*Consider a chessboard of order 8x8.

*the problem is to place 8 queens on this board, such that no two queens can attack each other

*. That means no two queens can be placed on the same row, column or diagonal.

The solution to 8-queens problem can be obtained using Backtracking method.

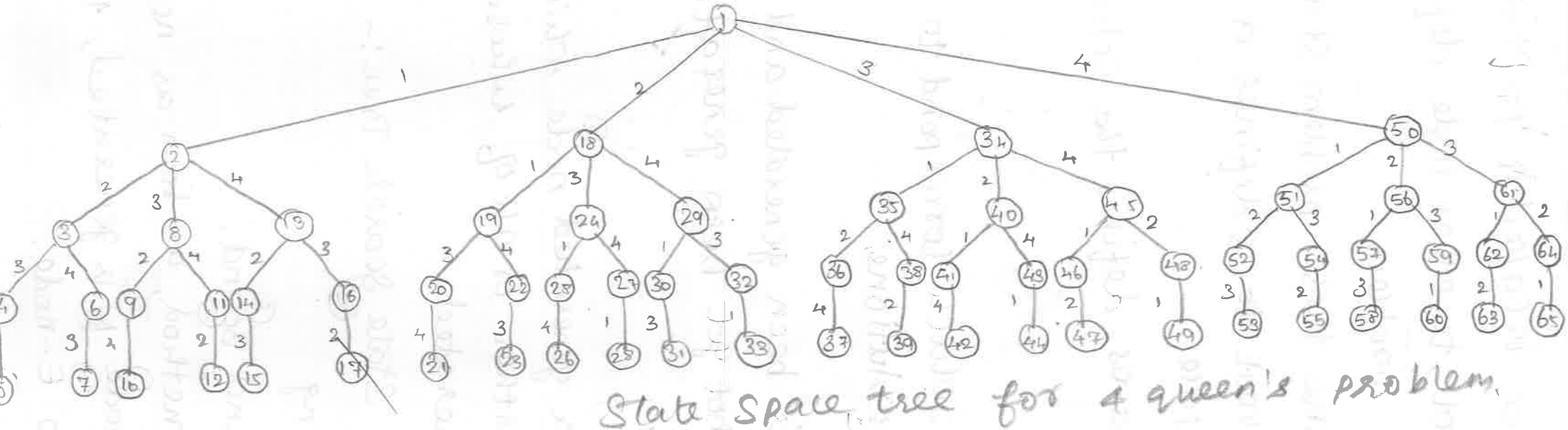


Some Terminologies used in BackTracking:

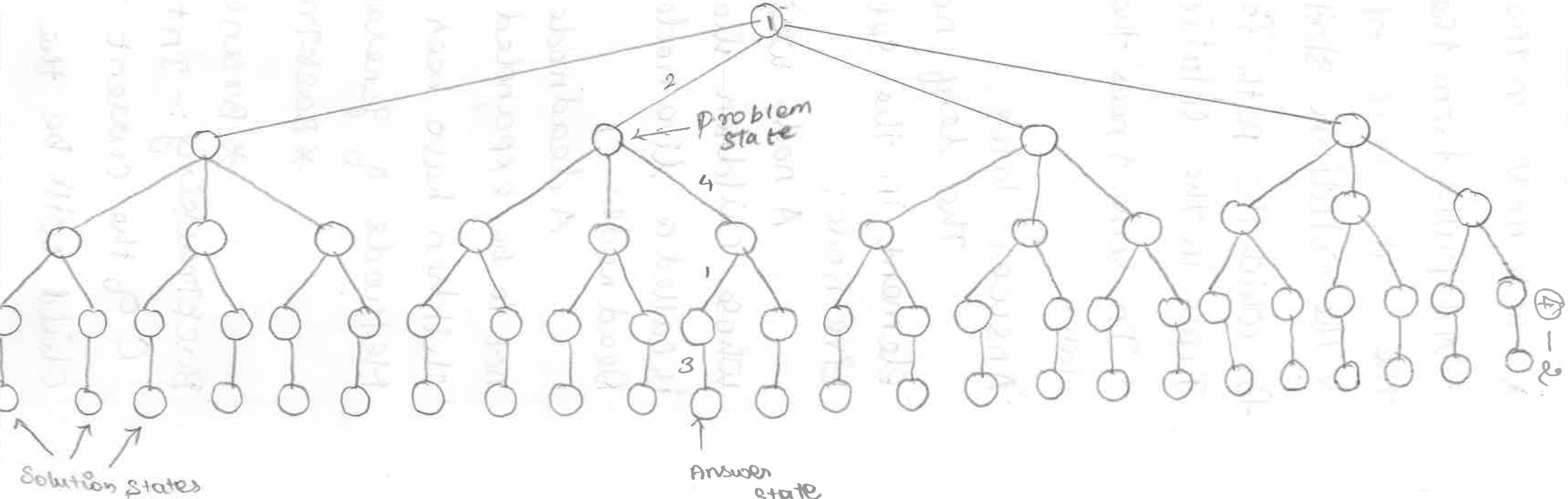
State Space Tree (4-Queens problem):-

Ex:

Consider a 4 queen's problem. It could be stated as there are 4 queens that can be placed on 4X4 chessboard. Then no two queens can attack each other



State Space tree for 4 queen's problem.



* Each node in the tree is called a Problem State.
* All paths from the root to other node defines the State Space of the problem.
* The Solution States are those problem States for which the path from root to S defines a Tuple in the solution Space.
* In some trees the leaves defines the Solution States.

Answer States:

The leaf nodes which correspond to an element in the set of solutions.

Live node:

A node which is been generated and all whose children have not yet been generated is called a live node.

Dead node:

A deadnode is a generated node which is not to be expanded further or all of whose children have been generated.

Methods of generating State Search Tree:-

* Backtracking
* Branch and Bound.

Backtracking:- In this method, as soon as new child C of the current E-node N is generated, this child will be the new E-node.

Branch and Bound - E node will remain as E-node until it is dead.

Algorithm:

```
Algorithm Backtrack ()
{
for (each ak that belongs to T (a1, a2 ..... ak-1) do
{
if (Bk (a1, a2, ..... ak) = true) then
{
if ((a1, a2 ..... ak) is a path to answer node) then
print (a[1], a[2] ..... a[k]);
if (k<n) then
Backtrack (k+1);
}
}
}.
```

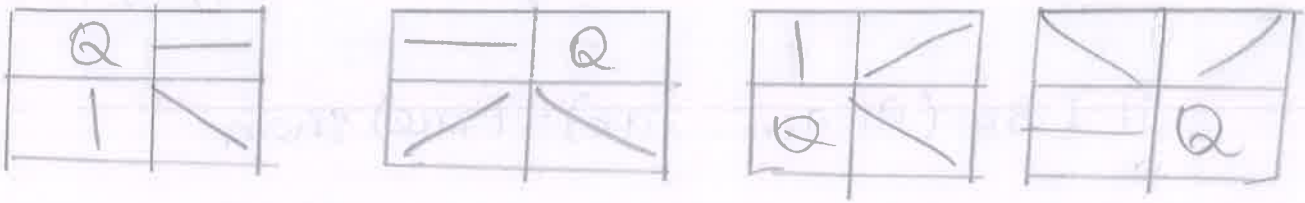
n - Queens Problem;

Consider a n x n chessboard on which we have to place n queens so that no two queens attack each other by being in the same row or in the same column or on the same diagonal.

2 Queen's problem :-

2 Queen's problem is not solvable.

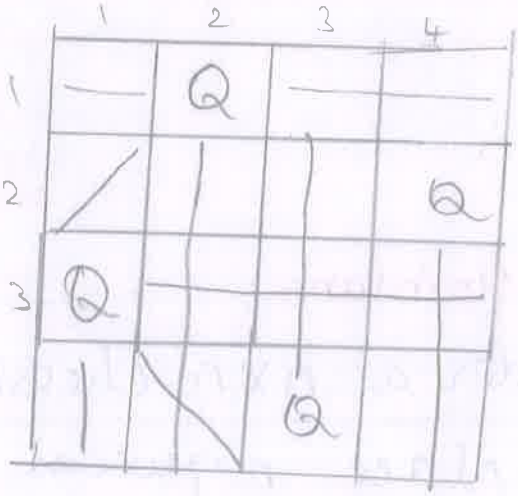
Because 2 queens cannot be placed on 2 x 2 chessboard.



4 Queen's problem :-

A Queen's problem is solvable.

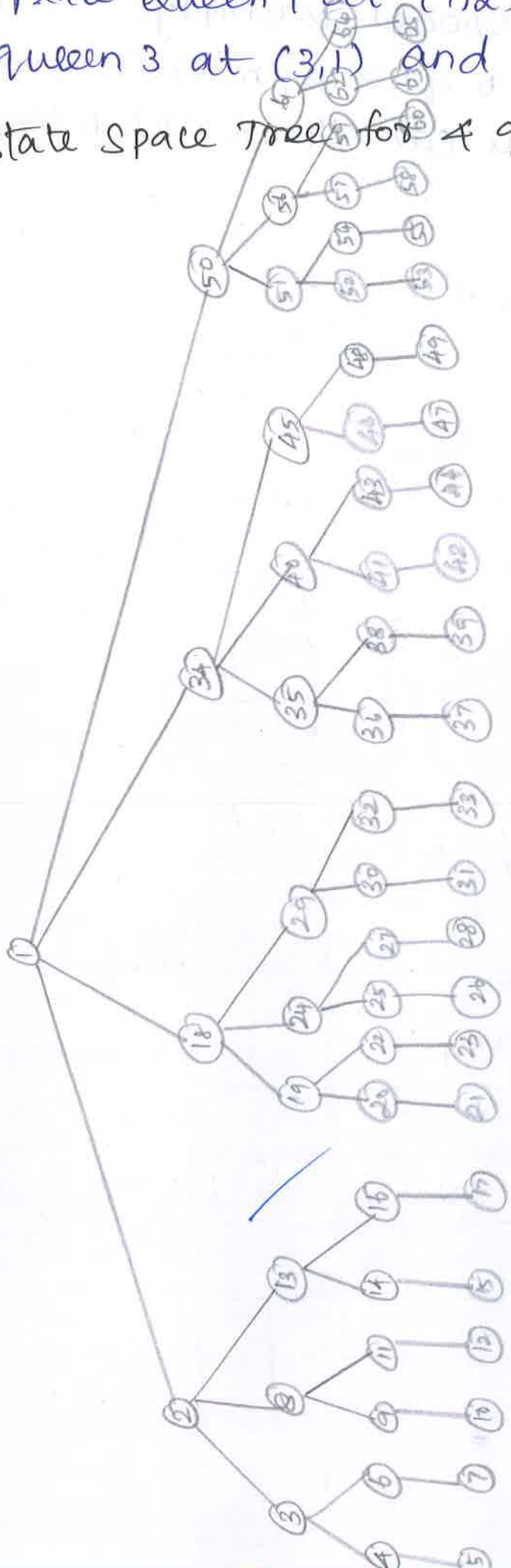
No two queen's can attack each other.



* We start with empty chessboard.
* Place queen 1. in the first possible position of its row.
* Then place queen 2 after trying unsuccessful place.
* we need to backtrack all the way up to queen 1 and move it to (1,2).

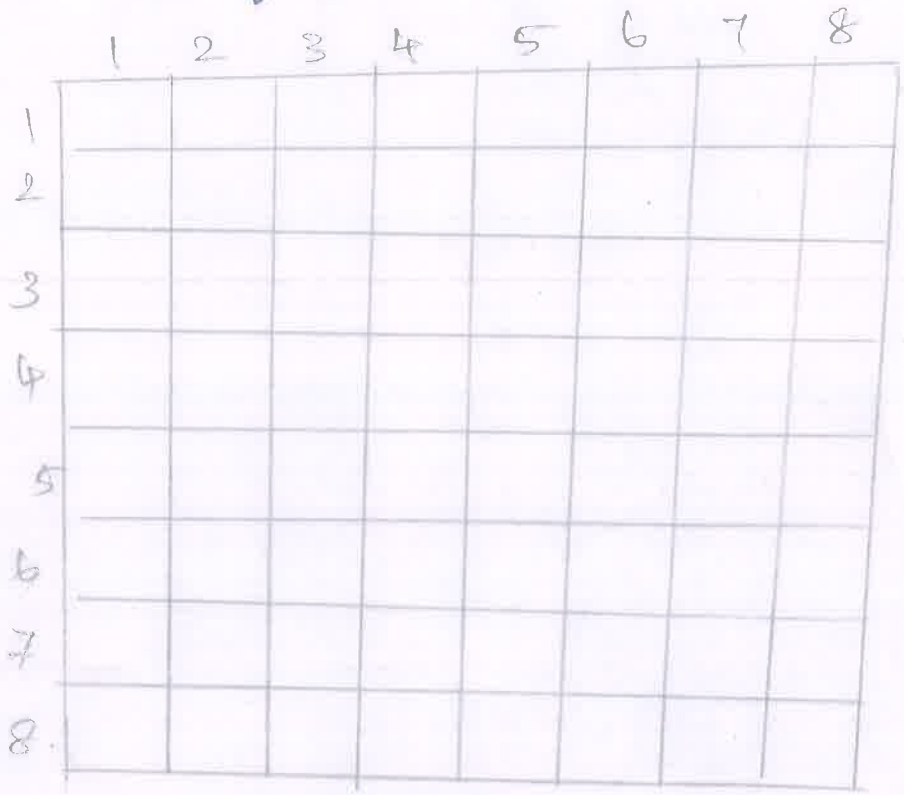
* Place Queen 1 at (1,2), queen 2 at (2, 4), queen 3 at (3,1) and queen 4 at (4, 3).

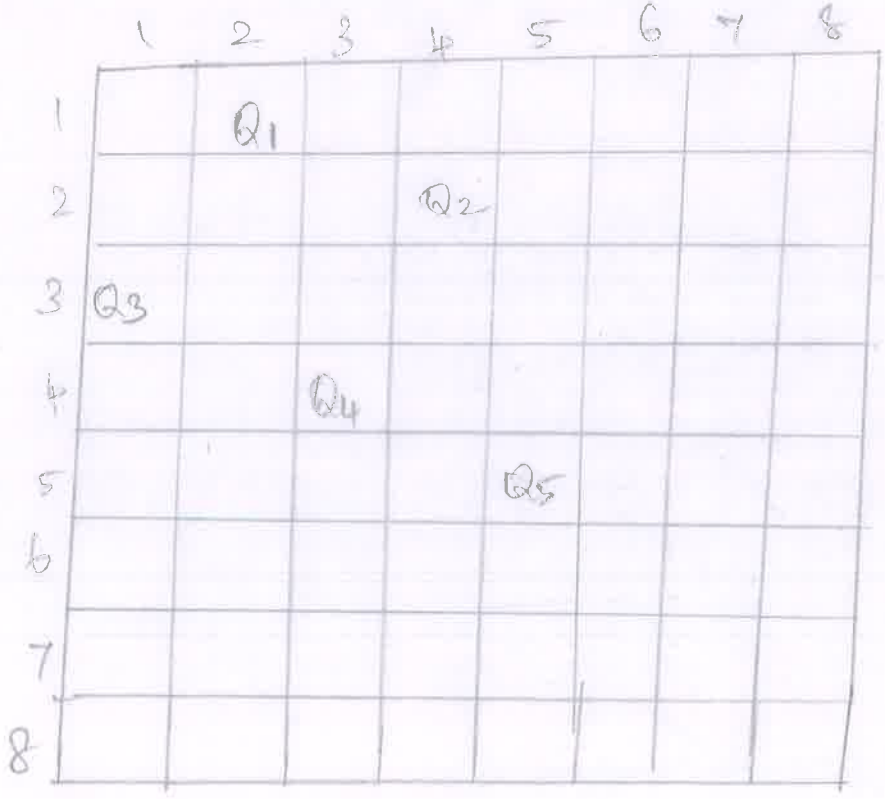
State Space Tree for 4 queen's problem:



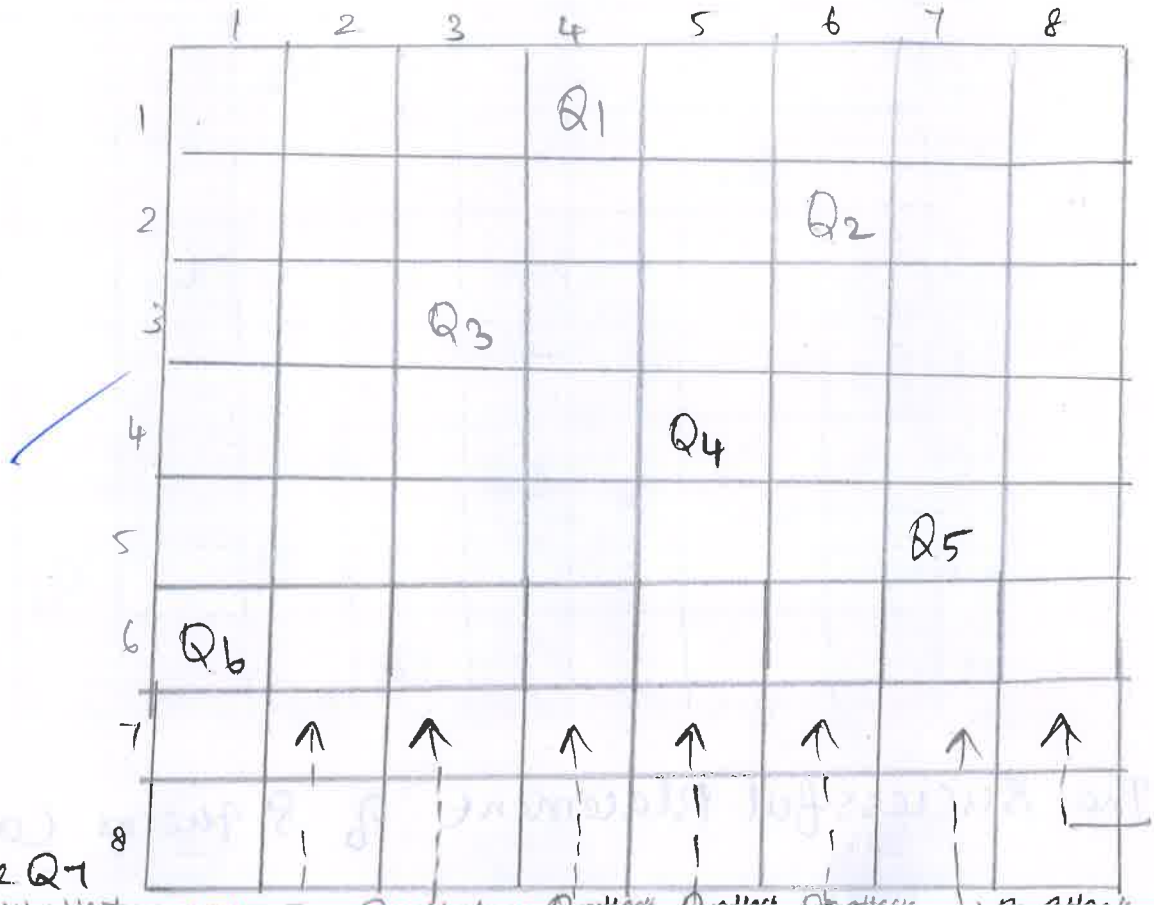
8 Queen's Problem :

* Initially the chessboard is empty.
* we have placed 5 queens in such a way that no two queens can attack each other.

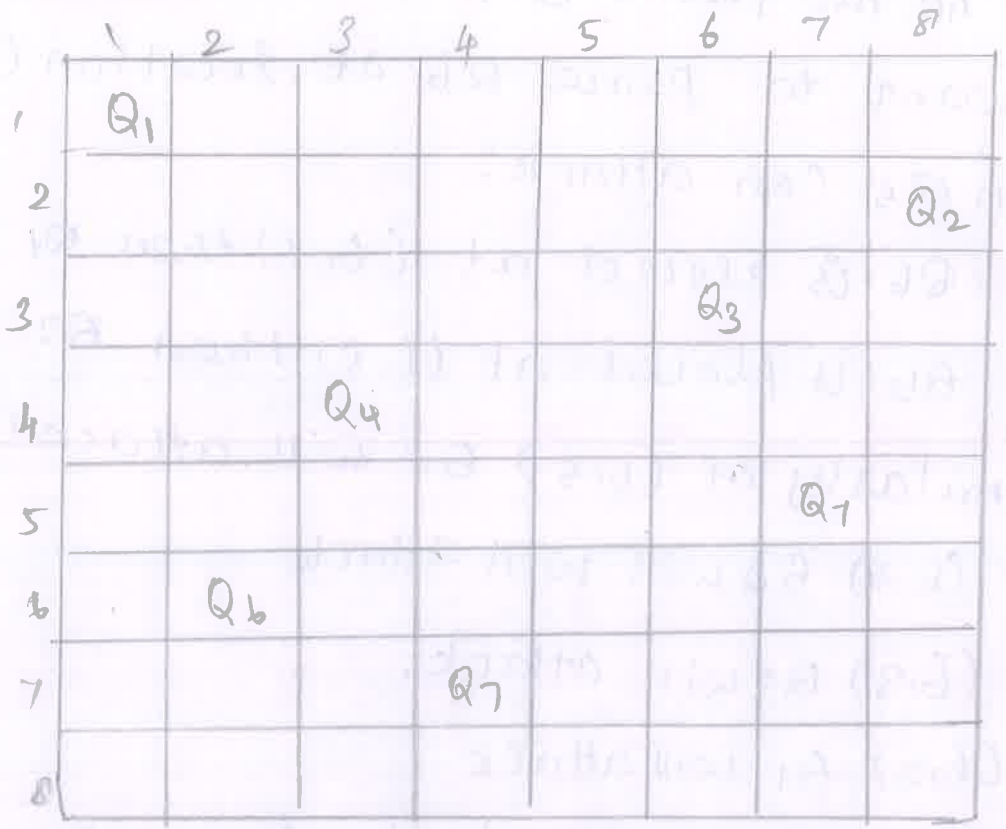




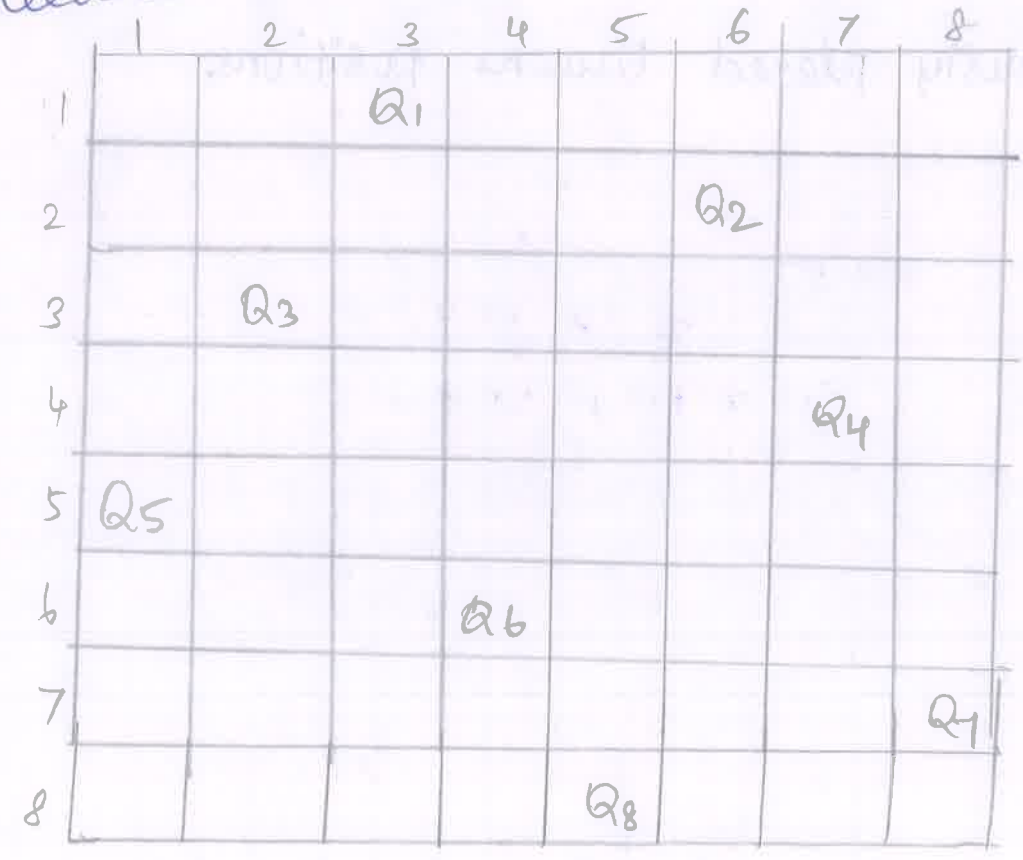
* We have placed 5 queens in such a way that no two queens can attack each other.
* We want to place Q6 at location (6,6) then queen Q5 can attack.
* If Q6 is placed at (6,7) then Q1 can attack.
* If Q6 is placed at (6,8) then Q2 can attack.
* Similarly at (6,5) Q5 will attack it.
* At (6,4) Q4 will will attack
* At (6,3) Q3 will attack.
* At (6,2) Q1 will attack
* At (6,1) Q3 will attack the Queen Q6.
* So we need to Backtrack and change the previously placed Queens positions.



Hence we have to backtrack to adjust already Placed Queens.



But again Q8 cannot be placed at any empty location. We need to Backtrack.



The Successful Placement of 8 queens can be placed.

Algorithm:

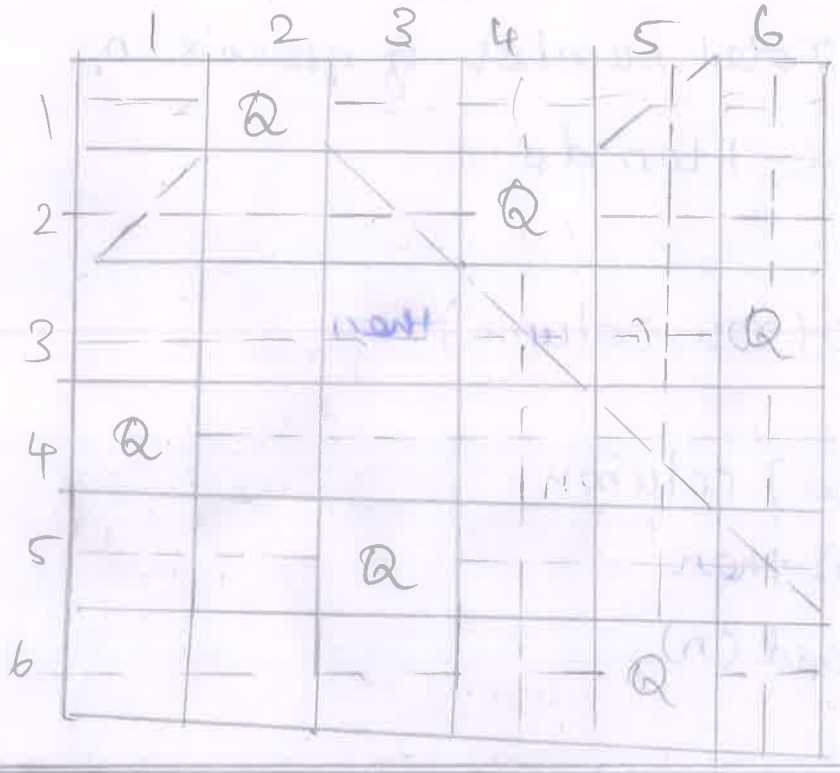
```
Algorithm Queen(n)
//problem Description: This algorithm is for implementing
                       n Queens problem.
// Input : Total number of queen's n,
for Column ← 1 to n do
{
if (place(row, column)) then
{
board[row] column
if (row = n) then
print-board(n)
else
  Queen(row+1, n)
  }
}
Algorithm place(row, column)
//problem Description: This algorithm is for placing
                       the queen at appropriate position
// Input : row and column of the chessboard,
//output : returns 0 for the row and column,
for i ← 1 to row-1 do
{
if (board[i] = column) then
return 0
else if (abs(board[i] - column) = abs(i - row)) then
return 0.
}
```

Eg:

Solve N queens problem and trace it for n=6,

Soln;

n=6, the solution would be,



Hamiltonian Circuit problem:-

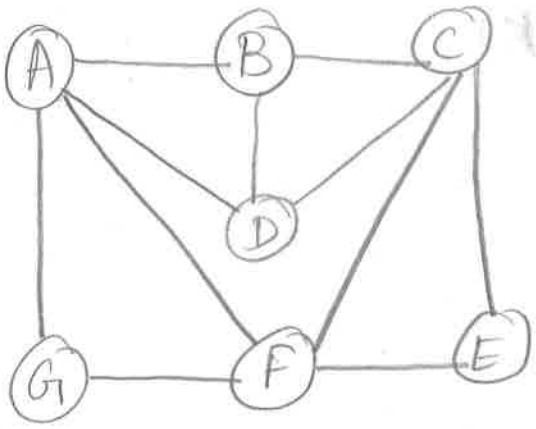
A hamiltonian circuit, also known as a Hamiltonian cycle.

Hamiltonian cycle is a cycle that passes through each vertex of a graph exactly once, except for the starting vertex, which is also the ending vertex.

In other words, a hamiltonian circuit is a closed walk in a graph that visits every vertex exactly once.

NP hard problem.

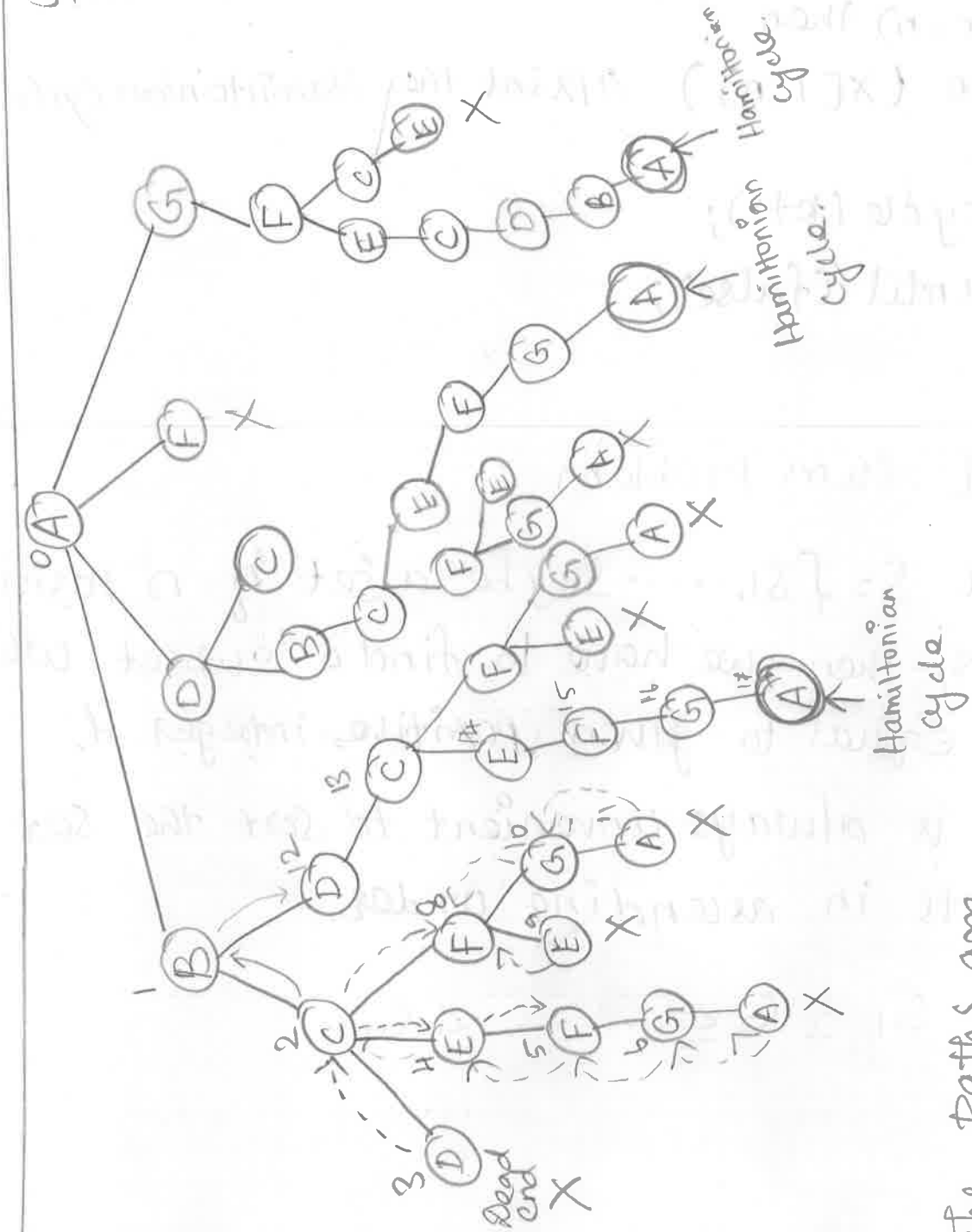
In a graph we start with the point and visit all other node in the graph and comes to starting



→ DFS (Deepest)
→ Backtracking
→ start with a vertex
→ State Space Tree.

Soh:

State Space Tree:



The paths are,

1) A → B → D → C → E → F → G → A
2) A → D → B → C → E → F → G → A
3) A → G → F → E → C → D → B → A.

Algorithm:

```
Algorithm H-cycle(k)
{
repeat
{
Next_Vertex(k);
if (x[k]=0) then
return;
if (k=n) then
write (x[1:n]) //print the Hamiltonian cycle.
else
H-cycle(k+1);
} until (false);
}.
```

Subset Sum problem

Let $S=\{s_1, \ldots s_n\}$ be a set of n positive integers, then we have to find a subset whose sum is equal to given positive integer d.

It is always convenient to sort the set of elements in ascending order.

$$s_1 \leq s_2 \leq \ldots \leq s_n.$$

Algorithm :-

1. Start with an empty set.
2. Add to the subset, the next element from the list.
3. If the subset is having sum d then stop with that subset as solution,
4. If the subset is not feasible or if we have reached the end of the set then backtrack through the subset until we find the most suitable value.
5. If the subset is feasible then repeat step 2.
6. If we have visited all the elements without finding a suitable subset and if no backtracking is possible then stop without Solution.

Ex:

1. There are 5 distinct numbers {1, 2, 5, 6, 8}. Find the combinations of these numbers such that the sum is 9. use the backtracking model to arrive at the solution.

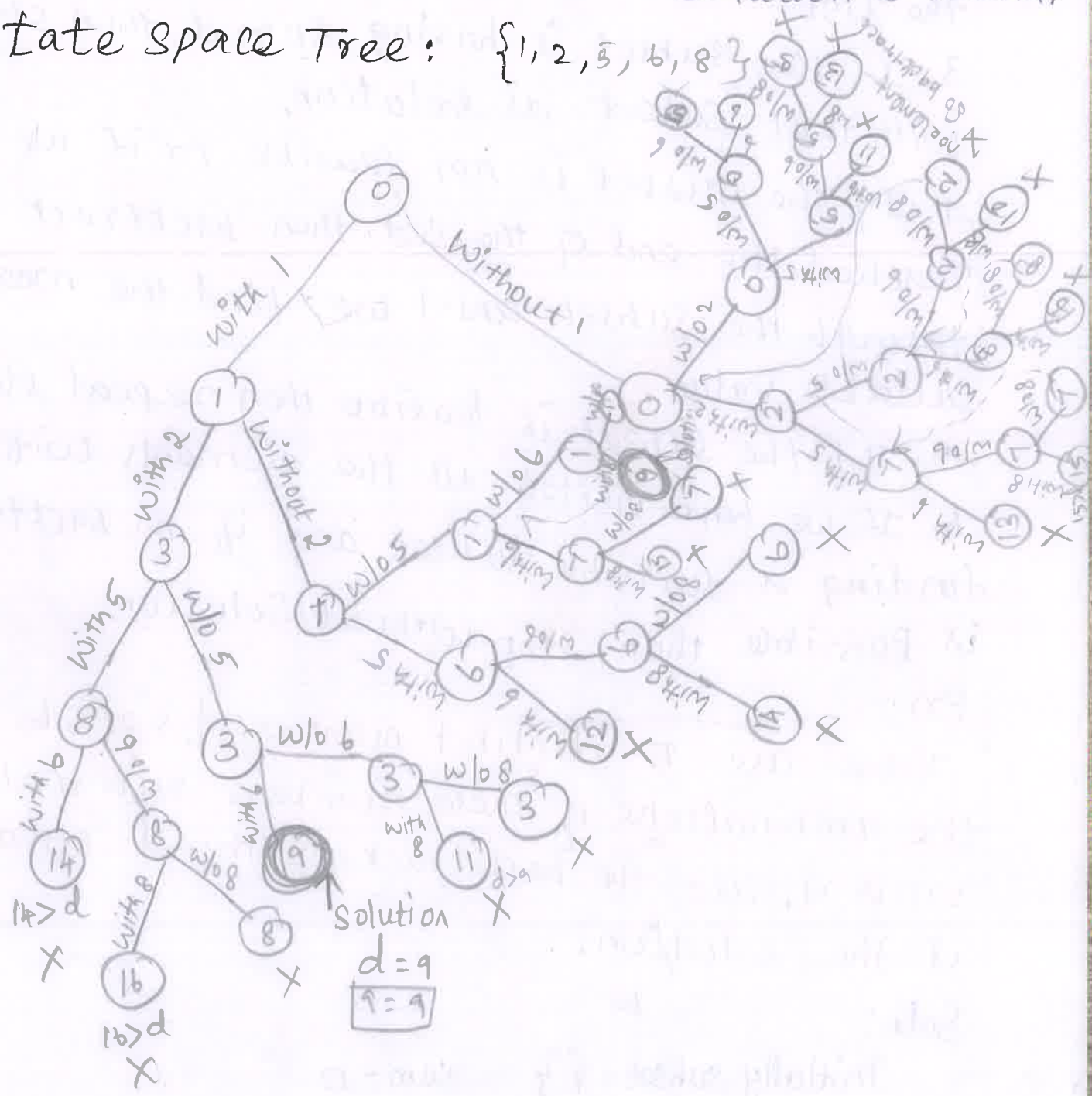
Soln:

Initially subset = { }	sum = 0	
1	1	Now add the next element
1, 2	3 [∵3<9]	Add next element
1, 2, 5	8 [∵8<9]	Add next element
1, 2, 5, 6	14 [∵14>9]	Sum exceeds the given constraint. Hence Backtrack

1, 2, 5, 8 — 16 [16>9] — Sum exceeds the given constraints, Hence Backtrack.

1, 2, 6 — 9 [9=9] — Solution is found.

State Space Tree: {1, 2, 5, 6, 8}



2 solutions:

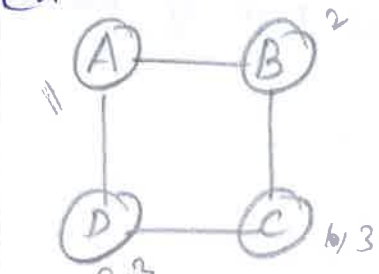
{1, 2, 6} ⇒ 1+2+6 = 9.

{1, 8} ⇒ 1+8 = 9.

Graph Colouring problem:-

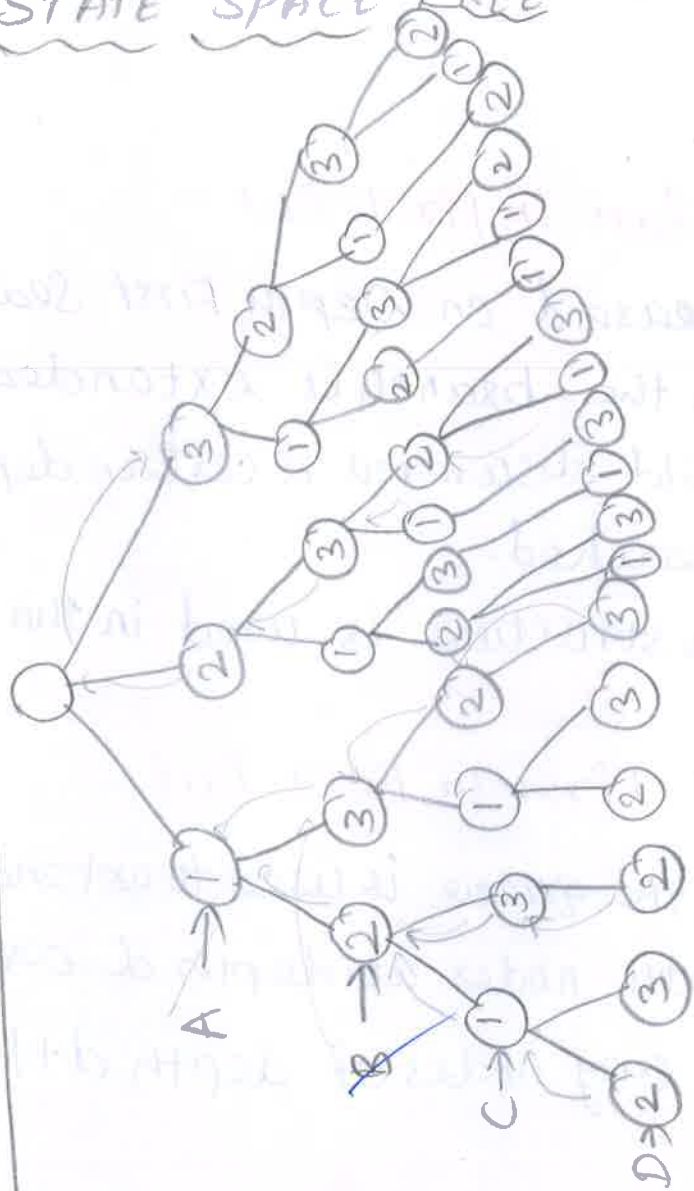
* Graph coloring is a problem of coloring each vertex in graph in such a way that no two adjacent vertices have same colour and get m-colors are used. This problem is also called m-coloring problem.

Eg:



m = 3

STATE SPACE TREE



Branch and Bound

Branch and Bound method creates the State Space tree by discovering the branches that need to be expanded.

To limit the number of possible solutions, the branch and bound method makes use of estimated bounds.

Strategies:-

1) LIFO search.

2) FIFO Search.

LIFO Search:-

* It stands for Last In first Out.

* This search is based on Depth First Search Technique, in which the branch is extended through every first child discovered a certain depth, until a leaf node is reached.

* The stack data structure is used in this search.

FIFO Search:-

* It stands for First In First Out.

* Oldest node in the queue is used to extend the branch, where all nodes at depth d are visited first, before any nodes at depth d+1 are visited.

* The queue datastructure is used in this Search.

Solving 15-puzzle problem;

* The 15 puzzle problem consist of 15 numbered tiles on a square from with a capacity of 16 tiles.

* we are given initial arrangement of the tiles and the objective is to transform this arrangement in to goal arrangement.

1	2	3	4
5	6		8
9	10	7	11
13	14	15	12

Initial arrangement

1	2	3	4
5	6	7	8
9	10	11	12
13	14	15	

goal arrangement

$$\hat{c}(n) = f(n) + \hat{g}(n)$$

There are 4 arrangements possible

* Left
* Right
* Up
* Down

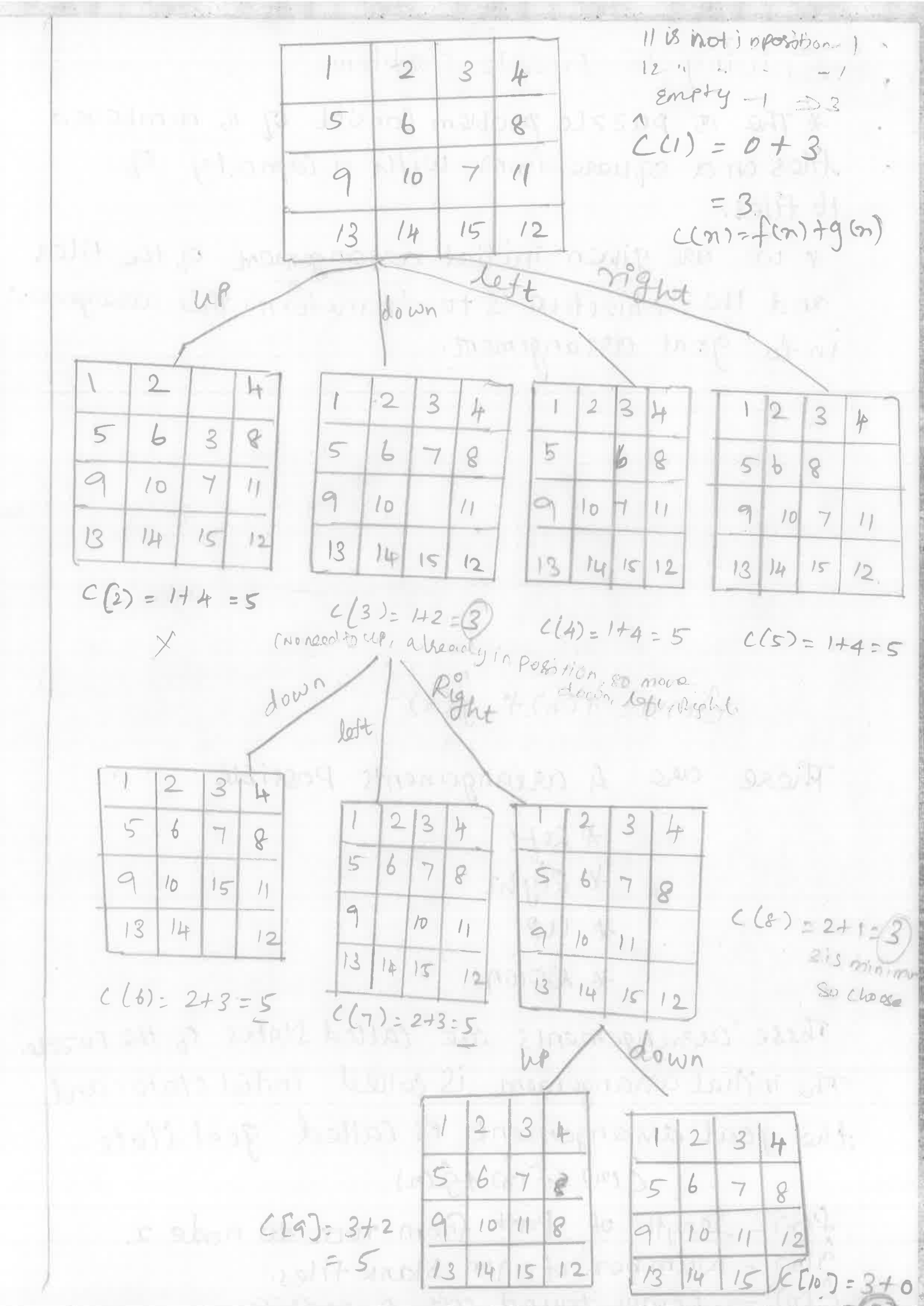
These arrangements are called states of the puzzle. The initial arrangement is called initial state and the goal arrangement is called goal state.

$$\hat{c}(n) = f(n) + \hat{g}(n)$$

$f(n)$ - length of path from root to node x.

$\hat{g}(n)$ - Number of non blank tiles.

$\hat{c}(n)$ — Lower bound cost of node x.


11 is not in position
12 " " " "
empty → 3
c(1) = 0 + 3
= 3
c(n) = f(n) + g(n)
up
down
left
right
c(2) = 1+4 = 5
X
c(3) = 1+2 = 3
(No need to up, already in position, so move down, left, right)
c(4) = 1+4 = 5
c(5) = 1+4 = 5
down
left
Right
c(6) = 2+3 = 5
c(7) = 2+3 = 5
c(8) = 2+1 = 3
2 is minimum
So choose
up
down
c[9] = 3+2
= 5
c[10] = 3+0

Assignment problem:

Problem Statement:

There are n people to whom n jobs are to be assigned so that total cost of assignment is as small as possible.

The assignment problem is specified by n by n matrix and each element in each row has to be selected in such a way that no two selected elements are in the same column and their sum is smallest as far as possible.

Example:

Find the optimal solution using Branch and Bound for the following assignment problem.

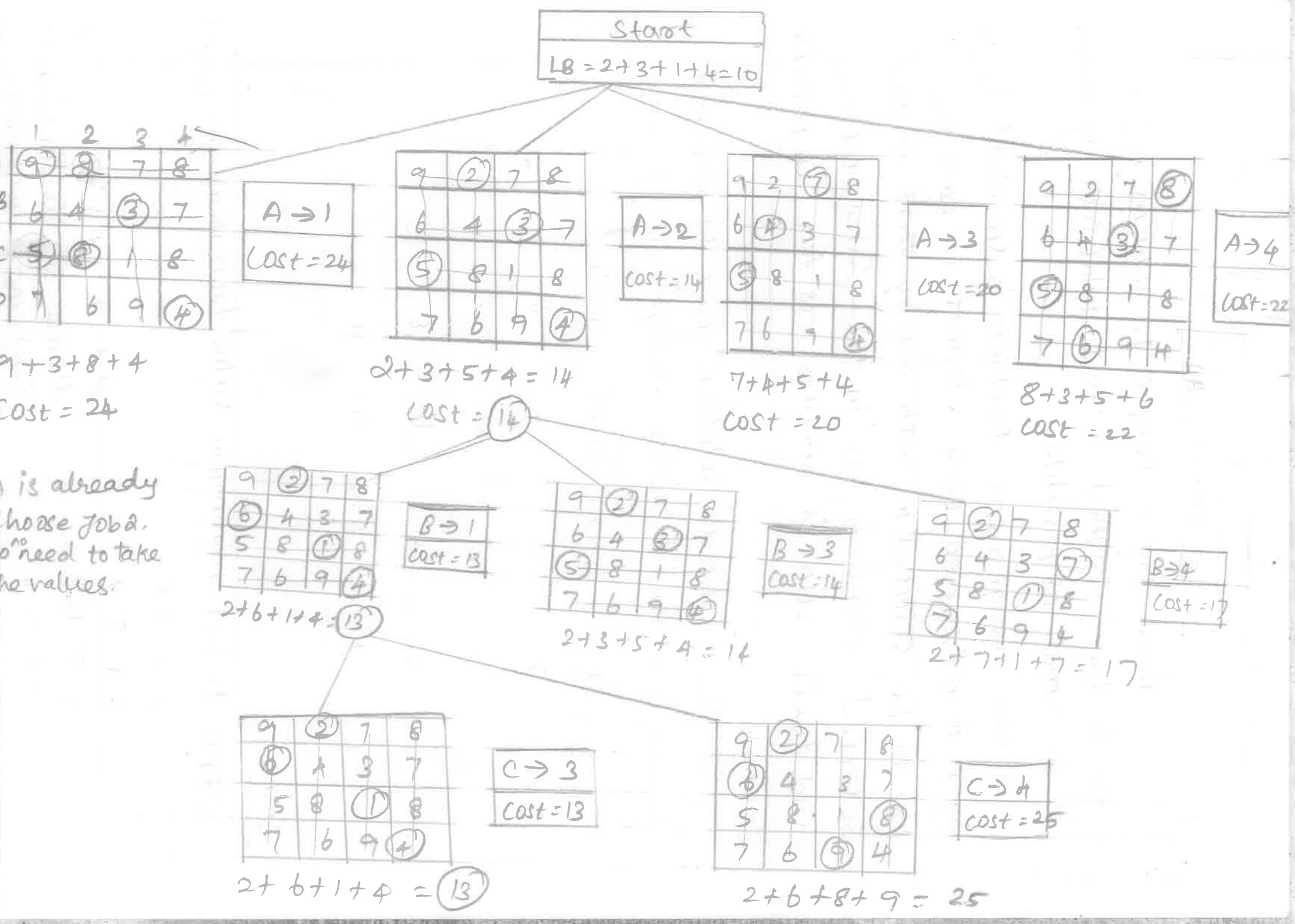
	Job1	Job2	Job3	Job4
A	9	2	7	8
B	6	4	3	7
C	5	8	1	8
D	7	6	9	4

Soln:

STEP1: Select minimum value from each row, we get

9	(2)	7	8
6	4	(3)	7
5	8	(1)	8
7	6	9	(4)

→ 2 + 3 + 1 + 4 = 10.
Hence set lower bound (LB) = 10 for root node.


Start
LB = 2+3+1+4=10
A→1
Cost=24
A→2
cost=14
A→3
cost=20
A→4
cost=22
9+3+8+4
Cost = 24
2+3+5+4 = 14
Cost = 14
7+4+5+4
cost = 20
8+3+5+6
cost = 22
is already
hoose job 2.
o need to take
he values.
B→1
cost=13
B→3
Cost=14
B→4
Cost=17
2+6+1+4=13
2+3+5+4=14
2+7+1+7=17
C→3
cost=13
C→4
cost=25
2+6+1+4 = 13
2+6+8+9 = 25

Thus we get the solution as,

Person a = Job 2

person b = Job 1

person c = Job 3

person d = Job 4.

Knapsack problem:

If we are given n objects and a knapsack in which the object i with weight w_i is to be placed. The knapsack has a capacity W. Then the profit value that can be earned is v_i. Then objective is to obtain filling of knapsack with maximum profit earned. But it should not exceed weight W of the knapsack.

The knapsack is filled up with selected objects.

We compute upperbound of the tree.

$v_1/w_1 \geq v_2/w_2 \geq v_3/w_3 \text{ ------ } v_n/w_n$.

We design a statespace tree by inclusion or exclusion of some items.

The upper bound can be computed using following formula.

$$ub = v + (W - w)(v_{i+1}/w_{i+1}).$$

Example:

Solve the following instance of the knapsack problem by the branch and bound algorithm.

Item	Weight	Value
1	4	$40
2	7	$42
3	5	$25
4	3	$12

The knapsack capacity $W = 10$.

Soln:

First we compute value/weight for each item.

Item	Weight	Value	Value/weight
1	4	$40	10
2	7	$42	6
3	5	$25	5
4	3	$12	4.

Node 6:

$i = 3,\ w = 4,\ v = 40$

$= 40 + (10 - 4)(4)$

$= 40 + 24$

$N_6 = 64$

Node 8:

$i = 4,\ w = 9,\ v = 65$

$= 65 + (10 - 9)(v_5 | w_5)$

$= 65 + (1)(0)$

$N_8 = 65$

Travelling Salesman problem:

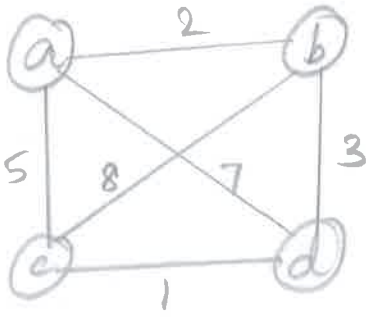
If there are n cities and cost of travelling from any city to any other city is given then we have to obtain the cheapest round trip such that each city is visited exactly once and then returning to starting city, completes the tour.

The lower bound is denoted by LB and can be obtained using,

$$LB = \sum_{v \in V} \left(\text{Sum of costs of the two least cost edges adjacent to } v \right) / 2$$

Example:

Apply Branch and Bound algorithm to solve the Traveling Salesman problem.



Soln:

STEP1:

We will obtain lower bound LB as,

$$LB = \left[\Sigma \text{ sum of cost of two least cost edges adjacent to the vertex } v \right] / 2.$$

$$= \left[[(a-b)+(a-c)] + [(b-a)+(b-d)] + [(c-a)+(c-d)] + [(d-b)+(d-c)] \right]$$

$$= [2+5] + [2+3] + [5+1] + [3+1]$$

$$= 7+5+6+4$$

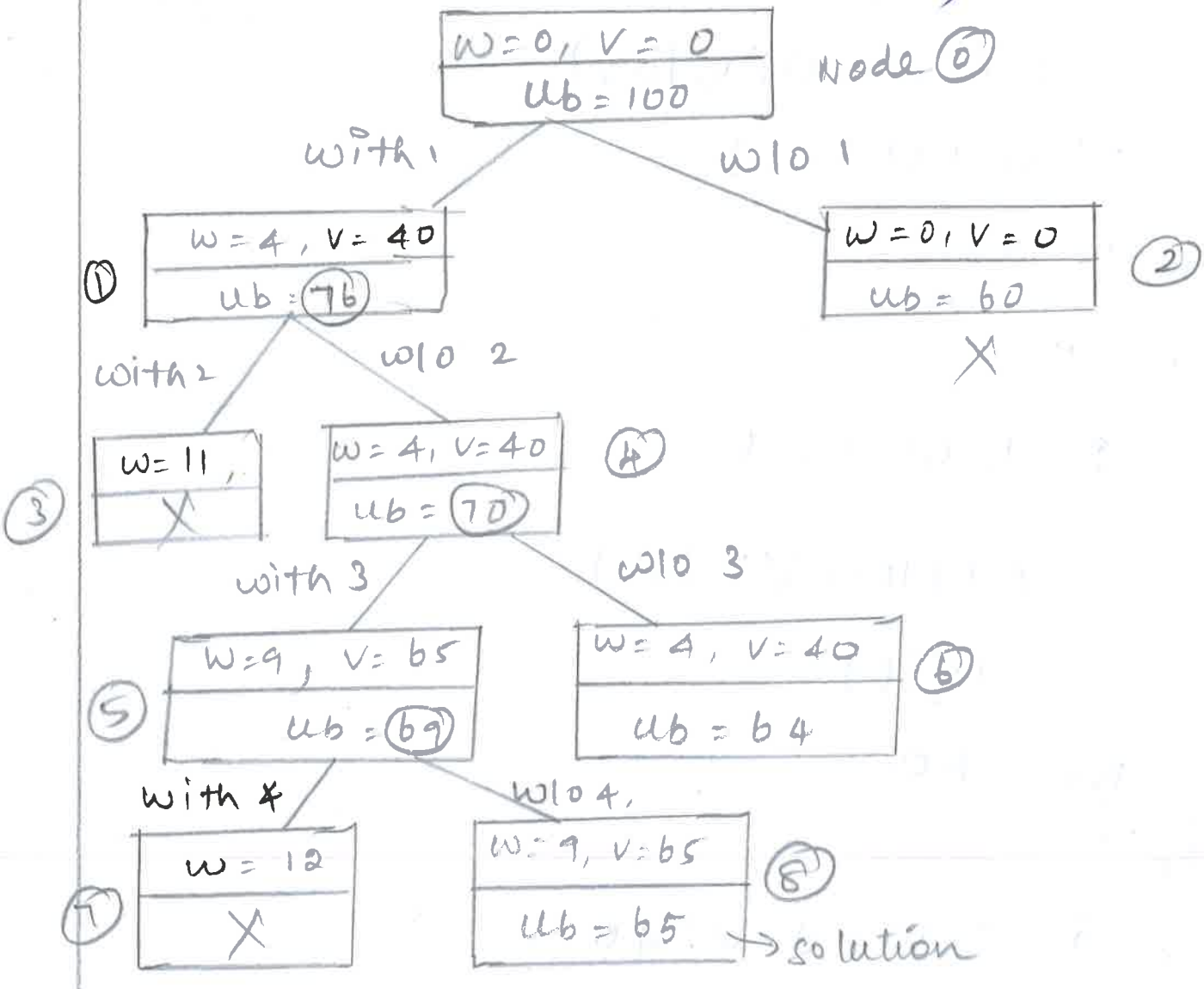
$$LB = 22$$

$$LB = 22/2$$

$$LB = 11.$$

The upper bound can be calculated as,

$$ub = v + (w - w)(v_{i+1} / w_{i+1})$$



Node 0:

$i = 0, w = 0, v = 0$

$\Rightarrow v + (w - w)(v_{i+1} / w_{i+1})$

$\Rightarrow 0 + (10 - 0)(v_1 / w_1)$

$= 10\ (10)$

$N_0 = 100$

Node 1:

$i = 1, w = 4, V = 40$

$= 40 + (10 - 4)(V_2 | w_2)$

$= 40 + (6)(6)$

$N_1 = 76$

Node 2:

$i = 1, w = 0, V = 0$

$= 0 + (10 - 0)(V_2 | w_2)$

$= 10(6)$

$N_2 = 60.$

Node 4:

$i = 2, w = 4, V = 40$

$= 40 + (10 - 4)(V_3 | w_3)$

$= 40 + (6)(5)$

$N3 = 70$

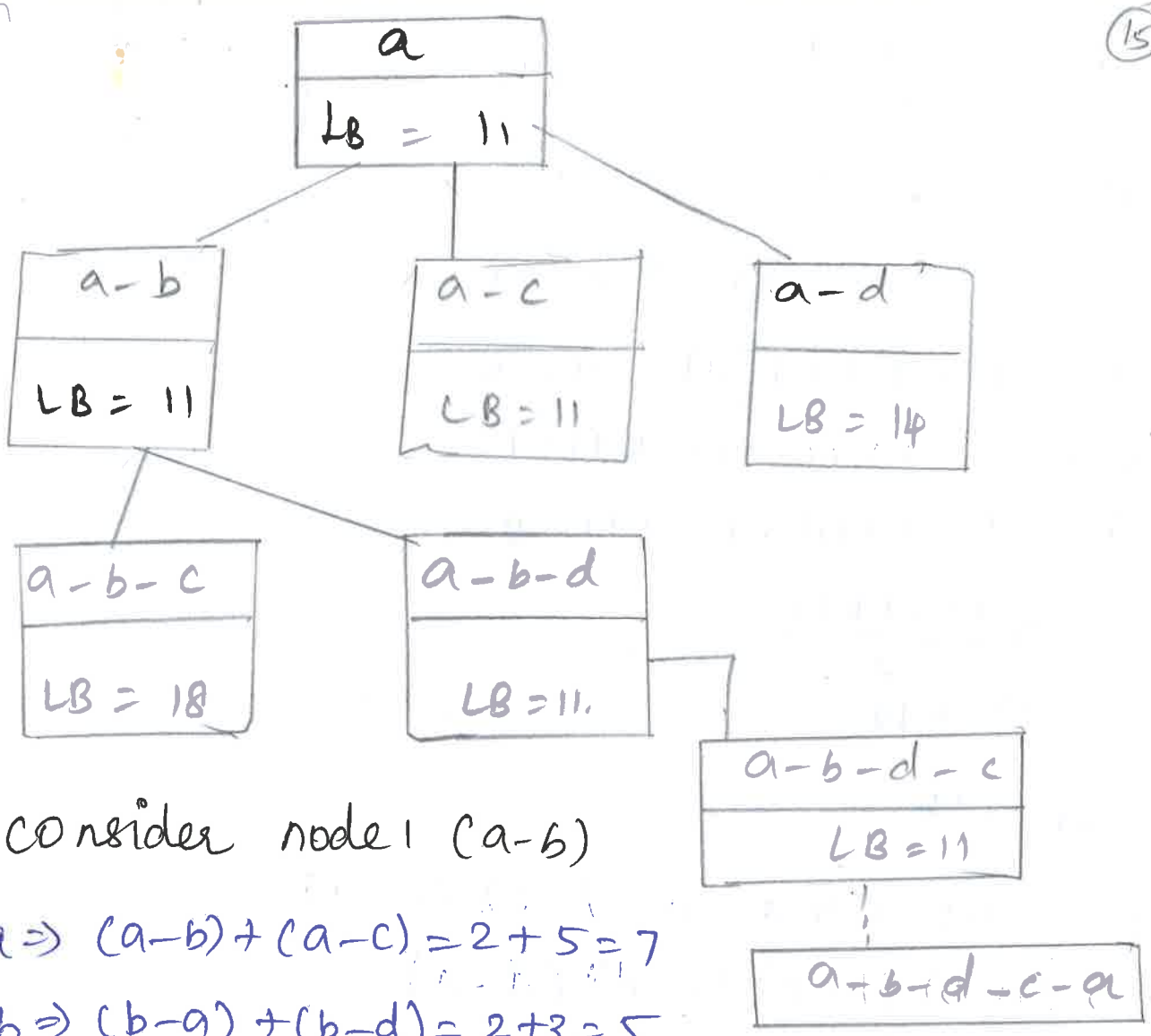
Node 5:

$i = 3, w = 9, V = 65$

$= 65 + (10 - 9)(V_4 | w_4)$

$= 65 + (1)(4)$

$N5 = 69$



Solution:

consider node 1 (a-b)

a ⇒ (a-b) + (a-c) = 2 + 5 = 7

b ⇒ (b-a) + (b-d) = 2+3 = 5

c ⇒ (c-a) + (c-d) = 5+1 = 6

d ⇒ (d-c) + (d-b) = 1+3 = 4

$$LB = \frac{7+5+6+4}{2}$$

$$= \frac{22}{2}$$

LB = 11

consider node 2 (a-c)

a ⇒ (a-c) + (a-b) = 5+2 = 7

b ⇒ (b-a) + (b-d) = 2+3 = 5

c ⇒ (c-a) + (c-d) = 5+1 = 6

d ⇒ (d-c) + (d-b) = 1+3 = 4

$LB = \frac{7+5+6+4}{2} = \frac{22}{2} = 11.$

Consider node 3 (a-d)

$a \Rightarrow (a-d)+(a-b) = 7+2 = 9$

$b \Rightarrow (b-a)+(b-d) = 2+3 = 5$

$c \Rightarrow (c-a)+(c-d) = 5+1 = 6$

$d \Rightarrow (d-a)+(d-c) = 7+1 = 8$

$\Rightarrow \frac{9+5+6+8}{2}$

$\Rightarrow 28 \mid 2$

$LB \Rightarrow 14$

Consider node 4 (a-b-c) (d, a)

$\Rightarrow (a-b)(b-c)(c-d)(d-a)$

Take edges from above list

$a = (a-b)+(d-a) = 2+7 = 9$

$b = (a-b)+(b-c) = 2+8 = 10$

$c = (b-c)+(c-d) = 8+1 = 9$

$d = (c-d)+(d-a) = 1+7 = 8$

$\Rightarrow \frac{9+10+9+8}{2}$

$= \frac{36}{2}$

$LB = 18$

Consider node 5 (a-b-d) (c-a)
(a-b) (b-d) (d-c) (c-a)

a = (a-b) + (c-a) = 2+5 = 7

b = (a-b) + (b-d) = 2+3 = 5

c = (d-c) + (c-a) = 1+5 = 6

d = (b-d) + (d-c) = 3+1 = 4

$$\Rightarrow \frac{7+5+6+4}{2} = \frac{22}{2}$$

LB = 11.

The Shortest Tour is

a - b - d - c - a

2 + 3 + 1 + 5

Cost = 11.

Important Questions:

PART-A:

1. State the principle of Backtracking.
2. What is state space tree.
3. What are the applications of Backtracking.
4. Give the formal definition of n-queen's problem.
5. Difference between explicit and implicit constraints
6. Explain why 2 queens problem is not solvable
7. What is the difference between live node and dead node.

8. Describe the Sum of Subset problem.
9. State the principle of Branch and Bound technique.
10. Define hamiltonian circuit problem
11. What is meant by graph coloring problem.
12. Difference between Backtracking & Branch and Bound

PART-B

1. Elaborate how backtracking technique can be used to solve the n-Queens problem. Explain with an example.
2. Explain in detail about Hamiltonian circuit problem with an example.
3. Explain subset sum problem and discuss the possible solution strategies using Backtracking.
4. Write an algorithm for graph coloring problem using backtracking method.
5. Explain how Job assignment problem could be solved given n tasks and n agents where each agent has a cost to complete each task using branch and bound technique.
6. Explain and detail about knapsack problem
7. Explain how to solve TSP using branch and bound method.

UNIT – V

NP COMPLETE AND APPROXIMATION ALGORITHM

Tractable and Intractable problems:

* The class of solvable problems is known as decidable problems. That means decidable problems can be solved in measurable amount of time or space.

* The tractable problems are the class of problems that can be solved within reasonable time and space.

Eg:. Sorting a list, multiplication of integers.

* The Intractable problems are the class of problems that can be solved within polynomial time.

Eg: List of all permutations of n numbers, Tower of Hanoi.

* This has lead to two classes of solving problems. P and NP class problems.

Polynomial Time Algorithms and Venn Diagram:-

* There are two groups in which a problem can be classified.

* The first group consists of the problems that can be solved in polynomial time.

Ex: Searching of an element from the list $O(\log n)$, Sorting of elements $O(\log n)$.

* The second group consists of problems that can be solved in non-deterministic polynomial time.

Ex: Knapsack problem $O(2^{n/2})$ and travelling Salesman problem $(O(n^2 2^n))$.

* Any problem for which answer is either yes or no is called decision problem.
* The algorithm for decision problem is called decision algorithm.
* Any problem that involves the identification of optimal cost is called optimization problem. The algorithm for optimization problem is called Optimization algorithm.

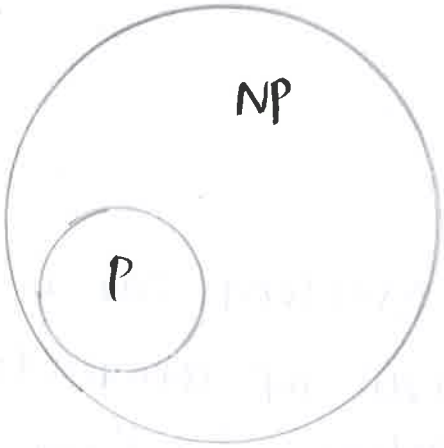
Definition of P:

* problems that can be solved in Polynomial time.
* P stands for polynomial.
* The polynomial time is nothing but the time expressed in terms of polynomial.

Definition of NP:

It stands for Non deterministic polynomial time.

The NP class problems are those problems that can be solved in non-deterministic polynomial time but can be verified in polynomial time.



P and NP class.

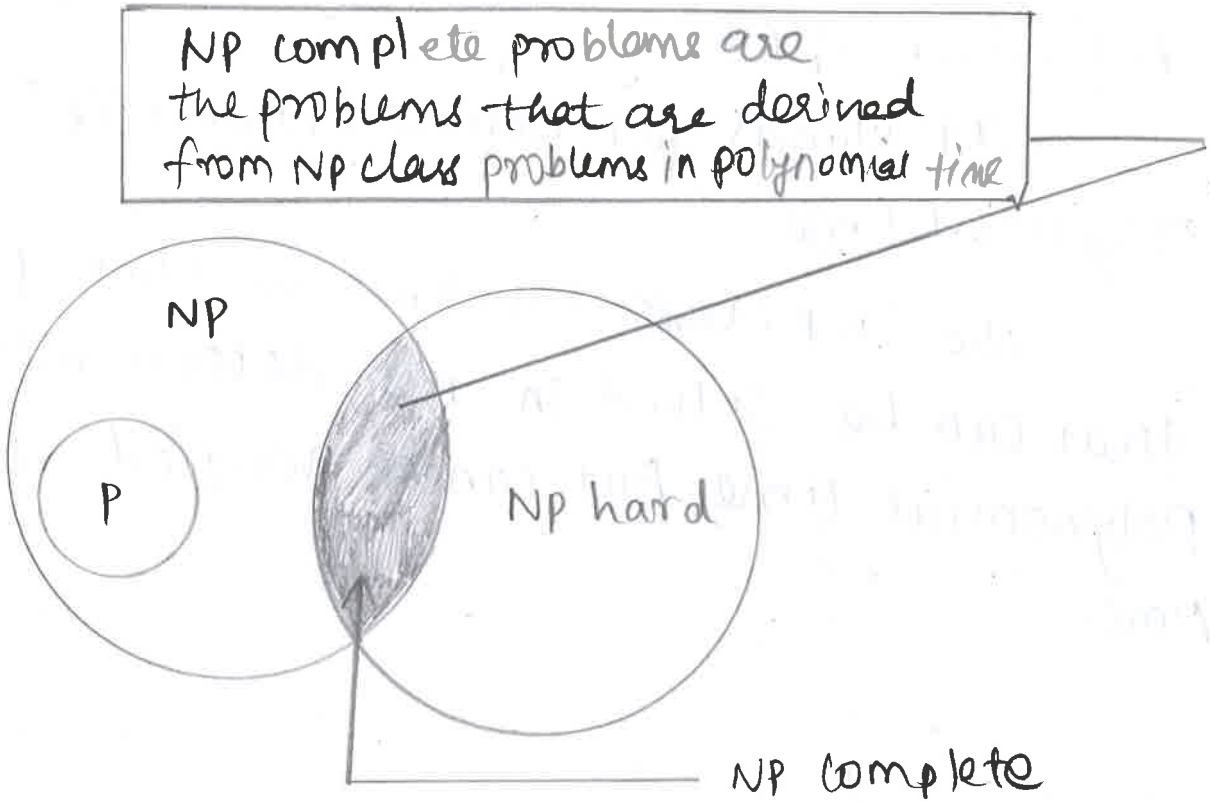
NP algorithms and NP-hardness:

The NP class problems can be further categorized into NP-complete and NP-hard problems.

A problem D is called NP-complete if

i) It belongs to class NP

ii) Every problem in NP can also be solved in polynomial time.



* If an NP-hard problem can be solved in polynomial time then all NP-complete problems can also be solved in polynomial time.

All NP-complete problems are NP-hard but all NP-hard problems cannot be NP-complete.

The NP complete problems are intersection of NP class problems and NP hard problems.

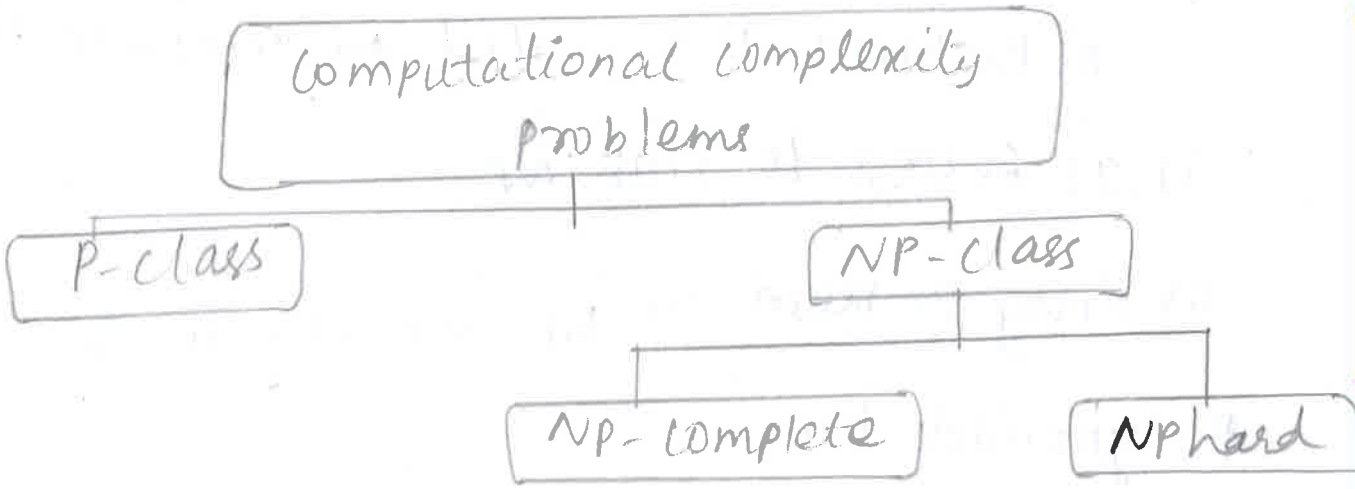


FIG: class of Computational complexity

Normally the NP complete problems are decision problems.

The NP hard problems are optimization problems.

Computational complexity:

The computational problem is an infinite collection of instances with a solution for every instance.

Computational Classes:

The complexity Classes is a set of problems of related complexity. It includes function problems, P classes, NP classes, optimization problems.

Intractability:

problems that can be solved by taking a longtime for their solutions is known as intractable problems.

If NP is not same as P then NP Complete problems are called intractable problems

The P class problems are considered as tractable problems.

Example of P class problem:

Kruskal's algorithm:

In kruskals algorithm the minimum weight is obtained. In this algorithm also the circuit should not be formed.

Each time the edge of minimum weight has to be selected from the graph.

It is not necessary in this algorithm to have edges of minimum weights to be adjacent

Example:

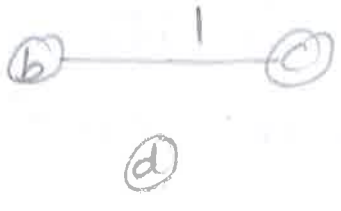
Find the minimum spanning tree for the following figure using kruskal's algorithm.

Soln:

STEP 1:

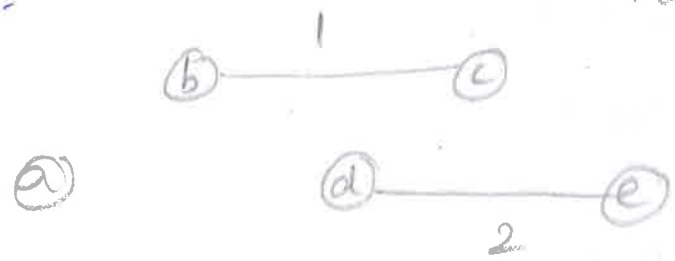
Total weight = 0

Step 2:-



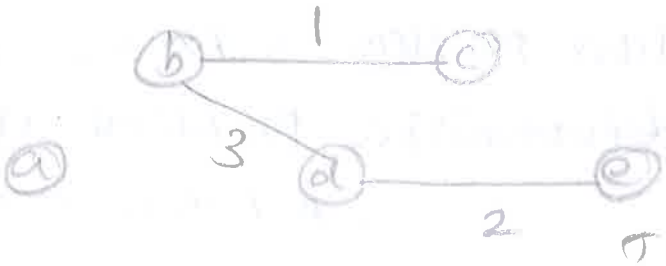
Step 3:-

Total weight = 1



Step 4:

Total weight = 3



Total weight = 6

Step 5:

Total weight = 11.

In Kruskal's algorithm, we will start with some vertex and will cover all the vertices with minimum weight. the vertices need not be adjacent.

Example of NP Class problem:

Travelling Salesman problem (TSP):-

The problem can be stated as, "given a set of cities and cost to travel between each pair of cities, determine whether there is

a path that visits every city once and returns to the first city. such that the cost travelled is less.

Difference between P and NP class problem:

P class problem	NP class problem
1. All the P class problems are basically deterministic.	1. All the NP class problems are basically non deterministic.
2. Every problem which is a P class is also in NP class.	2. Every problem which is in NP is not the P class problem.
3. P class problems can be solved efficiently.	4. NP class problems can not be solved as efficiently as P class problems.
4. Eg: Binary Search, Bubble sort	4. Eg: Knapsack, TSP problem

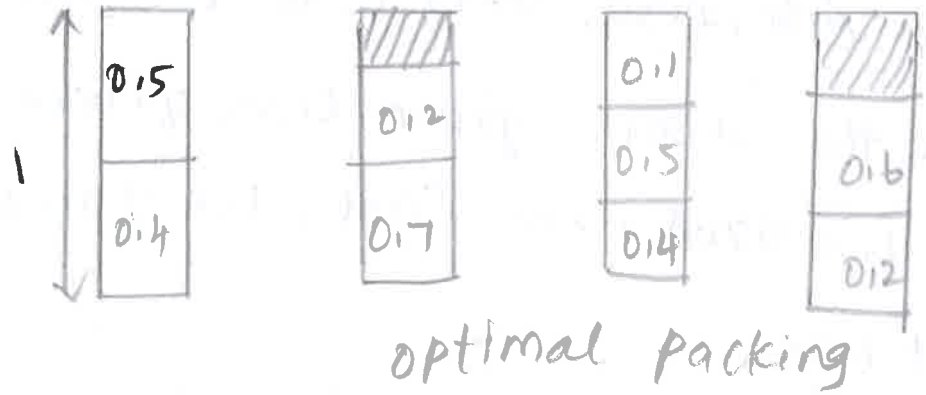
Bin packing problem:

Bin packing is a technique of assigning n items of different weights into the bins of capacity c, such that number of bins is minimized.

It may be assumed that all items have weights smaller than bin capacity.

Eg:
Consider the sizes of items to be {0.4, 0.7, 0.6, 0.2, 0.4, 0.2, 0.5, 0.1, 0.6}. For Bin packing problem, consider the size of bin as 1.

The most optimal solution will be



optimal packing

Number of bins = 4.

Lower Bound:

minimum number of bins >= ceil ((Total weight / Bin capacity))

Total weight = 0.4, 0.7, 0.6, 0.2, 0.4, 0.2, 0.5, 0.1, 0.6
= 3.7

Bin capacity = 1.

Hence,

Total weight = ceil (3.7/1)

= 4 bins.

Algorithms:

1. Next fit algorithm
2. First fit algorithm
3. Best fit algorithm.

Next fit algorithm:

It checks the current item fits in the current bin. If so then place the item in that current bin otherwise, start with new bin.

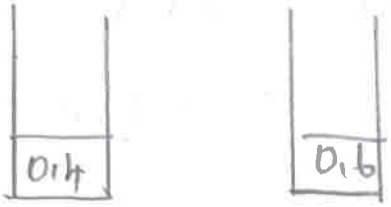
Consider the above given sizes of item,

Consider 0.4 sized item first, we can place it in first bin.

{0.4, 0.7, 0.6, 0.2, 0.4, 0.2, 0.5, 0.1, 0.6}

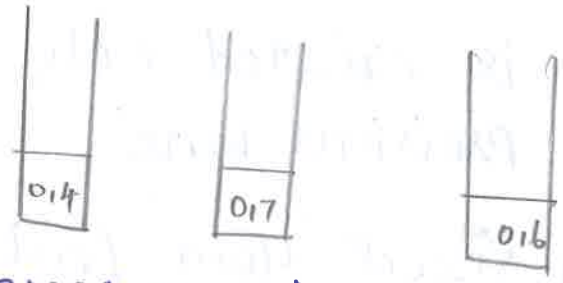
Move on to 0.7 sized item, but Item can not be fit in current bin. Hence we create a new bin.

{0.4, 0.7, 0.6, 0.2, 0.4, 0.2, 0.5, 0.1, 0.6}



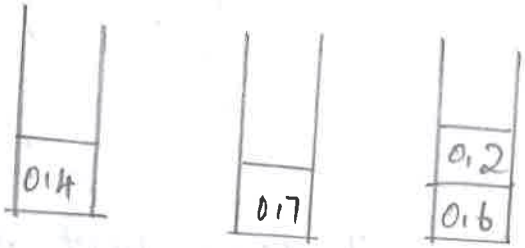
Moving on to next 0.6 sized item, again it can not fit in current bin, create one new bin.

{0.4, 0.7, 0.6, 0.2, 0.4, 0.2, 0.5, 0.1, 0.6}

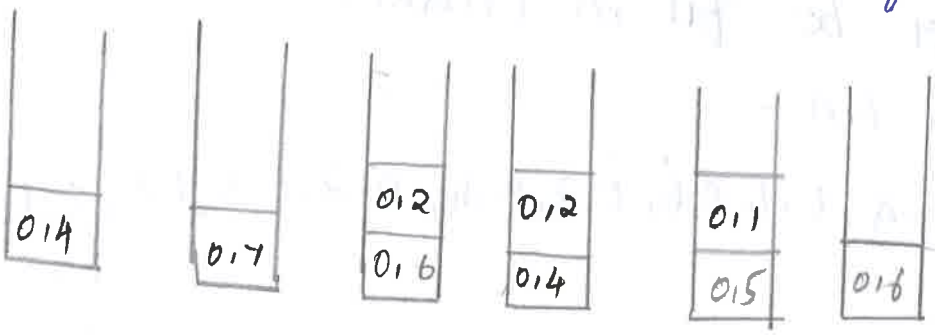


Next comes 0.2 sized item, it can be placed in the current bin.

{0.4, 0.7, 0.6, 0.2, 0.4, 0.2, 0.5, 0.1, 0.6}



Continuing in this manner, we will finally get,



Thus we require 6 bins whereas the optimal solution is of 4 bins.

Thus the Next fit algorithm is not efficient

(2) First fit algorithms:

In this algorithm, scans the bins in order and place the new item in the first bin that is large enough to hold it.

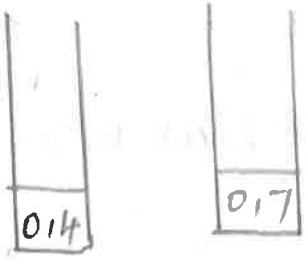
A new bin is created only when an item does not fit in previous bins.

Consider 0.4 sized item first, we can place it in first bin,

{0.4, 0.7, 0.6, 0.2, 0.4, 0.2, 0.5, 0.1, 0.6}

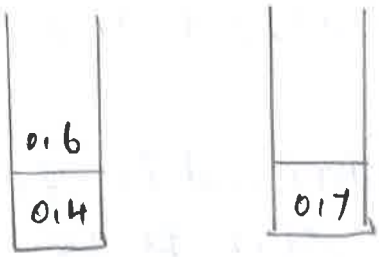
Move on to 0.7 sized item but this item can not be fit in current bin. Hence we create a new bin.

{0.4, 0.7, 0.6, 0.2, 0.4, 0.2, 0.5, 0.1, 0.6}



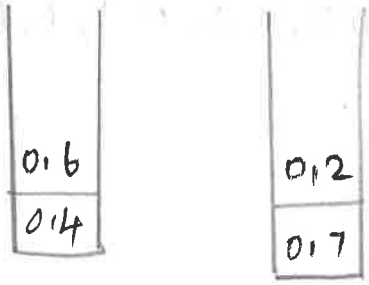
Moving on to next 0.6 sized item, it can be fitted in first bin.

{0.4, 0.7, 0.6, 0.2, 0.4, 0.2, 0.5, 0.1, 0.6}



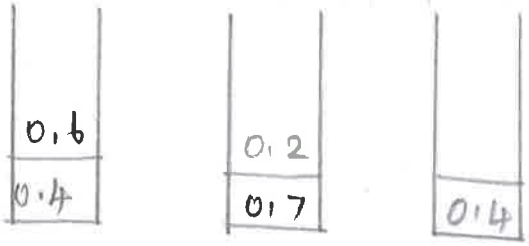
Similarly, next item is of size 0.2, it can not be fitted in first bin, but it can be placed in second bin.

{0.4, 0.7, 0.6, 0.2, 0.4, 0.2, 0.5, 0.1, 0.6}

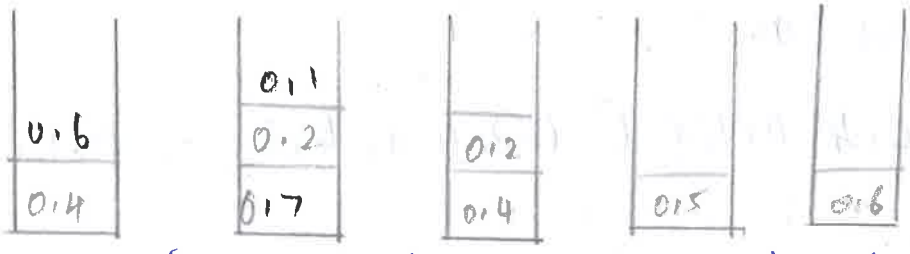


Now, next item is of size 0.4, it cannot be fitted in any of the existing bin. So we will create a new bin.

{0.2, 0.7, 0.6, 0.2, 0.4, 0.2, 0.5, 0.1, 0.6}



In this way, we can fill the items and we will require,



Thus we require 5 bins and optimal solution requires four bins. That means the first bit is

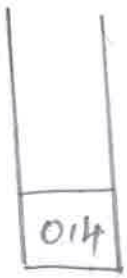
efficient than the next fit algorithm.

Best fit algorithms:-

The Bestfit is obtained by first fit by assigning the current item to be in any feasible bin having the smallest remaining empty place.

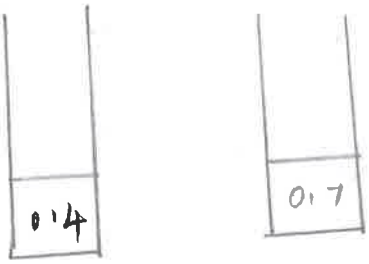
consider 0.4 sized item first, we can place it in first bin.

{0.4, 0.7, 0.6, 0.2, 0.4, 0.2, 0.5, 0.1, 0.6}



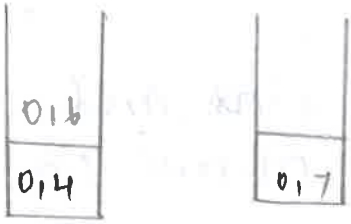
move on to the 0.7 sized item, but this item cannot be fit in current bin. Hence we create a new bin.

{0.4, 0.7, 0.6, 0.2, 0.4, 0.2, 0.5, 0.1, 0.6}



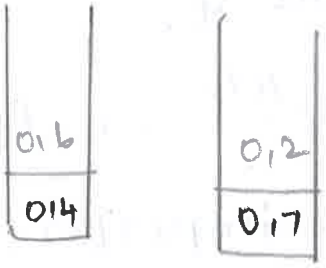
moving on to next 0.6 sized item, it can be fitted in first bin.

{0.4, 0.7, 0.6, 0.2, 0.4, 0.2, 0.5, 0.1, 0.6}



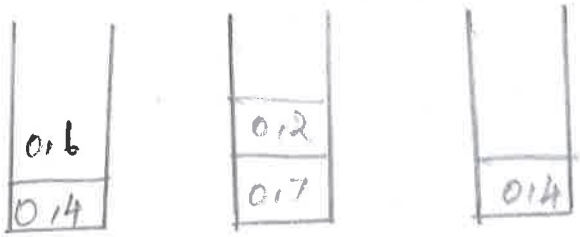
Next item of size 0.2, it can not be fitted in first bin, but it can be placed in second bin.

{0.4, 0.7, 0.6, 0.2, 0.4, 0.2, 0.5, 0.1, 0.6}

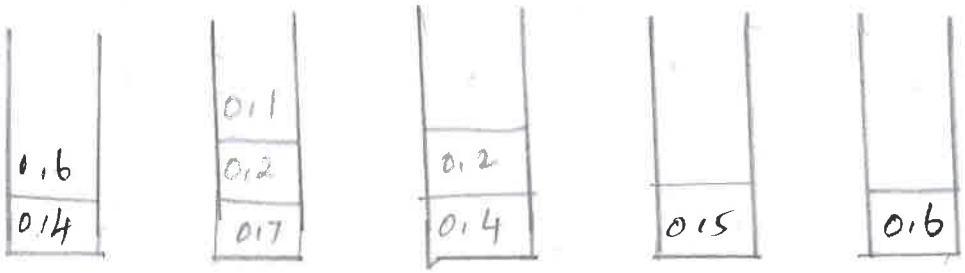


Now, next item is of size 0.4, it can not be fitted in any of the existing bin. so we will create a new bin.

{0.4, 0.7, 0.6, 0.2, 0.4, 0.2, 0.5, 0.1, 0.6}



In this way, we can fill the items and we will require,



The best fit algorithm requires 5 bins, thus best fit is also efficient than next fit algorithm

Applications of Bin packing:

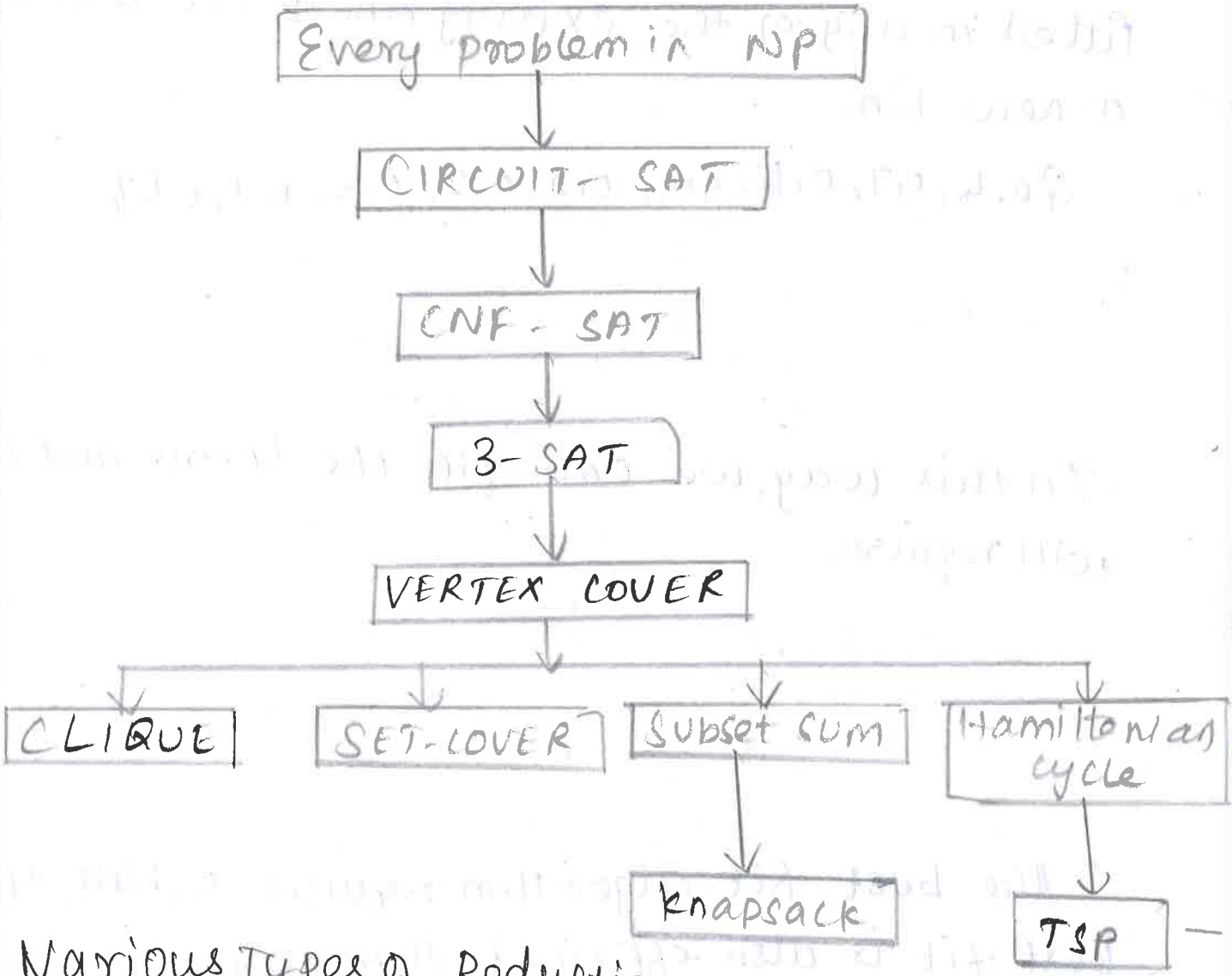
1. Loading of trucks with material
2. placing data on multiple disks
3. Job Scheduling.

Problem Reduction:

To prove whether particular problem is NP complete or not we use polynomial time reducibility. That means if,

$A \xrightarrow{Poly} B$ and $B \xrightarrow{Poly} C$ then $A \xrightarrow{Poly} C$

The reduction is an important task in NP Completeness proofs.



Various Types of Reductions:

Various types of reductions are,

1) Local replacement

2) Component design.

Local replacement:

In this reduction $A \rightarrow B$ by dividing input to A in the form of components and then these components can be converted to Components of B.

Component design:-

In this reduction $A \rightarrow B$ by building Special Component for input B that enforce properties required by A.

The 3-SAT, CNF problem:

CNF-SAT problem:

This problem is based on Boolean formula. The boolean formula has various boolean operations such as OR(+), AND(.) and NOT.

There are some notations such as $\rightarrow$(means implies) and $\leftrightarrow$(means if and only if).

A Boolean formula is in conjuctive normal form (CNF) if it is formed as collection of sub expressions. These sub expressions are stalled clauses

Eg:

$(\bar{a}+b+d+\bar{g})(c+\bar{e})(\bar{b}+d+\bar{f}+h)(a+c+e+\bar{h})$

This formula evaluates to 1 if b, c, d are 1.

Proof:

1) SAT is NP

2) Circuit SAT or (C-SAT) reduces to SAT. The reduction function f is as follows,

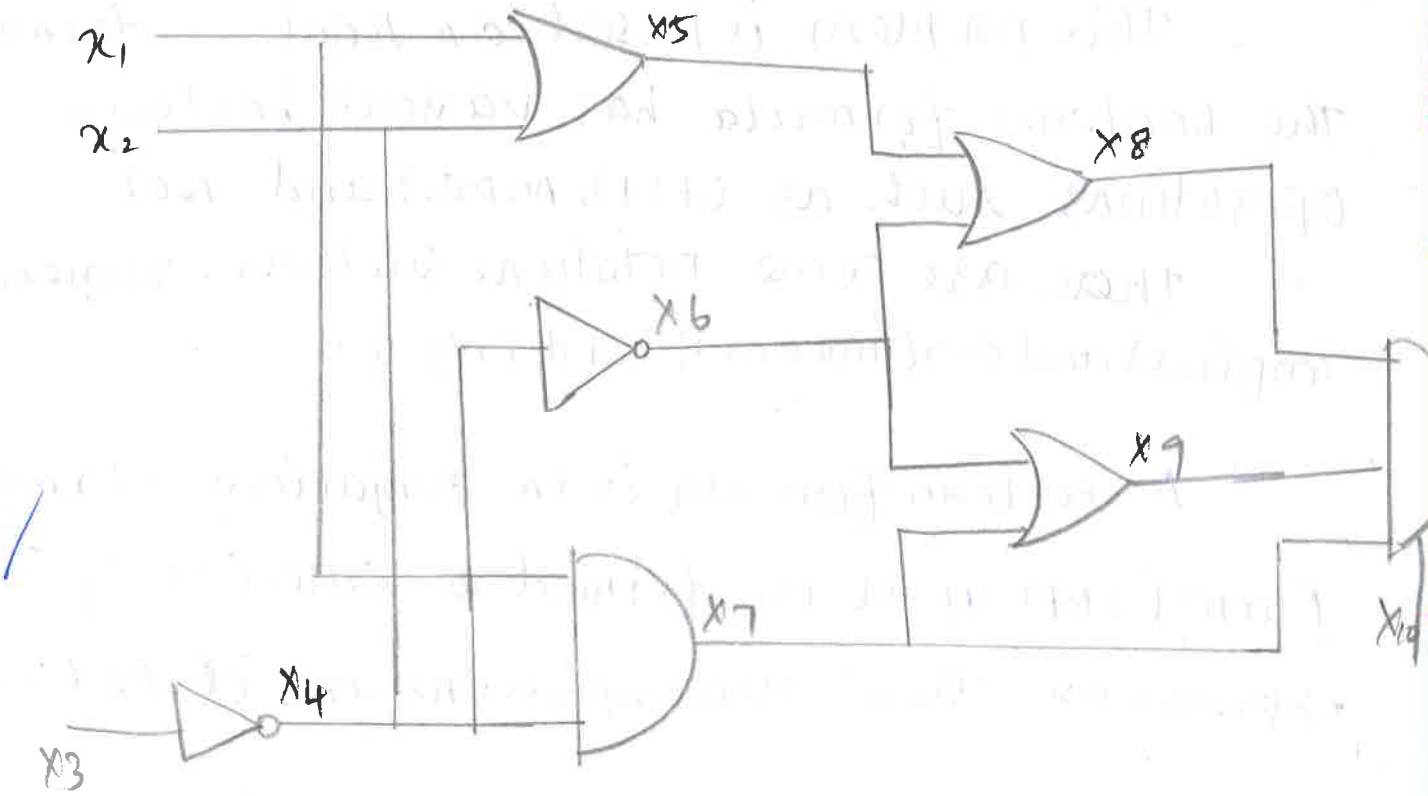
i) for every input wire add a new variable.

ii) for every output wire add a new variable.

iii) An equation is prepared for each gate.

iv) These sets of equations are separated by $\wedge$ values and adding final output variable at the end.

This transformation can be done in linear time



$x_5 = x_1 \vee x_2$

$x_4 = \neg x_3$

$x_6 = \neg x_4$

$x_7 = x_1 \wedge x_2 \wedge x_4$

$x_8 = x_5 \vee x_6$

$x_9 = x_6 \vee x_7$

$x_{10} = x_7 \wedge x_8 \wedge x_9.$

$\therefore f = x_5 \wedge x_4 \wedge x_6 \wedge x_7 \wedge x_8 \wedge x_9 \wedge x_{10}.$

This shows that we can reduce arbitrary instance of circuit-SAT problem to a specialized instance of SAT in polynomial time.

Traveling Salesman Problem (TSP):

The traveling salesman problem consists of a salesman and a set of cities. The salesman has to visit each one of the cities starting from a certain one and returning to the same city.

Proof:

1. To prove TSP is NP-complete, first we have to prove that TSP belongs to NP.
2. In TSP we find a tour and check that the tour contains each vertex once. Then the total

Cost of the edges of the tour is calculated.

* Finally we check if the cost is minimum.
* This can be completed in polynomial time. Thus TSP belongs to NP.

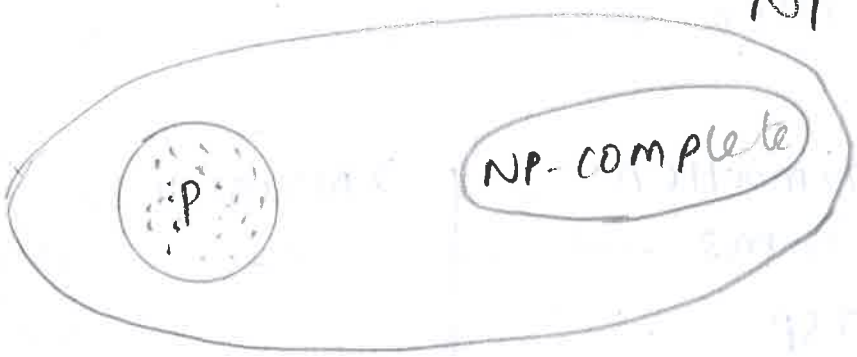
NP hard problem:

A problem A is NP-hard if there is an NP-complete problem B, such that B is reducible to A in polynomial time.

NP-hard problems are as hard as NP complete problems. NP hard problem need not be in NP-class.

A NP problem such that, if it is in P, then NP = P. If a problem has this same property then it is called NP hard.

Normally the decision problems are NP-complete, but optimization problems are NP-hard.



Approximation algorithms:

If decision version of a combinatorial optimization problem is proved to be NP complete then optimization version is NP-hard.

The approximation algorithms are algorithms used to find approximate solutions to optimization problems.

It is always necessary to know the accuracy of approximation to the actual optimal solution.

Hence accuracy ratio is defined as,

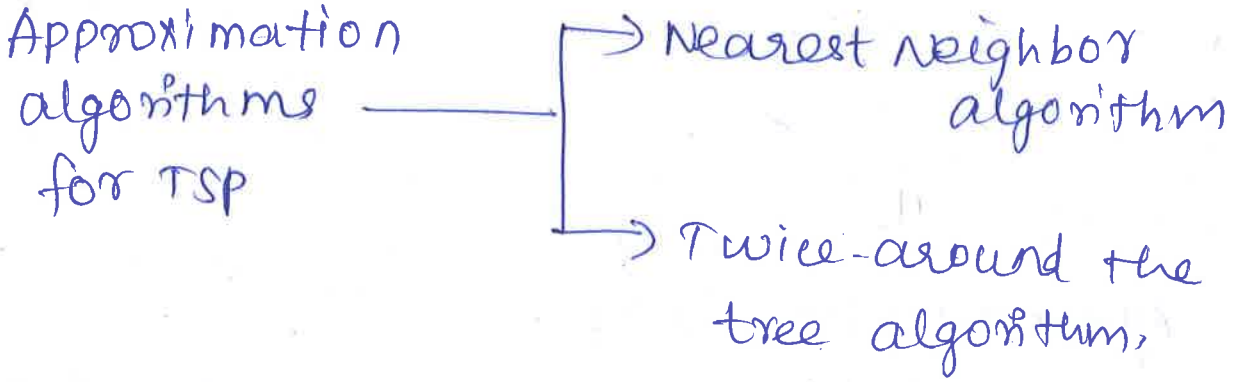
$$r(S_a) = \frac{f(S_a)}{f(S^*)}$$

$r(S_a)$ – accuracy ratio.

$f(S_a)$ – value of objective function for solution given by approximation algorithm

$f(S^*)$ – value of objective function.

Approximation algorithms for TSP:



Nearest neighbor algorithm:

This algorithm is based on the idea of Choosing nearest-neighbor while travelling from one city to another.

This nearest neighbor should be unvisited one.

algorithm:-

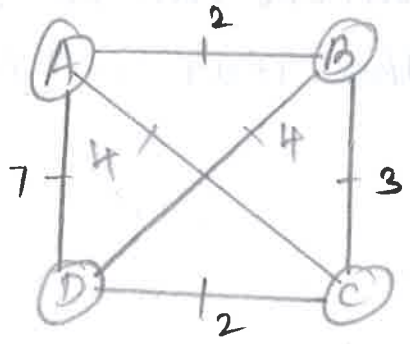
1) Start at any arbitrary city.

2) Repeat until all the nodes are visited. Go to the nearest city each time.

3) Return to the starting city.

Ex:

using nearest neighbor algorithm obtain the optimal solution for given travelling Salesman problem. Also find the accuracy ration for the same.



Soln:

We will generate all possible tours from node A.

A – B – D – C – A length = 12

A – B – C – D – A length = 14

A – C – B – D – A length = 18

A – C – D – B – A length = 18

A – B – C – B – A length = 14

A – B – D – C – A length = 18.

The optimum tour is A–B–D–C–A, with length 12 f(S*).

The nearest neighbor with this tour is A–B–C–D–A with length 14 f(Sa).

$S_a = 2 + 3 + 2 + 7$

$S_a = 14.$

Now the optimal solution can be obtained by exhaustive search. The tour will be,

A - B - D - C - A

$s^* = 2+4+2+4$

$s^* = 12$

The accuracy ratio will be $r(s_a)$ =>

$$r(s_a) = \frac{f(s_a)}{f(s^*)}$$

$$= \frac{14}{12}$$

$r(s_a) = 1.16$

Hence the tour s_a is the 16% longer than optimum tour s^*.

Twice-around-the-tree algorithm :-

This algorithm is based on important Subset instance called Euclidean by which accuracy for the nearest neighbor algorithm can be obtained,

1. Triangle inequality:

$$dist[i,j] \leq dist[i,k] + dist[k,j].$$

Where i, j and k denotes cities.

Symmetry:

dist [i, j] = dist [j, i]

The distance from city i to j should be Same as distance between j to i.

$$r(Sa) = \frac{f(sa)}{f(s^*)} \leq \frac{1}{2}\left[\lceil \log_2 n \rceil + 1\right).$$

where n is total number of cities.

Randomized algorithms

Concept and Application:

In probability theory various "experiments" are carried out. The outcomes or results of those experiments determine the specific characteristics

Ex:

picking up a card from a deck of 52 cards, tossing coin for five times choosing a red ball from an red and white balls rolling die four times.

Each possible result of such experiment is called sample point. The set of all sample points is called Sample space.

The Sample space is denoted by S. The Sample Space S is finite set. Event E occurs from Sample space. For m Sample points there are 2^m possible events.

Probability:

The probability of event E is the ratio of E to S. Hence,

$$\text{Probability} = \frac{|E|}{|S|}.$$

Eg:

When a coin is tossed, then we may get either Head (H) or Tail (T).

We have tossed four coins together then there are 16 possible outcomes.

HHHH, HHHT, HHTH, HHTT, HTHH, HTHT, HTTT, THHH, THHT, THTH, THTT, TTHH, TTHT, TTTH, TTTT.

For 4 events {HHTH, THTT, TTHH, TTTT} The probability is $\frac{4}{16} = \frac{1}{4}$.

Primality Testing:

Deciding whether the given number n is prime or not is a problem of primality testing

The application of primality testing is Cryptology.

Any integer greater than one is said to be prime if it is divisible by 1 or by that number itself. We consider 1 as non-prime number but 2, 3, 5, 7, 11 and 13 are some prime numbers.

To check whether given number n is prime or not we must check every m elements from interval 2 to $\lfloor \sqrt{n} \rfloor$ whether m divides n.

If there is no such element which divides n then n is prime.

Algorithm:

```
algorithm prime_number(num)
{
//problem Description: If num is prime then it returns
 true Otherwise false.
j←num - 1
for (j←1 to n) do  // n indicates some range.
{
 temp←j
 y←1
 a←random() mod j+1
 temp1←a
 while (temp >0) do
 {
 while (temp mod 2==0)
 {
 temp1←temp1^2 mod num
 temp←(temp/2)
 }
 temp←temp-1.
```

```
y ← (y * temp1) mod num
}
if (y != 1) then
return 0
}
return 1
}.
```

Randomized Quicksort:

The Quicksort depends upon how we select our partition or pivot element.

If an input array is already sorted and if we select the first or a last element as a pivot for applying the quicksort method then it results in worst case.

We can have following choices of pivot,

* use the middle element of the subarray as pivot.
* use a random element of the array as the pivot.
* Take the median of three elements. (first, last or middle) as a pivot.

The quicksort works better in average case but its performance is very poor in worst case.

Algorithm;

algorithm quicksort-R(low, high)

{

//problem Description: The algorithm chooses the pivot element randomly and performs the quicksort.

//Input: The low points to the first element of unsorted array and high points to the last element of unsorted array.

//Output: Array will be sorted in ascending order.

```
if (low<high) then
{
 if((high - low) >5) then
 Swap (a, (random () mod (high-low+1)+low),
                                    low);

  partition (a, low, high+1);
  quicksort_R (low, k-1);
  quicksort - R (k+1, high);
  }
 }.
```

The time Complexity of randomized quick sort is O(n log n).

Finding k^{th} Smallest number:-

An array of elements and value of k is given, where k is the smaller than size of array. all the elements of array are distinct.

Step 1:

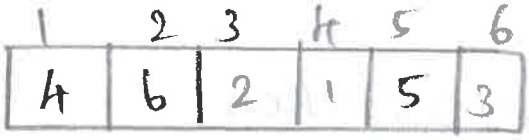
Sort the input array in ascending order.

Step 2:

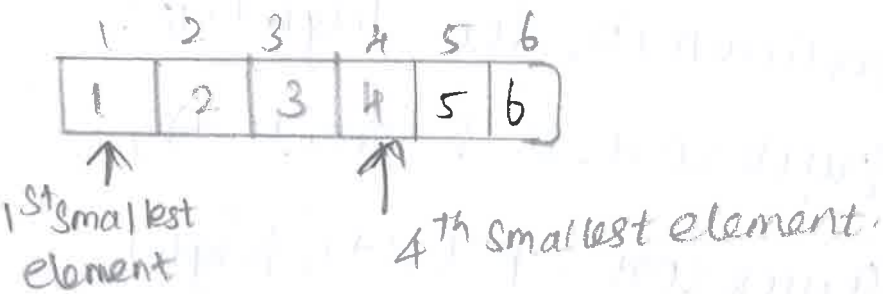
Return the $(k-1)^{th}$ index in the sorted array.

Ex:

Let the input array is,



If k=4 that means we have to find k^{th} Smallest element.



Randomized algorithm:

In this algorithm we apply the quick Sort method, but we do not apply the quick Sort method completely, but stop the algorithm at the point when pivot itself is k^{th} Smallest elemen

The steps for the algorithm are as follows,

Step 1: Apply quicksort algorithm on the input array.

Step 2: During quicksort, select a pivot element randomly from the range of the array from low to high and move to its correct position.

Step 3: If index of pivot is equal to k then return the value.

Step 4: Else if the index of pivot is greater than k, scan for the left subarray recursively, else scan right subarray.

Step 5: Repeat this process until the element at index k is not found.

Advantages:

1. These algorithms are simple to implement.
2. These algorithms are many times efficient than traditional algorithms.

Disadvantages:

1. The small degree of error may be dangerous for some applications.
2. It is not always possible to obtain better results using randomized algorithms.

Important Questions

PART-A

1. Define NP hard and NP completeness.
2. List the two properties that must be satisfied by a problem L to be NP-complete.
3. What is Nondeterministic polynomial time?
4. Difference between NP complete and NP hard?
5. What is the time complexity of all the deterministic search algorithm?
6. Define P and NP problems.
7. What are tractable and intractable problems.
8. Difference between P class and NP class problems.
9. Define Bin packing problem.
10. What are the algorithms specified by the Bin packing algorithm.
11. What are the applications of Bin Packing.
12. What are the types of reductions.
13. What is meant by Primality testing.
14. What is meant by quicksort.
15. What are the different approximation algorithms for Traveling Salesman problem.

PART-B

1. Implement an algorithm for Knapsack problem using NP-hard approach.
2. What is class NP? Discuss about any five problems for which nonPolynomial time for TSP problem.
3. Discuss the approximation algorithm for NP hard problem?
4. Explain in detail about Bin packing problem.
5. Write an algorithm to solve the k^{th} Smallest number.

References.

1) www.w3schools.com | Algorithms_cs3401.
2) www.geeksforgeeks.org | Algorithms
3) Anany Levitin "Introduction to the design and analysis of Algorithms" 3rd edition, Pearson education, 2012.
4) S. Sridhar, "Design and Analysis of Algorithms", Oxford University Press, 2014.

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II CSE/IV SEM

CS3401/ALGORITHMS

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COURSE OBJECTIVES:

- To understand and apply the algorithm analysis techniques on searching and sorting algorithms
- To critically analyze the efficiency of graph algorithms
- To understand different algorithm design techniques
- To solve programming problems using state space tree
- To understand the concepts behind NP Completeness, Approximation algorithms and randomized algorithms.

UNIT I INTRODUCTION **9**

Algorithm analysis: Time and space complexity - Asymptotic Notations and its properties Best case,Worst case and average case analysis – Recurrence relation: substitution method - Lower bounds –searching: linear search, binary search and Interpolation Search, Pattern search: The naïve stringmatching algorithm - Rabin-Karp algorithm - Knuth-Morris-Pratt algorithm. Sorting: Insertion sort –heap sort

UNIT II GRAPH ALGORITHMS **9**

Graph algorithms: Representations of graphs - Graph traversal: DFS – BFS - applications - Connectivity,strong connectivity, bi-connectivity - Minimum spanning tree: Kruskal's and Prim's algorithm- Shortestpath: Bellman-Ford algorithm - Dijkstra's algorithm - Floyd-Warshall

algorithm Network flow: Flow networks - Ford-Fulkerson method – Matching: Maximum bipartite matching

UNIT III ALGORITHM DESIGN TECHNIQUES **9**

Divide and Conquer methodology: Finding maximum and minimum - Merge sort - Quick sort Dynamic programming: Elements of dynamic programming — Matrix-chain multiplication - Multi stage graph — Optimal Binary Search Trees. Greedy Technique: Elements of the greedy strategy - Activity-selection problem –- Optimal Merge pattern — Huffman Trees.

UNIT IV STATE SPACE SEARCH ALGORITHMS **9**

Backtracking: n-Queens problem - Hamiltonian Circuit Problem - Subset Sum Problem – Graph colouring problem Branch and Bound: Solving 15-Puzzle problem - Assignment problem – Knapsack Problem - Travelling Salesman Problem

UNIT V NP-COMPLETE AND APPROXIMATION ALGORITHM **9**

Tractable and intractable problems: Polynomial time algorithms – Venn diagram representation - NPalgorithms - NP-hardness and NP-completeness – Bin Packing problem - Problem reduction: TSP – 3-CNF problem. Approximation Algorithms: TSP - Randomized Algorithms: concept and application - primality testing - randomized quick sort - Finding kth smallest number.

45 PERIODS

TEXT BOOKS:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", 3rd Edition, Prentice Hall of India, 2009.

2. Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran "Computer Algorithms/C++" Orient Blackswan, 2nd Edition, 2019.

REFERENCES:

1. Anany Levitin, "Introduction to the Design and Analysis of Algorithms", 3rd Edition, Pearson Education, 2012.

2. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, "Data Structures and Algorithms", Reprint Edition, Pearson Education, 2006.

3. S. Sridhar, "Design and Analysis of Algorithms", Oxford university press, 2014.

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

LESSON PLAN

FACULTY NAME	:	**P.SASIREKA**
DESIGNATION	:	**AP/ CSE**
SUBJECT CODE / TITLE	:	**CS 3401 / ALGORITHMS**
BRANCH/SEMEMSTER	:	**CSE / IV**
YEAR	:	**II**

OBJECTIVES:

- To understand and apply the algorithm analysis techniques on searching and sorting algorithms
- To critically analyze the efficiency of graph algorithms
- To understand different algorithm design techniques
- To solve programming problems using state space tree

HOURS	TOPICS TO BE COVERED	DATE	PERIOD	TEACHING METHODOLOGY	TEACHING AID	REMARKS
UNIT I - INTRODUCTION						
1	**Algorithm analysis**: Time and space complexity	15-3-24	2	LECTURE	BOARD & CHALK	
2	Asymptotic Notations and its properties, Best case, Worst case and average case analysis	15-3-24	5	LECTURE	BOARD & CHALK	
3	Recurrence relation:	18-3-24	7	LECTURE	BOARD & CHALK	

	substitution method- Lower bounds , linear search	18-3-24	7	LECTURE	BOARD & CHALK	
4	Binary search and Interpolation Search	19-3-24	2	LECTURE	BOARD & CHALK	
5	**Pattern search:** The naïve string- matching algorithm	22-3-24	2	LECTURE	BOARD & CHALK	
6	Rabin-Karp algorithm	22-3-24	5	LECTURE	BOARD & CHALK	
7	Knuth-Morris-Pratt algorithm	23-3-24	7	LECTURE	BOARD & CHALK	
8	**Sorting:** Insertion sort ,	25-3-24	7	LECTURE	BOARD & CHALK	
9	Heap sort	1-4-24	7	LECTURE	BOARD & CHALK	
UNIT II GRAPH ALGORITHMS						
1	Graph algorithms: Representations of graphs,	2-4-24	2	LECTURE	BOARD & CHALK	
2	Graph traversal: DFS, BFS , applications	5-4-24	2	LECTURE	BOARD & CHALK	
3	Connectivity, strong connectivity,bi connectivity	5-4-24	5	LECTURE	BOARD & CHALK	
4	Minimum spanning tree: Kruskal's and Prim's algorithm	6-4-24	7	LECTURE	BOARD & CHALK	
5	Shortest path: Bellman-Ford algorithm	8-4-24	7	LECTURE	BOARD & CHALK	
6	Dijkstra's algorithm	12-4-24	2	LECTURE	BOARD & CHALK	
7	Floyd-Warshall algorithm	12-4-24	5	LECTURE	BOARD & CHALK	
8	Network flow: Flow networks , Ford-Fulkerson method	13-4-24	7	LECTURE	BOARD & CHALK	
9	Matching:Maximum bipartite matching	15-4-24	7	LECTURE	BOARD & CHALK	
UNIT III ALGORITHM DESIGN TECHNIQUES						

1	**Divide and Conquer methodology**: Finding maximum and minimum	16-4-24	2	LECTURE	BOARD & CHALK	
2	Merge sort , Quick sort	22-4-24	7	LECTURE	BOARD & CHALK	
3	**Dynamic programming:** Elements of dynamic programming	23-4-24	2	LECTURE	BOARD & CHALK	
4	Matrix-chain multiplication	29-4-24	7	LECTURE	BOARD & CHALK	
5	Multi stage graph	30-4-24	2	LECTURE	BOARD & CHALK	
6	Optimal Binary Search Trees	3-5-24	2	LECTURE	BOARD & CHALK	
7	**Greedy Technique**: Elements of the greedy strategy	3-5-24	5	LECTURE	BOARD & CHALK	
8	Activity selection problem	6-5-24	7	LECTURE	BOARD & CHALK	
9	Optimal Merge pattern,Huffman Trees	7-5-24	2	LECTURE	BOARD & CHALK	
UNIT IV STATE SPACE SEARCH ALGORITHMS						
1	**Backtracking**: n-Queens problem	10-5-24	2	LECTURE	BOARD & CHALK	
2	Hamiltonian Circuit Problem	10-5-24	5	LECTURE	BOARD & CHALK	
3	Subset Sum Problem	11-5-24	7	LECTURE	BOARD & CHALK	
4	Graph colouring problem	13-5-24	7	LECTURE	BOARD & CHALK	
5	Branch and Bound	14-5-24	2	LECTURE	BOARD & CHALK	
6	Solving 15-Puzzle problem	17-5-24 17-5-24	2 5	LECTURE	BOARD & CHALK	
7	Assignment problem	20-5-24	7	LECTURE	BOARD & CHALK	
8	Knapsack Problem	21-5-24	2	LECTURE	BOARD & CHALK	

9	Travelling Salesman Problem	24-5-24 24-5-24	2 5	LECTURE	BOARD & CHALK	
UNIT V - NP-COMPLETE AND APPROXIMATION ALGORITHM						
1	Tractable and intractable problems: Polynomial time algorithms	25-4-24	7	LECTURE	BOARD & CHALK	
2	Venn diagram representation ,NP-algorithms	27-4-24	7	LECTURE	BOARD & CHALK	
3	NP-hardness and NP-completeness	28-4-24	2	LECTURE	BOARD & CHALK	
4	Bin Packing problem	31-4-24	2	LECTURE	BOARD & CHALK	
5	Problem reduction:TSP , 3- CNF problem.	31-4-24	2	LECTURE	BOARD & CHALK	
6	**Approximation Algorithms**: TSP	3-6-24	7	LECTURE	BOARD & CHALK	
7	**Randomized Algorithms**: concept and application, primality testing	3-6-24	2	LECTURE	BOARD & CHALK	
8	Randomized quick sort	4-6-24	7	LECTURE	BOARD & CHALK	
9	Finding k^{th} smallest number	4-6-24	2	LECTURE	BOARD & CHALK	

TEXT BOOK

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", 3rd Edition, Prentice Hall of India, 2009.
2. Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran "Computer Algorithms/C++" Orient Blackswan, 2nd Edition, 2019.

REFERENCES

1. Anany Levitin, "Introduction to the Design and Analysis of Algorithms", 3rd Edition, PearsonEducation, 2012.
2. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, "Data Structures and Algorithms", Reprint Edition, Pearson Education, 2006.
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SECOND	16-08-2023 – 14-09-2023	21-09-2023 (Thursday) 22-09-2023 (Friday) 23-09-2023 (Saturday)	26-09-2023
THIRD	15-09-2023 – 16-10-2023	12-10-2023 (Thursday) 13-10-2023 (Friday) 14-10-2023 (Saturday)	19-10-2023
FOUR	17-10-2023 – 17-11-2023	09-11-2023 (Thursday) 10-11-2023 (Friday) 11-11-2023 (Saturday)	18-11-2023

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SECOND	18-10-2023 to 16-12-2023	31-11-2023 (Thursday) 01-12-2023 (Friday) 02-12-2023 (Saturday)	07-12-2023

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SECOND	22-09-2023 to 17-11-2023	09-11-2023 (Thursday) 10-11-2023 (Friday) 11-11-2023 (Saturday)	18-11-2023

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SECOND	08-11-2023 to 30-12-2023	28-12-2023 (Thursday) 29-12-2023 (Friday) 30-12-2023 (Saturday)	04-01-2024

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SECOND	14-11-2023 to 04-01-2024	28-12-2023 (Thursday) 29-12-2023 (Friday) 30-12-2023 (Saturday)	04-01-2024

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SECOND	18-11-2023 to 04-01-2024	28-12-2023 (Thursday) 29-12-2023 (Friday) 30-12-2023 (Saturday)	04-01-2024

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All the UG Degree **(B.E/B.TECH) THIRD YEAR (VI - SEMESTER)** students are informed that **First and Second Internal Assessment Scheduled are,**

Report No	Report Period	Internal Assessment Date	Report Entry last date
FIRST	01-02-2024 – 13-03-2024	07-03-2024(Thursday) 08-03-2024 (Friday) 09-03-2024 (Saturday)	19-03-2024
SECOND	14-03-2024 – 03-05-2024	25-04-2024 (Thursday) 26-04-2024 (Friday) 27-04-2024 (Saturday)	03-05-2024

All the subject handlers are informed that should **produce Two Set of Question papers** (Maximum marks 50) in Examcell within two days before the exam date.

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JKKMCT/CIRCULAR/0174/FEB-24

DATE: 10/02/2024

CIRCULAR

All the UG Degree **(B.E/B.TECH) Final YEAR (VIII - SEMESTER)** students are informed that **First, Second & Third Internal Assessment Scheduled are,**

Report No	Report Period	Internal Assessment Date	Report Entry last date
First	01-02-2024 – 19-02-2024	---	22-02-2024
Second	20-02-2024 – 13-03-2024	07-03-2024(Thursday) 08-03-2024 (Friday) 09-03-2024 (Saturday)	19-03-2024
Third	14-03-2024 – 06-04-2024	04-04-2024(Thursday) 05-04-2024 (Friday) 06-04-2024 (Saturday)	11-04-2024
Fourth	08-04-2024 – 03-05-2024	25-04-2024(Thursday) 26-04-2024 (Friday) 27-04-2024 (Saturday)	03-05-2024

All the subject handlers are informed that should **produce Two Set of Question papers** (Maximum marks 50) in Examcell within two days before the exam date.

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JKKMCT/CIRCULAR/0191/MAR-24 **DATE: 30/03/2024**

CIRCULAR

All the UG / PG Degree **(B.E/B.TECH/M.E/MBA/MCA)** First year & Second Year **(II & IV- SEMESTER)** students are informed that First, Second Assessment Scheduled are,

Report No	Report Period	Internal Assessment Date	Report Entry last date
First	13-03-2024 to 29-04-2024	**25-04-2024(Thursday)** **26-04-2024 (Friday)** **27-04-2024 (Saturday)**	**02-05-2024 (Thursday)**
Second	30-04-2024 to 13-06-2024	**06-06-2024(Thursday)** **07-06-2024 (Friday)** **08-06-2024 (Saturday)**	**13-06-2024 (Thursday)**

All the subject handlers are informed that should **produce Two Set of Question papers** (Maximum marks 50) in **EXAMCELL** within two days before the exam date.

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JKKMCT/CIRCULAR/0205/MAY-24 **DATE: 10/05/2024**

CIRCULAR

All the UG & PG students are informed that Anna University **APRIL / MAY 2024** Theory Examination **Commencement on 15-05-2024 is POSTPONED and Rescheduled date to commencement from 06-06-2024** due to Vote Counting Centre for general election and some of security reason highly restricted in the vote counting zone & Revised time table will be intimate later.

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JKKMCT/CIRCULAR/0107/SEP-23 **DATE: 12/09/2023**

CIRCULAR

All the UG Degree (B.E/B.Tech) **FINAL YEAR** students are informed that

First, Second & Third Internal ASSESSMENT SCHEDULED are,

Report No	Report Period	Internal Assessment Date	Report Entry last date
FIRST	27-07-2023 – 14-08-2023	--	26-09-2023
SECOND	16-08-2023 – 14-09-2023	21-09-2023 (Thursday) 22-09-2023 (Friday) 23-09-2023 (Saturday)	26-09-2023
THIRD	15-09-2023 – 16-10-2023	12-10-2023 (Thursday) 13-10-2023 (Friday) 14-10-2023 (Saturday)	19-10-2023
FOUR	17-10-2023 – 17-11-2023	09-11-2023 (Thursday) 10-11-2023 (Friday) 11-11-2023 (Saturday)	18-11-2023

All the subject handlers are informed that should **produce Two Set of Question papers** (Maximum marks 50) in Examcell within two days before the exam date.

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JKKMCT/CIRCULAR/0108/SEP-23 **DATE: 12/09/2023**

CIRCULAR

All the **PG Degree MCA SECOND YEAR (III SEMESTER)** students are informed that **First and Second Internal ASSESSMENT SCHEDULED are**

Report No	Report Period	Internal Assessment Date	Report Entry last date
FIRST	25-08-2023 to 17-10-2023	12-10-2023 (Thursday) 13-10-2023 (Friday) 14-10-2023 (Saturday)	20-10-2023
SECOND	18-10-2023 to 16-12-2023	31-11-2023 (Thursday) 01-12-2023 (Friday) 02-12-2023 (Saturday)	07-12-2023

All the subject handlers are informed that should **produce Two Set of Question papers** (Maximum marks 50) in Examcell within two days before the exam date.

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JKKMCT/CIRCULAR/0144/NOV-23 **DATE: 28/11/2023**

CIRCULAR

All the PG Degree (M.E, MBA) FIRST YEAR (I SEMESTER) students are informed that **First and Second Internal Assessment Scheduled are,**

Report No	Report Period	Internal Assessment Date	Report Entry last date
FIRST	11-09-2023 to 07-11-2023	16-11-2023 (Thursday) 17-11-2023 (Friday) 18-11-2023 (Saturday)	29-11-2023
SECOND	08-11-2023 to 30-12-2023	28-12-2023 (Thursday) 29-12-2023 (Friday) 30-12-2023 (Saturday)	04-01-2024

All the subject handlers are informed that should **produce Two Set of Question papers** (Maximum marks 50) in Examcell within two days before the exam date.

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JKKMCT/CIRCULAR/0145/NOV-23 **DATE: 28/11/2023**

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All the PG Degree – MCA FIRST YEAR (I SEMESTER) students are informed that **First and Second Internal Assessment Scheduled are,**

Report No	Report Period	Internal Assessment Date	Report Entry last date
FIRST	29-09-2023 to 17-11-2023	16-11-2023 (Thursday) 17-11-2023 (Friday) 18-11-2023 (Saturday)	29-11-2023
SECOND	18-11-2023 to 04-01-2024	28-12-2023 (Thursday) 29-12-2023 (Friday) 30-12-2023 (Saturday)	04-01-2024

All the subject handlers are informed that should **produce Two Set of Question papers** (Maximum marks 50) in Examcell within two days before the exam date.

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J K K MUNIRAJAH COLLEGE OF TECHNOLOGY

DEPARTMENT OF M.E CSE

INTERNAL ASSESSMENT-I SCHEDULE - NOVEMBER-2023

I YEAR M.E CSE

EXAM TIMING – FN: 09.30 AM TO 12.30 AM

S.NO	DATE	DAY	I YEAR M.E CSE	SIGNATURE
			FN	
1	15.11.2023	WEDNESDAY	MA4151 AP&SFCE	
2	16.11.2023	THURSDAY	RM4151 RM&IPR	
3	17.11.2023	FRIDAY	CP4151 ADSA	
4	18.11.2023	SATURDAY	CP4152 DP	
5	20.11.2023	MONDAY	CP4153 NT	
6	21.11.2023	TUESDAY	CP4154 POPL	

HOD

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DEPARTMENT OF M.E CSE

INTERNAL ASSESSMENT -I- NOVEMBER 2023

DUTY CHART FOR STAFF MEMBERS

HALL NO: CC3

S.NO	STAFF NAME	15.11.2023	16.11.2023	17.11.2023	18.11.2023	20.11.2023	21.11.2023
		FN	FN	FN	FN	FN	FN
1	S.SAMYUKTHA						
2	M.C.SAVITHRI						
3	P.POORNAPRIYA						
4	R.GNANASEKAR						
5	V.NIROSHA						
6	R.PRASANTH						

NOTE:

1 Staff going for exam duty must present at 9.15 AM for FN

2 Students should not be allowed to leave the hall before 12.30 AM

3 Students should not be allowed to write exam with out ID card.

4 Students are not permitted to get anything from anybody inside exam hall.

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DEPARTMENT OF M.E CSE

INTERNAL ASSESSMENT -I -NOVEMBER-2023

STUDENTS SEATING ARRANGEMENT / **HALL: CC3 LAB**		
SEATING POSITION	**ROLL NO**	**M.E CSE/I YEAR/I SEM**
TABLE 1	1	ADHISESHAN N
TABLE 2	2	MATHIYAZHAGAN M
TABLE 3	3	POORNIMA K
TABLE 4	4	PRIYADHARSHINI T
TABLE 5	5	SATHIYAPRIYA K
TABLE 6	6	SNEHALAL T V

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JKKMCT/CIRCULAR/0191/MAR-24 **DATE: 30/03/2024**

CIRCULAR

All the UG / PG Degree **(B.E/B.TECH/M.E/MBA/MCA)** First year & Second Year **(II & IV- SEMESTER)** students are informed that First, Second Assessment Scheduled are,

Report No	Report Period	Internal Assessment Date	Report Entry last date
First	13-03-2024 to 29-04-2024	**25-04-2024(Thursday)** **26-04-2024 (Friday)** **27-04-2024 (Saturday)**	**02-05-2024 (Thursday)**
Second	30-04-2024 to 13-06-2024	**06-06-2024(Thursday)** **07-06-2024 (Friday)** **08-06-2024 (Saturday)**	**13-06-2024 (Thursday)**

All the subject handlers are informed that should **produce Two Set of Question papers** (Maximum marks 50) in **EXAMCELL** within two days before the exam date.

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DEPARTMENT OF CSE

INTERNAL ASSESSMENT-I SCHEDULE - APRIL-2024 II-YEAR CSE

II YEAR CSE

EXAM TIMING – FN: 10.00 AM TO 11.30 AM **AN: 2.30 PM TO 4.00 PM**

S.NO	DATE	DAY	II YEAR CSE	
			FN	AN
1	25.04.2024	THURSDAY	CS3452 TOC	CS3491 AIML
2	26.04.2024	FRIDAY	CS3492 DBMS	CS3401 ALGORITHMS
3	27.04.2024	SATURDAY	CS3451 IOS	GE3451 EVS
STAFF SIGNATURE				
TUTOR				

HOD

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DEPARTMENT OF CSE

INTERNAL ASSESSMENT -I, II & III- APR-2024

DUTY CHART FOR STAFF MEMBERS

HALL NO:CC3,CC2 & 303

YEAR/CLASS **II CSE , III CSE & IV CSE**

S.NO	STAFF NAME	25.04.2024		26.04.2024		27.04.2024		SIGNATURE
		FN	AN	FN	AN	FN	AN	
1	Mrs.M.C.SAVITHRI	*			*			
2	Mrs.P.SASIREKA		*			*		
3	Mr.E.ANANTH			*				
4	Mr.S.DHARANITHARAN	*						
5	Mr.P.SANGEETHKUMAR				*			
6	Mrs.K.SUDARVIZHI		*				*	
7	Mrs.V.NIROSHA			*				
8	Mrs.P.POORNAPRIYA					*	*	
9	Mr.K.S.VINOTHAN		*					
10	Mrs.L.DHARANI	*				*		
11	Mrs.S.GOMATHI			*				
12	Mr.PONNUSAMY				*			

NOTE:

1 Staff going for exam duty must present at 9.45 AM for FN & 2.15 for AN.

2 Students should not be allowed to leave the hall before 11.30 AM for FN & 4.00 PM for AN.

3 Students should not be allowed to write exam with out ID card.

4 Students are not permitted to get anything from anybody inside exam hall.

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DEPARTMENT OF CSE

INTERNAL ASSESSMENT -I -SEP-2023

STUDENTS SEATING ARRANGEMENT / **HALL: CC3 LAB**				
SEATING POSITION	**ROLL NO**	**IV-CSE**	**ROLL NO**	**III-CSE**
TABLE 1	1	ABINAYA G	1	AADHI SURYA K
TABLE 2	2	BALU R	2	ARULMURUGAN S
TABLE 3	3	CHARLES WILLIAM.L	3	BABUSHANKAR S
TABLE 4	4	DEEPAK.S	4	BAMBAVASAN V
TABLE 5	5	DEEPIKA.S	5	CHANDRA PRAKASH K
TABLE 6	6	DHARANISELVI. M	6	DHAKSHINA MOORTHI E
TABLE 7	7	JAGATHESWARAN.P	7	DURGA K
TABLE 8	8	KARUNYAA.M	8	GUNASEKARAN P

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INTERNAL ASSESSMENT -I -SEP-2023

STUDENTS SEATING ARRANGEMENT / **HALL: CC3 LAB**				
SEATING POSITION	**ROLL NO**	**IV-CSE**	**ROLL NO**	**III-CSE**
TABLE 9	9	KATHIRESAN.K	9	GUNASEKARAN S
TABLE 10	10	KAVIN.M	10	HARIPRABHA V
TABLE 11	11	LOGANATHAN.T	11	KAMALESH K
TABLE 12	12	NIRMALRAJ.S	12	LALITHA T
TABLE 13	13	RAMYA.S	13	MADHAN G
TABLE 14	14	ROHITH.R	14	MOUSIKA S
TABLE 15	15	ROSHMA I	15	NANDHINI P
TABLE 16	16	SIVALINGAM.K	16	PANDIYARAJ P

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INTERNAL ASSESSMENT -I -SEP-2023

STUDENTS SEATING ARRANGEMENT / **HALL: CC2 LAB**				
SEATING POSITION	**ROLL NO**	**IV-CSE**	**ROLL NO**	**III-CSE**
TABLE 1	17	SUNDARAGANESAN.K	17	PRIYA DHARSHINI S
TABLE 2	18	VIGNESH.M	18	RAVI KUMAR P
TABLE 3	19	VINISHA.T	19	RUBIKA G
TABLE 4	20	VINITHA.A	20	SHYAMKUMAR S
TABLE 5	21	VINOTHKUMAR.R	21	SENTHILVEL S
TABLE 6	22	BOOPALAN.M	22	SUGANYA K
TABLE 7	23	DHAMODARAN.G	23	SURYA S

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INTERNAL ASSESSMENT -I -SEP-2023

STUDENTS SEATING ARRANGEMENT / **HALL: CC2 LAB**				
SEATING POSITION	**ROLL NO**	**III-CSE**	**ROLL NO**	**III-CSE**
TABLE 9	24	SUSHMINA M	31	NANDINI M
TABLE 10	25	VASANTHKUMAR S	32	SNEHA L
TABLE 11	26	VIGNESH M	33	SRINIVAS V
TABLE 12	27	YAMUNA K	34	SUBASHINI P
TABLE 13	28	AMUTHAMALAR R	35	NIKETHA S
TABLE 14	29	BHARANI DHARAN.M		
TABLE 15	30	GAYATHRI R		

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INTERNAL ASSESSMENT -I -NOV-2023

STUDENTS SEATING ARRANGEMENT / **HALL: CC3 LAB**				
SEATING POSITION	**ROLL NO**	**II CSE**	**ROLL NO**	**II CSE**
TABLE 1	1	ABINAYA P	6	DEVADHARSHINI M
TABLE 2	2	BHARATH KRISHNAN V	7	ELAKKIYA K
TABLE 3	3	CHANDRAKALA N	8	GIBSON SHANTHAKUMAR R
TABLE 4	4	CHANDRU K	9	GOKILA S
TABLE 5	5	DEEPA T	10	GOKULRAJA G

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STUDENTS SEATING ARRANGEMENT / **HALL: CC3 LAB**				
SEATING POSITION	**ROLL NO**	**II-CSE**	**ROLL NO**	**II-CSE**
TABLE 9	11	HAFILA A	16	JOTHI N
TABLE 10	12	INIKA C	17	JOTHI S
TABLE 11	13	JAYASHREE K	18	KARTHI K
TABLE 12	14	JAYASREE D	19	KARUNYA K
TABLE 13	15	JAYASURYA B	20	KEERTHIGA V

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DEPARTMENT OF CSE

INTERNAL ASSESSMENT -I -NOV-2023

STUDENTS SEATING ARRANGEMENT / HALL: CC2 LAB				
SEATING POSITION	**ROLL NO**	**II-CSE**	**ROLL NO**	**II-CSE**
TABLE 1	21	LAKSHMI B	26	PRAZWAL B
TABLE 2	22	LINGARAJU K	27	PUSHPASRI M
TABLE 3	23	NEETHU S	28	RAKSHITHA V
TABLE 4	24	NIVETHA P	29	SAHEER H
TABLE 5	25	POOMATHI S	30	SANJAIKUMAR S

EXAMCELL INCHARGE

PRINCIPAL
JKK MUNIRAJAH COLLEGE
OF TECHNOLOGY
T.N. PALAYAM (Po)-638 506.
GOBI (Tk). ERODE (Dt).

HOD

REGISTER NUMBER												

J.K.K.MUNIRAJAH COLLEGE OF TECHNOLOGY, T.N.PALAYAM

INTERNAL ASSESSMENT-I, APRIL -2024

Fourth Semester

DEPARTMENT OF COMPUTER SCIENCE ENGINEERING

CS3401- ALGORITHMS

Time: 1.30hrs **Maximum Marks: 50**

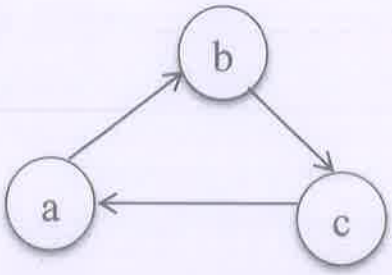
Date: 26.04.24 **Session: AN**

Answer ALL questions

PART A - (9 X 2 = 18 marks)

S.NO	QUESTION	MARKS	BTL
1	Define the Notion of Algorithm.	2	L1
2	What are the properties of an Algorithm?	2	L1
3	Write an algorithm to count the Sum of n numbers.	2	L1
4	Difference between Time complexity and Space Complexity.	2	L4
5	What is meant by Recurrence relation?	2	L1
6	Define digraph and Weighted graph.	2	L1
7	What is meant by sorting and searching.	2	L1
8	What is meant by Minimum Spanning Tree.	2	L1
9	What is meant by Adjacency Matrix and Adjacency List..	2	L1
	PART B - (2 X 16 = 32 marks)		
10 a)	Show the comparisons the Naïve string matcher makes for the pattern P=mango and Text T= raman likes mango.	16	L3
	(Or)		
10 b)	Show the comparisons of the Knuth Morris Pratt Algorithm with the Text t=abcxabcdabxabcdabcdabcy and Pattern P=abcdabcy	16	L2

BTL-BLOOMS TAXONOMY LEVEL

11 a)	Sort the elements of a given array in ascending order using HEAP SORT.The elements are 48,0,-1,82,108,72,54.	16	L3
	(Or)		
11 b)	Explain in detail about the Warshalls algorithm.Apply Warshalls algorithm for the following graph. 	16	L3

Prepared by	Checked by	Verified by	Approved by
Sign:			
Name: Mrs.P.SASIREKA **AP/CSE**	HOD	IQAC COORDINATOR	PRINCIPAL

BTL-BLOOMS TAXONOMY LEVEL

J.K.K. MUNIRAJAH COLLEGE OF TECHNOLOGY, T.N. PALAYAM, GOBI-638506

DEPARTMENT OFCOMPUTER SCIENCE AND ENGINEERING

CLASS: II - B.E (CSE) IV SEMESTER

ACADEMIC YEAR 2023-24

INTERNAL ASSESSMENT -I

CS3401/ALGORITHMS

S.NO	REG. NO.	NAME	INTERNAL MARKS(50)	INTERNAL MARKS(100)	INTERNAL MARK(60)	ASSIGNMENT MARK(40)	TOTAL(100)
1	731222104001	ABINAYA P	30	60	36	40	76
2	731222104002	BHARATH KRISHNAN V	31	62	37	39	76
3	731222104003	CHANDRAKALA N	37	74	44	40	84
4	731222104004	CHANDRU K	21	42	25	39	64
5	731222104005	DEEPA T	42	83	50	40	90
6	731222104006	DEVADHARSHINI M	31	62	37	40	77
7	731222104008	ELAKKIYA K	32	64	38	40	78
8	731222104009	GIBSON SHANTHAKUMAR R	17	34	20	38	58
9	731222104010	GOKILA S	45	90	54	40	94
10	731222104011	GOKULRAJA G	AB	AB	AB	AB	AB
11	731222104012	HAFILA A	39	78	47	40	87
12	731222104013	INIKA C	48	95	57	40	97
13	731222104014	JAYASHREE K	38	75	45	40	85
14	731222104015	JAYASREE D	43	85	51	40	91
15	731222104016	JAYASURYA B	34	68	41	40	81
16	731222104018	JOTHI N	AB	AB	AB	39	39
17	731222104019	JOTHI S	38	75	45	40	85
18	731222104020	KARTHI K	35	70	42	40	82
19	731222104021	KARUNYA K	36	71	43	40	83
20	731222104022	KEERTHIGA V	32	63	38	40	78
21	731222104023	LAKSHMI B	33	66	40	40	80
22	731222104024	LINGARAJU K	15	30	18	40	58
23	731222104025	NEETHU S	39	78	47	40	87
24	731222104026	NIVETHA P	36	72	43	39	82

25	731222104027	POOMATHI S	44	87	52	40	92
26	731222104028	PRAZWAL.B	14	28	17	AB	17
27	731222104029	PUSHPASRI M	37	73	44	40	84
28	731222104030	RAKSHITHA V	36	71	43	40	83
29	731222104031	SAHEER H	31	62	37	40	77
30	731222104032	SANJAIKUMAR S	30	59	35	40	75
31	731222104033	SANJAY V	27	53	32	40	72
32	731222104034	SANJAY KUMAR S	35	70	42	40	82
33	731222104035	SATHIYALAKSHMI M	37	73	44	40	84
34	731222104036	SHAKTHI S	46	92	55	40	95
35	731222104038	SIDHARAJ S	31	62	37	40	77
36	731222104039	SOWDESWARI A	39	77	46	40	86
37	731222104040	SOWNDHAR D	28	55	33	40	73
38	731222104041	SUMITHRA S	46	91	55	40	95
39	731222104302	GOWTHAM A	38	75	45	40	85

SUBJECT INCHARGE

HOD

Principal
J.K.K.Munirajah College of Technology
(Autonomous)
T.N.Palayam, Gobi (Tk),
Erode (Dt) - 638 506.

INTERNAL ASSESSMENT I

26/4/24

Name : Sumithra.S

Reg No : 731222104041

Year & Dept : II - BE - Computer Science and Engineering

Subject Code : CS 3401

Subject Name : Algorithms

Date & Session : 26/04/2024 & AN

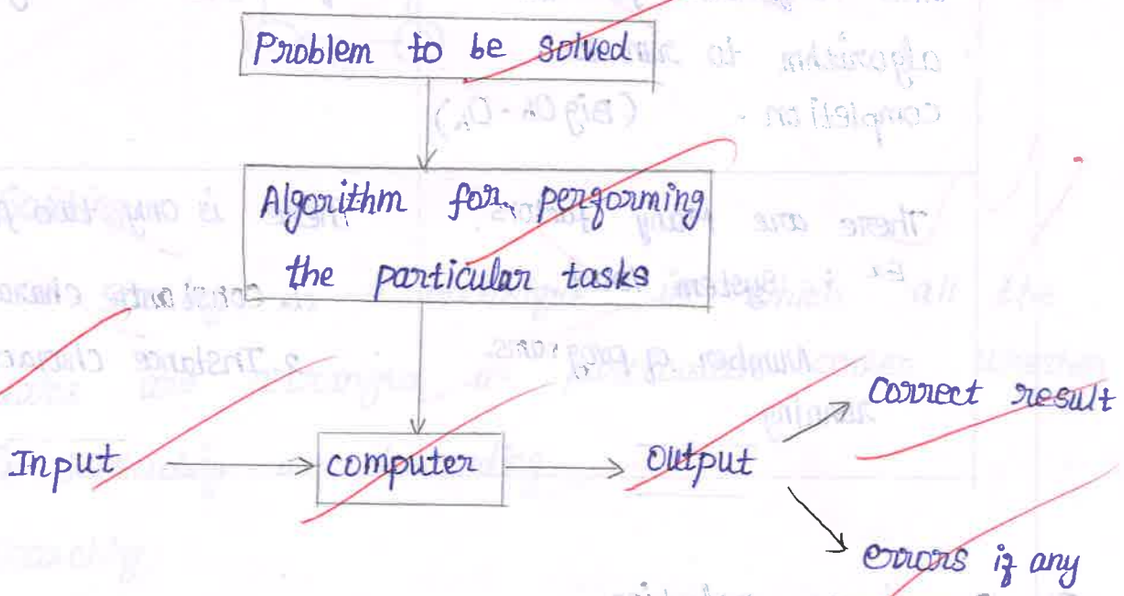
45/50

9/10

Good. Neat Presentation

PART-A

1. Notion of algorithm



2. Properties of an algorithm

1. Non-ambiguity
2. Range of input
3. Speed
4. Finiteness
5. Multiplicity

3. Algorithm to count the sum of n numbers.

1. Count the

4. Difference between Time complexity and Space complexity.

Time complexity	Space complexity
The amount of computer time required for an algorithm to run to completion. (Big Oh - O_h)	The amount of Memory required for an algorithm
There are Many factors. Ex : System load, Number of programs running	There is only two factor 1. Constante characteristic 2. Instance characteristic

5. Recurrence relation :

$$T(n) = T(n-1) + n$$

* This equation is called recurrence relation.

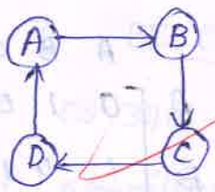
$$T(0) = 0$$

* It is the initial condition.

6. Digraph :

* The graph in which all the edges are directed is called digraph or directed graph.

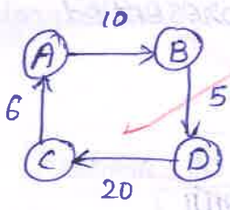
Ex :



Weighted graph:

* The graph in which the all the edges are given some values (weights) is called weighted graph.

Ex:



7. Sorting :

* Sorting is a technique in which all the datas are arranged in particular order whether in ascending or descending.

Searching:

* Searching is the process of determining whether the elements are present in the given list of elements or not.

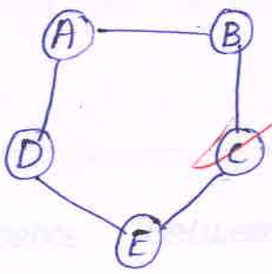
8. Minimum Spanning Tree:

* Minimum spanning Tree is the ~~kind~~ kind of spanning tree with the connected weighted graph G with limited or smallest weight.

9. Adjacency Matrix :

Adjacency Matrix is represented by two, dimensional.

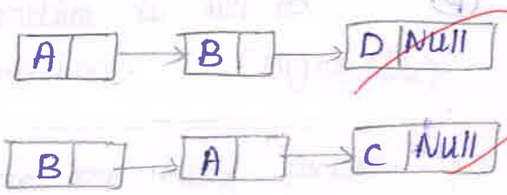
Ex:



	A	B	C	D	E
A	0	1	0	1	0
B	1	0	1	0	0
C	0	1	0	0	1
D	1	0	0	0	1
E	0	0	1	1	0

Adjacency list :

Adjacency list is represented by this form. list. in such manner.



PART - B

10. a) Naive String Matching Algorithm:

* String Matching means finding one or more generally all the occurrences of the text.
* These occurences are also called as pattern.
* String Matching algorithm also called as Pattern searching algorithm.
* In this Naive string matching every pattern should be compared with the text index.

* If the match is not found shift to the right by one position until all the strings are equal to the string of text.

Solution :

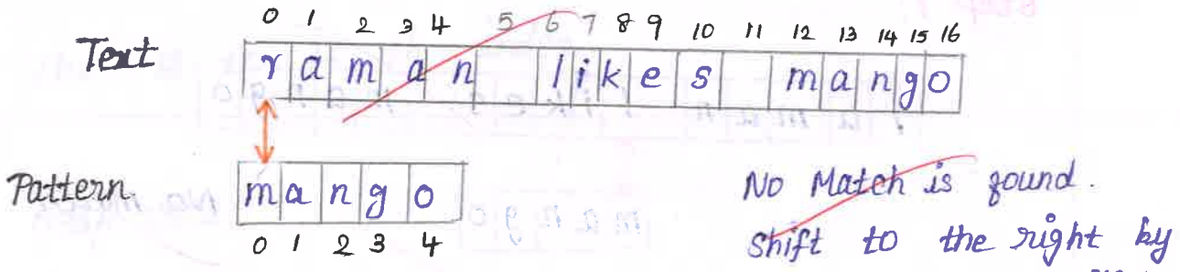
P = Mango

T = raman likes mango.

Step 1:

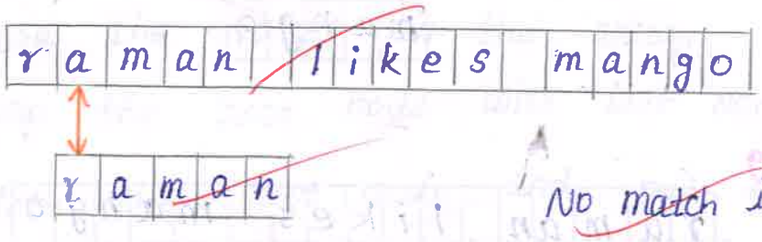
* Start matching the pattern with the text at the 0th location.

* If the pattern is not matched shift to the right by 1 position.



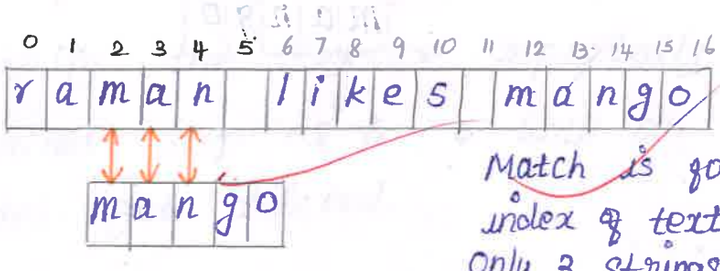
No Match is found.
Shift to the right by 1 position

Step 2 :



No match is found.

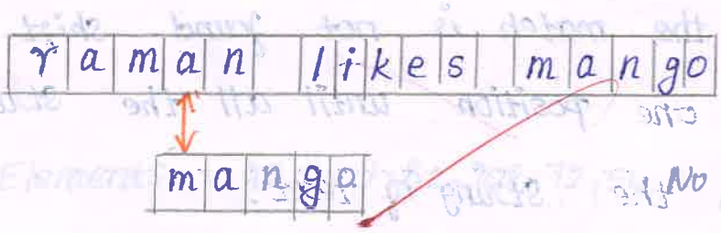
Step 3 :



Match is found at 2nd index of text
Only 3 strings are matching.

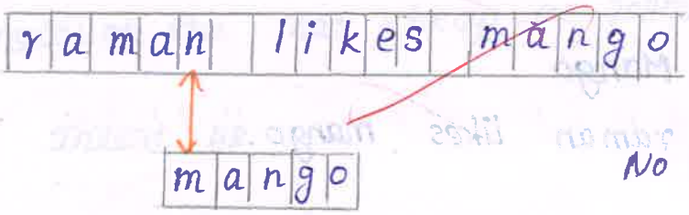
So shift right by 1 position.

Step 4:



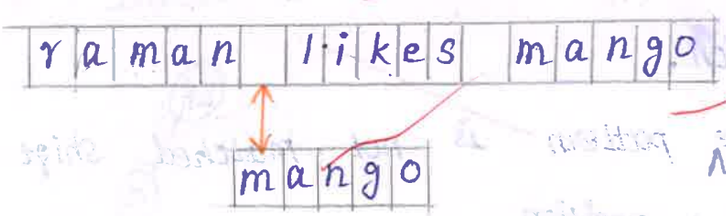
No match is found

Step 5:



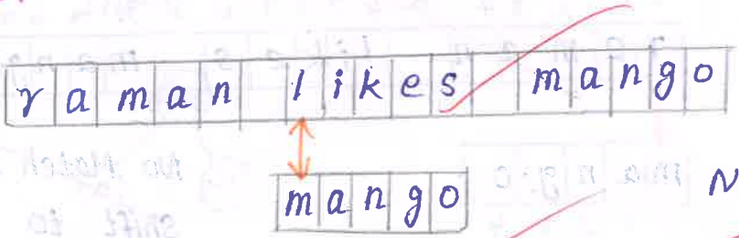
No match is found.

Step 6:



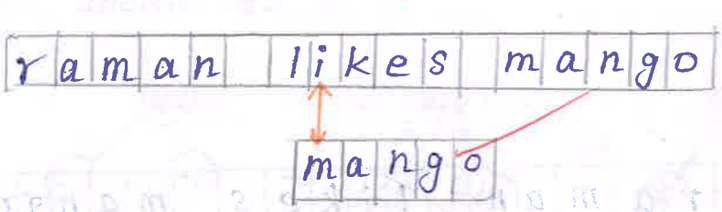
No match

Step 7:



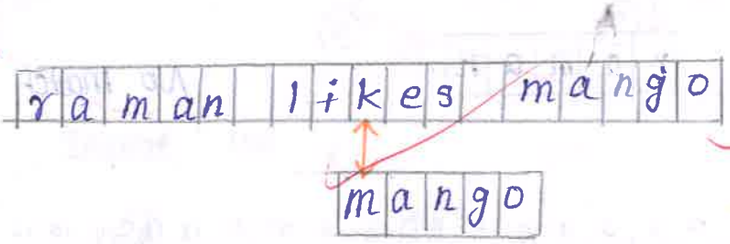
No match

Step 8.



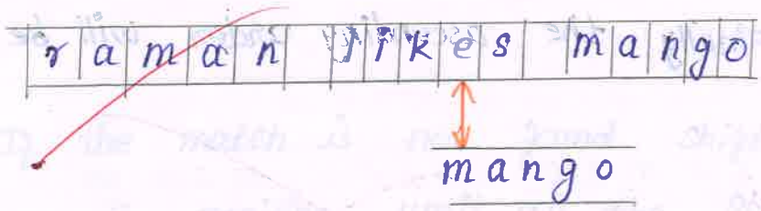
No match

Step 9.

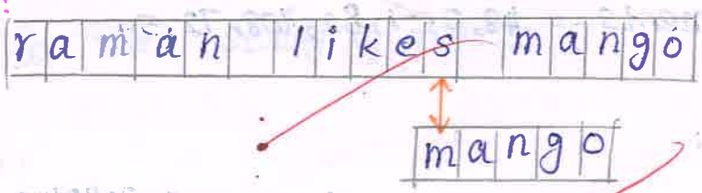


No match

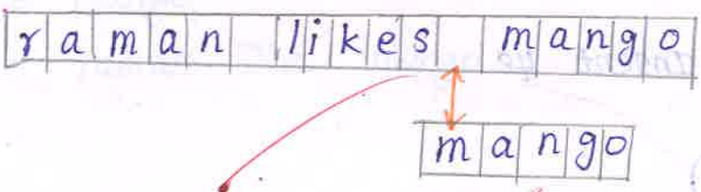
Step 10:



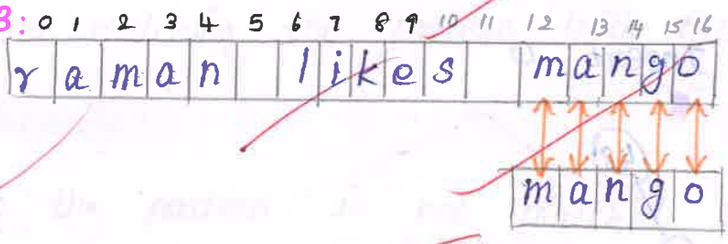
Step 11:



Step 12:



Step 13:



∴ The pattern match is found at the text from the 12 to 16 th index.

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11. a) Heap sort:

Algorithm:

1. Construct the maximum heap
2. Store the values in the array.
3. Swap the root node with last node.
4. Delete the root node and put in the last position of array
5. Heapify the structure repeatedly.
6. Continue step 2 to 4 until all the nodes get deleted.

7. Delete last node and insert in the array.

8. Finally the ascending order will be got.

Solution:

Elements = 48, 0, -1, 82, 108, 72, 54

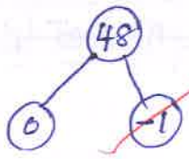
STAGE I :

Construct the max heap as follows.

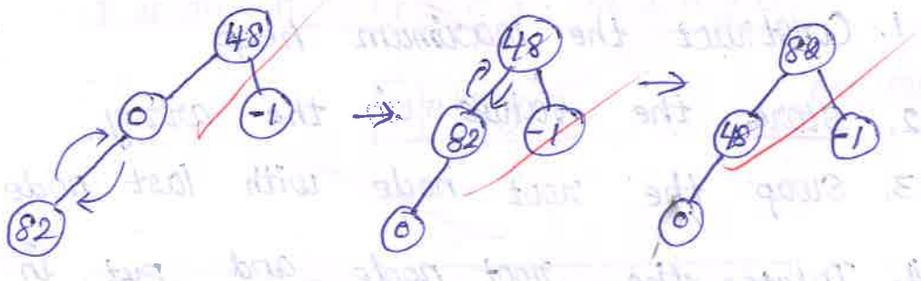
Step 1: Insert 48

Step 2: Insert 0

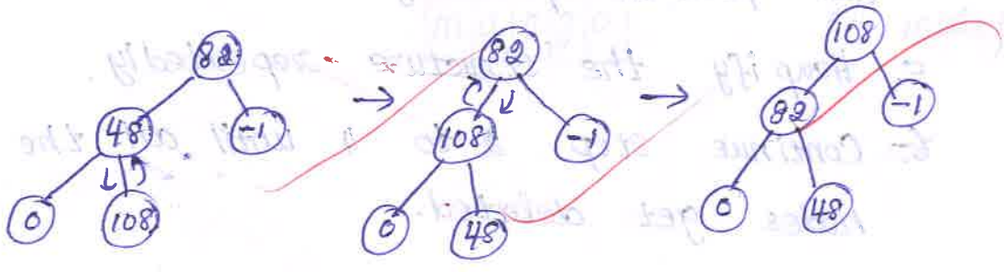
Step 3: Insert -1



Step 4: Insert 82

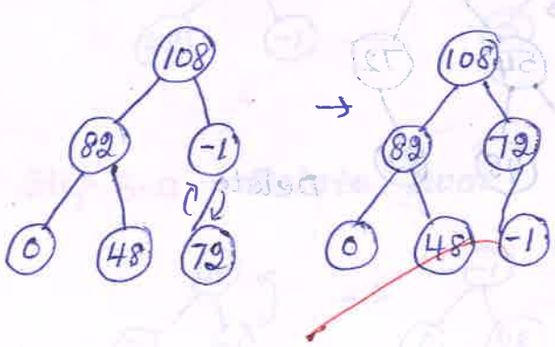


Step 5: Insert 108

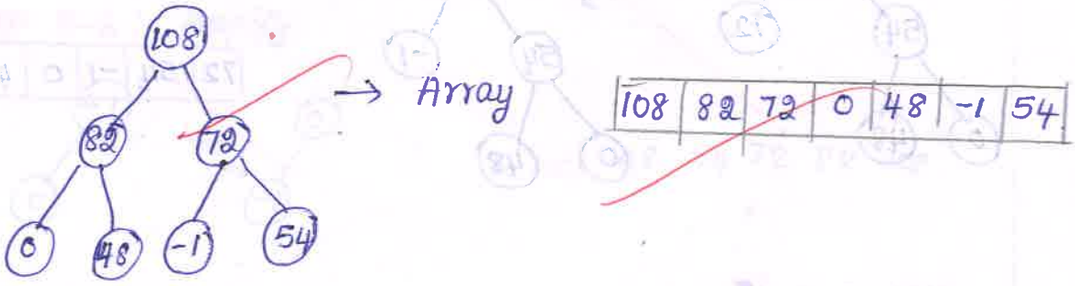


26/4/24

Step 6: Insert 72

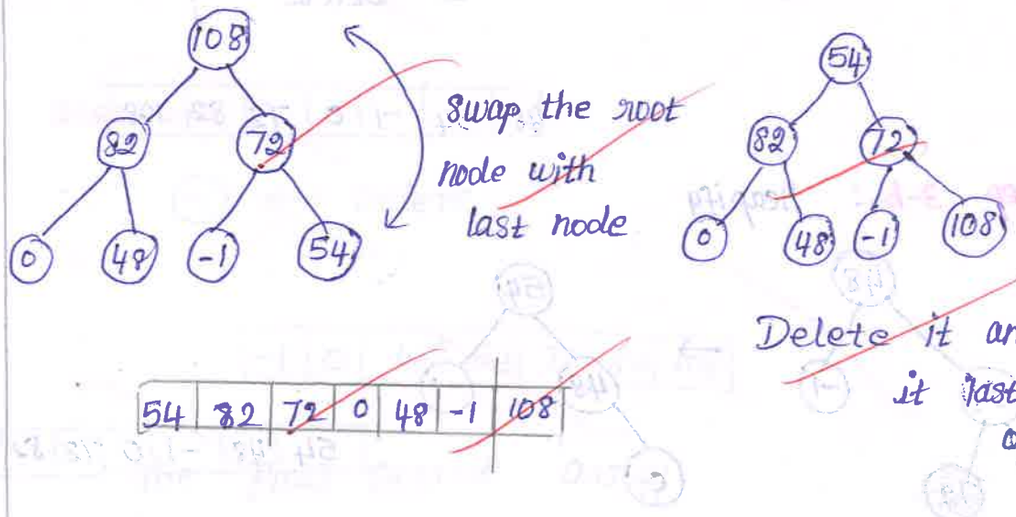


Step 7: Insert 54

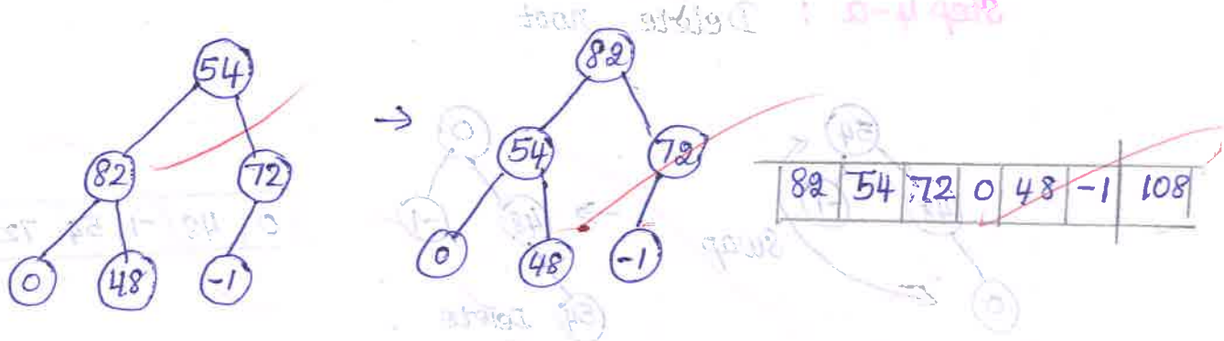


STAGE II : Delete root and heapify repeatedly.

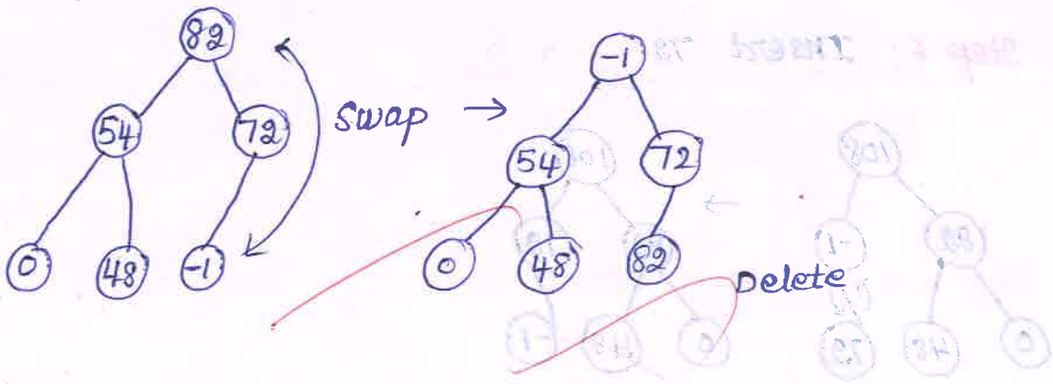
Step 1-a: Delete root



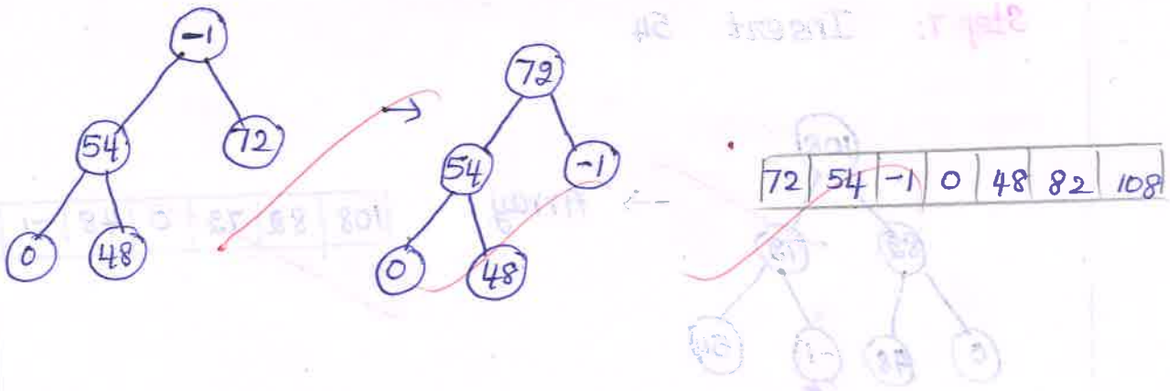
Step 1-b :



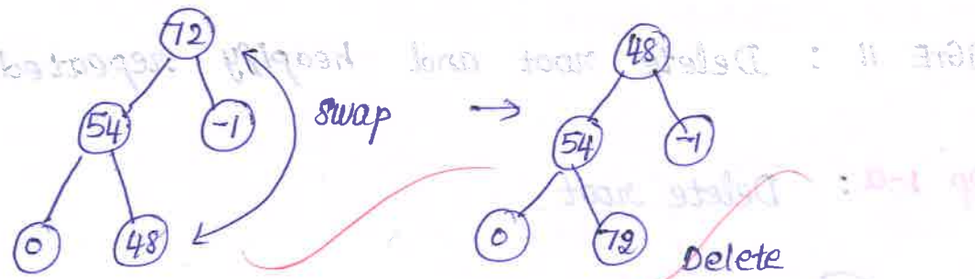
Step 2-a :



Step 2-b :

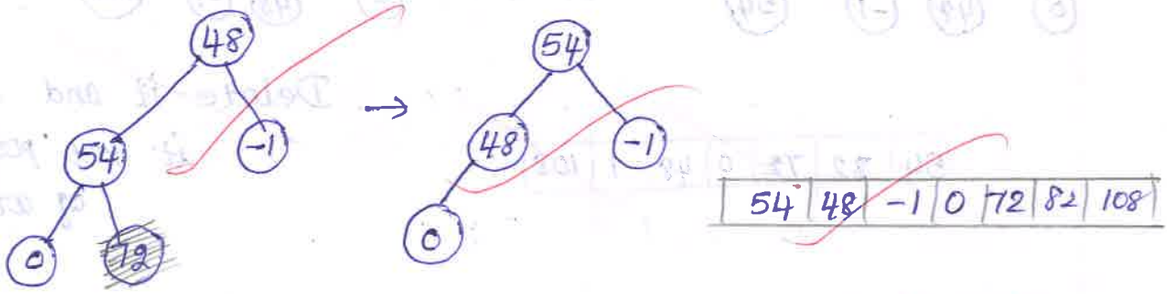


Step 3-a :



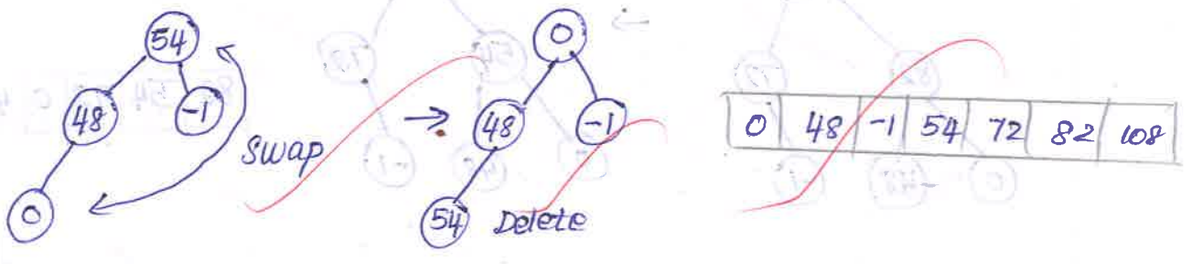
48	54	-1	0	72	82	108

Step 3-b : Heapify



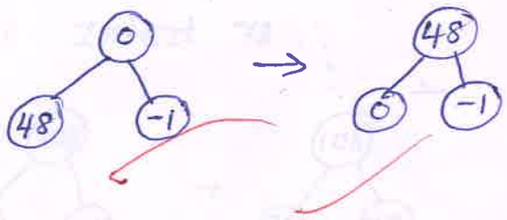
54	48	-1	0	72	82	108

Step 4-a : Delete root



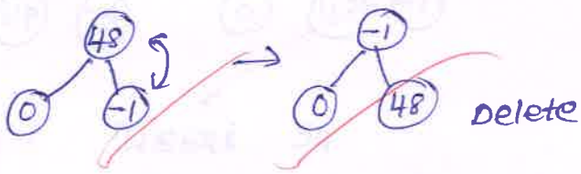
0	48	-1	54	72	82	108

Step 4-b : Heapify



48 0 -1 54 72 82 108

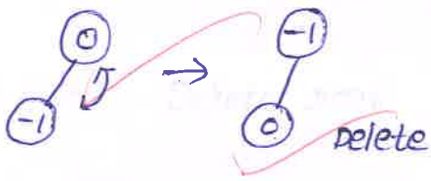
Step 5-a : Delete root



Step 5-b : Heapify

0 -1 48 54 72 82 108

Step 6-a: Delete root.



Step 6-b:

-1	0	48	54	72	82	108

The final sorted array.

Reg no : 731222104038.

Name : S. Sanjaikumar.

Year & Dept : II-year & BE-CSE

Subject : Algorithms

Subject code : CS3401

Exam : Internal Assessment-I

Date & Sess : 26/04/24 & AN

29/30

27/30

1. * An Algorithm is a set of instruction for solving the problem and accomplishing a task.

* This called as a Algorithm.

2. Properties of Algorithm :

1. non-ambiguity.
2. Range of input
3. Multiplicity
4. Speed
5. Finiteness.

This is properties of an Algorithm.

4.

Time Complexity	Space Complexity
* The time complexity of an algorithm is a amount of computer time required van algorithm to run to completion. * This is amount of Computer required algorithm	* The space complexity defined as a amount of memory required of an algorithm to run * this is amount of memory required algorithm.

6. Digraph and Weighted Graph:

* Digraph is a directed graph in which gauess the solution an made.

* Weighted graph is calculated the cost.

* This is weighted graphe.

10)

a)

Given,

Text

r	a	m	a	n		l	i	k	e	s		M	a	n	g	o
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

Pattern

m	a	n	g	o
0	1	2	3	4

Algorithm:

* Starting the 0th position. move on right side.
* 0th position is match not found. So move on the next position. (2th position).
* 2nd position match not found, so next position. this moves is naive string matches.
* All words matched this processing is Stoped.
* This is naive string matches Algorithm.

Step 1:

Text

r	a	m	a	n		l	i	k	e	s		M	a	n	g	o

Pattern

m	a	n	g	o

match not found.
go to next position.

Step 2:

Text

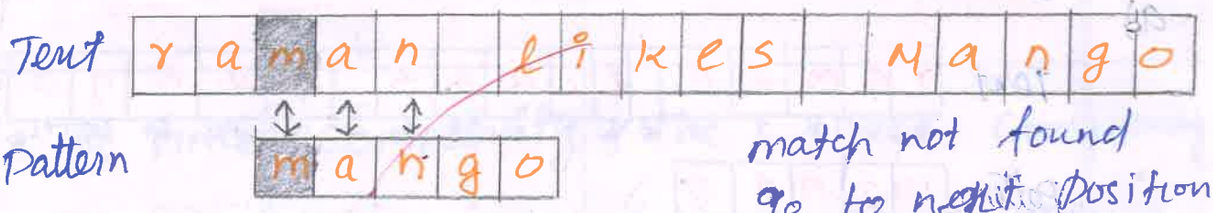
r	a	m	a	n		l	i	k	e	s		M	a	n	g	o

pattern

m	a	n	g	o

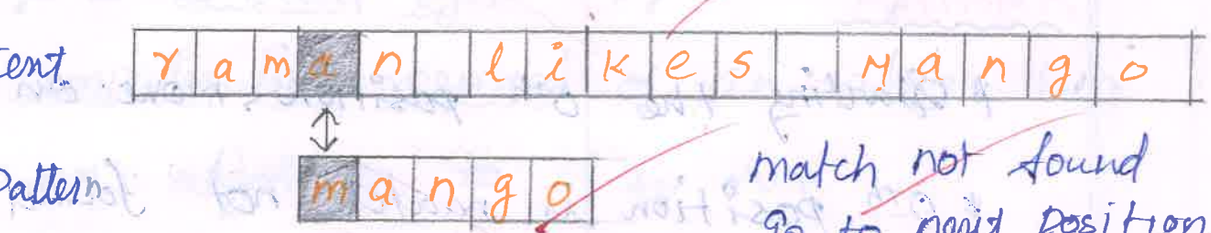
match not found
go to next position

Step 3:



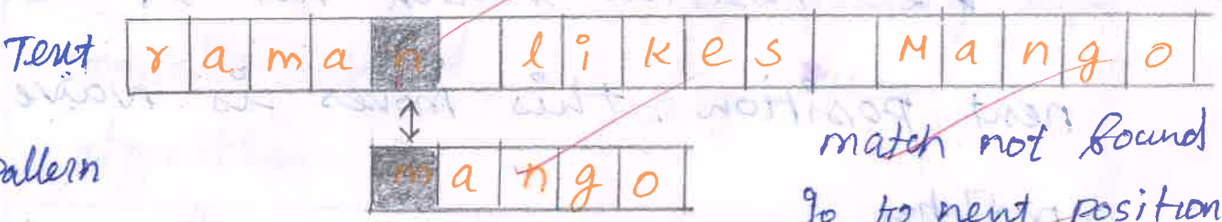
match not found
go to next position.

Step 4:



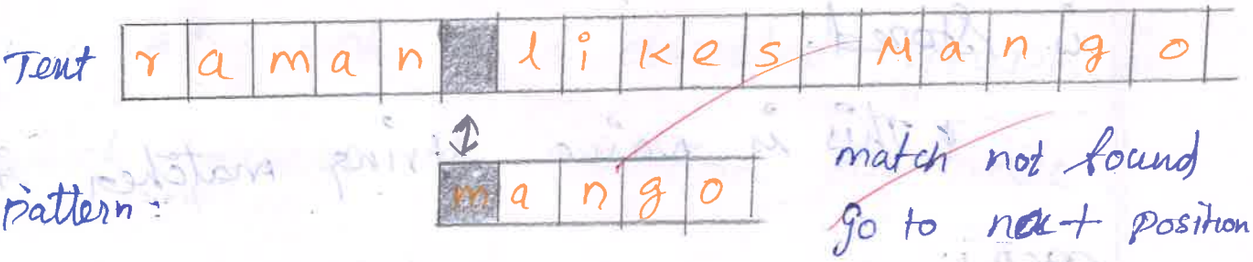
match not found
go to next position.

Step 5:



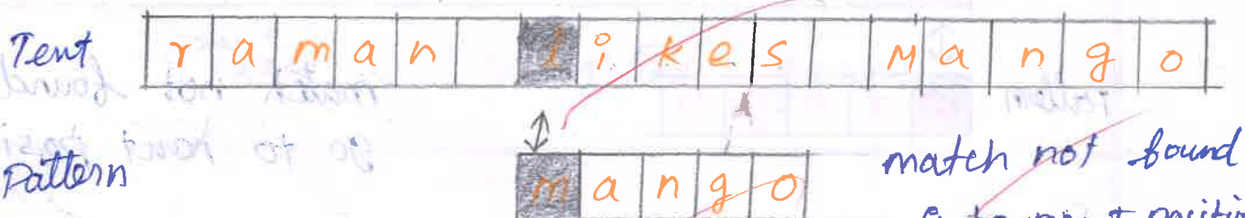
match not found
go to next position.

Step 6:



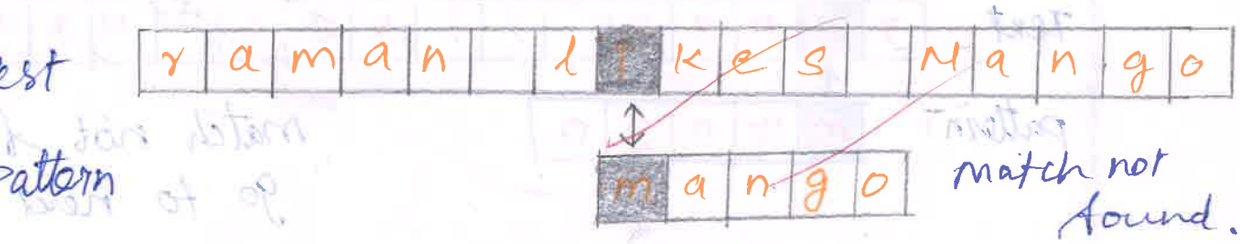
match not found
go to next position

Step 7:



match not found
go to next position

Step 8:



match not found.

Step 9:-

Text: r a m a n _ l i k e s _ m a n g o

pattern: m a n g o

⇒ match not found
go to next position

Step 10:

Text: r a m a n _ l i k e s _ m a n g o

Pattern: m a n g o

match not found
go to next position

Step 11:

Text: r a m a n _ l i k e s _ m a n g o

Pattern: m a n g o

∴ match not found

Step 12:

Text: r a m a n _ l i k e s _ m a n g o

Pattern: m a n g o

⇒ match not found
go to next positron

Step 13:

Text: r a m a n _ l i k e s _ m a n g o

Pattern: m a n g o

∴ finally matched the pattern and
went.

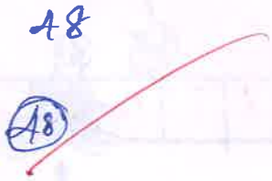
11.

a) Given,

48, 0, -1, 82, 108, 72, 54.

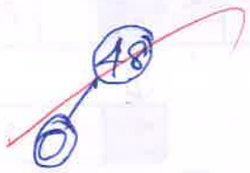
Step1:

Insert 48



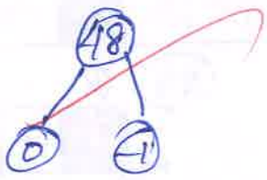
Step2:

Insert 0



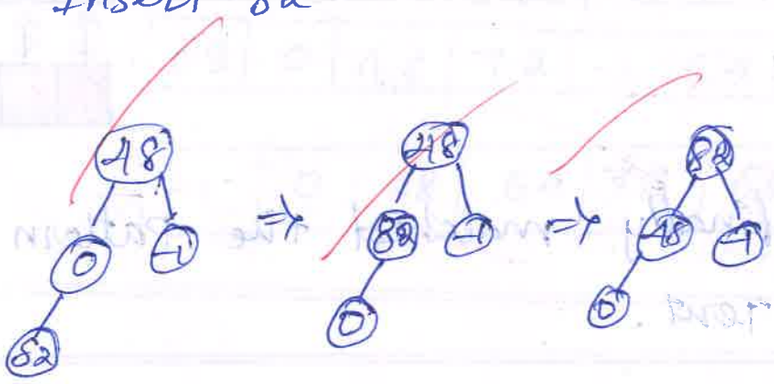
Step3:

Insert -1



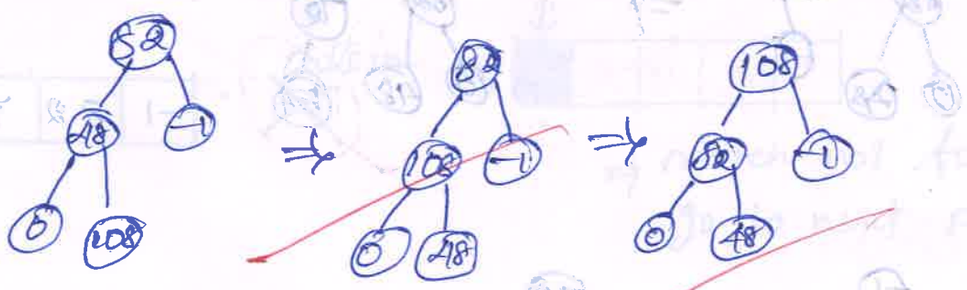
Step4:

Insert 82



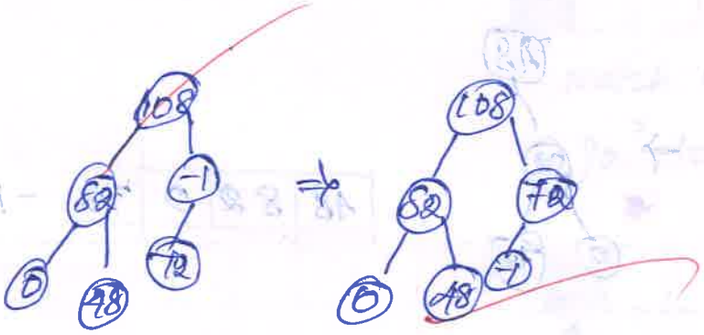
Step: 5

Insert 108.



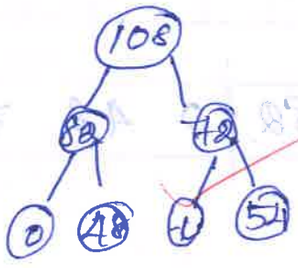
Step 6:

Insert 72

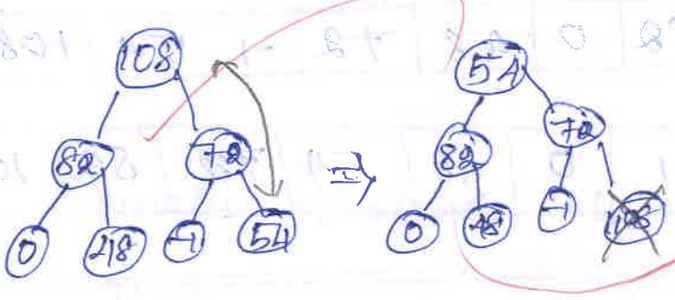


Step 7:

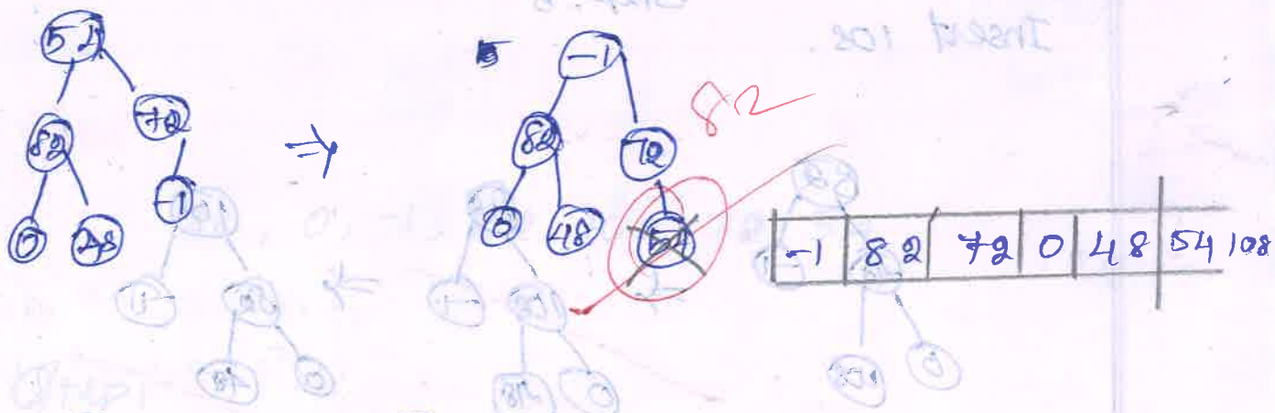
Insert 54

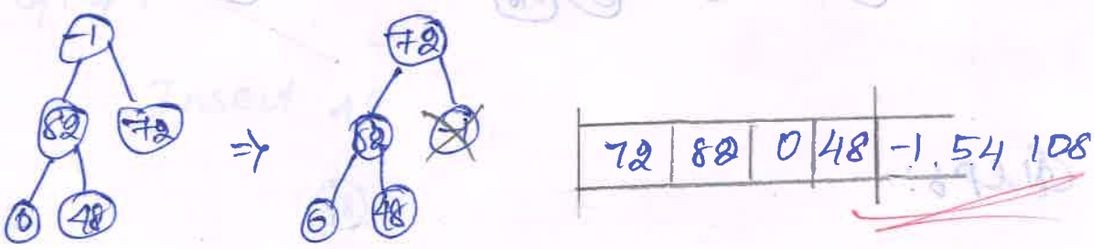


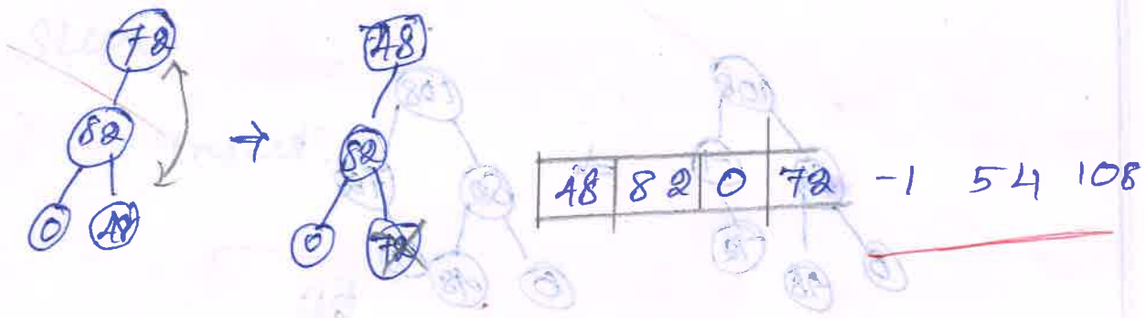
Stage → II

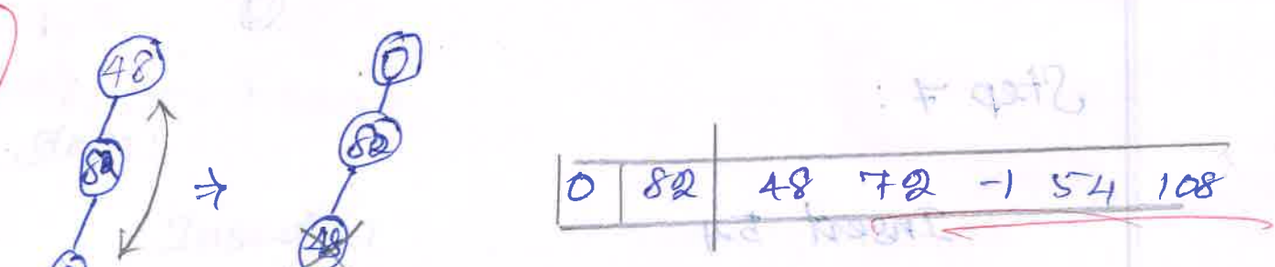


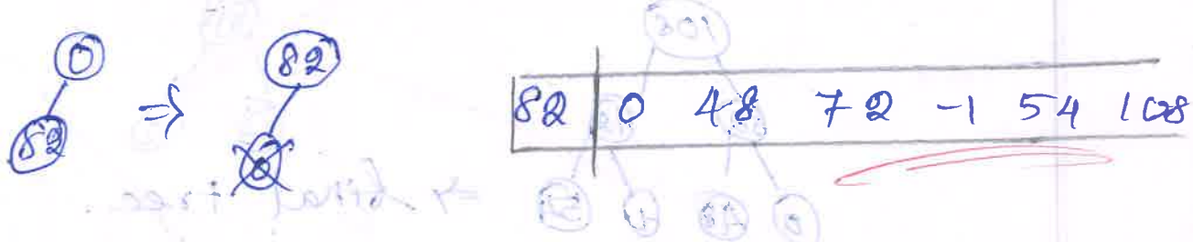
54	52	72	0	48	-1	108



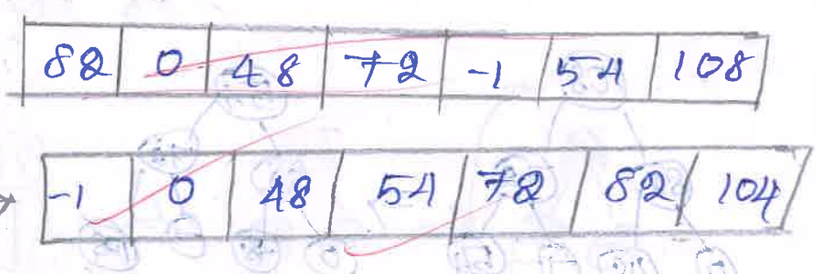








Finally Heap short is,



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COLLEGE OF TECHNOLOGY
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Accreditation with
"A" GRADE

ISO 9001:2015

JKKMCT/CIRCULAR/0191/MAR-24 **DATE: 30/03/2024**

CIRCULAR

All the UG / PG Degree **(B.E/B.TECH/M.E/MBA/MCA)** First year & Second Year **(II & IV- SEMESTER)** students are informed that First, Second Assessment Scheduled are,

Report No	Report Period	Internal Assessment Date	Report Entry last date
First	13-03-2024 to 29-04-2024	**25-04-2024(Thursday)** **26-04-2024 (Friday)** **27-04-2024 (Saturday)**	**02-05-2024 (Thursday)**
Second	30-04-2024 to 13-06-2024	**06-06-2024(Thursday)** **07-06-2024 (Friday)** **08-06-2024 (Saturday)**	**13-06-2024 (Thursday)**

All the subject handlers are informed that should **produce Two Set of Question papers** (Maximum marks 50) in **EXAMCELL** within two days before the exam date.

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3/4/24

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Copy To,

1. All the HoDs and Faculty Members Circulation
2. First Year and Second Year Student's Circulation,
3. Notice Board.
4. File

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J K K MUNIRAJAH COLLEGE OF TECHNOLOGY
DEPARTMENT OF CSE
INTERNAL ASSESSMENT-II SCHEDULE - JUNE-2024
II-YEAR CSE

EXAM TIMING – FN: 10.00 AM TO 11.30 AM **AN: 2.30 PM TO 4.00 PM**

S.NO	DATE	DAY	II YEAR CSE	
			FN	AN
1	06.06.2024	THURSDAY	CS3452 TOC	CS3491 AIML
2	07.06.2024	FRIDAY	CS3492 DBMS	CS3401 ALGORITHMS
3	08.06.2024	SATURDAY	CS3451 IOS	GE3451 EVS
STAFF SIGNATURE				
TUTOR			P. Puja	

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JKK MUNIRAJAH COLLEGE OF TECHNOLOGY

DEPARTMENT OF CSE

INTERNAL ASSESSMENT -II- JUNE-2024

DUTY CHART FOR STAFF MEMBERS

HALL NO: CC3,CC2 **YEAR/CLASS II CSE**

S.NO	STAFF NAME	06.06.2024		07.06.2024		08.06.2024		SIGNATURE
		FN	AN	FN	AN	FN	AN	
1	Mrs.M.C.SAVITHRI	*			*			
2	Mrs.P.POORNAPRIYA		*			*		
3	Mrs.V.NIROSHA	*					*	
4	Mrs.P.SASIREKA			*			*	
5	Mr.K.S.VINOTHAN		*			*		
6	Mr.PONNUSAMY			*	*			

NOTE:

1 Staff going for exam duty must present at 9.45 AM for FN & 2.15 for AN.

2 Students should not be allowed to leave the hall before 11.30 AM for FN & 4.00 PM for AN.

3 Students should not be allowed to write exam with out ID card.

4 Students are not permitted to get anything from anybody inside exam hall.

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JKK MUNIRAJAH COLLEGE OF TECHNOLOGY

DEPARTMENT OF CSE

INTERNAL ASSESSMENT -II & III -NOV-2023

STUDENTS SEATING ARRANGEMENT / HALL: CC3 LAB				
SEATING POSITION	ROLL NO	IV-CSE	ROLL NO	III-CSE
TABLE 1	1	ABINAYA G	1	AADHI SURYA K
TABLE 2	2	BALU R	2	ARULMURUGAN S
TABLE 3	3	CHARLES WILLIAM.L	3	BABUSHANKAR S
TABLE 4	4	DEEPAK.S	4	BAMBAVASAN V
TABLE 5	5	DEEPIKA.S	5	CHANDRA PRAKASH K
TABLE 6	6	DHARANISELVI. M	6	DHAKSHINA MOORTHI E
TABLE 7	7	JAGATHESWARAN.P	7	DURGA K
TABLE 8	8	KARUNYAA.M	8	GUNASEKARAN P

EXAMCELL INCHARGE

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STUDENTS SEATING ARRANGEMENT / HALL: CC3 LAB				
SEATING POSITION	ROLL NO	IV-CSE	ROLL NO	III-CSE
TABLE 1	1	ABINAYA G	1	AADHI SURYA K
TABLE 2	2	BALU R	2	ARULMURUGAN S
TABLE 3	3	CHARLES WILLIAM.L	3	BABUSHANKAR S
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INTERNAL ASSESSMENT -II & III NOV-2023

STUDENTS SEATING ARRANGEMENT / HALL: CC3 LAB				
SEATING POSITION	ROLL NO	IV-CSE	ROLL NO	III-CSE
TABLE 9	9	KATHIRESAN.K	9	GUNASEKARAN S
TABLE 10	10	KAVIN.M	10	HARIPRABHA V
TABLE 11	11	LOGANATHAN.T	11	KAMALESH K
TABLE 12	12	NIRMALRAJ.S	12	LALITHA T
TABLE 13	13	RAMYA.S	13	MADHAN G
TABLE 14	14	ROHITH.R	14	MOUSIKA S
TABLE 15	15	ROSHMA I	15	NANDHINI P
TABLE 16	16	SIVALINGAM.K	16	PANDIYARAJ P

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INTERNAL ASSESSMENT -II -DEC-2023

STUDENTS SEATING ARRANGEMENT / HALL: CC3 LAB				
SEATING POSITION	**ROLL NO**	**II CSE**	**ROLL NO**	**II CSE**
TABLE 1	1	ABINAYA P	6	DEVADHARSHINI M
TABLE 2	2	BHARATH KRISHNAN V	7	ELAKKIYA K
TABLE 3	3	CHANDRAKALA N	8	GIBSON SHANTHAKUMAR R
TABLE 4	4	CHANDRU K	9	GOKILA S
TABLE 5	5	DEEPA T	10	GOKULRAJA G

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SEATING POSITION	**ROLL NO**	**II-CSE**	**ROLL NO**	**II-CSE**
TABLE 9	11	HAFILA A	16	JOTHI N
TABLE 10	12	INIKA C	17	JOTHI S
TABLE 11	13	JAYASHREE K	18	KARTHI K
TABLE 12	14	JAYASREE D	19	KARUNYA K
TABLE 13	15	JAYASURYA B	20	KEERTHIGA V

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INTERNAL ASSESSMENT -II -DEC-2023

STUDENTS SEATING ARRANGEMENT / HALL: CC2 LAB				
SEATING POSITION	**ROLL NO**	**II-CSE**	**ROLL NO**	**II-CSE**
TABLE 1	21	LAKSHMI B	26	PRAZWAL B
TABLE 2	22	LINGARAJU K	27	PUSHPASRI M
TABLE 3	23	NEETHU S	28	RAKSHITHA V
TABLE 4	24	NIVETHA P	29	SAHEER H
TABLE 5	25	POOMATHI S	30	SANJAIKUMAR S

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INTERNAL ASSESSMENT -II -DEC-2023

STUDENTS SEATING ARRANGEMENT / **HALL: CC2 LAB**				
SEATING POSITION	**ROLL NO**	**II-CSE**	**ROLL NO**	**II-CSE**
TABLE 9	31	SANJAY V	36	SOWDESWARI A
TABLE 10	32	SANJAY KUMAR S	37	SOWNDHAR D
TABLE 11	33	SATHIYALAKSHMI M	38	SUMITHRA S
TABLE 12	34	SHAKTHI S	39	GOWTHAM A
TABLE 13	35	SIDHARAJ S		

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REGISTER NUMBER												

J.K.K.MUNIRAJAH COLLEGE OF TECHNOLOGY, T.N.PALAYAM

INTERNAL ASSESSMENT-2, JUNE -2024

Fourth Semester

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

CS3401- ALGORITHMS

Time: 1.30hrs **Maximum Marks: 50**

Date:07.06.24 **Session: AN**

Answer ALL questions

PART A - (9 X 2 = 18 marks)

S.NO	QUESTION	MARKS	BTL
1	Define Optimal Binary search tree.	2	L1
2	What kind of problems can be solved using divide and conquer method.	2	L1
3	What are the elements of Dynamic Programming	2	L1
4	State the principle of "optimality" and "Duality".	2	L1
5	Define Huffman tree.	2	L1
6	What are the applications of backtracking.	2	L1
7	Difference between divide and conqure & dynamic programming.	2	L1
8	Define NP hard and NP completeness.	2	L1
9	List any three problems that have polynomial time algorithms.Justify your answer.	2	L1
	PART B - (2 X 16 = 32 marks)		
10 a)	For the following list of elements trace the recursive algorithm for finding max and min and determine how many comparisons have been made.22,13,-5,-8,15,60,17,31,47.	16	L1,L2

BTL-BLOOMS TAXONOMY LEVEL

	(Or)		
10 b)	Write greedy algorithm for Activity selection problem.Give its Time complexity.For following intervals select the activities according to your algorithm.I1(1-3),I2(0-2),I3(3-6),I4(2-5),I5(5-8),I6(3-10),I7(7-9).	16	L3
11a)	Let A={i/119,m/96,c/247,g/283,h/72,f/77,k/92,j/91}be the letters and its frequency of distribution in a text file.Compute a suitable Huffman coding to compress the data Effectively.	16	L1, L3
	(Or)		
11 b)	Write an algorithm to determine the sum of subsets for a given sum and a set of numbers. Draw the tree representation to solve the subset sum problem given the numbers set as (3,5,6,7,2) with sum=15.Derive all the subsets.	16	L1, L3

Prepared by	Checked by	Verified by	Approved by
Sign:			
Name: Mrs.P.SASIREKA	**HOD**	IQAC **COORDINATOR**	**PRINCIPAL**

BTL-BLOOMS TAXONOMY LEVEL

J.K.K. MUNIRAJAH COLLEGE OF TECHNOLOGY, T.N. PALAYAM, GOBI-638506

DEPARTMENT OFCOMPUTER SCIENCE AND ENGINEERING

CLASS: II - B.E (CSE) IV SEMESTER

ACADEMIC YEAR 2023-24

INTERNAL ASSESSMENT -II

CS3401/ALGORITHMS

S.NO	REG. NO.	NAME	INTERNAL MARKS(50)	INTERNAL MARKS(100)	INTERNAL MARK(60)	ASSIGNMENT MARK(40)	TOTAL(100)
1	731222104001	ABINAYA P	27.5	55	33	40	73
2	731222104002	BHARATH KRISHNAN V	33.5	67	40	40	80
3	731222104003	CHANDRAKALA N	40	80	48	40	88
4	731222104004	CHANDRU K	3	6	4	40	44
5	731222104005	DEEPA T	33.5	67	40	40	80
6	731222104006	DEVADHARSHINI M	32	64	38	40	78
7	731222104008	ELAKKIYA K	37	74	44	40	84
8	731222104009	GIBSON SHANTHAKUMAR R	14	28	17	40	57
9	731222104010	GOKILA S	45.5	91	55	40	95
10	731222104011	GOKULRAJA G	AB	AB	AB	AB	AB
11	731222104012	HAFILA A	41.5	83	50	40	90
12	731222104013	INIKA C	45	90	54	40	94
13	731222104014	JAYASHREE K	45	90	54	40	94
14	731222104015	JAYASREE D	33	66	40	40	80
15	731222104016	JAYASURYA B	30	60	36	40	76
16	731222104018	JOTHI N	22.5	45	27	40	67
17	731222104019	JOTHI S	33	66	40	40	80
18	731222104020	KARTHI K	32.5	65	39	40	79
19	731222104021	KARUNYA K	26	52	31	40	71
20	731222104022	KEERTHIGA V	28	56	34	40	74
21	731222104023	LAKSHMI B	16.5	33	20	40	60
22	731222104024	LINGARAJU K	10	20	12	40	52
23	731222104025	NEETHU S	31	62	37	40	77
24	731222104026	NIVETHA P	31.5	63	38	40	78

25	731222104027	POOMATHI S	42	84	50	40	90
26	731222104028	PRAZWAL.B	AB	AB	AB	AB	AB
27	731222104029	PUSHPASRI M	32	64	38	40	78
28	731222104030	RAKSHITHA V	35.5	71	43	40	83
29	731222104031	SAHEER H	37	74	44	40	84
30	731222104032	SANJAIKUMAR S	32	64	38	40	78
31	731222104033	SANJAY V	18	36	22	40	62
32	731222104034	SANJAY KUMAR S	23.5	47	28	40	68
33	731222104035	SATHIYALAKSHMI M	35	70	42	40	82
34	731222104036	SHAKTHI S	44	88	53	40	93
35	731222104038	SIDHARAJ S	42	84	50	40	90
36	731222104039	SOWDESWARI A	48	96	58	40	98
37	731222104040	SOWNDHAR D	29	58	35	40	75
38	731222104041	SUMITHRA S	49	98	59	40	99
39	731222104302	GOWTHAM A	32.5	65	39	40	79

SUBJECT INCHARGE

HOD

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INTERNAL ASSESSMENT - 02

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Subject - Algorithms.
sub code - CS-3401.
Branch - B.E (CSE) II - yr.
Date/sess - 01.06.2024 / AN.

44

7/6/24

88 1/2

PART - A

1. **Optimal Binary Search Tree:**

* Let $a_1, a_2, a_3, a_4, \ldots a_n$ be a set of identifiers such that $a_1 < a_2 < a_3 < \ldots < a_n$.

*. Let $P(i)$ be the probability of Successfull search where a_i → Successful Search. and $q(i)$ be the probability of Searching element x such that $a_i < x < a_{i+1}$ where $0 \le i \le n$ → unsuccessful Search.

∴ $P(i)$ = Successful Search
$q(i)$ = unsuccessful Search.

*. A Tree which costs a optimal from $\sum_{i=1}^{n} P(i)$ and $\sum_{i=1}^{n} q(i)$ is called optimal Binary Search Tree (OBST).

2. Solving Methods of Divide & Conquer method.

* A problem can be divided into sub-problems.
* On solving the sub-problems, the solution for the original problem can be obtained.
* Such problems can be solved using divide and conquer method.

* Merge Sort
* Quick sort
* Binary Search
* Finding maximum and minimum.

3. Elements of Dynamic programming:

* Overlapped sub problem.
  - Top-down approach.
  - Bottom-up approach.
* Optimal sub structure

4. Principle of Optimality & Duality:

optimality:

The principle of optimality

states that "in an optimal sequence of decisions or choices, then the sequence must be an optimal."

Duality:

* The Duality of boolean statement states that, if the boolean statement is true, then the normal, Dual statement is also true.

* The Duality of boolean statement is found by replacing this statement for their counterpart.

*. That means, if '0' becomes '1'
'1' becomes '0'
'+' becomes '.'
'.' becomes '+'.

5. Huffman Tree:

* Huffmann Tree is a binary tree used in lossless Data compression.

*. Huffman Trees are constructed by encoding the given text with in characters.

*. While encoding, each characters are associated with some text or bit sequence.

* Such bit sequence is called "code word".

6. Applications of Backtracking:

* Knapsack's problem.
* Finding Hamiltonian path
* Eight Queens problem
* Sum of subset problem.

7.

Divide & Conquer	Dynamic programming
* It consumes more time for execution	* It consumes less time for the execution.
* It is recursive	* It is non-recursive
* It is Top-down approach	* It is Bottom-up approach.
* Sub-problems are independent of each other.	* sub problems are inter-dependent of each other.
Eg:- Merge sort, Quick sort.	Eg: Fibonacci series or number.

10) b)

Activity Selection Problem:

Greedy Algorithm:

Step 1 : Sort the given items in ascending order according to their finishing time.

Step 2 : consider the item 1 and check whether the condition 'ST < FT' is true or not.

Step 3 : If the condition is true, move on to the next step.

Step 4 : consider the finishing time of 1st Item, check whether the starting time contains same finishing time value

Step 5 : If it contains then proceed with that Item.

Step 6 : If not then stop the activity.

Given:

$I_1(1-3), I_2(0-2), I_3(3-6), I_4(2-5),$
$I_5(5-8), I_6(3-10), I_7(7-9).$

activity	starting time	Finishing time
I_1	1	3
I_2	0	2
I_3	3	6
I_4	2	5
I_5	5	8
I_6	3	10
I_7	7	9

Solution :

activity	Starting time	Finishing time
I_2	0	2
I_1	1	3
I_4	2	5
I_3	3	6
I_5	5	8
I_7	7	9
I_6	3	10

I_2 :

ST = 0

FT = 2

ST < FT

(condition is true)

∴ 0 < 2

I_4:

$ST = 2$

$FT = 5$

$ST < FT$

$\therefore 2 < 5$ (condition is true)

I_5:

$ST = 5$

$FT = 8$

$ST < FT$

$\therefore 5 < 8$ (condition is true)

The activity does not contain the finishing time value in the starting time.

Then the Time Complexity = $\{I_2, I_4, I_5\}$

11.)

a.) Huffmann Tree:

* Huffmann Tree is a binary tree used in lossless data compression

Huffman trees are constructed by encoding the given text with in characters.

While encoding, each characters are associated with a "bit sequence".

* Such a bit sequence is called "code word".

* 2 techniques
  - Fixed Length
  - Variable Length.

* Fixed length are associated with "bit values" with same length.

* Variable length are associated with "code word" with different length.

Given problem:-

character	i	m	c	g	h	f	k	j
Frequency	119	96	247	283	72	77	92	91

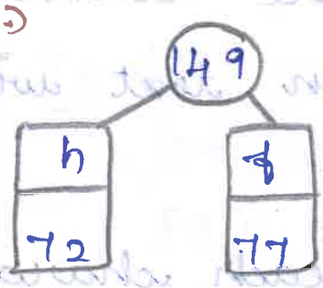
Solution:

A & O:

h f j k m i c g

72 77 91 92 96 119 247 283.

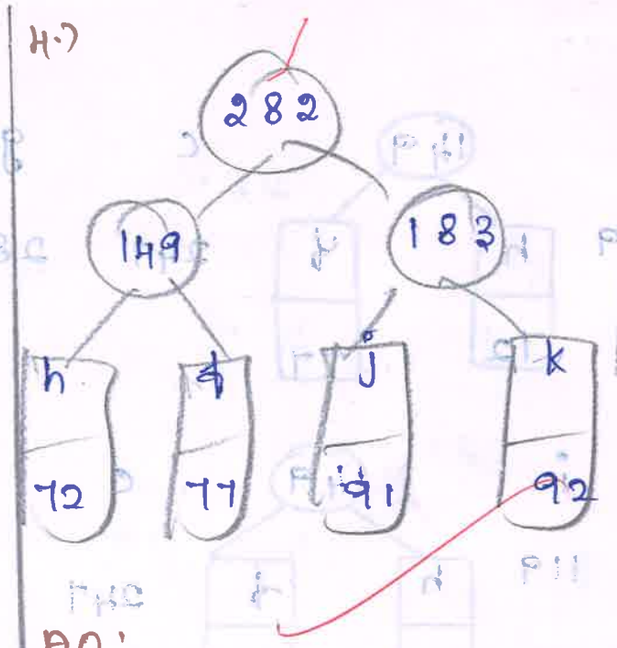
B)



j k m i c g

91 92 96 119 247 283

H:)


282
149
183
h
72
d
77
j
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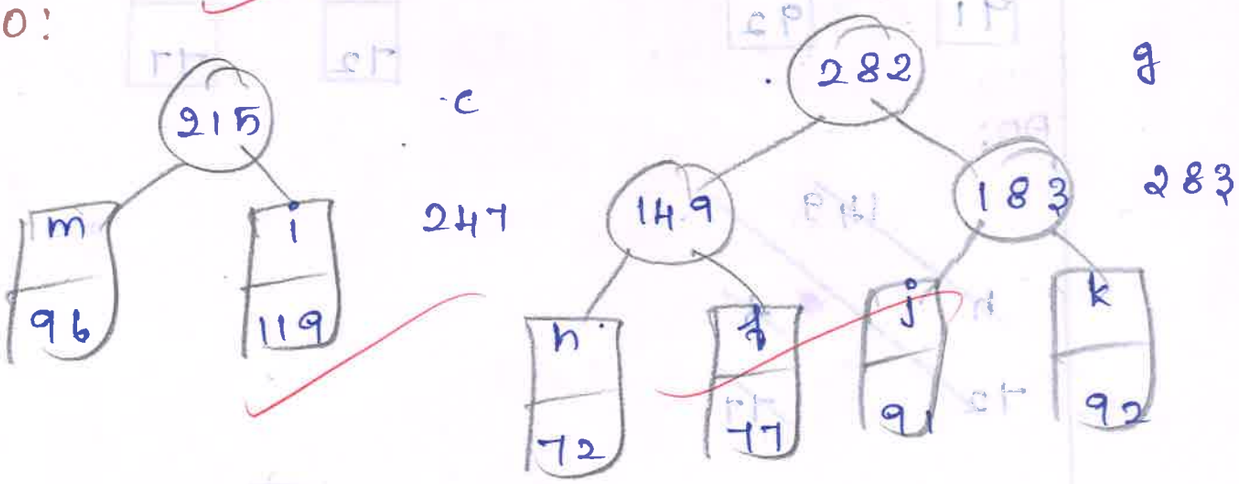
k
92
215
m
96
i
119
e
247
g
283

AO: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m
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77
j
91
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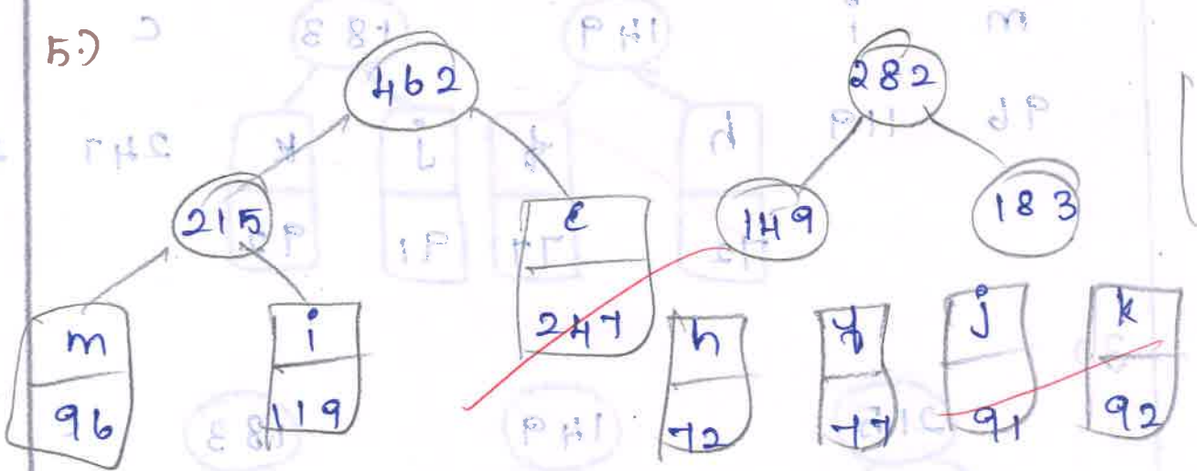
g
283

5:)


462
215
m
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i
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e
247
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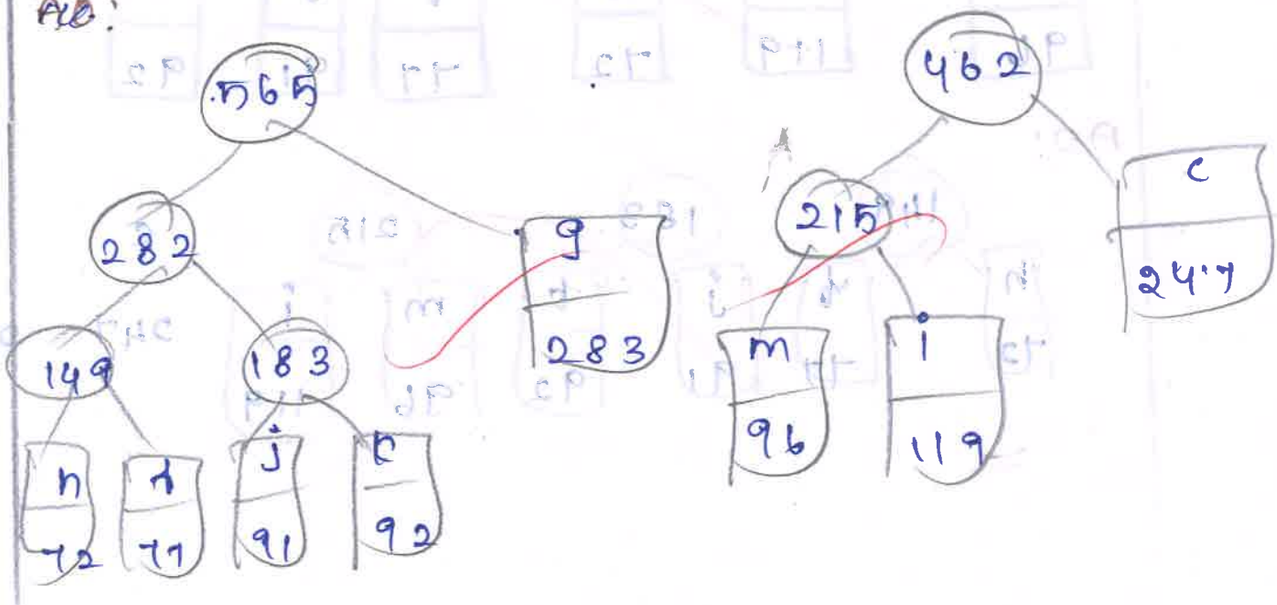
149
183
h
72
d
77
j
91
k
92
g
283

AO:


462
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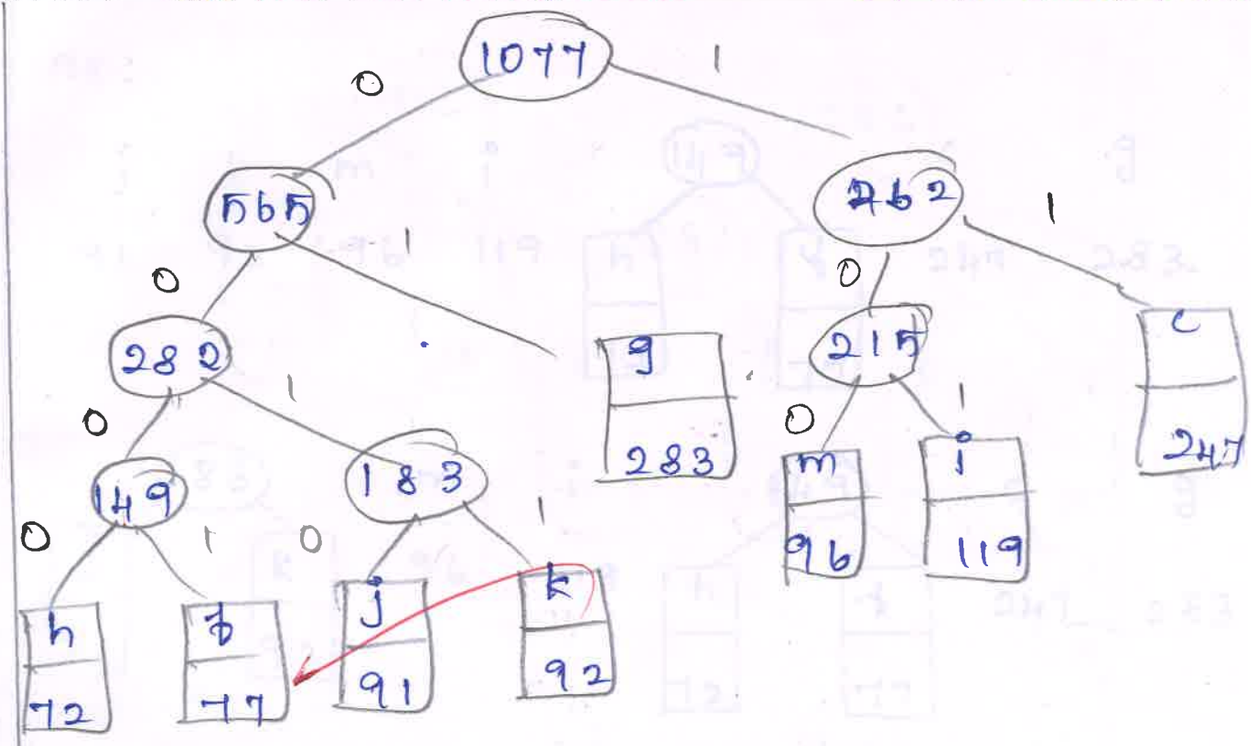


Huffman Code.

i - 101

m - 100

c - 11

g - 01

h - 0000

f - 0001

k - 0011

j - 0010.

NAME : V. KEERTHIGHA

REG NO : 731222104022

SUBJECT : ALGORITHMS

SUBJECT : CS3401

CLASS : II-nd YEAR CSE

DATE & SESSION : 7/8/24 & AN

28/50

56%

7/8/24

INTERNAL ASSESSMENT - II

Part - B

10 b $I_1(1-3)$, $I_2(0-2)$, $I_3(3-6)$, $I_4(2-5)$, $I_5(5-8)$, $I_6(3-10)$, $I_7(7-9)$

Solution

algorithm

Step 1: start to arange assending with finising element

Step 2: next check all at assending order or not.

Step 3:

find starting time compare with finishing time less than or.

Step 4:

less than means go to finishing element and continue with as.

Step 1

	Starting time	finishing time
I_1	1	3
I_2	0	2
I_3	3	6
I_4	2	5
I_5	5	8
I_6	3	10
I_7	7	9

Step

finishing time base arrage assending order.

	Starting time	finishing time
I_2	0	2
I_1	1	3
I_4	2	5
I_3	3	6
I_5	5	8
I_7	7	9
I_6	3	10

Step 3

find less than or

I_2 $ST < FT$

I_2 $0 < 2$ (condition true)

I_4 $ST < FT$

I_4 $2 < 5$ (condition true)

$ST < FT$

I_5 $5 < 8$ (condition true)

∴ The activity selection I_2, I_4, I_5

11

b) Sum of Subsets

(3, 5, 6, 7, 2) with sum : 15

Solution

algorithm

Step 1: Start the empty set.

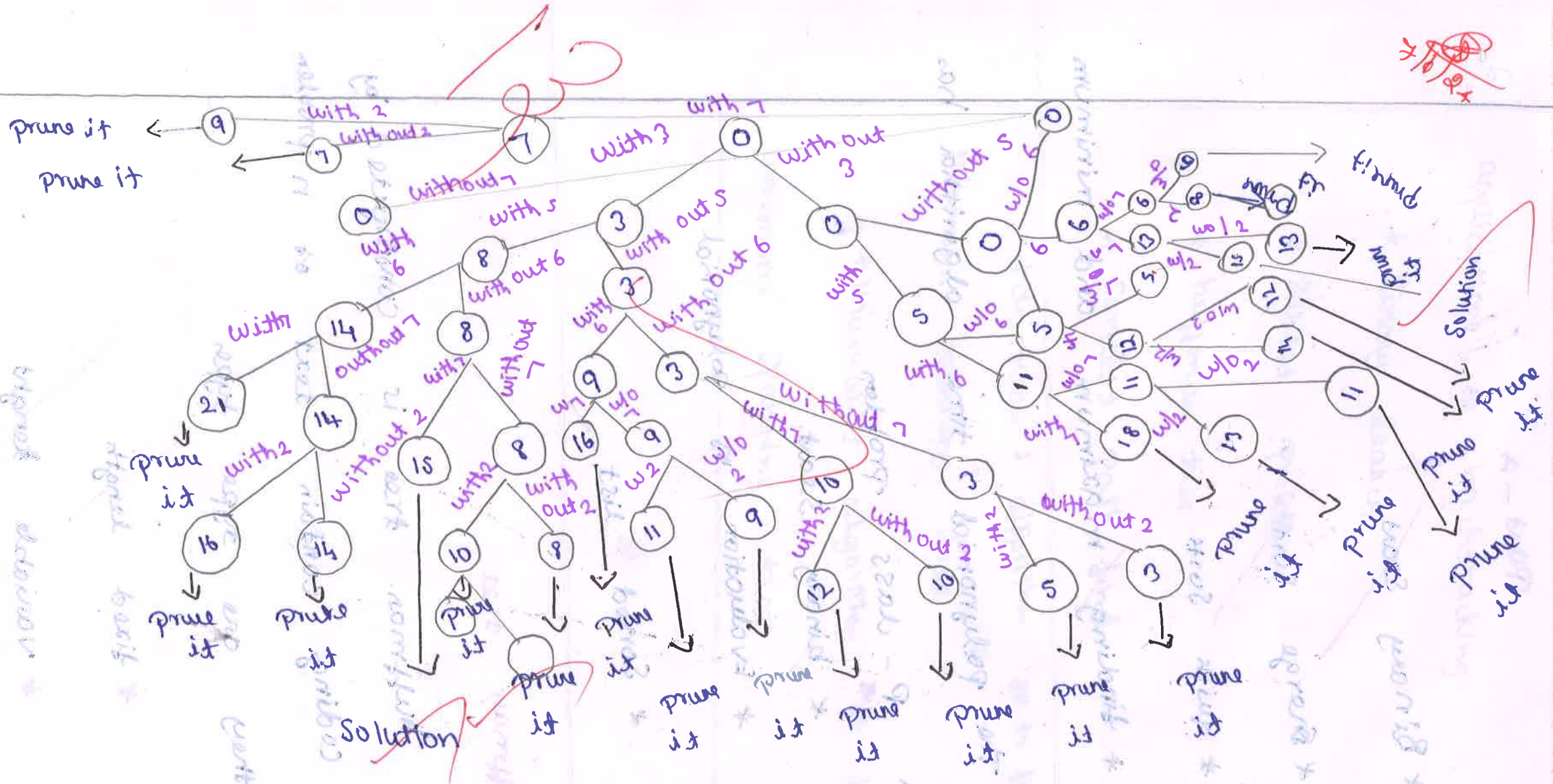
Step 2: Insert one element with and without condition base.

Step 3: arrange all element should

Step 4: calculate sum of subset element.

(3, 5, 6, 7, 2)	
3	move i to next state
3 + 5 = 8	go to next state
3 + 5 + 6 = 14	go to next state
3 + 6 = 9	now to to next state
7 + 2 + 3 = 12	not found move next
6 + 7 = 13	not found move to next state
6 + 7 + 2 = 15	element is match

draw the tree representation of the Sum of Subset



Sum of subset 15 = 15

Part – A

1.

* Binary Search
* Merge Sort
* Quick Sorts
* finding maximum and minimum

9.

The polynomial time algoritha has been P - class problem

* binary Search
* Evaluation of polynomial
* Sorted list

5.

huffman tree

Huffman tree is constructed by en coding contain text or n problem they are type types

* fixed length
* variable lenght

6.

Applications of backtracking

* Binary Search
* Subset problem
* huffman tree
* Sortest path find
  * dijstkstra's algorithm to finding minimum spanning tree
  * Kruskal's algorithm to find minimum spanning tree

JKK MUNIRAJAH COLLEGE OF TECHNOLOGY(AUTONOMOUS)

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

II CSE/IV SEM

CS3401/ALGORITHMS

ASSIGNMENT-1

S.NO	REG NO	NAME	BATCH NO	TOPICS	MARKS
1	731222104001	ABINAYA P	BATCH 1	Asymptotic Notation and its Properties,Breadth First Search	40
2	731222104002	BHARATH KRISHNAN V			39
3	731222104003	CHANDRAKALA N			40
4	731222104004	CHANDRU K			39
5	731222104005	DEEPA T	BATCH 2	Depth First Search,Asymptotic Notation and its Properties	40
6	731222104006	DEVADHARSHINI M			40
7	731222104008	ELAKKIYA K			40
8	731222104009	GIBSON SHANTHAKUMAR R			38
9	731222104010	GOKILA S			40
10	731222104011	GOKULRAJA G	BATCH 3	Linear Search,Kruskals Algorithm	AB
11	731222104012	HAFILA A			40
12	731222104013	INIKA C			40
13	731222104014	JAYASHREE K			40
14	731222104015	JAYASREE D			40
15	731222104016	JAYASURYA B			40

16	731222104018	JOTHI N	**BATCH 4**	Binary Search Tree,Prims Algorithm	39
17	731222104019	JOTHI S			40
18	731222104020	KARTHI K			40
19	731222104021	KARUNYA K			40
20	731222104022	KEERTHIGA V			40
21	731222104023	LAKSHMI B	**BATCH 5**	Interpolation Search,Dijkstra's Algorithm	40
22	731222104024	LINGARAJU K			40
23	731222104025	NEETHU S			40
24	731222104026	NIVETHA P			39
25	731222104027	POOMATHI S			40
26	731222104028	PRAZWAL.B			AB
27	731222104029	PUSHPASRI M	**BATCH 6**	Insertion Sort,Floyd Warshalls algorithm	40
28	731222104030	RAKSHITHA V			40
29	731222104031	SAHEER H			40
30	731222104032	SANJAIKUMAR S			40
31	731222104033	SANJAY V	**BATCH 7**	Naïve String Matching Algorithm,Merge Sort	40
32	731222104034	SANJAY KUMAR S			40
33	731222104035	SATHIYALAKSHMI M			40
34	731222104036	SHAKTHI S			40
35	731222104038	SIDHARAJ S			40

36	731222104039	SOWDESWARI A	BATCH 8	Rabin Karp Algorithm,Quick Sort	40
37	731222104040	SOWNDHAR D			40
38	731222104041	SUMITHRA S			40
39	731222104302	GOWTHAM A			40

SUBJECT INCHARGE

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G. Inika

BE-II CSE

Algorithms

CS3401

731222104013

Assignment-1

40/40

1. Linear Search

Searching :-

* Seaching is the process of determing whether the element is present in the given list of elements or not.

* The searching technique is based on the search key.

* This key compare with the array elements.

* If the key and the current element matches then position of that element is returened.

* Common searching algorithm are Linear Search, Binary search and then iterpolation search.

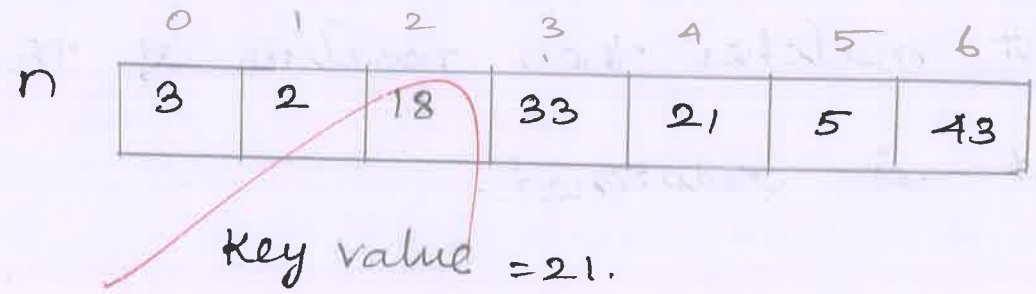
Linear search:-

* It is also called as sequential search.

Linear searching is a searching technique in which every element is compared with the key. Linearly from first to last element of list.

* The time complexity of algorithm is O(n). The time complexity will increase linearly with these values of n.

Example:-



solution:

* 21 is compared with the first element in the list (21 ≠ 3). so the

element is not found so compare next element.

* 21 is compared with second element in the list (21 ≠ 2). So the element is not found so compare next element.

* 21 is compared with third element in the list (21 ≠ 18). so the element is not found so compare next element.

* 21 is compared with Fourth element in the list (21 ≠ 33). so the element is not present so we compare the next element.

* 21 is compared with Fifth element with the element 21 with value of 21 [21 = 21]. The element is found.

* No need to compare the next elements.

Implementation of Linear Search Algorithm:

```
// C++ code to linearly search x in a arr[].

#include <bits/stdc++.h>
using namespace std;

int search(int arr[], int N, int x)
{
    for (int i=0; i<N; i++)
        if (arr[i] == x)
            return i;
    return -1;
}
// Driver code
int main(void)
{
    int arr[] = {2, 3, 4, 10, 40};
    int x = 10;
    int N = sizeof(arr) / sizeof(arr[0]);
    // Function call
    int result = search(arr, N, x);
```

```
(result == -1)
    ? cout << "Element is not present in
                                array"
    : cout << "Element is present at
                index " << result;
    return 0;
}
```

Output:

* Element is present at index 3

Advantages:

* It is simple to implement It Does not requring specific ordering before applying the method

Disadvantage:-

* It is less efficient

2. Kruskal's Algorithm

*In this article, we will discuss Kruskal's algorithm. Here, we will also see the complexity, working, example, and implementation of the Kruskal's algorithm.

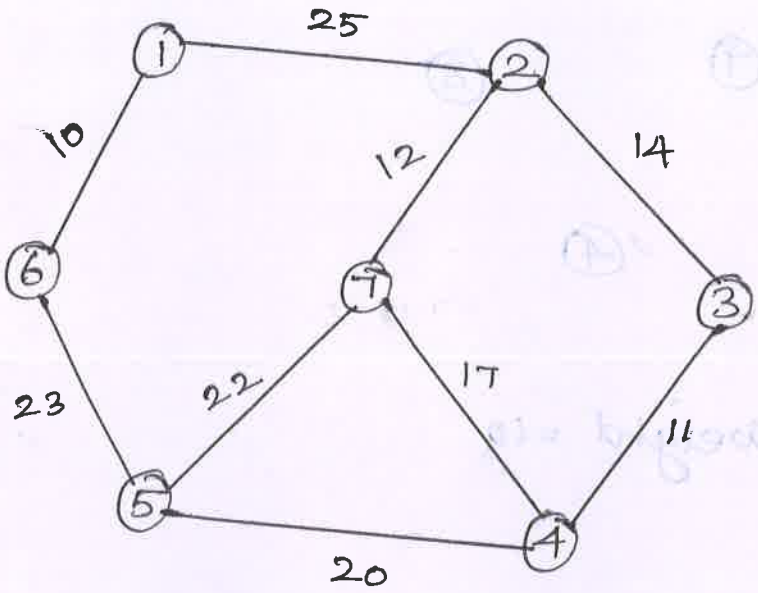
*But before moving directly towards the algorithm, we should first understand the basic terms such as spanning tree and minimum Spanning tree.

*Spanning tree - A spanning tree is th sub graph of an undirected connected graph.

*Minimum spanning tree - Minimum spanning tree can be defined as the spanning tree in which the sum of the weights of the edge is minimum. The weight of the Spanning tree is the sum of the weights given to the edges of the spanning tree.

Example:-

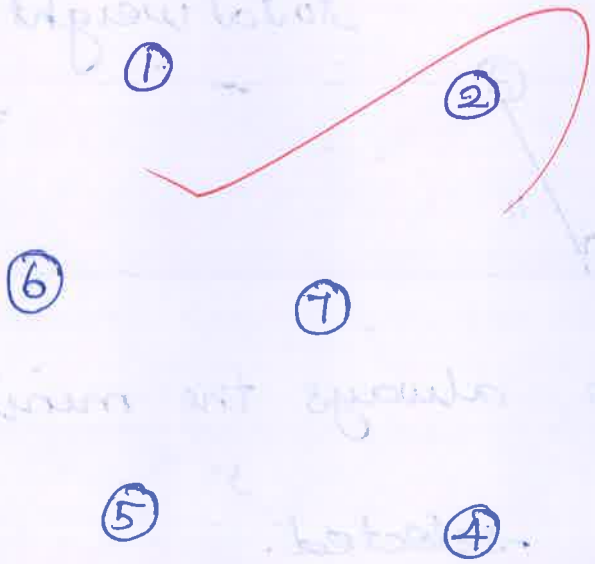
Apply Kruskalis algorithm for the graph.



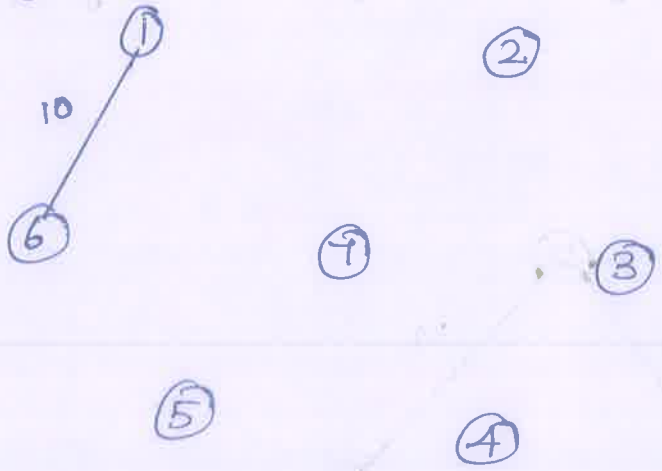
solution:

Step 1:

empty graph



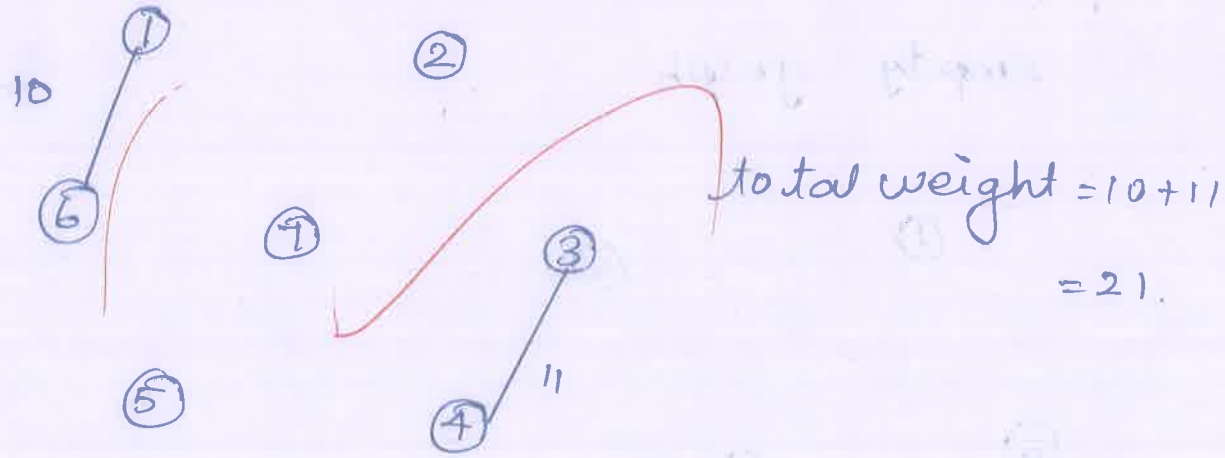
Step : 2 we will find the graph lowest weight.



total weight = 10

step 3 :

we will find the graph is



total weight = 10 + 11

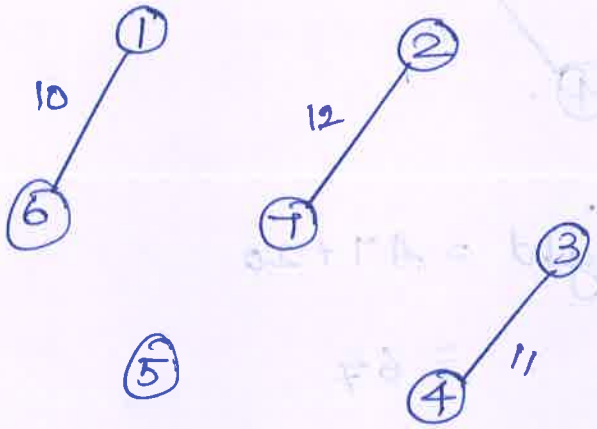
= 21.

In this algorithm always the minimum cost edge has to be selected.

But it is not necessary that selected optimum edge is adjacent.

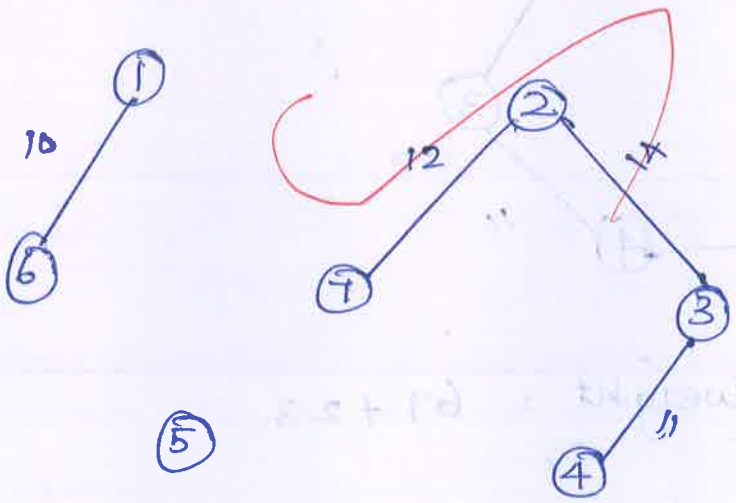
It should not be forming a circuit.

Step 4:



total weight = 21+12 = 33

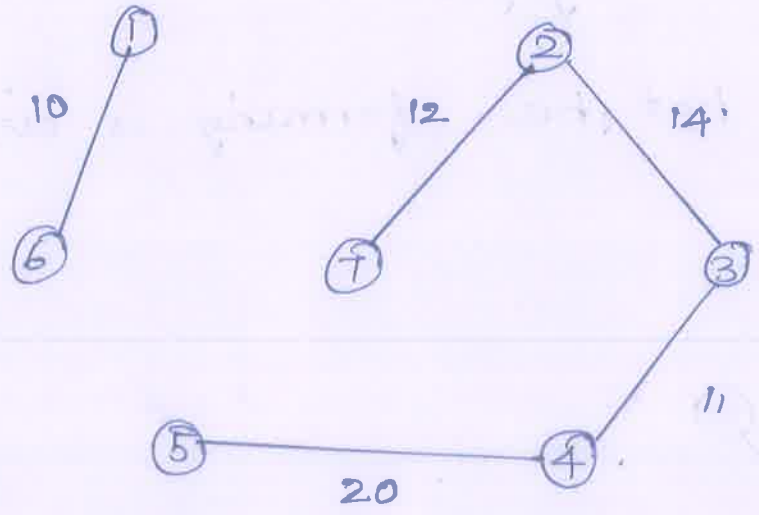
Step 5:



total weight = 33+14

= 47

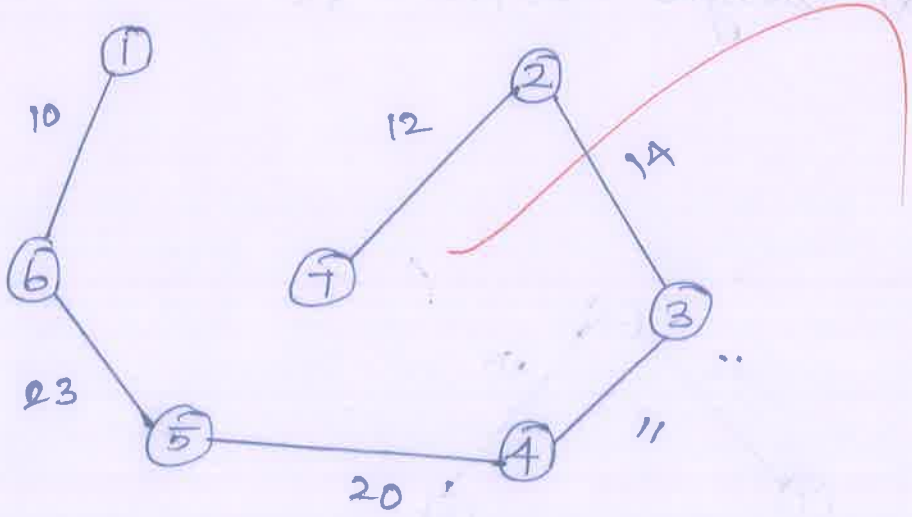
Step 6:



Net total weight = 47 + 20

= 64

Step 7:



total weight = 67 + 23

= 90.

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ABINAYA.P

B.E - CSE

II nd YEAR

ALGORITHM

CS 3401

ASSIGNMENT-I

40/40

ASMPTOTIC NOTATIONS AND ITS PROPERTIES

Asmptotic Notations are the mathematics used to describe the running time of an algorithm when the input return tens towards a particular value are a limiting value.

varience notations such as Ω, Θ, O are called asymptotic notations

Bigoh (O) notation:-

The Bigoh notations such denoted by (O) It is a method of a representing the upper bound of algorithms running time using Bigoh notation we can give largest

amount of time taken by the algorithm to complete.

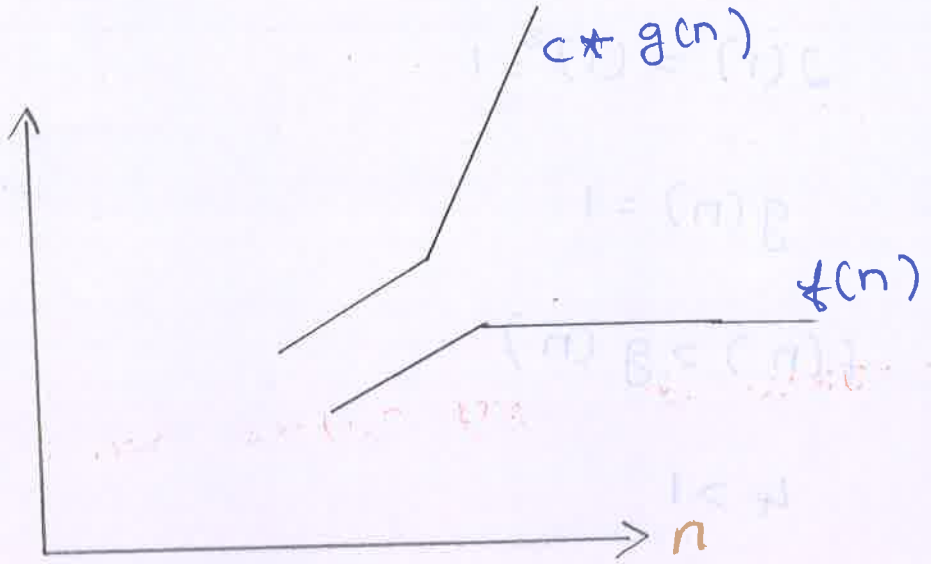
Definition:-

Let $f(n)$ and $g(n)$ be two non-negative function & Let no and constant c and two integers such that no denoted some value of input and $n > no$

c is constant such that c greather o we can write $f(n) \leq c * g(n)$ then $f(n)$ is bigoh of $g(n)$

It is also denoted as $f(n) \in O$ $g(n)$.

c is constant such that c greather o we can write $f(n) \leq c * g(n)$.



Example :-

constant the function $f(n)=2n+2$ and $g(n)=n^2$. Then we have to find same constant c so that $f(n) \leq c * g(n)$ - then we find c for n=1

soln :-

$f(n) = 2n+2$

$n=1;$

$=2(1)+2$

$f(n)=4$

$g(n)=n^2$

$2(1) = (1)^2 = 1$

$g(n) = 1$

$f(n) > g(n)$

$4 > 1$

if $n = 2$

$f(n) = 2n + 2$

$= 2(2) + 2 = 6$

$g(n) = n^2$

$= 2^2 = 4$

$f(n) > g(n)$

$6 > 4$

if $n = 3$

than,

$f(n) = 2n + 2$

$= 2(3) + 2$

$= 8$

$g(n) = n^2 = 3^2 = a$

$f(n) < g(n)$

$18 < 9$

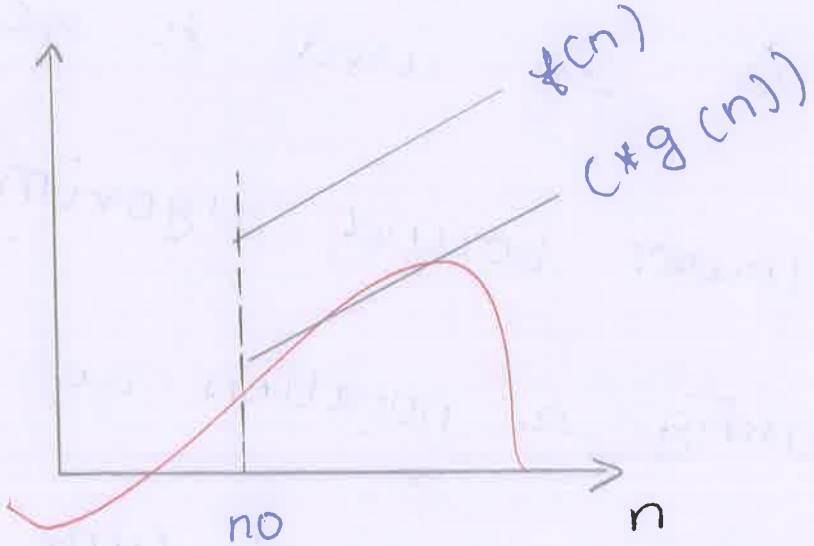
Omega :-

omega Ω notation is denoted by this is used to represent the lower bound algorithms running time. using Ω notation we can denoted shortest amount of time taken by algorithm.

using Ω notation we can denoted shorest amount of time taken by algorithm.

Definition:-

The function $f(n)$ is set to be in $\Omega(g(n))$ if $f(n)$ is bound below by some possective constant multiple of G of n such $f(n) \geq c*(g(n))$ for all $n \geq n_0$.



Ex:-

consider $f(n) = 2n^2 + 5$ and $g(n) = 7n$

if $n = 0$

$f(n) = 2(0)^2 + 5 = 5$

$g(n) = 7(0) = 0$

$f(n) > g(n)$

But if $n=1$

$f(n) = 2(1)^2 + 5 = 7$

$g(n) = 7(1) = 7$

$f(n) = g(n)$

if $n=3$ then

$f(n) = 2(3)^2 + 5$

$= 18 + 5 = 23$

$g(n) = 7(3)$

$= 21$

$f(n) > g(n)$

If can be represented as,

$$2n^2 + 5 \in \Omega(n)$$

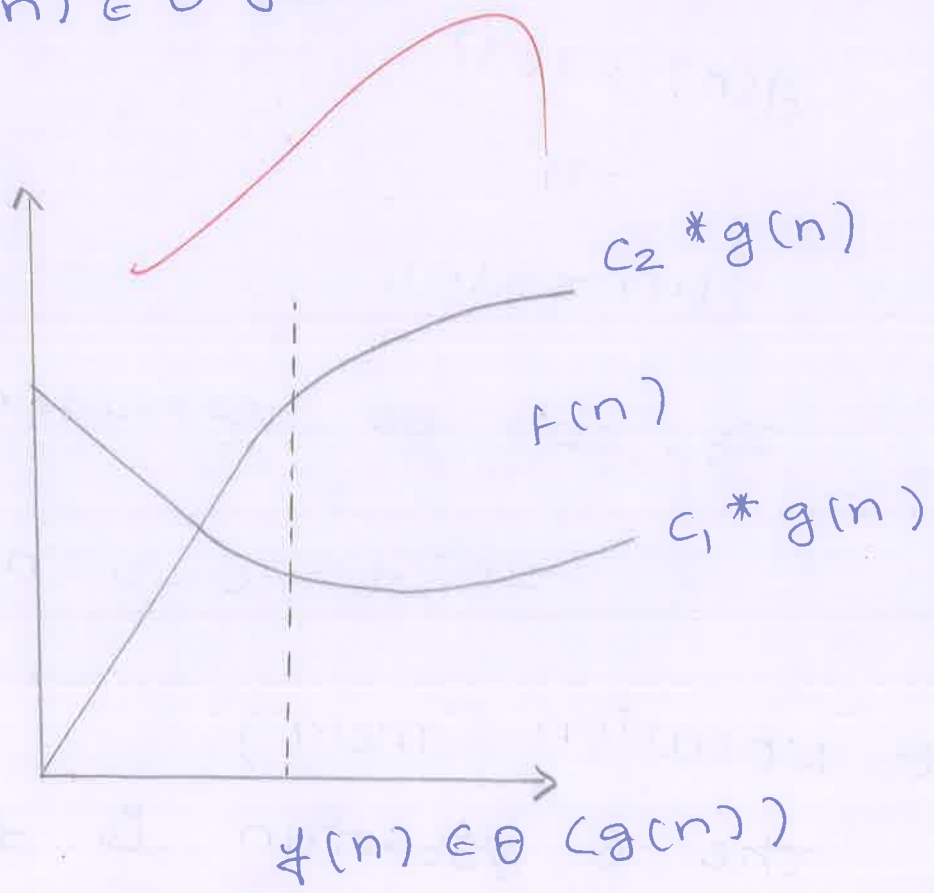
Θ Notation (Theta)

The Θ Notation is denoted

by this method the running time between lower bound and upper lower.

Definition:-

Let $f(n)$ and $g(n)$ be to non negative Function, There are to postive constant namely c_1 and c_2. such that c_1 into $g(n) \leq c_2 * g(n)$ we can say that $f(n) \in \Theta\, g(n)$



properties of Asymptotic Notations:-

As we know,

* Big oh notation is used for upper bound values.

* Big omega notation is used for lower bound values.

* Big theta notation is used for average bound values.

properties:-

1) General properties:-

i) If $f(n) = O(g(n))$ then $a * f(n) = O(g(n))$

ii) If $f(n) = \Omega(g(n))$ then $a * f(n) = \Omega(g(n))$

iii) If $f(n) = \Theta(g(n))$ then $a * f(n) = \Theta(g(n))$

2) Reflexive:-

If $f(n)$ is given then $f(n) = O(f(n))$ for

example - If $f(n) = n^2$ then $f(n) = O(n^2)$

similarly $f(n) = \Omega(f(n))$

$f(n) = \Theta(f(n))$

3) symmetry:-

$f(n) = \Theta(g(n))$ if any only if $g(n) = \Theta(f(n))$

If $f(n) = n^3$ and $g(n) = n^3$ then

$f(n) = \Theta(n^3)$ and $g(n) = \Theta(n^3)$

Note that symmetry property is true only for Θ notation.

4) transitivity:-

If $f(n) = O(g(n))$ and if $g(n) = O(h(n))$ then

$f(n) = O(n(n))$ is true

$f(n) = \Theta(g(n))$ and $O(g(n))$

$f(n) = \Omega(g(n))$ and $g(n)$

5) Transpose symmetry:-

$f(n) = O(g(n))$ if and only if

$g(n) = \Omega(f(n))$

$f(n) = n$

$g(n) = n^2$

then n is $O(n^2)$ and n^2 is $\Omega(n)$

If $f(n) = O(g(n))$

$f(n) = \Omega(g(n))$

$f(n) = \Theta(g(n))$

7) $\Theta(f(n) + g(n) = \max(f(n), g(n))$

2) BFS:- (Breadth First search):-

The BFS uses a Queue as an data structure to store nodes for further processing.

Algorithm:-

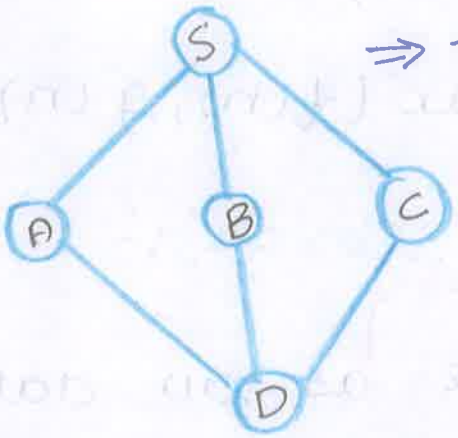
1) visit the adjacent visited vertex mark it as display it and insert

and a Queue.

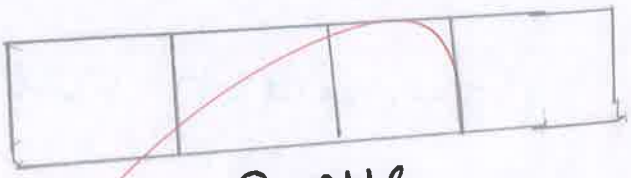
2) If node adjcent vertex is count remove the first vertex from the Queue.

3) Repeat one and two until Queue is empty.

EX:-

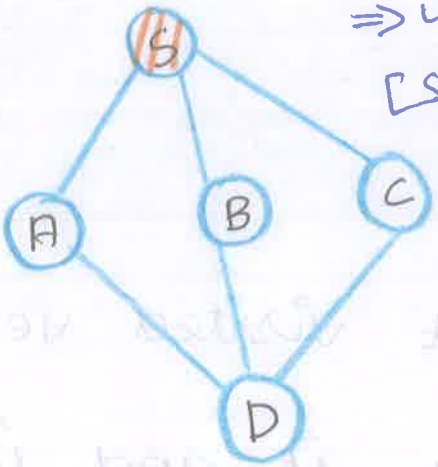


⇒ Initialize the Queue



Queue.

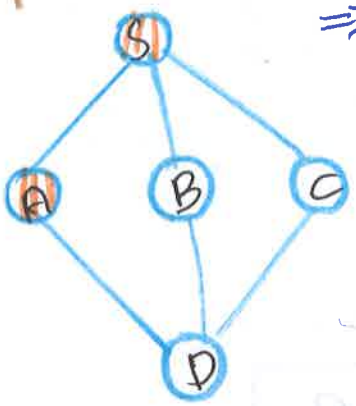
step : 2



⇒ we start from visiting s [starting node] and mark it is visited.

Queue.

Step:3

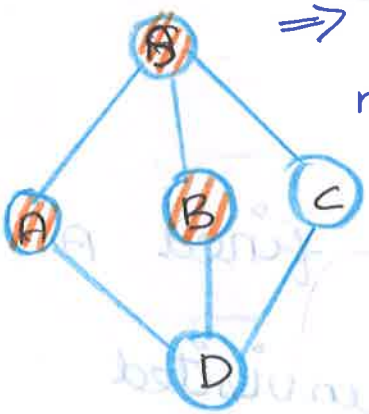


⇒ we see an unvisited adjcent node from S we have three nodes but alphatitically we c whose A.

A			

Queue

Step !4

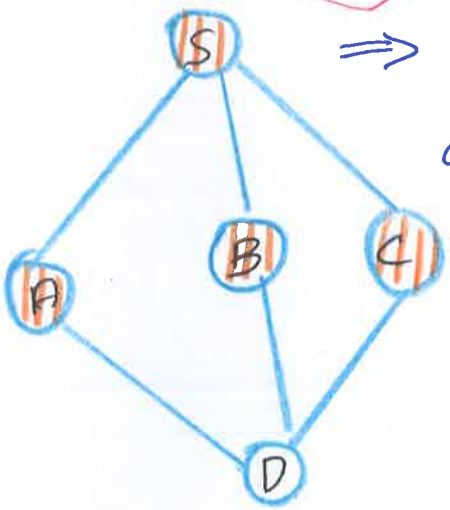


⇒ next the unvisited adjacent node from S in B we mark it as visited and enqueue.

B	A		

Queue.

Step 5 :-

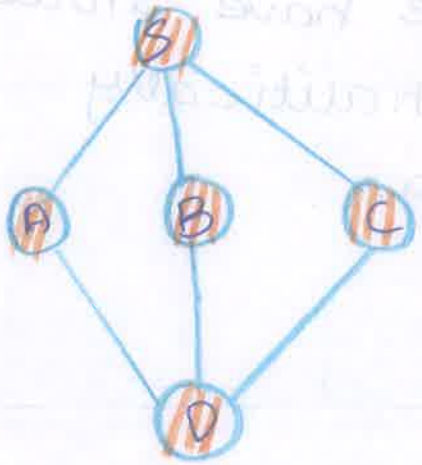


⇒ next, the unvisited adjcent node from S in B we mark it as S is visited and enqueue

C	B	A	

Queue.

step 6 :-



D	C	B	A

⇒ Now is left, with no unvisited adjacent nodes.

⇒ so we dequeue and fined A from A we have D as unvisited adjacent nodes.

JKK MUNIRAJAH COLLEGE OF TECHNOLOGY(AUTONOMOUS)

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

II CSE/IV SEM

CS3401/ALGORITHMS

ASSIGNMENT-2

S.NO	REG NO	NAME	BATCH NO	TOPICS	MARKS
1	731222104001	ABINAYA P	BATCH 1	Multi Stage Graph,Subset Sum Problem	40
2	731222104002	BHARATH KRISHNAN V			40
3	731222104003	CHANDRAKALA N			40
4	731222104004	CHANDRU K			40
5	731222104005	DEEPA T			40
6	731222104006	DEVADHARSHINI M	BATCH 2	Optimal Binary Search Tree,n-Queens Problem	40
7	731222104008	ELAKKIYA K			40
8	731222104009	GIBSON SHANTHAKUMAR R			40
9	731222104010	GOKILA S			40
10	731222104011	GOKULRAJA G	BATCH 3	Activity Selection Problem,Polynomial Time Algorithms	AB
11	731222104012	HAFILA A			40
12	731222104013	INIKA C			40
13	731222104014	JAYASHREE K			40
14	731222104015	JAYASREE D			40
15	731222104016	JAYASURYA B			40
16	731222104018	JOTHI N	BATCH 4	Huffman Trees,TSP-3CNF Problem	40
17	731222104019	JOTHI S			40
18	731222104020	KARTHI K			40
19	731222104021	KARUNYA K			40
20	731222104022	KEERTHIGA V			40

21	731222104023	LAKSHMI B	BATCH 5	Hamiltonian Circuit Problem,Primality Testing	40
22	731222104024	LINGARAJU K			40
23	731222104025	NEETHU S			40
24	731222104026	NIVETHA P			40
25	731222104027	POOMATHI S			40
26	731222104028	PRAZWAL.B			AB
27	731222104029	PUSHPASRI M	BATCH 6	Graph Colouring Problem,Randomized Quicksort	40
28	731222104030	RAKSHITHA V			40
29	731222104031	SAHEER H			40
30	731222104032	SANJAIKUMAR S			40
31	731222104033	SANJAY V	BATCH 7	Solving 15Puzzle Problem,Finding K th Smallest Number	40
32	731222104034	SANJAY KUMAR S			40
33	731222104035	SATHIYALAKSHMI M			40
34	731222104036	SHAKTHI S			40
35	731222104038	SIDHARAJ S			40
36	731222104039	SOWDESWARI A	BATCH 8	Assignment Problem,Huffman Trees	40
37	731222104040	SOWNDHAR D			40
38	731222104041	SUMITHRA S			40
39	731222104302	GOWTHAM A			40

SUBJECT INCHARGE

HOD

Principal
J.K.K.Munirajah College of Technology
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T.N.Palayam, Gobi (Tk),
Erode (Dt) - 638 506.

Assignment - 2

S. Sumithra

BE - II CSE

731222104041

Algorithms

CS3401

01.06.2024

40/40

1. Assignment Problem.

* There are n people to n jobs are to be assigned so that total cost of assignment is as small as possible.

* The assignment problem is specified by n by n matrix and each element in each row has to be selected in each row has to be selected in such a way that no two selected items are in the same column. and their sum is smallest.

Example:

Find the optimal solution using branch and bound for the following assignment problem.

	Job 1	Job 2	Job 3	Job 4
A	9	2	7	8
B	6	4	3	7
C	5	8	1	8
D	7	6	9	4

Solution :

Select Minimum value for each Row we get,

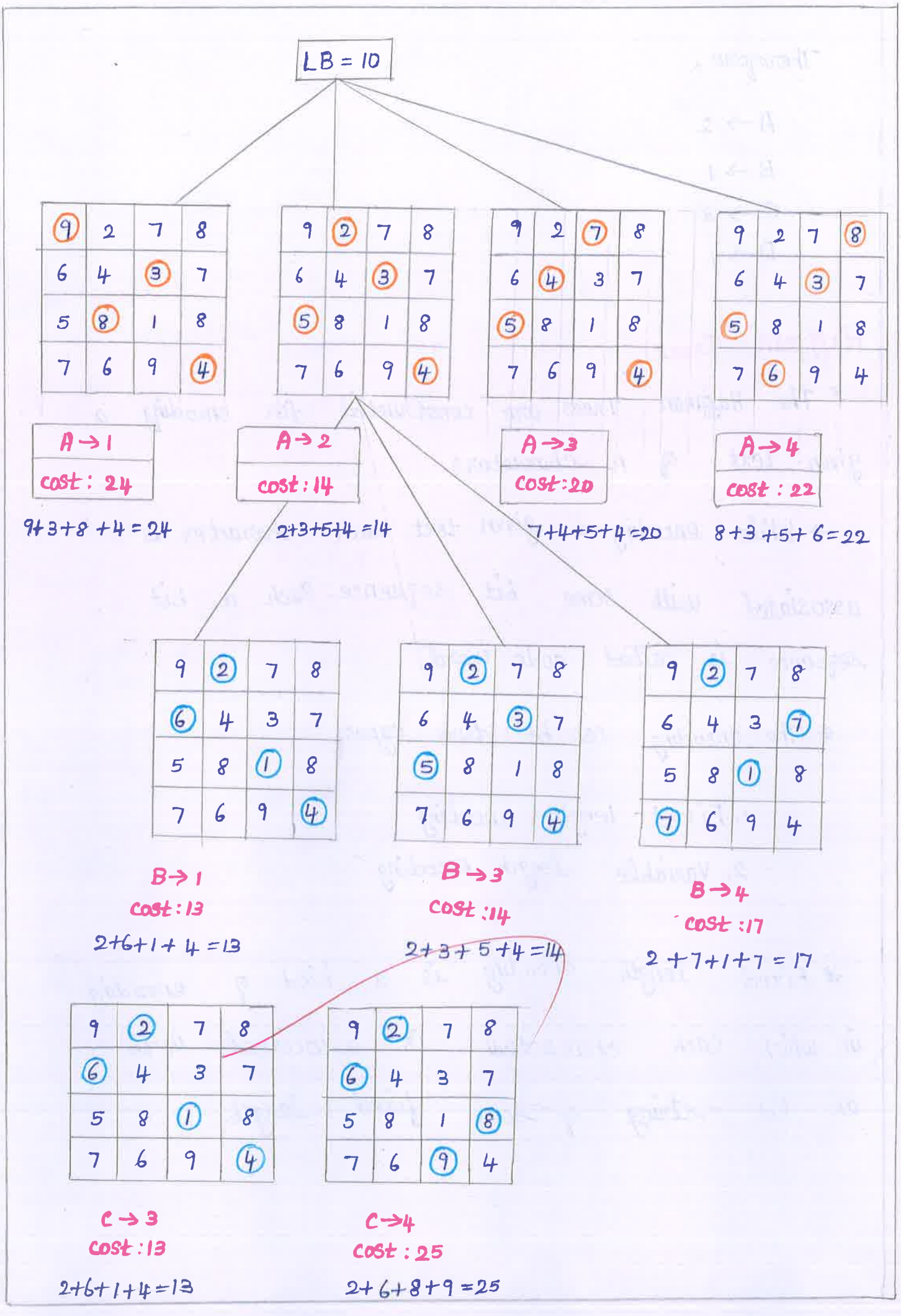
	Job 1	Job 2	Job 3	Job 4
A	9	(2)	7	8
B	6	4	(3)	7
C	5	8	(1)	8
D	7	6	9	(4)

Minimum value for each row

$= 2+3+1+4$

$= 10$

Lower bound = 10.


LB = 10
A → 1
cost : 24
9+3+8+4 = 24
A → 2
cost : 14
2+3+5+4 = 14
A → 3
cost : 20
7+4+5+4 = 20
A → 4
cost : 22
8+3+5+6 = 22
B → 1
cost : 13
2+6+1+4 = 13
B → 3
cost : 14
2+3+5+4 = 14
B → 4
cost : 17
2+7+1+7 = 17
C → 3
cost : 13
2+6+1+4 = 13
C → 4
cost : 25
2+6+8+9 = 25

Therefore,

A → 2

B → 1

C → 3

D → 4.

2. Huffman Trees:

The Huffman Trees are constructed for encoding a given text of n characters.

* While encoding a given text each character is assosiated with some bit sequence. Such a bit sequence is called code word.

* The encoding can be two types.

1. Fixed length encoding
2. Variable length encoding

* Fixed length encoding is a kind of encoding in which each characted is associated with an bit string of some fixed length.

Variable length encoding is a kind of encoding in which each character is associated with a code word of different lengths.

Example:

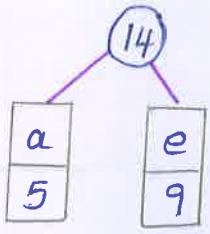
Character	a	b	c	d	e	f
Frequency	5	12	16	13	9	45

Solution:

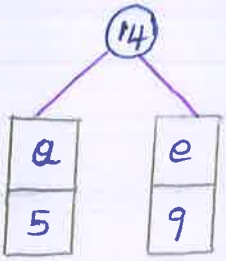
1) Arrange the values in ascending order

a	e	b	d	c	f
5	9	12	13	16	45

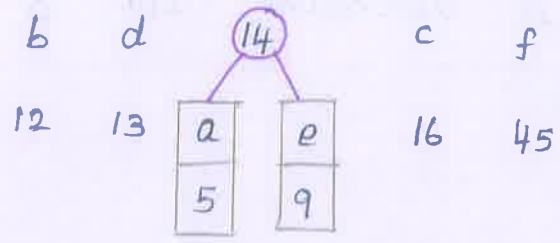
2) Take least two values to form the tree



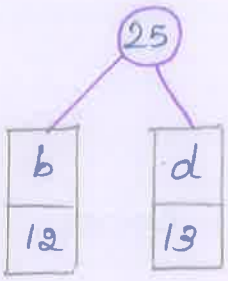
b	d	c	f
12	13	16	45

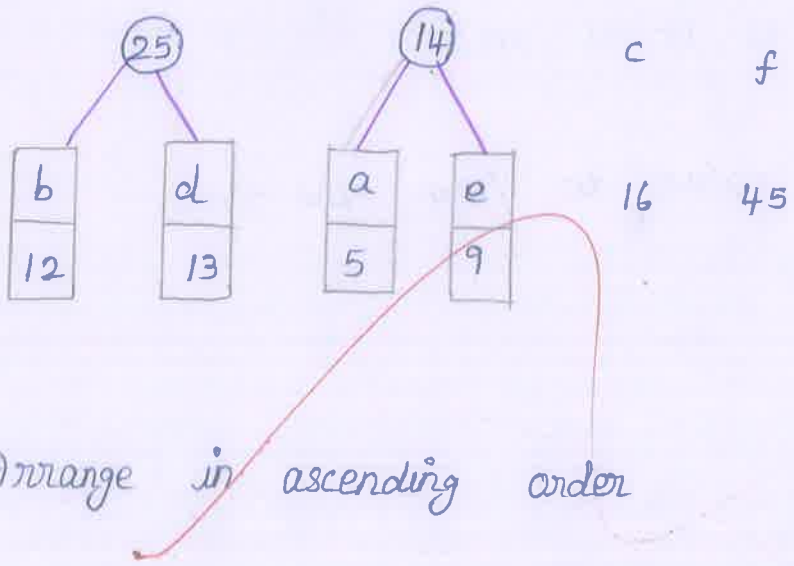


3) Next arrange in ascending order

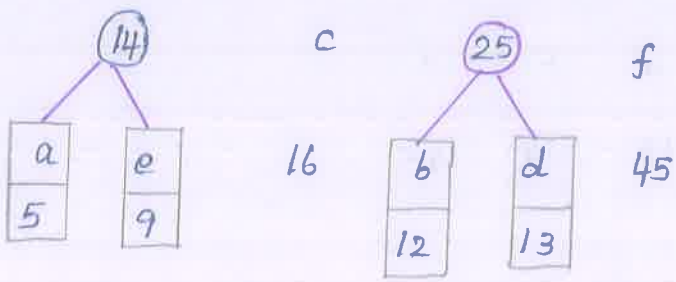


4) Take least two values to form the tree

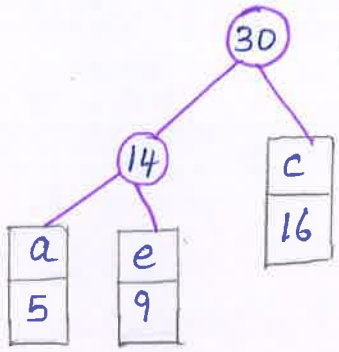


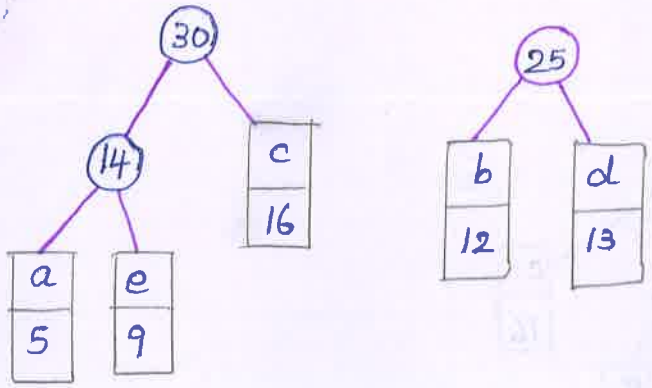


5) Arrange in ascending order



6) Take least two values to form the tree.

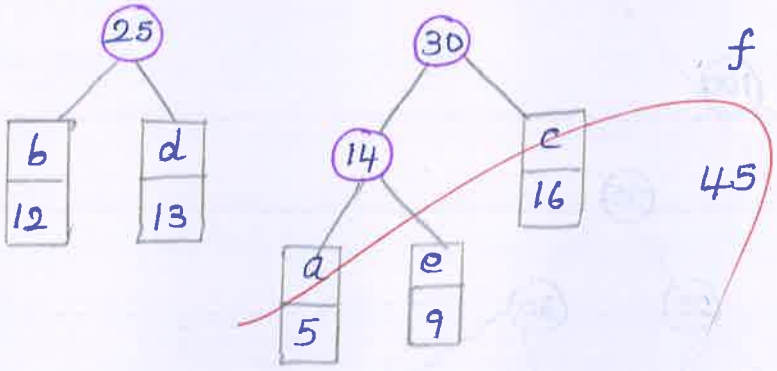




f

45

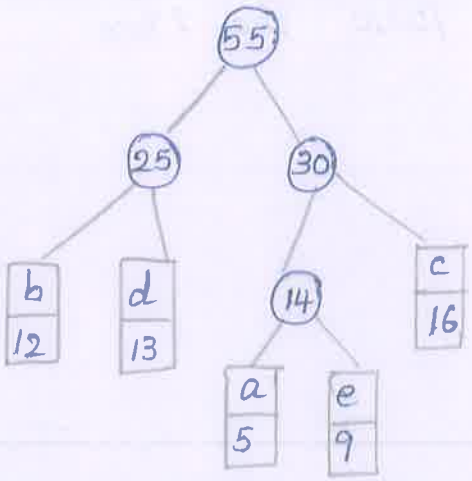
7) Arrange in ascending order



f

45

8) Take least two values to form the tree.



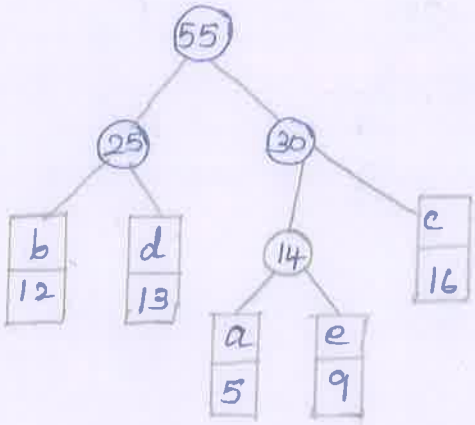
f

45

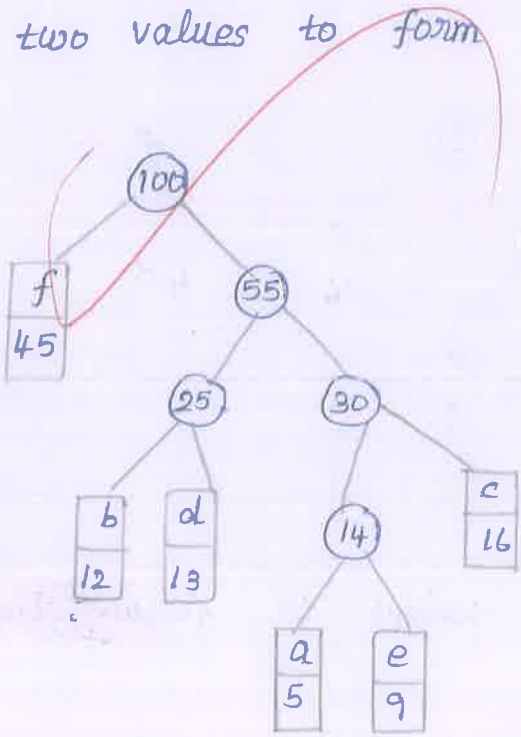
9) Arrange in ascending order

f

45

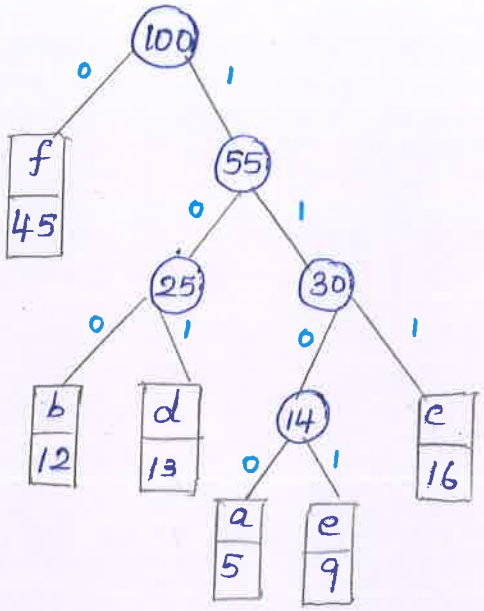


10) Take least two values to form the tree



11) Assign left child = 0

Right child = 1



a → 1100

b → 100

c → 111

d → 101

e → 1101

f → 0

S. SHAKTHI.
B.E (CSE).
II-yr
JKKMCT.
731222104036
ALGORITHMS.
CS-3401
ASSIGNMENT-2

40/40

Huffmann Trees:

* Huffman Tree problem is a greedy approach based lossless data compression algorithm.

* It uses variable-length encoding to compress the data

* The main idea in Huffman coding is to assign each character with a variable length code.

* The length of each character is decided on the basis of its occurence frequency.

* Huffman Tree problem was introduced by David Huffman.

* It generally compresses the most frequently occuring characters.

* It is implemented using the prefix rule.

Eg:-

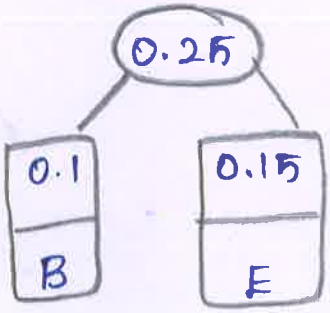
Symbol	A	B	C	D	E
Frequency	0.35	0.1	0.2	0.2	0.15

Ascending order:

0.1 0.15 0.2 0.2 0.35

B E C D E

1.)



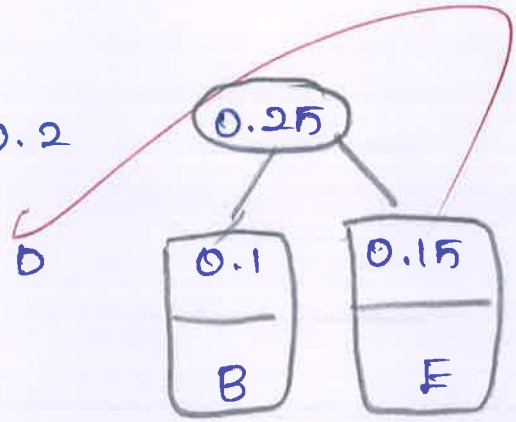
0.2 0.2 0.35.

C D E

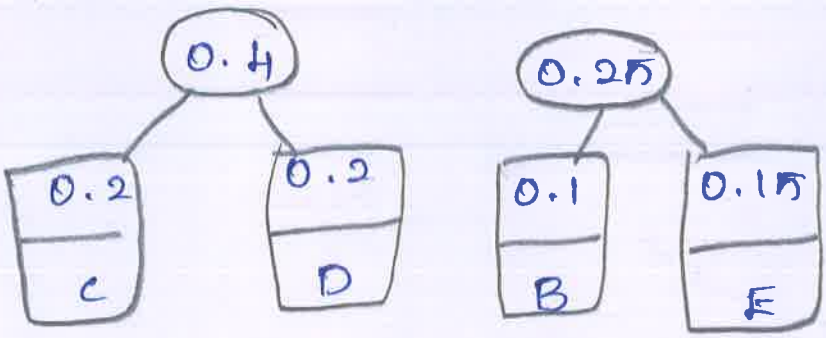
A : 0.

0.2 0.2 0.35

C D A



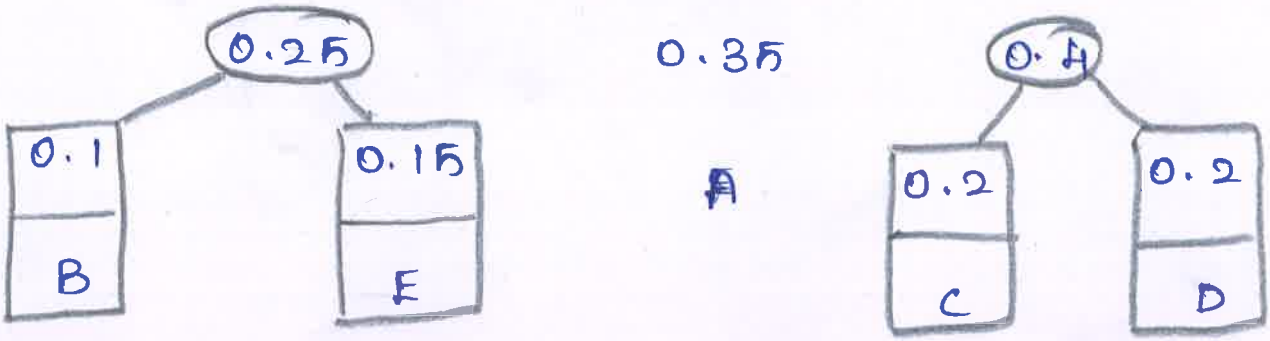
2)



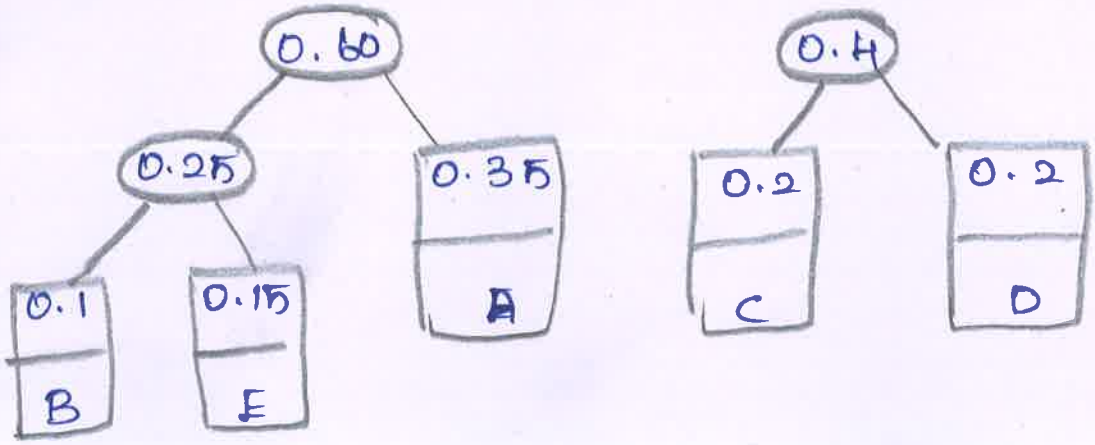
0.35

A

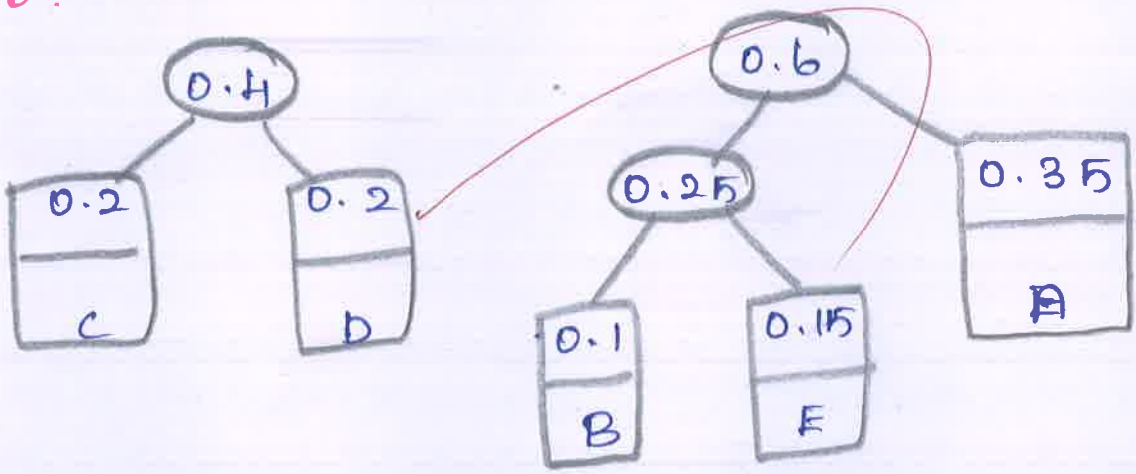
A0:


0.25
0.1
B
0.15
E
0.35
A
0.4
0.2
C
0.2
D

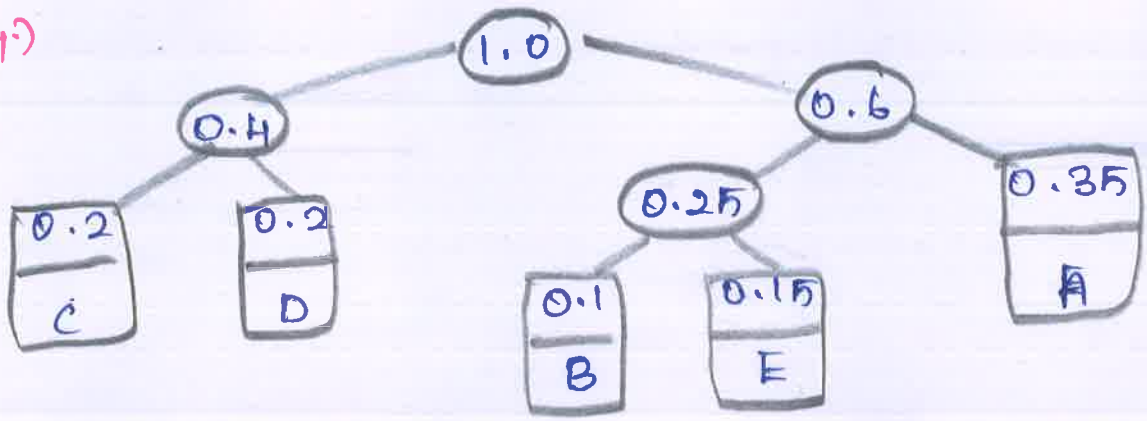
3:)


0.60
0.25
0.1
B
0.15
E
0.35
A
0.4
0.2
C
0.2
D

A0:


0.4
0.2
C
0.2
D
0.6
0.25
0.1
B
0.15
E
0.35
A

4:)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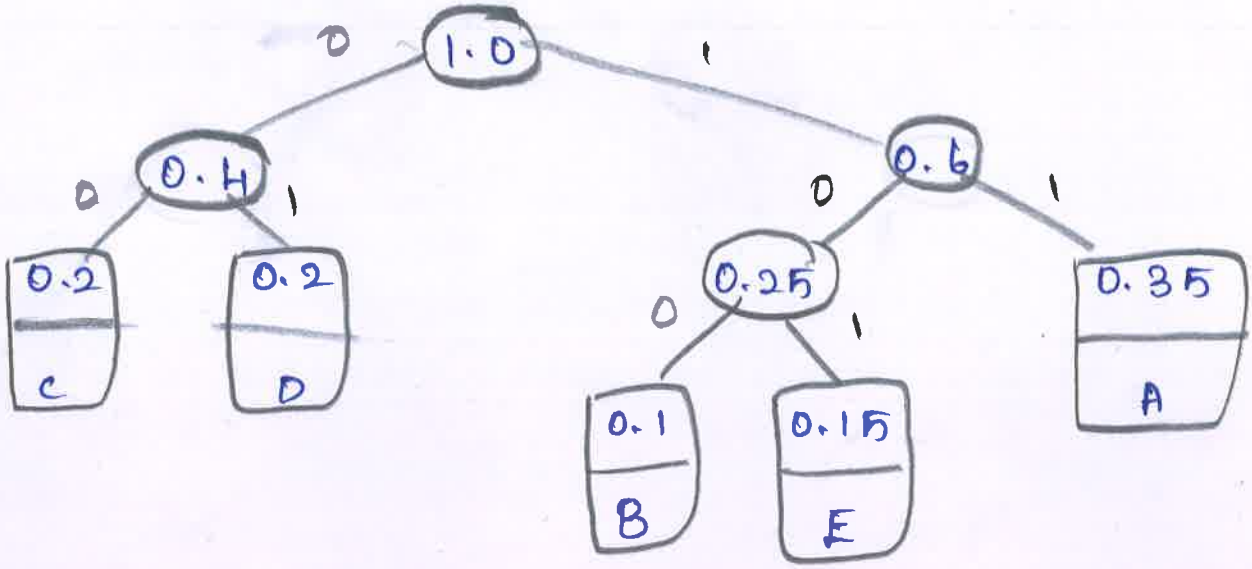


Huffman code:

A - 11

B - 100

C - 00

D - 01

E - 101

Assignment problem:

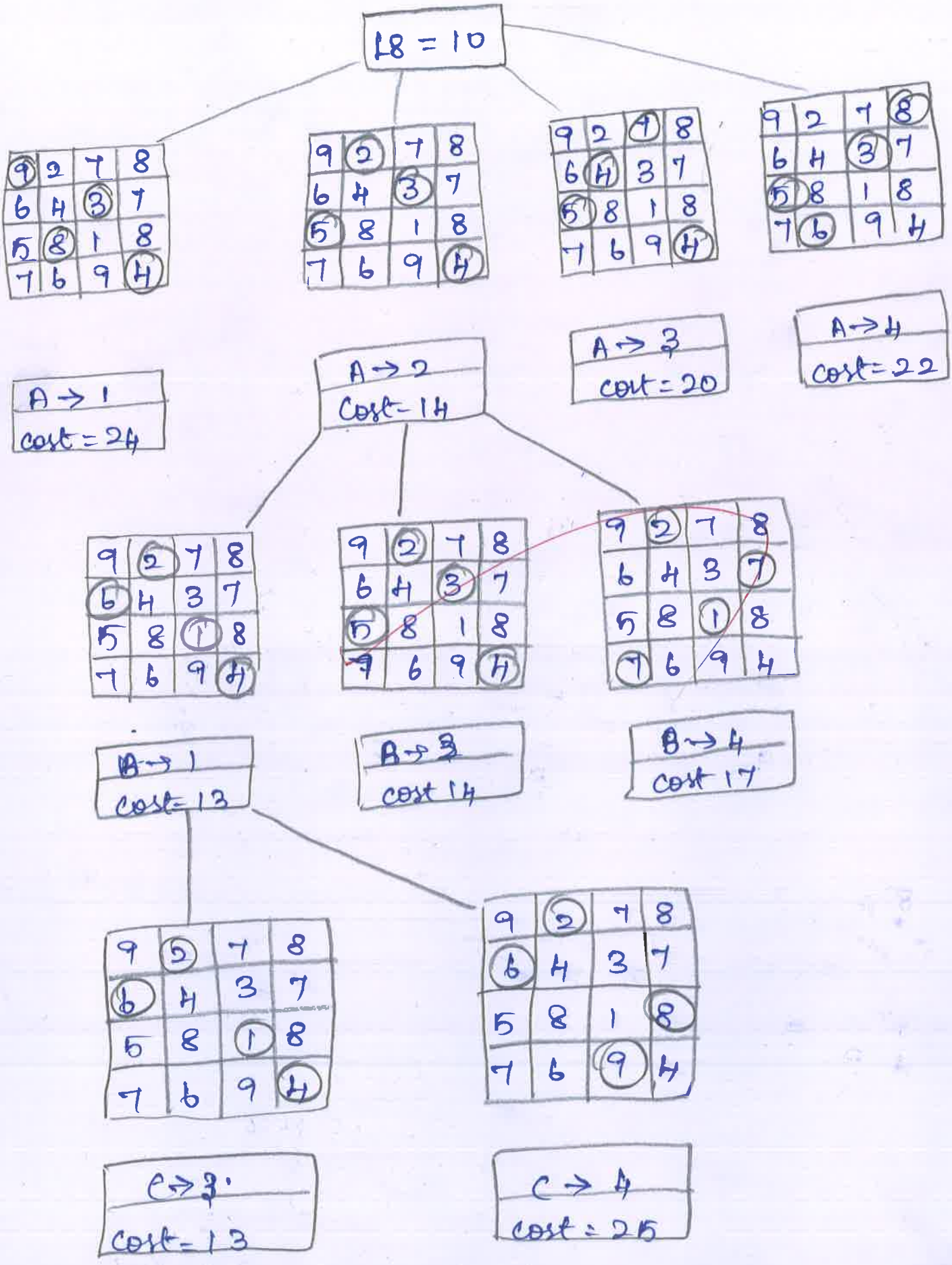
There are n people to n jobs are to be assigned so that total cost of assignment is as small as possible.

The assignment problem is specified by n by n matrix and each element in each row has to be selected in such a way that no two selected elements are in the same column and their sum is smallest as far as possible.

Eg:- Find optimal solution using branch & bound for the following assignment problem:

	J_1	J_2	J_3	J_4
A	9	2	7	8
B	6	4	3	7
C	5	8	1	8
D	7	6	9	4

Soln.


LB = 10
A → 1
cost = 24
A → 2
Cost = 14
A → 3
cost = 20
A → 4
Cost = 22
B → 1
cost = 13
B → 3
cost 14
B → 4
cost 17
C → 3
cost = 13
C → 4
cost = 25

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V. RAKSHITHA

B.E - CSE

II nd YEAR

ALGORITHMS

CS 3401

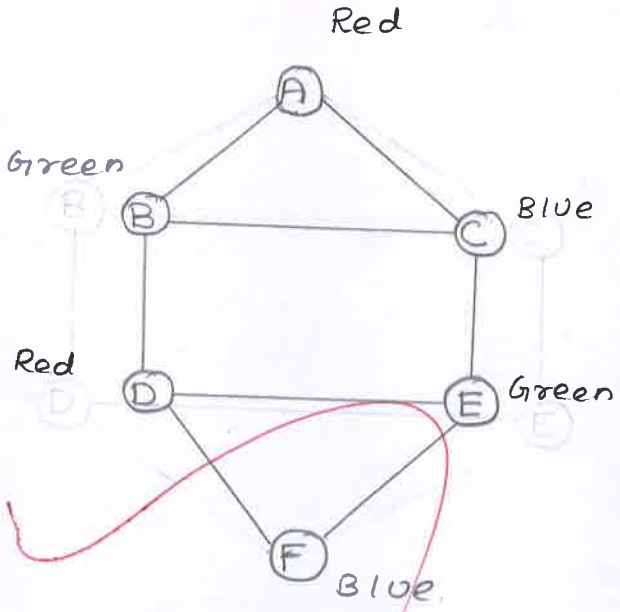
ASSIGNMENT - 02

***

40/40

GRAPH COLOURING PROBLEM

Graph coloring is a problem of coloring each vertex in graph in such a way that no two adjacent vertices have same colour and yet m-colors are used. this problem is also called m-coloring problem. If the degree of given graph is d then we can color it with d+1 colors. The least number of colors needed to color the graph is called its chromatic number. For example: consider a graph given diagram.



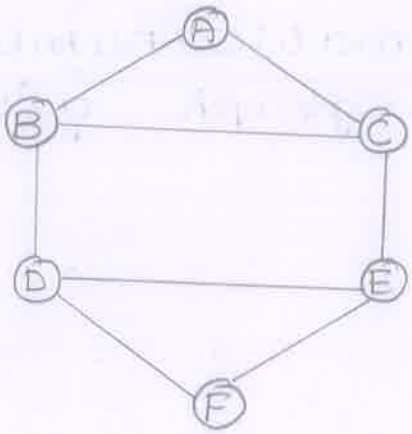
Graph and its coloring

The given diagram we require three colors to color the graph. Hence the chromatic number of given graph is. 3.

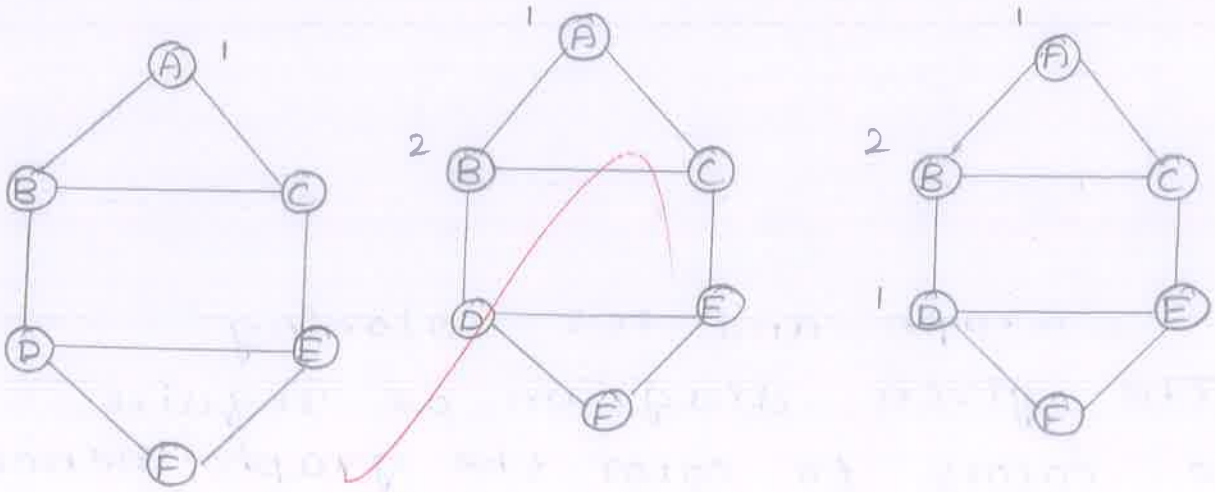
We can use backtracking technique to solve the graph colouring problem as follows.

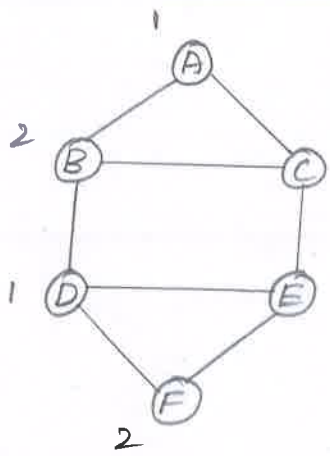
Step 1:

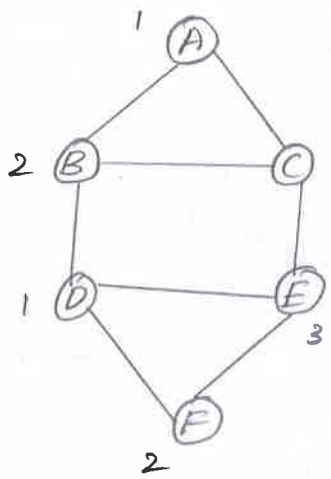
A Graph G consists of vertices from A to F there are three colors used red, Green and blue, we will number them out. that means 1 indicates Red, 2 indicates Green and 3 indicates Blue color.

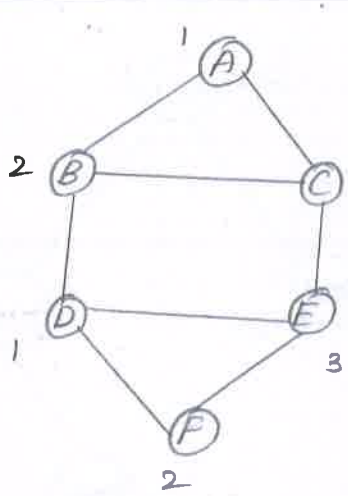


Step 2:





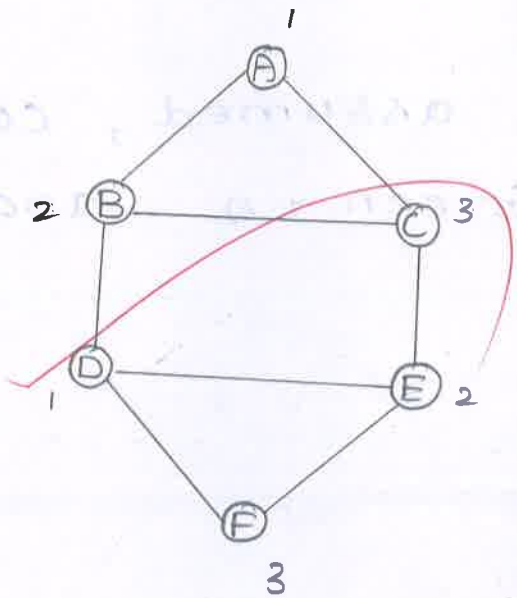


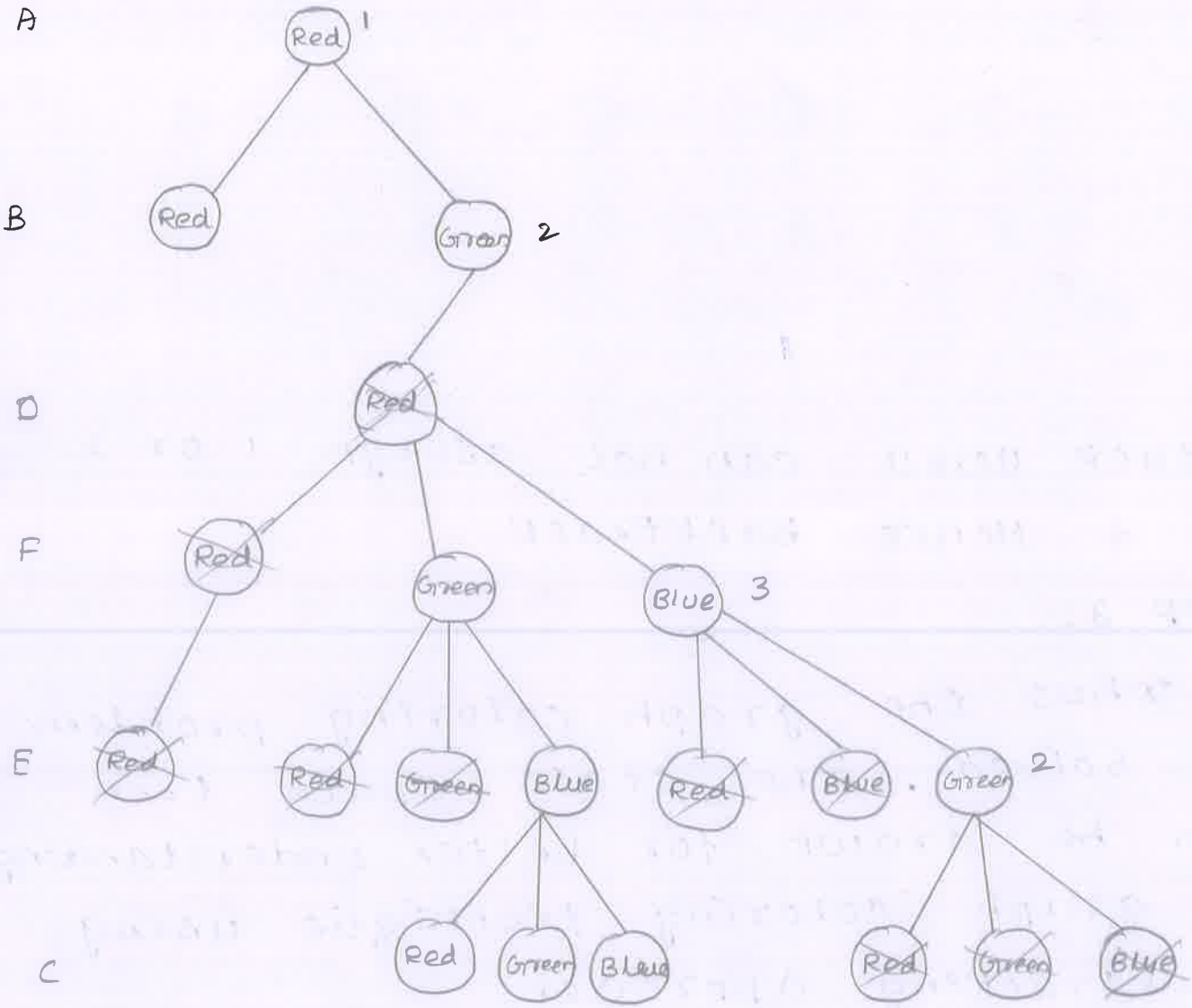


Stuck Here!! can not assign 1 or 2 or 3 Hence backtrack.

Step 3:

Thus the graph coloring problem is solved. The state-space tree can be drawn for better understanding of graph coloring technique using backtracking approach.





Hence, we have assumed, color index Red = 1, Green = 2 and Blue = 3.

RANDOMIZED QUICK SORT :

* The worst case for QUICK sort depends upon how we select our partition or pivot element. IF an input array is already sorted and it we select the first or a last element as a pivot for applying the QUICK sort method then it results in worst case.

* TO bring improvement over the QUICK sort choice of pivot is the key factor, we can have following choice of pivot.

(i) Use the middle element of the sub array as pivot.

(ii) Use a random element of the array as the pivot.

(iii) TAKE the random element of the array median of three elements (First, Last or middle) as a pivot.

* The QUICK sort works better in average case but its performance is very poor in worst case.

* Hence From above mentioned three choices randomization is the better choice to improve the performance of the Quick sort in worst case.

* let us discuss the algorithm for randomized Quick sort.

Quick sort -

```
Algorithm QuickSort - R (low, high)
{
// problem description : the algorithm
                         chooses the pivot element
                                randomly and
// performs the Quick sort,
// input : The low points to the first
                element of unsorted array
                and high points to the
// last element of unsorted array
// output : By this recursive algorithm
                the array will be sorted
                in ascending order.
```

```
// The element stored in array a[1,n]
                are in not sorted initially

// # is total number of elements
if (low < high) their
{
  IF (high - low) > 5) then
      swap (a, (random () mod (high -
          low+1) + low), low);

// partition is used to divide the
          array the array into two
          sub arrays and K is the
                position of
// partitioning element
      partition (a, low, high+1);
   // recursively sort the sub arrays
      Quicksort - R (low, K-1);
      Quicksort - R (K+1, high);

  }

}
```

In above algorithm we invoke the random() function only if the (high, low) > 5, the number 5 is not a magic number but it is observed that is gives best results with this value. the time complexity of above algorithm is O(n log n)

DEPARTMENT OF CSE

II YEAR – IV SEMESTER

CS3401 ALGORITHMS

QUESTION BANK

CS 3401- ALGORITHMS

UNIT I

INTRODUCTION

PART - A

1.Define Algorithm?

2.What is performance measurement?

3.Give the diagram representation of Notion of algorithm.

4.What are the types of algorithm efficiencies?

5.What is space complexity?

6.What is time complexity?

7.What is an algorithm design technique?

8.What is pseudo code?

9.What are the types of algorithm efficiencies?

10.What do you mean by "worst-case efficiency" of and algorithm?

11.What is best-case efficiency?

12.What is average case efficiency?

13.Define asymptotic notations.

14.Define the asymptotic notation "Big oh" (0) .

15.Define the asymptotic notation "Omega" (Ω).

16.Define the asymptotic notation "theta" (θ)

17.What is recursive algorithm?

18.Define recurrence.

19.What are the Best, Worst and Average Case complexity of Linear Search?

20.Difference between Best Case and Worst Case Complexities.

21.What is binary search?

22.Give computing time for Binary search?

23.Write the algorithm for Iterative binary search?

24.Give the general plan for analyzing non recursive algorithm

25.What is validation of algorithm?

26.What are all the methods available for solving recurrence relations?

27.What are the types of recurrence relations?

28.Define Substitution Method.

29.Define Recurrence Relation.

30.How to measure an algorithm running time?

31.Define best,worst,average case time complexity.

32.How do you measure the efficiency of an

33.Define naïve string matching alogorithm.

34.Define Rabin-Karp algorithm.

35.Define Knuth-Morris-Pratt algorithm.

36.Define Heap sort?

PART- B

1.Define the asymptotic notations used for best case average case and worst case analysis?

2.Explain properties of BIG (oh) Notation.

3. Distinguish between Big Oh, Theta and Omega natation.

4. Analyze the best, worst and average case analysis for linear search.

5 . Explain how analysis of linear search is done with a suitable illustration.

6.Define recurrence equation and explain how solving recurrence equations are done

7.Explain how Time Complexity is calculated. Give an example.

8.Discuss all the asymptotic notations in detail.

9.Write an algorithm for finding maximum element of an array, perform best, worst and average case complexity with appropriate order.

10.Write an algorithm to find mean and variance of an array perform best, worst and average case complexity.

11.Briefly explain the time complexity, space complexity estimation

12.Write the linear search algorithm and analyze its time complexity

13.Find the time complexity and space complexity of the following problems. Factorial using recursion and Compute n^{th} Fibonacci number using Iterative statements.

14.Give an algorithm to check whether all the Elements in a given array of n elements are distinct. Find the worst case complexity of the same.

15.Give the recursive algorithm which finds the number of binary digits in the binary representation of a positive decimal integer. Find the recurrence relation and complexity.

16.State the general plan for analyzing the time efficiency of non-recursive algorithm and explain with an example.

17.Write the asymptotic notations used for best case,average case and worst case analysis of algorithms.

18.Write an algorithm for finding maximum elements in an array. Give best,worst and average case complexities.

19.Solve the following recurrence relation:

$T(n)=T(n/2)+1$, where $n=2^k$ for all $k\geq 0$

$T(n)=T(n/3)+T(2n/3)+cn$, where 'c' is a constant and 'n' is the input size.

20.Explains the steps involved in problem solving.

21.Explain in detail about naïve string matching alogorithm.

22.Explain in detail about Rabin-Karp algorithm.

23.Explain in detail about Knuth-Morris-Pratt algorithm.

24.Explain in detail about insertion sort?

UNIT II

GRAPH ALGORITHMS

PART-A

1.Define a graph.

2.What are the different types of Graph?

3.What is complete graph? What is sub graph?

4.What is connected graph?

5.What are directed graphs?

6.What are undirected graphs?

7.Define cycle.

8.Define Acyclic graph.

9.Define weighted graph.

10.Define strongly connected graph.

11.What is weakly connected graph.

12.Define path in a graph.

13.What is the degree of a graph?

14.What is adjacent node?

15.What are the applications of graphs?

16.What is a single source shortest path problem?

17.What are the different kinds of graph traversals?

18.What is depth-first traversal? Give an example.

19.What is biconnectivity?

20.What is a Spanning Tree?

21.Define prims algorithm.

22.Define Kruskal algorithm.

23.Define Bellman Ford algorithm.

24.Define Dijkstra's algorithm.

25.Define Floyd-Warshall algorithm.

26.Give the Floyd's algorithm

27.Define Prims Algorithm.

28.Write down the optimization technique used for Warshalls algorithm. State the rules and assumptions which are implied behind that.

29.Define the single source shortest path problem.

30.How to calculate the efficiency of dijkstra's algorithm.

31.Define transitive closure of a directed graph.

32.Write short notes on the Maximum-Flow problem.

33.Define maximum matching.

34.Define maximum cardinality.

35.Define maximum flow problem.

36.Define Bipartite Graphs?

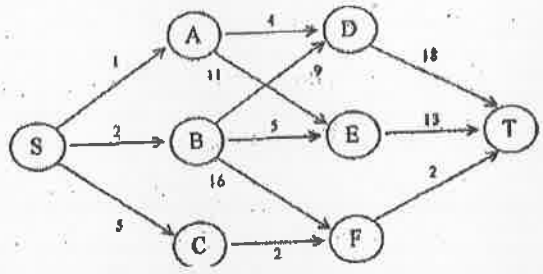
37.What do you meant by perfect matching in bipartite graph? Define flow cut.

PART –B

1.Write an algorithm for all pairs shortest path algorithm and what are the time and space complexity of the algorithm.

2.Explain Floyd algorithm with example.

3. Write down and explain the algorithm to solve all pairs shortest paths problem.



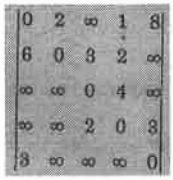
4.With a suitable example, explain all-pair shortest paths problem.

5.How do you construct a minimum spanning tree using Kruskals algorithm? Explain?

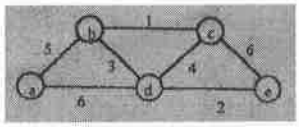
6.Discuss about the algorithm and pseudocode to find the Minimum Spanning Tree using Prim's Algorithm. Find the Minimum Spanning Tree for the graph. Discuss about the efficiency of the

algorithm.

7.Solve the all-Pairs shortest-path problem for the diagraph with the following weight matrix:



8.Apply Kruskal's algorithm to find a minimum spanning tree of the following graph.



9.Write down the Dijkstra's algorithm and explain it with an example

10.Write suitable ADT operation for shortest path problem. Show the simulation of shortest path with an example graph.

11.What is single source shortest path problem? Discuss Dijkstra's single source shortest path algorithm with an example.

12.Explain Depth – first & Breadth – First Traversal algorithms.

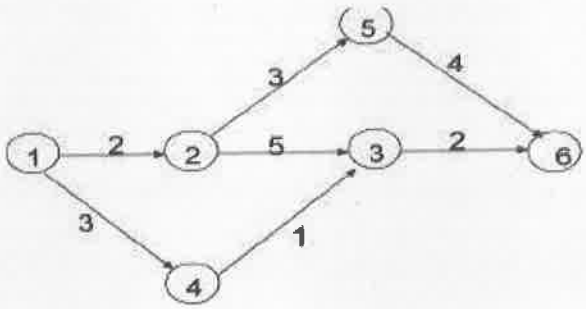
13.Write short notes on Biconnectivity?

14.Distinguish between breadth first search and depth first search with example

15.Explain the algorithm for Maximum Bipartite Matching.

16.State and Prove Maximum Flow Min cut Theorem.

17.Apply the shortest Augmenting Path algorithm to the network shown below.



18.Explain KMP string matching algorithm for finding a pattern on the text, and analysis the algorithm.

UNIT III

ALGORITHM DESIGN TECHNIQUES

PART A

1.Give the general plan for divide-and-conquer algorithms.

2.List the advantages of Divide and Conquer Algorithm.

3.Give the recurrence relation of divide-and-conquer?

4.Define Quick Sort.

5.List out the Disadvantages in Quick Sort

6.What is the difference between quicksort and mergesort?

7.Define merge sort.

8.List out Disadvantages of Divide and Conquer Algorithm

9.List out the Advantages in Quick Sort

10.Describe the recurrence relation of merge sort?

11.State Master's theorem.

12.List out the Disadvantages in Quick Sort

13.What are the differences between dynamic programming and divide and conquer approaches?

14.What is the time and space complexity of Merge sort?

15.Define dynamic programming. What are the features of dynamic programming?

16.Write the general procedure of dynamic programming.

17.Write the difference between the Greedy method and Dynamic programming

18.Define the principle of optimality.

19.What is the difference between dynamic programming and greedy algorithm.

20.State the general principle of greedy algorithm.

21.Define an optimization problem?

22.Write all the Greedy Properties?

23.Define multistage graphs. Give an example

24.State the principle of optimality.

PART-B

1.Define divide and conquer to apply the technique in binary search algorithm and to analysis it.

2.Explain in detail in merge sort give an example .

3.Distinguish between Quick sort and Merge sort, and arrange the following numbers in increasing order using merge sort. (18, 29, 68, 32, 43, 37, 87, 24, 47, 50)

4.Trace the steps of Mergesort algorithm for the elements 122,25,70,175,89,90,95,102,123 and also compute its time complexity.

5.Write an algorithm to perform binary search on a sorted list of elements. Analyze the algorithm for the best case, average case and worst case.

6.Using the divide and conquer approach to find the maximum and minimum in a set of 'n' elements. Also find the recurrence relation for the number of elements compared and solve the same.

7.Trace maximum and minimum (using divide and conquer) algorithm for the following set of numbers. 20, 35, 18, 8, 14, 41, 3, 39,-20.

8.Write a pseudo code using divide and conquer technique for finding the position of the largest element in an array of N numbers.

9.Sort the following set of elements using merge sort: 12, 24, 8, 71, 4, 23, 6, 89, and 56.

10.Explain in detail quick sorting method. Provide a complete analysis of quick sort.

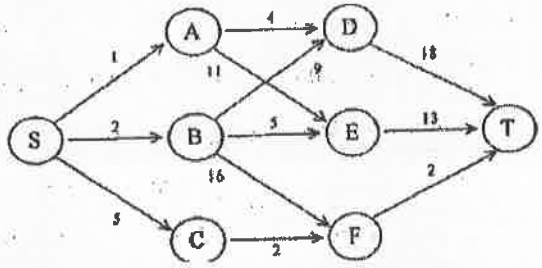
11.Write the algorithm for quick sort. Provide a complete analysis of quick sort for the given set of numbers 12,33,23,43,44,55,64,77 and 76.

13.Write the quick sort algorithm and explain it with an example. Derive the worst case and average case time complexity.

14.(i)Write an algorithm to construct the optimal binary search tree (or) Discuss the algorithm for finding a minimum cost binary search trees.

(ii) Explain how dynamic programming is applied to solve travelling salesperson problem

Using Dynamic approach programming, solve the following graph using the backward approach.



15.(i) Let A ={l/119,m/96,c/247,g/283,h/72,f/77,k/92,j/19} be the letters and its frequency of distribution in a text file. Compute a suitable Huffman coding to compress the data effectively.

(ii)Write an algorithm to construct the optimal binary search tree given the roots r(i,j),$0 \le i \le j \le n$. Also prove that this could be performed in time O(n).

16.Write the Huffman's Algorithm. Construct the Huffman's tree for the following data and obtain its Huffman's Code.

Characters	A	B	C	D	E	_
Probability	0.5	0.35	0.5	0.1	0.4	0.2

17.Explain the steps in building a Huffman Tree. Find the codes for the alphabets given below as according to frequency

A	2
E	5
H	1
I	2
L	2
M	2
P	2
R	1
S	2
X	1

18) Generate the Huffman code for the following data comprising of alphabet and their frequency.

a:1,b:1,c:2,d:3,e:5,f:8,g:13,h:21

UNIT IV

STATE SPACE SEARCH ALGORITHMS

PART - A

1.What are the factors that influence the efficiency of the backtracking algorithm?

2.What is backtracking

3.What is n-queens problem?

4.Draw the solution for the 4-queen problem.

	Q		
			Q
Q			
		Q	

5.Define the Hamiltonian cycle.

6.What is the subset-sum problem?

7.Find a subset of a given set S={s1,.....,sn} of 'n' positive integers whose sum is equal to a given positive integer 'd'.

8.How can the output of a backtracking algorithm be thought of?

9.Give a template for a generic backtracking algorithm.

10.What is the method used to find the solution in n-queen problem by symmetry?

11.What are the two types of constraints used in Backtracking?

12.Define implicit constraint.

13.Define explicit constraint.

14.Define state space tree.

15.Define a dead node.

16. Compared to backtracking and branch and bound?

17.Give the formula used to find the upper bound for knapsack problem.

18.Define Hamiltonian circuit problem.

19.State Assignment problem.

20.What is state space tree?

21.Give the purpose of lower bound.

22.What is The Euclidean minimum spanning tree problem?

23.What is an articulation point in the graph?

24.Differentiate feasible solution and optimal solution.

25.What are tractable and non-tractable problems?

26.Give an example for sum-of-subset problem

27.State Hamiltonian circuit problem.

PART –B

1.Explain the n-Queen's problem & discuss the possible solutions.

2. Apply backtracking technique to solve the following instance of subset sum problem : S={1,3,4,5} and d=11.

3.Explain subset sum problem & discuss the possible solution strategies using backtracking.

4.Write a recursive backtracking algorithm to find all the Hamiltonian cycles of a given graph.

5.What is backtracking explain detail .

6.Explain graph coloring in detail.

7.Give the backtracking algorithm for knapsack problem.

8.Explain the algorithm for finding all m-colorings of a graph.

9.Describe the backtracking solution to solve 8-Queens problem.

10.With an example, explain Graph Coloring Algorithm.

11.Explain the n-Queen's problem and trace it for n=6.

12.Explain Hamiltonian cycles.

13.Explain the control abstraction for Backtracking method. Describe the backtracking solution to solve 8-Queens problem.

13. Let w= {5, 7, 10, 12, 15, 18, 20} and m=35.Find all possible subset of w whose sum is equivalent to m.Draw the portion of state space tree for this problem.

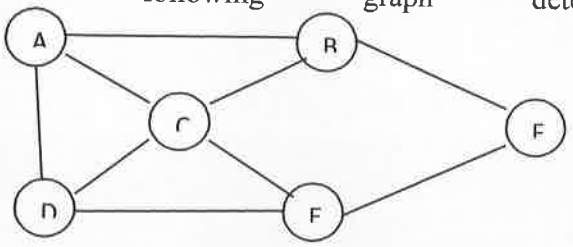
14.How backtracking works on 8-Queens problem with suitable example?

15. Give the backtracking algorithm for knapsack problem.

16. Explain elaborately recursive backtracking algorithm.

17.Using backtracking, find the optimal solution to a knapsack problem for the knapsack instance n=8, m=110,(p1…p7)=(11,21,31,33,43,53,55,65) and (w1…w7)=(1,11,21,33,43,53,55,65).

18.Write an algorithm to determine Hamiltonian cycle in a given graph using back tracking. For the following graph determine the Hamiltonian cycle.



19.Write an algorithm to determine the Sum of Subsets for a given sum and a Set of numbers. Draw the tree representation to solve the subset sum problem given the numbers set as {3, 5, 6, 7, 2} with the sum=15. Derive all the subsets.

20.Write an algorithm for N QUEENS problem and Trace it for n=6.

21.What is Branch and bound? Explain in detail.

22.Suggest an approximation algorithm for travelling salesperson problem. Assume that the cost function satisfies the triangle inequality.

23.Explain how job assignment problem could be solved, given n tasks and n agents where each agent has a cost to complete each task, using branch and bound.

24.Implement an algorithm for Knapsack problem using NP-Hard approach.

State the subset-sum problem and Complete state-space tree of the backtracking algorithm applied to the instance A={3, 5, 6, 7} and d=15 of the subset-sum problem.

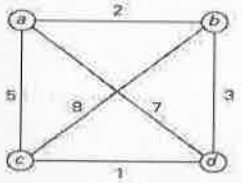
25.Draw a decision tree and find the number of key comparisons in the worst and average cases for the three element bubble sort.

26.Write backtracking algorithm for 4 queen's problem and discuss the possible solution.

27.Solve the following instance of knapsack problem by branch and bound algorithm W= 15.

ITEMS	WEIGHT	PROFIT
1	5	40
2	7	35
3	2	18
4	4	4
5	5	10
6	1	2

28.Apply Branch and bound algorithm to solve the travelling salesman problem.



29.Give the methods for Establishing Lower Bound.

30.Find the optimal solution using branch and bound for the following assignment problem.

	Job1	Job 2	Job 3	Job 4
A	9	2	7	8
B	6	4	3	7
C	5	8	1	8
D	7	6	9	4

31.Consider the travelling salesperson instances defined by the following cost matrix.

∞	20	30	10	11
15	∞	16	4	2
3	5	∞	2	4
19	6	18	∞	3
16	4	7	16	∞

32.Write an algorithm for subset sum and explain with an example.

33.Explain the 4-queens problem using backtracking. Write the algorithms . Give the estimated cost for all possible solutions of 4-queens problem.Specify the implicit and explicit constrints.

UNIT V

NP-COMPLETE AND APPROXIMATION ALGORITHM

PART-A

1.What are NP- hard and NP-complete problems?

2.Define bounding.

3.List example of NP hard problem.

4.What is meant by NP hard and NP complete problem?

5.How NP-Hard problems are different from NP-Complete?

6.Define P and NP problems.

7.What are tractable and non-tractable problems?

8.Define P and NP problems.

9.Define NP completeness and NP hard.

10.What do you meant by primality testing?

11.What is Kth smallest number?

12.How quick sort using random pivoting?

PART –B

1.Suggest an approximation algorithm for travelling salesperson problem. Assume that the cost function satisfies the triangle inequality.

2.Implement an algorithm for Knapsack problem using NP-Hard approach.

3.Discuss the approximation algorithm for NP hard problem?

4.What is class NP? Discuss about any five problems for which no polynomial time for TSP problem.

5.Elaborate on the nearest-neighbor algorithm and multifragment- heuristic algorithm for TSP problem.

6.Discuss the approximation algorithm for NP-hard problem.

7.Write an algorithm to solve the travelling salesman problem and prove that it is a 2 time approximation algorithm.

SUBJECT INCHARGE

HOD

Principal
J.K.K.Munirajah College of Technology
(Autonomous)
T.N.Palayam, Gobi (Tk),
Erode (Dt) - 638 506.

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Reg. No. : E N G G T R E E . C O M

Question Paper Code : 50901

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2024.

Fourth Semester

Computer Science and Engineering

CS 3401 — ALGORITHMS

(Regulations 2021)

Time : Three hours | Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. State how the running time of an algorithm is measured.
2. Outline the significance of performing worst case analysis of an algorithm.
3. List the data structures that are used for representing graphs.
4. What is a strongly connected graph? Give an example.
5. What kinds of problems are solved using divide and conquer approach?
6. State the elements of greedy approach.
7. With an example, define Hamiltonian circuit.
8. Why is branch and bound approach found to be appropriate for solving travelling salesman problem?
9. State the difference between tractable and non-tractable problems.
10. When is a problem said to be NP- hard? Give an example.

PART B — (5 × 13 = 65 marks)

11. (a) (i) Explain in detail about various asymptotic notations and it's properties. (8)

(ii) Use substitution method to show that $T(n) = 2T(n/2) + n$ is $O(n \log(n))$. (5)

Or

(b) (i) With a suitable example, illustrate the time and space complexity analysis of binary search and linear search. (8)

(ii) Explain the working of naïve string matching algorithm with ABCCDDAEFG as the text input and CDD as the search string. (5)

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12. (a) (i) Write the pseudocode for BFS and DFS traversals on the graph given below in fig. 12 (a) (i) and compare the time and space complexity of the two traversals. (7)

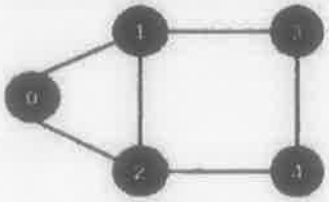

Fig. 12 (a) (i)

(ii) Find the Minimum Spanning Tree of the following graph in fig. 12 (a) (ii) using Kruskal's algorithm. (6)

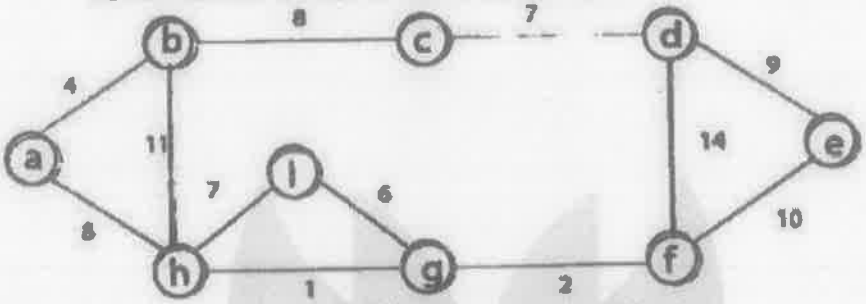

Fig. 12 (a) (ii)

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Or

(b) (i) Given a graph and a source vertex in the graph, find the shortest paths from the source vertex 0 to all vertices in the given graph 12 (b) (i). (8)

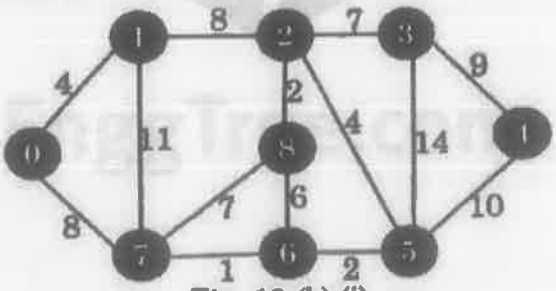

Fig. 12 (b) (i)

(ii) Using Ford-Fulkerson algorithm find the maximum possible flow in the network given below Fig 12 (b) (ii). (6)

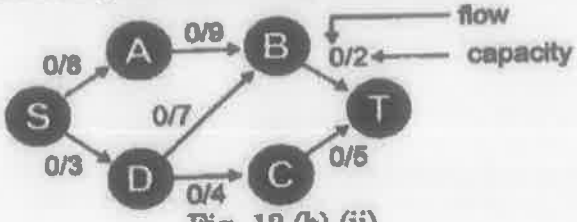

Fig. 12 (b) (ii)

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13. (a) (i) Demonstrate divide and conquer approach by Performing quick sort on the following values. (7)

44, 33, 11, 55, 77, 90, 40, 60, 99, 22, 88

(ii) Using Dynamic programming, Solve matrix chain multiplication problem. (6)

Or

(b) (i) Solve the following problem using Greedy algorithm. Given activities with their start and finish times, select the maximum number of activities that can be performed by a single person, assuming that a person can only work on a single activity at a time. (8)

(ii) A character-coding problem. A data file of 100,000 characters contains only the characters a–f, with the frequencies indicated as below

	a	b	c	d	e	f
Frequency (in thousands)	45	13	12	16	9	5

Show the steps in constructing the final Huffman tree representing the optimal prefix code. (5)

14. (a) (i) Explain the steps in solving n-queens problem using backtracking approach. (5)

(ii) Solve the following subset sum problem using back tracking. Let $S = \{3,7,9,13,26,41\}$; $d(sum) = 51$. (8)

Or

(b) (i) Discuss briefly about the general method of branch and Bound approach and state how it differs from backtracking. (8)

(ii) Explain the branching mechanism in the Branch and Bound Strategy to solve 0/1 Knapsack problem. (5)

15. (a) (i) Show that if an algorithm makes atmost a constant number of calls to polynomial time subroutines and performs an additional amount of work that also takes polynomial time, then it runs in polynomial time. (8)

(ii) Show that the satisfiability of Boolean formulas in 3-conjunctive normal form (3- CNF) is NP-complete. (5)

Or

(b) (i) Illustrate polynomial-time approximation scheme for the sum of subsets problem. (7)

(ii) Illustrate the working of Miller-Rabin randomized primality test. (6)

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PART C — (1 × 15 = 15 marks)

16. (a) (i) How many spurious hits does the Rabin-Karp matcher encounter in the text T = 3141592653589793 when Working modulo q = 11 and looking for the pattern P = 26. Briefly write about the processing time, worst-case running time and average-case running time of Rabin-Karp algorithm. (10)

(ii) With an example to show the best-case, worst-case and average case analysis of heap sort. (5)

Or

(b) (i) Run the Bellman-Ford algorithm on the directed graph of figure 16 (b) (i) below using vertex s as the source and show the results after each pass of an algorithm. (7)

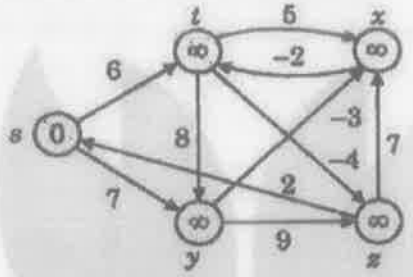

Fig. 16 (b) (i)

(ii) With an example, Show that the cardinality of a maximum matching M in a bipartite graph G equals the value of a maximum flow f in its corresponding flow network G'. (8)

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Reg. No. : E N G G T R E E . C O M

Question Paper Code : 20868

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2023.

Fourth Semester

Computer Science and Engineering

CS 3401 – ALGORITHMS

(Regulations 2021)

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Time : Three hours **Maximum : 100 marks**

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

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1. Define recursion relation.
2. Discuss the time and space complexity of insertion sort.
3. What is minimum spanning tree?
4. What is bipartite graph?
5. What is meant by principle of optimality?
6. Write down the steps to build Huffman free.
7. Write short notes on graph colouring.
8. What is travelling salesman problem? Give an example.
9. Differentiate tractable and intractable problems.
10. Write an algorithm to find the k^{th} smallest number.

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PART B — (5 × 13 = 65 marks)

11. (a) Write the asymptotic notations used for best case, average case and worst case analysis of algorithms. Also write an algorithm of finding maximum element of an array and perform best, worst and average case complexity with appropriate order notations. (13)

Or

(b) (i) Write and explain naïve string mating algorithm. (6)

(ii) Suppose $T = 1011101110$ and $p = 111$. Find all valid ships. (7)

12. (a) Write and explain the pseudo code for breadth first search and discuss its time complexity. (13)

Or

(b) Write and explain the pseudo code for Floyd Warshall algorithm and write its time complexity. (13)

13. (a) Explain in detail about merge sort. Illustrate the algorithm with a numeric example and provide complete analysis of merge sort algorithm. (13)

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Or

(b) Explain the dynamic programming approach of matrix multiplication with an example. (13)

14. (a) Write down the steps to solve subset sum problem using backtracking approach explain with an example. (13)

Or

(b) Write down the steps to solve Travelling Salesperson problem using branch and bound approach. Explain with an example. (13)

15. (a) Write short notes on the following :

(i) NP algorithms (4)

(ii) NP Hardness (4)

(iii) NP-Completeness (5)

Or

(b) Write short notes on the following :

(i) Problem Reduction (4)

(ii) Primality testing (4)

(iii) Randomized sorting (5)

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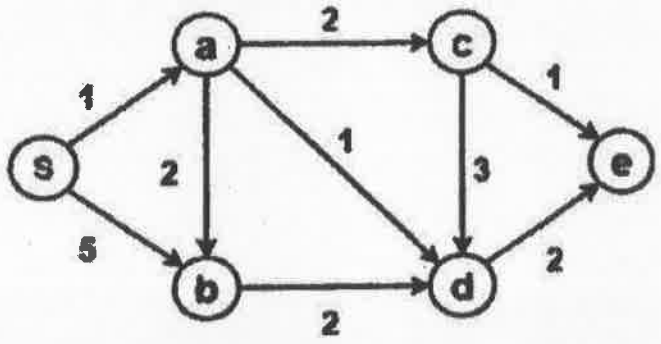
PART C — (1 × 15 = 15 marks)

16. (a) Write and explain the Dijikstra's algorithm. Find the shortest path the following graph using Dijikstra's algorithm.



Or

(b) Solve the following instance of Knapsack problem by branch and bound algorithm.

Item	Weight	Profit
1	5	$40
2	7	$35
3	2	$18
4	4	$4
5	5	$10
6	1	$2

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INSTRUCTION

1. This is an important document and the faculty in-charge shall keep the entries up-to-date and correct.

2. Attendance shall be marked in the relevant column noting the date, month and period.

3. At the end of each period, the number of absentees should be clearly noted in the last row of the column in each page and installed as a token of check.

4. Topics covered in each period shall be recorded in the space provided.

5. Marks for tests shall be entered in the columns provided.

6. At the end of each report, the entries in the record shall be attested by the HOD of the faculty(the due dates for reports will be announced by the principal)

7. This register shall be handed over to the HOD of the faculty whenever the faculty member goes on long leave or when he/she resigns.

8. At the end of the semester, the faculty handling the subjects shall prepare the list of students who secured less than 75% attendance and send it to the Tutor/Chairman-class committee for consolidating the cases of shortage of attendance.

9. At the end of the semester the entries shall be checked and endorsed by the HOD of the faculty, then by the HOD of students and finally by the principal, signing in the spaces provided for this purpose. Finally the attendance and assessment records shall be under the safe custody of the principal.

Principal
J.K.K.Munirajah College of Technology
(Autonomous)
T.N.Palayam, Gobi (Tk),
Erode (Dt) - 638 506.

Name of the Faculty SASIREKA. P

Department COMPUTER SCIENCE AND ENGINEERING

Class II

Branch Specialization (PG Subject) CSE

Semester 04

Sub Code CS3401

Class Strength 39

Sub Name ALGORITHMS

Semester from 14-03-2024 **to** 11-06-2024

COURSE TIME TABLE

Day	1	2	3	4	5	6	7	8
Mon							ALG	
Tue		ALG						
Wed								
Thu								
Fri		ALG			ALG			
Sat							ALG	

Internal Assessment Report	1	2	3
Internal Assessment Test Date	26-04-24	07-06-24	
Corrected test Papters returned on	29-04-24	10-06-24	
% of students with marks <50%	0.05%	0.02%	
% of students absent	0.02%	0.05%	
Initials of the HOD of faculty with Date	29/4/24	10/6/24	

ATTENDANCE

Reg.No	Name	M	MARCH							
		D	F 15	F 15	M 18	Tu 19	F 22	F 22	Sa 23	25
		Hr	2	5	7	2	2	5	7	7
	Cumulative No. of period handled		1	2	3	4	5	6	7	8
731222104001	ABINAYA. P		/	/	/	/	/	/	/	/
731222104002	BHARATH KRISHNAN. V		/	/	/	/	/	/	/	/
731222104003	CHANDRAKALA. N		/	/	/	/	/	/	/	/
731222104004	CHANDRU. K		a	a	a	/	/	/	a	/
731222104005	DEEPA. T		/	/	/	/	/	/	/	/
731222104006	DEVADHARSHINI. M		/	/	/	/	/	/	/	/
731222104008	ELAKKIYA. K		/	/	/	/	/	/	/	/
731222104009	GIBSON SHANTHAKUMAR. R		a	a	/	/	/	/	/	/
731222104010	GOKULA. S		/	/	/	/	/	/	/	/
731222104011	GOKULRAJA. G		/	/	/	/	/	/	/	/
731222104012	HAFILA. A		/	/	a	a	/	/	/	/
731222104013	INIKA. E		/	/	/	/	/	/	/	/
731222104014	JAYASHREE. K		/	/	/	/	/	/	/	/
731222104015	JAYASREE. D		/	/	/	/	/	/	/	/
731222104016	JAYASURYA. B		/	/	/	/	/	/	/	/
731222104018	JOTHI. N		/	/	/	/	/	/	/	/
731222104019	JOTHI. S		/	/	/	/	/	/	/	/
731222104020	KARTHI. K		/	/	/	/	/	/	/	/
731222104021	KARUNYA. K		/	/	/	/	/	/	/	/
731222104022	KEERTHIGA. V		/	/	/	/	/	/	/	/

M	APRIL															MAY							
D	1	2	5	5	6	8	12	12	13	15	16	22	23	29	30	3	3	6	7	10	10	11	
Hr	7	2	2	5	7	7	2	5	7	7	2	7	2	7	2	2	5	7	2	2	5	7	
	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
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731222104005	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	
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731222104019	/	/	/	/	/	/	/	/	/	/	/	a	/	/	/	/	/	/	/	/	/	/	
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731222104021	/	/	/	a	a	a	a	a	/	/	/	/	/	/	/	/	/	/	/	/	/	/	
731222104022	/	/	/	/	/	/	/	/	/	a	/	/	/	/	/	/	/	/	/	/	/	/	

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M	JUNE																								
D	13	14	17	17	20	21	24	24	25	27	28	31	31	3	4	10	11								
Hr	7	2	2	5	7	2	2	5	7	7	2	2	5	7	2	7	2								
	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52			
01	a	a	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/								
02	/	a	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/								
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10	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/								
11	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a								
12	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/								
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14	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/									
15	/	/	/	/	a	/	/	/	/	a	/	/	/	/	/	a	a								
16	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/								
18	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/								
19	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/								
20	/	/	a	a	/	/	/	/	/	a	/	/	/	/	/	a	/								
21	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/								
22	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	a	a								

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Hr																									
	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75		

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ASSESSMENT

	ASSIGNMENT / SEMINAR					IA Test 1	IA Test 2	IA Test 3	Model 1	Model 2	Attendance	Internal Attendance (Max.....)	Remarks
	I	II	III	IV	V								
01	40	40				76	73						
02	39	40				76	80						
03	40	40				84	88						
04	39	40				64	44						
05	40	40				90	80						
06	40	40				77	78						
08	40	40				78	84						
09	38	40				58	57						
10	40	40				94	95						
11	AB	AB				AB	AB						
12	40	40				87	90						
13	40	40				97	94						
14	40	40				85	94						
15	40	40				91	80						
16	40	40				81	76						
18	39	40				39	67						
19	40	40				85	80						
20	40	40				82	79						
21	40	40				83	71						
22	40	40				78	74						

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ATTENDANCE

Reg.No	Name	M	MARCH							
		D	15	15	18	19	22	22	23	25
		Hr	2	5	7	2	2	5	7	7
	Cumulative No. of period handled		1	2	3	4	5	6	7	8
731222104023	LAKSHMI.B		/	/	/	/	/	/	/	/
731222104024	LINGARAJU.K		/	/	/	/	/	/	/	/
731222104025	NEETHU.S		/	/	/	/	/	/	/	/
731222104026	NIVETHA.P		/	/	/	/	/	/	/	/
731222104027	POOMATHI.S		/	/	/	/	/	/	/	/
731222104028	PRAZWAL.B		/	/	/	/	/	/	/	/
731222104029	PUSHPASRI.M		/	/	/	/	/	/	/	/
731222104030	RAKSHITHA.V		/	/	/	/	/	/	/	/
731222104031	SAHEER.H		/	/	/	/	/	/	/	/
731222104032	SANJAIKUMAR.S		/	/	/	/	a	a	/	/
731222104033	SANJAY.V		/	/	/	/	/	/	/	/
731222104034	SANJAYKUMAR.S		a	a	/	/	/	/	/	/
731222104035	SATHYALAKSHMI.M		/	/	/	/	/	/	/	/
731222104036	SHAKTHI.S		/	/	/	/	/	/	/	/
731222104038	SIDHARAJ.S		/	/	/	/	/	/	/	/
731222104039	SOWDESWARI.A		/	/	/	/	/	/	/	/
731222104040	SOWNDHAR.D		/	/	/	/	/	/	/	/
731222104041	SUMITHRA.S		/	/	/	/	/	/	/	/
731222104042	GOWTHAM.A		/	/	/	/	/	/	/	/

M	APRIL															MAY						
D	1	2	5	5	6	8	12	12	13	15	16	22	23	29	30	3	3	6	7	10	10	11
Hr	7	2	2	5	7	7	2	5	7	7	2	7	2	7	2	2	5	7	2	2	5	7
	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
023	/	/	/	/	/	/	a	a	a	/	/	/	/	/	/	/	/	/		/	/	/
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028	/	/	/	/	/	a	a	a	a	a	a	/	/	/	a	a	a	a	a	a	a	
029	/	/	/	/	/	/	a	a	/	/	/	/	/	/	/	/	/	/	a	a	/	
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M	JUNE																					
D	13	14	17	17	20	21	24	24	25	27	28	31	31	3	4	10	11					
Hr	7	2	2	5	7	2	2	5	7	7	2	2	5	7	2	7	2					
	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52
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	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a					
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M																						
D																						
Hr																						
	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75

ASSESSMENT

	ASSIGNMENT / SEMINAR					IA Test 1	IA Test 2	IA Test 3	Model 1	Model 2	Attendance	Internal Attendance (Max.....)	Remarks
	I	II	III	IV	V								
23	40	40				80	66						
24	40	40				58	52						
25	40	40				87	59						
26	39	40				82	78						
27	40	40				92	90						
28	AB	AB				17	AB						
29	40	40				84	78						
30	40	40				83	83						
31	40	40				77	84						
32	40	40				75	78						
33	40	40				72	62						
34	40	40				82	68						
35	40	40				84	82						
36	40	40				95	93						
38	40	40				77	90						
39	40	40				86	98						
40	40	40				73	75						
41	40	40				95	99						
42	40	40				85	79						

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RECORD OF CLASS WORK

RECORD OF CLASS WORK

Sl.No.	Date	Period	Topics Covered	Initials
			UNIT-I INTRODUCTION	
1.	15.3.24	2	Algorithm analysis: Time and Space complexity	
2.	15.3.24	5	Asymptotic notations and its properties, Best case, Worst case and average case analysis	
3.	18.3.24	7	Recurrence relation: Substitution method - lower bound, linear search	
4.	19.3.24	2	Binary search and Interpolation search	
5.	22.3.24	2	Pattern search: The naive string matching algorithm	
6.	22.3.24	5	Rabin Karp algorithm	
7.	23.3.24	7	Knuth-morris-pratt algorithm	
8.	25.3.24	7	Sorting: Insertion sort	
9.	1.4.24	7	Heap sort.	
			UNIT-II GRAPH ALGORITHMS	
1.	2.4.24	2	Graph algorithms: Representation of graphs	
2.	5.4.24	2	Graph Traversal: DFS, BFS, applications	

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RECORD OF CLASS WORK

Sl.No.	Date	Period	Topics Covered	Initials
3.	5.4.24	5	Connectivity, Strong Connectivity Bi-connectivity	
4.	6.4.24	7	Minimum Spanning Tree: Kruskal's and prim's algorithm	
5.	8.4.24	7	Shortest Path: Bellman-Ford Algorithm	
6.	12.4.24	2	Dijkstra's algorithm	
7.	12.4.24	5	Floyd-warshall algorithm	
8.	13.4.24	7	Flow Network; Ford-fulkerson method	
9.	15.4.24	7	Matching: Maximum bipartite Matching	
			UNIT-III - ALGORITHM DESIGN TECHNIQUES	
1.	16.4.24	2	Divide and conquer methodology: Finding maximum and Minimum	
2.	22.4.24	7	Merge sort, Quick sort	
3.	23.4.24	2	Dynamic programming: Elements of dynamic programming	
4.	29.4.24	7	Matrix-chain multiplication	
5.	30.4.24	2	Multistage graph	
6.	3.5.24	2	Optimal Binary Search Tree	

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RECORD OF CLASS WORK

Sl.No.	Date	Period	Topics Covered	Initials
7.	3.5.24	5	Greedy Technique: Elements of the greedy strategy	
8.	6.5.24	7	Activity selection problem	
9.	7.5.24	2	Optimal Merge pattern, Huffman Trees	
			UNIT-IV - STATE SPACE SEARCH ALGORITHMS	
1.	10.5.24	2	Backtracking: n Queens Problem	
2.	10.5.24	5	Hamiltonian circuit problem	
3	11.5.24	7	Subset sum problem	
4.	13.5.24	7	Graph colouring problem	
5.	14.5.24	2	Branch and Bound	
6.	17.5.24 17.5.24	2 5	Solving 15 puzzle problem	
7.	20.5.24	7	Assignment problem	
8.	21.5.24	2	Knapsack problem	
9.	24.5.24 24.5.24	2 5	Travelling Salesman problem	

RECORD OF CLASS WORK

Sl.No.	Date	Period	Topics Covered	Initials
			UNIT-V NP COMPLETE AND APPROXIMATION ALGORITHM	
1.	25-4-24	7	Tractable and intractable problems: polynomial time algorithms	
2.	27-4-24	7	Venn diagram representation, NP algorithms	
3.	28-4-24	2	NP hardness and NP completeness	
4.	31-4-24	2	Bin packing problem	
5.	31-4-24	5	problem reduction: TSP, 3-CNF problem	
6.	3-6-24	7	Approximation algorithms: TSP	
7.	3-6-24	2	Randomized algorithms: concept and application, Primality testing	
8.	4-6-24	7	Randomized Quicksort	
9.	11-6-24	2	Finding Kth Smallest number	

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WORK HOURS

Period	Time
1	9:30 am to 10:15 am
2	10:15 am to 11:00 am
3	11:10 am to 11:55 am
4	11:55 am to 12:40 pm
5	1.25 pm to 02:05 pm
6	02:05 pm to 2:45 pm
7	02:55 pm to 3:35 pm
8	03:35 pm to 4:15 pm

To be signed at the end of semester

	Signature with Date
Faculty in-charge	P. 11/6/24
HOD of Faculty	12/6/24
HOD of Student	
Principal	12/6/24

ANNA UNIVERSITY, CHENNAI - 600 025
TIME TABLE-B.E./B.Tech./B.Arch. DEGREE EXAMINATIONS - APRIL/MAY-2024
(REGULATIONS-2021)
CHOICE BASED CREDIT SYSTEM (CBCS)

Branch Name **B.E. Computer Science and Engineering**

	Semester	*Subject Code*	*Subject Name*	*Exam Date*	*Session*
1	01	PH3151	Engineering Physics	12-JUL-24	A.N.
2	01	HS3152	Professional English - I	15-JUL-24	A.N.
3	01	HS3151	Professional English - I	15-JUL-24	A.N.
4	01	GE3152	Heritage of Tamils	20-JUL-24	A.N.
5	01	GE3151	Problem Solving and Python Programming	23-JUL-24	A.N.
6	01	MA3151	Matrices and Calculus	29-JUL-24	F.N.
7	01	CY3151	Engineering Chemistry	30-JUL-24	A.N.
8	02	HS3251	Professional English - II	10-JUL-24	F.N.
9	02	HS3252	Professional English - II	10-JUL-24	F.N.
10	02	MA3251	Statistics and Numerical Methods	11-JUL-24	F.N.
11	02	CS3251	Programming in C	13-JUL-24	F.N.
12	02	BE3251	Basic Electrical and Electronics Engineering	16-JUL-24	F.N.
13	02	GE3251	Engineering Graphics	19-JUL-24	F.N.
14	02	GE3251	Engineering Graphics*	19-JUL-24	A.N.
15	02	GE3252	Tamils and Technology	22-JUL-24	F.N.
16	02	PH3256	Physics for Information Science	27-JUL-24	F.N.
17	03	CS3391	Object Oriented Programming	16-JUL-24	A.N.
18	03	MA3354	Discrete Mathematics	18-JUL-24	A.N.
19	03	CS3301	Data Structures	25-JUL-24	F.N.
20	03	CS3351	Digital Principles and Computer Organization	26-JUL-24	A.N.
21	03	CS3352	Foundations of Data Science	29-JUL-24	A.N.
22	04	GE3451	Environmental Sciences and Sustainability	10-JUL-24	A.N.
23	04	CS3491	Artificial Intelligence and Machine Learning	12-JUL-24	F.N.
24	04	CS3401	Algorithms	15-JUL-24	F.N.
25	04	CS3452	Theory of Computation	18-JUL-24	F.N.
26	04	CS3451	Introduction to Operating Systems	20-JUL-24	F.N.
27	04	CS3492	Database Management Systems	23-JUL-24	F.N.
28	05	CS3551	Distributed Computing	06-JUN-24	A.N.
29	05	CS3501	Compiler Design	08-JUN-24	F.N.
30	05	CCS375	Web Technologies	10-JUN-24	F.N.
31	05	CCS346	Exploratory Data Analysis	10-JUN-24	F.N.
32	05	CCS335	Cloud Computing	10-JUN-24	F.N.
33	05	CCS344	Ethical Hacking	10-JUN-24	F.N.
34	05	CMG349	Statistics for Management	11-JUN-24	F.N.
35	05	CMG343	Principles of Public Administration	11-JUN-24	F.N.
36	05	CMG331	Financial Management	11-JUN-24	F.N.
37	05	CMG337	Foundations of Entrepreneurship	11-JUN-24	F.N.
38	05	CES331	Sustainable infrastructure Development	11-JUN-24	A.N.
39	05	CCS333	Augmented Reality/Virtual Reality	12-JUN-24	F.N.
40	05	CCS372.	Virtualization	12-JUN-24	F.N.
41	05	CEC368	IoT Based Systems Design		

NOTE: Student who opted for minor degree should refer the timetable for the subjects under the branch which offers Minor degree.

FN: FORENOON (10.00 A.M. TO 01. 00 P.M.)
AN:AFTERNOON (02.00 P.M. TO 5.00 P.M.)

CONTROLLER OF EXAMINATIONS

Principal
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J.K.K. MUNIRAJAH COLLEGE OF TECHNOLOGY
T.N. PALAYAM
DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

CIRCULAR

All the faculty members who are handling classes for Second year student members of class committee from first year asked to attend the class committee meeting for Second year at Second CSE class room at 3.30pm on

CLASS COMMITTEE MEETING-I			
CLASS:II YEAR CSE	Date:12/09/2023	Time:3.30PM	Venue: II CSE class room
Members: II CSE class handling faculty members & student representatives			

S.NO	AGENDA
1	Course materials
2	Syllabus completion-theory courses
3	Class test I, assignment I, internal test I
4	Placement activities
5	General discipline & other activities

CHAIRPERSON

HOD/CSE

NAME OF THE STAFF	DESIGNATION	SIGNATURE
Dr.N.SATHYABALAJI	HOD/CSE	
Mrs.M.C.SAVITHRI	AP/CSE	
Mrs.P.SASIREKA	AP/CSE	
Mrs.P.POORNAPRIYA	AP/CSE	
Mrs.S.GOMATHI	AP/ECE	
Ms.P.MAHASAKTHI	S&H-MATHS	

NAME OF THE STUDENT	YEAR	SIGNATURE
N.CHANDRAKALA	II	
S.GOKILA	II	
B.JAYASURYA	II	
M.DEVADHARSHINI	II	
K.LINGARAJU	II	

Principal
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J.K.K. MUNIRAJAH COLLEGE OF TECHNOLOGY

T.N. PALAYAM

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

MINUTES OF CLASS COMMITTEE MEETING -I

CLASS COMMITTEE MEETING-I		ACADEMIC YEAR:(2023-2024) ODD	
CLASS:II YEAR CSE	Date: 12/09/2023	Time:3.30PM	Venue: II CSE class room
Members: II CSE class handling faculty members & student representatives			

S.NO	AGENDA
1	Course materials
2	Syllabus completion-theory courses
3	Class test I, assignment I, internal test I
4	Placement activities
5	General discipline & other activities

MEMBERS PRESENT

S.NO	MEMBERS	NAME	DESIGNATION/DEPT	SIGNATURE
1	HEAD OF THE DEPARTMENT	Dr.N.SATHYABALAJI	HOD/CSE	
2	CHAIRPERSON	Dr.N.SATHYABALAJI	HOD/CSE	
3	FACULTY MEMBERS HANDLING THE COURSE	Mrs.M.C.SAVITHRI	AP/CSE	
4		Mrs.P.SASIREKA	AP/CSE	
5		Mrs.P.POORNAPRIYA	AP/CSE	
6		Mrs.S.GOMATHI	AP/ECE	
7		Ms.P.MAHASAKTHI	S&H-MATHS	
8	STUDENTS REPRESENTATIVES	N.CHANDRAKALA	II YEAR CSE	
9		S.GOKILA		
10		B.JAYASURYA		
11		M.DEVADHARSHINI		
12		K.LINGARAJU		

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T.N. PALAYAM

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

The first class committee meeting for Second year was conducted at Second year CSE class room at 3.30pm.the following points were discussed in the meeting.

- The committee members and faculty members were given warm welcome by the head of the department.
- Students have been informed about the text books of the respective courses and the purchase off text books should be done by individual student and course material will be issued by the department.
- Students have been informed about the submission of assignments for all the theory courses.
- The student members were advised to come to the college regularly and to follow proper dress code.
- Students have been asked to write class tests and assignments.
- Students have been asked to write internal test I well.
- Head of the department advised to study properly and score more marks in all subjects.
- Students are informed about the importance of presentation in the university examinations.
- Students have been informed to utilize the placement training. hours(aptitude,technical,soft skills)and attend the placement drive for their betterment.
- Students have been informed to participate technical contests that will be conducted by the department.
- Students have been informed to participate co-curricular & extra-curricular activities that will be conducted by the institution.
- The students expressed their feedback on each course about the syllabus completion and understanding of the subject and course materials provided by the faculty.

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S.NO	COURSE CODE	COURSE NAME	NAME OF THE FACULTY	DEPT	SYLLABUS COMPLETION	FEEDBACK FROM STUDENTS	REMEDIAL MEASURES TO BE TAKEN BY THE FACULTY	SIGNATURE OF THE FACULTY
1	CS3391	Object Oriented Programming	Mrs.M.C.SAVITHRI	CSE	2.5 Units completed	Easy to understand the subject	Action Taken	
2	CS3301	Data Structures	Mrs.P.SASIREKA	CSE	2.5 Units completed	Easy to understand the subject	Resolved	
3	CS3352	Foundations of Data Science	Mrs.P.POORNAPRIYA	CSE	2.5 Units completed	Easy to understand the subject	Action Taken	
4	CS3351	Digital Principles and Computer Organization	Mrs.S.GOMATHI	ECE	2.5 Units completed	Easy to understand the subject	Action Taken	
5	MA3354	Discrete Mathematics	Ms.P.MAHASAKTHI	S&H MATHS	2.5 Units completed	Easy to understand the subject	Resolved	

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GRIEVANCES/SUGGESTIONS FROM STUDENTS:

1. Need special coaching for Discrete Mathematics.
2. Difficult to do assignments, seminars for all subjects at the same time.
3. Need university pattern model examination.
4. All class tests and assignments can be written in A4 sheet and maintain in a single tagged file.

CHAIRPERSON

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J.K.K. MUNIRAJAH COLLEGE OF TECHNOLOGY

T.N. PALAYAM

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

ACTION TAKEN REPORT- CLASS COMMITTEE MEETING-I

CLASS COMMITTEE MEETING-I		ACADEMIC YEAR:(2023-2024) ODD	
CLASS:II YEAR CSE	Date: 12/09/2023	Time:3.30pm	Venue: II CSE class room

DATE:12/09/2023

S.NO	SUGGESTIONS/GRIEVANCES	CORRECTIVE ACTION
1	Need special coaching for Discrete Mathematics	Schedule arranged for Discrete Mathematics
2	Difficult to do assignments, seminars for all subjects at the same time.	subjects assignments and seminars given in alternative days
3	Need university pattern model examination	staffs has been asked to prepare university pattern model questions
4	All class tests and assignments can be written in A4 sheet and maintain in a single tagged file	Students can maintain their tests and assignments in the tagged file

CHAIRPERSON

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

CIRCULAR

All the faculty members who are handling classes for Second year student members of class committee from Second year asked to attend the class committee meeting-II for Second year at Second CSE class room at 3.30pm on

CLASS COMMITTEE MEETING-II			
CLASS:II YEAR CSE	Date: 21/03/2024	Time:3.30PM	Venue: II CSE class room
Members: II CSE class handling faculty members & student representatives			

S.NO	AGENDA
1	Course materials
2	Syllabus completion-theory courses
3	Class test III, assignment III, internal test III
4	Placement activities
5	General discipline & other activities

CHAIRPERSON **HOD/CSE**

NAME OF THE STAFF	DESIGNATION	SIGNATURE
Dr.N.SATHYABALAJI	HOD/CSE	
Mrs.M.C.SAVITHRI	AP/CSE	
Mrs.P.SASIREKA	AP/CSE	
Mrs.P.POORNAPRIYA	AP/CSE	
Mr.K.S.VINOTHAN	AP/CSE	
Mrs.V.NIROSHA	AP/CSE	
Mr.M.PONNUSAMY	HOD/S&H	

NAME OF THE STUDENT	YEAR	SIGNATURE
N.CHANDRAKALA	II	
S.GOKILA	II	
B.JAYASURYA	II	
M.DEVADHARSHINI	II	
K.LINGARAJU	II	

Principal
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J.K.K. MUNIRAJAH COLLEGE OF TECHNOLOGY

T.N. PALAYAM

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

MINUTES OF CLASS COMMITTEE MEETING -II

CLASS COMMITTEE MEETING-II		ACADEMIC YEAR:(2023-2024) EVEN	
CLASS: II YEAR CSE	Date: 21/03/2024	Time:3.30PM	Venue: II CSE class room
Members: II CSE class handling faculty members & student representatives			

S.NO	AGENDA
1	Course materials
2	Syllabus completion-theory courses
3	Class test III, assignment III, internal test III
4	Placement activities
5	General discipline & other activities

MEMBERS PRESENT

S.NO	MEMBERS	NAME	DESIGNATION/DEPT	SIGNATURE
1	HEAD OF THE DEPARTMENT	Dr.N.SATHYABALAJI	HOD/CSE	
2	CHAIRPERSON	Dr.N.SATHYABALAJI	HOD/CSE	
3	FACULTY MEMBERS HANDLING THE COURSE	Mrs.M.C.SAVITHRI	AP/CSE	
4		Mrs.P.SASIREKA	AP/CSE	
5		Mrs.P.POORNAPRIYA	AP/CSE	
6		Mrs.N.NIROSHSA	AP/CSE	
7		Mr.K.S.VINOTHAN	AP/CSE	
8		Mr.M.PONNUSAMY	HOD/S&H	
9	STUDENTS REPRESENTATIVES	N.CHANDRAKALA	II YEAR CSE	
10		S.GOKILA		
11		B.JAYASURYA		
12		M.DEVADHARSHINI		
13		K.LINGARAJU		

Principal
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(Autonomous)
T.N.Palayam, Gobi (Tk)
Erode (Dt) - 638 506

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

The Second class committee meeting for Second year was conducted at Second year CSE class room at 3.30pm.the following points were discussed in the meeting.

- The committee members and faculty members were given warm welcome by the head of the department.
- The student members were advised to come to the college regularly and to follow proper dress code.
- Class attendance is reviewed and irregular students identified.
- Students have been asked to communicate in English within the college campus to improve communication skills.
- Head of the department advised to study properly and score more marks in all subjects.
- Students are informed about the importance of presentation in the university examinations.
- Students have been informed to prepare 5 units to write model exams.
- Assignments and Tutorials given to the students reviewed.
- The students expressed their feedback on each course about the syllabus completion and understanding of the subject and course materials provided by the faculty.

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S.NO	COURSE CODE	COURSE NAME	NAME OF THE FACULTY	DEPT	SYLLABUS COMPLETION	FEEDBACK FROM STUDENTS	REMEDIAL MEASURES TO BE TAKEN BY THE FACULTY	SIGNATURE OF THE FACULTY
1	CS3401	Algorithms	Mrs.P.SASIREKA	CSE	4.5 Units completed	Easy to understand the subject (need live examples)	Action Taken	
2	CS3451	Introduction to Operating System	Mrs.M.C.SAVITHRI	CSE	4.5 Units completed	Easy to understand the subject	Resolved	
3	CS3452	Theory Of Computation	Mrs.N.NIROSHSA	CSE	4.5 Units completed	Easy to understand the subject	Action Taken	
4	CS3491	Artificial Intelligence And Machine Learning	Mr.K.S.VINOTHAN	CSE	4.5 Units completed	Easy to understand the subject	Action Taken	
5	CS3492	Database Management Systems	Mrs.P.POORNAPRIYA	CSE	4.5 Units completed	difficult to understand subject (need extra class)	Resolved	
6	GE3451	Environmental Sciences and Sustainability	Mr.M.PONNUSAMY	HOD/ S&H	4.5 Units completed	Easy to understand the subject	Resolved	

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GRIEVANCES/SUGGESTIONS FROM STUDENTS:

1. Students want to use net lab to prepare seminars.
2. Extra coaching class for sum paper.
3. The students requested to allow study holidays before exams.
4. Need library hours thrice in week

CHAIRPERSON **HOD/CSE**

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

ACTION TAKEN REPORT-CLASS COMMITTEE MEETING-II

CLASS COMMITTEE MEETING-II		ACADEMIC YEAR:(2023-2024) EVEN	
CLASS:II YEAR CSE	Date: 21/03/2024	Time:3.30pm	Venue: II CSE class room

DATE: 21/03/2024

S.NO	SUGGESTIONS/GRIEVANCES	CORRECTIVE ACTION
1	Students want to use net lab to prepare seminars	Permitted to use net lab for their assignment
2	Extra coaching class for sum paper	Decided to conduct extra coaching for sum paper
3	The students requested to allow study holidays before exams	Allowed to study holidays before the exams starts
4	Need library hours thrice in week	Allowed to utilize library thrice in Week

CHAIRPERSON

HOD/CSE

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ANNA UNIVERSITY, CHENNAI - 600 025
TIME TABLE-B.E./B.Tech./B.Arch. DEGREE EXAMINATIONS - APRIL/MAY-2024
(REGULATIONS-2021)
CHOICE BASED CREDIT SYSTEM (CBCS)

Branch Name **B.E. Computer Science and Engineering**

	Semester	*Subject Code*	*Subject Name*	*Exam Date*	*Session*
1	01	PH3151	Engineering Physics	12-JUL-24	A.N.
2	01	HS3152	Professional English - I	15-JUL-24	A.N.
3	01	HS3151	Professional English - I	15-JUL-24	A.N.
4	01	GE3152	Heritage of Tamils	20-JUL-24	A.N.
5	01	GE3151	Problem Solving and Python Programming	23-JUL-24	A.N.
6	01	MA3151	Matrices and Calculus	29-JUL-24	F.N.
7	01	CY3151	Engineering Chemistry	30-JUL-24	A.N.
8	02	HS3251	Professional English - II	10-JUL-24	F.N.
9	02	HS3252	Professional English - II	10-JUL-24	F.N.
10	02	MA3251	Statistics and Numerical Methods	11-JUL-24	F.N.
11	02	CS3251	Programming in C	13-JUL-24	F.N.
12	02	BE3251	Basic Electrical and Electronics Engineering	16-JUL-24	F.N.
13	02	GE3251	Engineering Graphics	19-JUL-24	F.N.
14	02	GE3251	Engineering Graphics*	19-JUL-24	A.N.
15	02	GE3252	Tamils and Technology	22-JUL-24	F.N.
16	02	PH3256	Physics for Information Science	27-JUL-24	F.N.
17	03	CS3391	Object Oriented Programming	16-JUL-24	A.N.
18	03	MA3354	Discrete Mathematics	18-JUL-24	A.N.
19	03	CS3301	Data Structures	25-JUL-24	F.N.
20	03	CS3351	Digital Principles and Computer Organization	26-JUL-24	A.N.
21	03	CS3352	Foundations of Data Science	29-JUL-24	A.N.
22	04	GE3451	Environmental Sciences and Sustainability	10-JUL-24	A.N.
23	04	CS3491	Artificial Intelligence and Machine Learning	12-JUL-24	F.N.
24	04	CS3401	Algorithms	15-JUL-24	F.N.
25	04	CS3452	Theory of Computation	18-JUL-24	F.N.
26	04	CS3451	Introduction to Operating Systems	20-JUL-24	F.N.
27	04	CS3492	Database Management Systems	23-JUL-24	F.N.
28	05	CS3551	Distributed Computing	06-JUN-24	A.N.
29	05	CS3501	Compiler Design	08-JUN-24	F.N.
30	05	CCS375	Web Technologies	10-JUN-24	F.N.
31	05	CCS346	Exploratory Data Analysis	10-JUN-24	F.N.
32	05	CCS335	Cloud Computing	10-JUN-24	F.N.
33	05	CCS344	Ethical Hacking	10-JUN-24	F.N.
34	05	CMG349	Statistics for Management	11-JUN-24	F.N.
35	05	CMG343	Principles of Public Administration	11-JUN-24	F.N.
36	05	CMG331	Financial Management	11-JUN-24	F.N.
37	05	CMG337	Foundations of Entrepreneurship	11-JUN-24	F.N.
38	05	CES331	Sustainable infrastructure Development	11-JUN-24	A.N.
39	05	CCS333	Augmented Reality/Virtual Reality	12-JUN-24	F.N.
40	05	CCS372.	Virtualization	12-JUN-24	F.N.
41	05	CEC368	IoT Based Systems Design		

NOTE: Student who opted for minor degree should refer the timetable for the subjects under the branch which offers Minor degree.

FN: FORENOON (10.00 A.M. TO 01. 00 P.M.)
AN:AFTERNOON (02.00 P.M. TO 5.00 P.M.)

CONTROLLER OF EXAMINATIONS

Principal
J.K.K.Munirajah College of Technology
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REQUISITION LETTER

From,

Head of the Department,
Computer Science and Engineering,
JKK Munirajah College of Technology,
T.N. Palayam.

To,

The Principal,
JKK Munirajah College of Technology,
T.N. Palayam.

Permission

Respected Sir,

Sub: Seeking permission for conducting a Certificate Program- Reg

We have planned to conduct a certificate program for III- and IV-year Computer Science and Engineering students on **"DATA VISUALIZATION WITH POWER BI: ADVANCED DASHBOARD TECHNIQUES"** from **21.08.2023 to 26.08.2023** by Program Coordinator **Mr.S.THIRUNVUKKARASU,** So, I request you to kindly provide a permission to conduct the certificate program.

Thanking You,

Yours Truly,

PRINCIPAL
JKK MUNIRAJAH COLLEGE
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GOBI (Tk). ERODE (Dt).

Place: T.N. Palayam

Date:16.08.2023

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JKKMCT/CIRCULAR/AUG-23 **17/08/2023**

CIRCULAR

The Department of Computer Science and Engineering is planning to organize a Certificate Program on "**DATA VISUALIZATION WITH POWER BI: ADVANCED DASHBOARD TECHNIQUES" (36 Hours)** for the benefit of the students from **21.08.2023 (Monday)** to **26.08.2023 (Tuesday).** Students those who are willing to attend the Program can enroll their names to their class in-charges respectively on or before **18.08.2023**

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Copy To,

All the HODs and Staff Members,
All the Students,
Notice Board, File

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

PROGRAM SYLLABUS

Name of the Certificate Program : DATA VISUALIZATION WITH POWER BI: ADVANCED DASHBOARD TECHNIQUES

Program Code : 23CSEDVPBIADTCP01

Name of the Program Coordinator: Mr.S.THIRUNAVUKKARASU

Academic Year: 2023-2024

Program Contents **Total Hours: 36**

Chapter 1: Power BI: Data Transformation, Advanced Modeling, and Time Intelligence

- Navigating Power BI Desktop and Importing Data
- Basic Data Cleaning and Transformation with Power Query
- Establishing Relationships: One-to-Many, Many-to-Many
- Introduction to Calculated Columns, Measures, and Tables
- Data Modelling: Star and Snowflake Schemas, Relationship Management
- Time-Based Calculations: Creating Date Tables and YTD, QTD, MTD Measures

Chapter 2: Advanced Visualizations and Interactivity

- Using advanced charts, custom visuals
- Conditional formatting
- Design dynamic dashboards with slicers and bookmarks
- Implementing slicers and filters for interactivity
- Dynamic titles and KPIs
- Hands-on: Build interactive dashboards with slicers

Chapter 3: Advanced DAX Calculations

- Basic to advanced DAX functions (CALCULATE, FILTER)
- Custom calculated measures and columns
- Using DAX for complex business metrics (e.g., YoY, Sales Growth)
- Hands-on: Create advanced DAX measures for metrics
- Optimizing DAX Performance for Large Datasets
- Debugging and Troubleshooting DAX Formulas

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Chapter 4: Power BI Service and Sharing Dashboards

- Publishing to Power BI Service
- Creating and managing workspaces and apps
- Sharing reports and dashboards
- Collaborating with teams and setting up alerts
- Hands-on: Share a dashboard and set up collaboration features
- Configuring Data Refresh and Scheduled Updates
- Embedding Power BI Reports in External Applications or Websites

Chapter 5: Performance Optimization Techniques

- Reducing model size (Star schema, aggregations)
- DirectQuery vs Import Mode
- Performance tuning with query folding
- Aggregations and incremental refresh
- Hands-on: Optimize and improve report performance
- Using Composite Models for Enhanced Performance
- Monitoring and Analyzing Power BI Performance with Performance Analyzer

Chapter 6: Final Project and Wrap-Up

- Building Interactive Dashboards with Advanced Visuals and DAX
- Optimizing Performance and Enhancing User Experience
- Final Project Presentation: Showcasing Power BI Solutions
- Review of Key Concepts and Next Steps for Advanced Learning
- Integrating Power BI with Other Microsoft Tools (Excel, Azure, etc.)
- Utilizing Power BI Mobile for On-the-Go Access

Prepared by:

Name: S. THIRUNAVUKKARASU

Designation: LEAD ENGINEER

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PROGRAM COORDINATOR | HOD | PRINCIPAL

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

PROGRAM SCHEDULE

Name of the Certificate Program : DATA VISUALIZATION WITH POWER BI: ADVANCED DASHBOARD TECHNIQUES

Program Code : 23CSEDVPBIADTCP01

Name of the Program Coordinator : Mr.S.THIRUNAVUKKARASU

Program Period : 21.02.2023 to 26.08.2023

Date/ Time	9:30AMto 11:30AM (2 Hours)	BREAK	11.45 AM to 12.45PM (1 Hour)	LUNCH	1:30 PM to 4.30 PM (3 Hours)
21.08.2023	Navigating Power BI Desktop and Importing Data, Basic Data Cleaning and Transformation with Power Query		Establishing Relationships: One-to-Many, Many-to-Many, Introduction to Calculated Columns, Measures, and Tables		Data Modelling: Star and Snowflake Schemas, Relationship Management, Time-Based Calculations: Creating Date Tables and YTD, QTD, MTD Measures
22.08.2023	Using advanced charts, custom visuals, Conditional formatting		Design dynamic dashboards with slicers and bookmarks, Implementing slicers and filters for interactivity		Dynamic titles and KPIs, Hands-on: Build interactive dashboards with slicers
23.08.2023	Basic to advanced DAX functions (CALCULATE, FILTER), Custom calculated measures and columns		Using DAX for complex business metrics (e.g., YoY, Sales Growth), Hands-on: Create advanced DAX measures for metrics		Optimizing DAX Performance for Large Datasets, Debugging and Troubleshooting DAX Formulas
24.08.2023	Publishing to Power BI Service, Creating and managing workspaces and apps		Sharing reports and dashboards, collaborating with teams and setting up alerts		Hands-on: Share a dashboard and set up collaboration features, Configuring Data Refresh and Scheduled Updates, Embedding Power BI Reports in External Applications or Websites

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25.08.2023	Reducing model size (Star schema, aggregations), DirectQuery vs Import Mode		Performance tuning with query folding, Aggregations and incremental refresh	Hands-on: Optimize and improve report performance, Using Composite Models for Enhanced Performance, Monitoring and Analyzing Power BI Performance with Performance Analyzer
26.08.2023	Building Interactive Dashboards with Advanced Visuals and DAX, Optimizing Performance and Enhancing User Experience		Final Project Presentation: Showcasing Power BI Solutions, Review of Key Concepts and Next Steps for Advanced Learning	Integrating Power BI with Other Microsoft Tools (Excel, Azure, etc.), Utilizing Power BI Mobile for On-the-Go Access

PROGRAM COORDINATOR HOD PRINCIPAL

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

RESOURCE PERSON PROFILE

Title of the Programme	DATA VISUALIZATION WITH POWER BI: ADVANCED DASHBOARD TECHNIQUES
Duration and Timing of the Programme	36 Hours and 9.30 AM to 4.30 PM
Name of the Resource Person	Mr.S.THIRUNAVUKKARASU
Photo Image of the Resource Person	
E-mail	Sadaiyappan.thirunavukkarasu@in.bosch.com
Mobile No:	9787200445
Designation	Lead Engineer
Official Address	Bosch Global Software Technologies Private Limited, CHIL-SEZ Keeranatham Village, Coimbatore 641035
Educational Qualification	M.Tech, MBA
Experience	13 Year experience
Field of Interest	Artificial Intelligence, Data Science

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

ACADEMIC YEAR 2023-2024

WILLING STUDENTS NAMELIST

CERTIFICATE PROGRAM ON DATA VISUALIZATION WITH POWER BI: ADVANCED DASHBOARD TECHNIQUES

S.NO	REGISTER NUMBER	NAME	WILLINGNESS		
			YES	NO	SIGN
IV YEAR					
1	731220104001	ABINAYA G	✓		
2	731220104003	BALU R	✓		
3	731220104004	CHARLES WILLIAM.L	✓		
4	731220104005	DEEPAK.S	✓		
5	731220104006	DEEPIKA.S	✓		
6	731220104007	DHARANISELVI. M	✓		
7	731220104009	JAGATHESWARAN.P	✓		
8	731220104010	KARUNYAA.M	✓		
9	731220104011	KATHIRESAN.K	✓		
10	731220104012	KAVIN.M	✓		
11	731220104014	LOGANATHAN.T	✓		
12	731220104019	NIRMALRAJ.S	✓		
13	731220104021	RAMYA.S	✓		
14	731220104022	ROHITH.R	✓		
15	731220104023	ROSHMA I	✓		
16	731220104024	SIVALINGAM.K	✓		
17	731220104025	SUNDARAGANESAN.K	✓		
18	731220104028	VIGNESH.M	✓		

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19	731220104029	VINISHA.T	✓		
20	731220104030	VINITHA.A	✓		
21	731220104031	VINOTHKUMAR.R	✓		
22	731220104301	BOOPALAN.M	✓		
23	731220104302	DHAMODARAN.G	✓		
		III YEAR			
24	731221104001	AADHI SURYA K	✓		
25	731221104004	ARULMURUGAN S	✓		
26	731221104005	BABUSHANKAR S	✓		
27	731221104007	BAMBAVASAN V	✓		
28	731221104008	CHANDRA PRAKASH K	✓		
29	731221104009	DHAKSHINA MOORTHI E	✓		
30	731221104012	DURGA K	✓		
31	731221104013	GUNASEKARAN P	✓		
32	731221104014	GUNASEKARAN S	✓		
33	731221104015	HARIPRABHA V	✓		
34	731221104017	KAMALESH K		AB	
35	731221104021	LALITHA T	✓		
36	731221104022	MADHAN G	✓		
37	731221104025	MOUSIKA S	✓		
38	731221104026	NANDHINI P	✓		
39	731221104027	PANDIYARAJ P	✓		
40	731221104028	PRIYA DHARSHINI S	✓		
41	731221104029	RAVI KUMAR P		✓	
42	731221104031	RUBIKA G	✓		

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43	731221104033	SHYAMKUMAR S	✓		
44	731221104034	SENTHILVEL S	✓		
45	731221104035	SUGANYA K	✓		
46	731221104036	SURYA S		✓	
47	731221104037	SUSHMINA M	✓		
48	731221104038	VASANTHKUMAR S	✓		
49	731221104039	VIGNESH M	✓		
50	731221104040	YAMUNA K	✓		
51	731221104301	AMUTHAMALAR R	✓		
52	731221104302	BHARANI DHARAN.M	✓		
53	731221104303	GAYATHRI R	✓		
54	731221104305	NANDINI M	✓		
55	731221104306	SNEHA L	✓		
56	731221104307	SRINIVAS V	✓		
57	731221104308	SUBASHINI P	✓		
58	731221104701	NIKETHA S	✓		
M.E-CSE - I YEAR					
59	731223405001	ADHISESHAN N	✓		
60	731223405003	MATHIYAZHAGAN M	✓		
61	731223405004	POORNIMA K	✓		
62	731223405005	PRIYADHARSINI T	✓		
63	731223405006	SATHIYAPRIYA M	✓		
64	731223405007	SNEHALAL T V	✓		

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PROGRAM COORDINATOR HOD PRINCIPAL

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

ACADEMIC YEAR 2023-2024

CERTIFICATE PROGRAM ON DATA VISUALIZATION WITH POWER BI: ADVANCED DASHBOARD TECHNIQUES

ENROLLED STUDENTS NAMELIST

DATE: 21.08.2023 to 26.08.2023

S.NO	REG. NO	NAME
IV YEAR		
1	731220104001	ABINAYA G
2	731220104003	BALU R
3	731220104004	CHARLES WILLIAM.L
4	731220104005	DEEPAK.S
5	731220104006	DEEPIKA.S
6	731220104007	DHARANISELVI. M
7	731220104009	JAGATHESWARAN.P
8	731220104010	KARUNYAA.M
9	731220104011	KATHIRESAN.K
10	731220104012	KAVIN.M
11	731220104014	LOGANATHAN.T
12	731220104019	NIRMALRAJ.S
13	731220104021	RAMYA.S
14	731220104022	ROHITH.R
15	731220104023	ROSHMA I
16	731220104024	SIVALINGAM.K
17	731220104025	SUNDARAGANESAN.K
18	731220104028	VIGNESH.M
19	731220104029	VINISHA.T
20	731220104030	VINITHA.A
21	731220104031	VINOTHKUMAR.R
22	731220104301	BOOPALAN.M
23	731220104302	DHAMODARAN.G

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III YEAR		
24	731221104001	AADHI SURYA K
25	731221104004	ARULMURUGAN S
26	731221104005	BABUSHANKAR S
27	731221104007	BAMBAVASAN V
28	731221104008	CHANDRA PRAKASH K
29	731221104009	DHAKSHINA MOORTHI E
30	731221104012	DURGA K
31	731221104013	GUNASEKARAN P
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34	731221104021	LALITHA T
35	731221104022	MADHAN G
36	731221104025	MOUSIKA S
37	731221104026	NANDHINI P
38	731221104027	PANDIYARAJ P
39	731221104028	PRIYA DHARSHINI S
40	731221104031	RUBIKA G
41	731221104033	SHYAMKUMAR S
42	731221104034	SENTHILVEL S
43	731221104035	SUGANYA K
44	731221104037	SUSHMINA M
45	731221104038	VASANTHKUMAR S
46	731221104039	VIGNESH M
47	731221104040	YAMUNA K
48	731221104301	AMUTHAMALAR R
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50	731221104303	GAYATHRI R
51	731221104305	NANDINI M
52	731221104306	SNEHA L
53	731221104307	SRINIVAS V
54	731221104308	SUBASHINI P
55	731221104701	NIKETHA S

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M.E CSE – I YEAR		
56	731223405001	ADHISESHAN N
57	731223405003	MATHIYAZHAGAN M
58	731223405004	POORNIMA K
59	731223405005	PRIYADHARSINI T
60	731223405006	SATHIYAPRIYA M
61	731223405007	SNEHALAL T V

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PROGRAM COORDINATOR HOD PRINCIPAL

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

ACADEMIC YEAR 2023-2024

CERTIFICATE PROGRAM ON DATA VISUALIZATION WITH POWER BI: ADVANCED DASHBOARD TECHNIQUES

ATTENDANCE SHEET

S.NO	REGISTER NO	NAME	ATTENDANCE OF THE PARTICIPANTS											
			21/8/2023		22/8/2023		23/8/2023		24/8/2023		25/8/2023		26/8/2023	
			FN	AN	FN	AN	FN	AN	FN	AN	FN	AN	FN	AN
IV YEAR														
1	731220104001	ABINAYA G	/	/	/	/	/	/	/	/	/	/	/	/
2	731220104003	BALU R	/	/	/	/	/	/	/	/	/	/	/	/
3	731220104004	CHARLES WILLIAM.L	/	/	/	/	/	/	/	/	/	/	/	/
4	731220104005	DEEPAK.S	/	/	/	/	/	/	/	/	/	/	/	/
5	731220104006	DEEPIKA.S	/	/	/	/	/	/	/	/	/	/	/	/
6	731220104007	DHARANISELVI. M	/	/	/	/	/	/	/	/	/	/	/	/
7	731220104009	JAGATHESWARAN.P	/	/	/	/	/	/	/	/	/	/	/	/
8	731220104010	KARUNYAA.M	/	/	/	/	/	/	/	/	/	/	/	/
9	731220104011	KATHIRESAN.K	/	/	/	/	/	/	/	/	/	/	/	/
10	731220104012	KAVIN.M	/	/	/	/	/	/	/	/	/	/	/	/
11	731220104014	LOGANATHAN.T	/	/	/	/	a	a	/	/	/	/	/	/
12	731220104019	NIRMALRAJ.S	/	/	/	/	/	/	/	/	/	/	/	/
13	731220104021	RAMYA.S	/	/	/	/	/	/	/	/	/	/	/	/
14	731220104022	ROHITH.R	/	/	/	/	/	/	/	/	/	/	/	/
15	731220104023	ROSHMA I	/	/	/	/	/	/	/	/	/	/	/	/

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16	731220104024	SIVALINGAM.K	(	1	(	1	(	1	(	1	1	1	1	1
17	731220104025	SUNDARAGANESAN.K	(	1	(	1	(	1	(	1	(	1	(	1
18	731220104028	VIGNESH.M	(	1	(	1	(	1	(	1	(	1	1	1
19	731220104029	VINISHA.T	(	1	(	1	(	1	(	1	(	1	1	1
20	731220104030	VINITHA.A	(	1	(	1	(	1	(	1	(	1	1	1
21	731220104031	VINOTHKUMAR.R	1	1	(	1	(	1	(	1	(	1	(	1
22	731220104301	BOOPALAN.M	(	1	(	1	1	1	1	1	a	a	(	1
23	731220104302	DHAMODARAN.G	(	1	(	1	(	1	1	1	(	1	(	1
		III YEAR												
24	731221104001	AADHI SURYA K	(	1	(	1	(	1	(	1	1	1	(	1
25	731221104004	ARULMURUGAN S	(	1	(	1	(	1	(	1	(	1	(	1
26	731221104005	BABUSHANKAR S	(	1	1	1	1	1	(	1	1	1	(	1
27	731221104007	BAMBAVASAN V	(	1	1	1	1	1	1	1	1	1	1	1
28	731221104008	CHANDRA PRAKASH K	(	1	(	1	(	1	1	1	(	1	(	1
29	731221104009	DHAKSHINA MOORTHI E	(	1	1	1	(	1	1	1	(	1	1	1
30	731221104012	DURGA K	(	1	(	1	(	1	(	1	1	1	(	1
31	731221104013	GUNASEKARAN P	1	1	1	1	1	1	1	1	(	1	1	1
32	731221104014	GUNASEKARAN S	1	1	(	1	(	1	(	1	1	1	(	1
33	731221104015	HARIPRABHA V	1	1	(	1	(	1	1	1	1	1	(	1
34	731221104021	LALITHA T	1	1	(	1	(	1	1	1	(	1	(	1
35	731221104022	MADHAN G	1	1	1	1	(	1	1	1	a	a	1	1
36	731221104025	MOUSIKA S	1	1	(	1	(	1	1	1	1	1	1	1
37	731221104026	NANDHINI P	1	1	(	1	(	1	1	1			1	1

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38	731221104027	PANDIYARAJ P	/	/	/	/	/	/	/	/	/	/	/	/
39	731221104028	PRIYA DHARSHINI S	/	/	/	/	/	/	/	/	/	/	/	/
40	731221104031	RUBIKA G	/	/	/	/	/	/	/	/	/	/	/	/
41	731221104033	SHYAMKUMAR S	/	/	/	/	a	a	/	/	/	/	/	/
41	731221104034	SENTHILVEL S	/	/	/	/	/	/	/	/	/	/	/	/
43	731221104035	SUGANYA K	/	/	/	/	/	/	/	/	/	/	/	/
44	731221104037	SUSHMINA M	/	/	/	/	/	/	/	/	/	/	/	/
45	731221104038	VASANTHKUMAR S	/	/	/	/	/	/	/	/	/	/	/	/
46	731221104039	VIGNESH M	/	/	/	/	/	/	/	/	/	/	/	/
47	731221104040	YAMUNA K	/	/	/	/	/	/	/	/	/	/	/	/
48	731221104301	AMUTHAMALAR R	/	/	/	/	/	/	/	/	/	/	/	/
49	731221104302	BHARANI DHARAN.M	/	/	a	a	/	/	/	/	/	/	/	/
50	731221104303	GAYATHRI R	/	/	/	/	/	/	/	/	/	/	/	/
51	731221104305	NANDINI M	/	/	/	/	/	/	/	/	/	/	/	/
52	731221104306	SNEHA L	/	/	/	/	/	/	/	/	/	/	/	/
53	731221104307	SRINIVAS V	/	/	/	/	/	/	/	/	/	/	/	/
54	731221104308	SUBASHINI P	/	/	/	/	/	/	/	/	/	/	/	/
55	731221104701	NIKETHA S	/	/	/	/	/	/	/	/	/	/	/	/
M.E CSE – I YEAR														
56	731223405001	ADHISESHAN N	/	/	/	/	/	/	/	/	/	/	/	/
57	731223405003	MATHIYAZHAGAN M	/	/	/	/	/	/	/	/	/	/	/	/
58	731223405004	POORNIMA K	/	/	/	/	/	/	/	/	/	/	/	/
59	731223405005	PRIYADHARSINI T	/	/	/	/	/	/	/	/	/	/	/	/

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60	731223405006	SATHIYAPRIYA M	/	/	/	/	/	/	/	/	/	/	/	/
61	731223405007	SNEHALAL T V	/	/	/	/	/	/	/	/	/	/	/	/
TOTAL NO OF STUDENTS PRESENT			61	61	60	60	59	59	61	61	59	59	61	61
TOTAL NO OF STUDENTS ABSENT			NIL	NIL	01	01	02	02	NIL	NIL	02	02	NIL	NIL
SIGNATURE OF THE PROGRAM COORDINATOR														
SIGNATURE OF THE HOD														

PROGRAM COORDINATOR

HOD

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

ACADEMIC YEAR 2023-2024

DATA VISUALIZATION WITH POWER BI: ADVANCED DASHBOARD TECHNIQUES

ASSESSMENT

ANSWER ALL QUESTIONS (30*1=30 MARKS)

1. **What is the primary purpose of Power BI?**
   a) Data storage
   b) Data analysis and visualization
   c) Data cleaning
   d) Data manipulation
2. **Which Power BI component allows you to create interactive reports and dashboards?**
   a) Power BI Desktop
   b) Power BI Service
   c) Power BI Gateway
   d) Power BI Mobile
3. **What is the role of Power BI Gateway?**
   a) To publish reports to the Power BI Service
   b) To connect on-premises data sources with the cloud
   c) To clean and transform data
   d) To display data on mobile devices
4. **Which of the following is NOT a data source supported by Power BI?**
   a) SQL Server
   b) Excel
   c) Google Sheets
   d) Salesforce
5. **What is Power Query used for in Power BI?**
   a) Data visualization
   b) Data transformation and loading
   c) Data modeling
   d) Creating dashboards

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6. **What is a "Measure" in Power BI?**
   a) A static data values
   b) A predefined field that cannot be modified
   c) A calculation used to summarize data
   d) A filter applied to data
7. **Which DAX function is used to calculate the running total in Power BI?**
   a) SUM
   b) CUMULATIVE
   c) DATESYTD
   d) RANKX
8. **What is the purpose of Power BI's "What-If" analysis?**
   a) To predict future trends
   b) To create visualizations for large datasets
   c) To compare different scenarios based on input parameters
   d) To filter the data dynamically
9. **What is a "Bookmark" in Power BI?**
   a) A saved visualization
   b) A method to navigate to specific pages within a report
   c) A quick filter applied to data
   d) A way to store raw data for reference
10. **Which feature in Power BI allows users to create dynamic reports with different views or settings?**
    a) Conditional formatting
    b) Bookmarks
    c) Drillthrough
    d) Query parameters
11. **What is a "Treemap" in Power BI used for?**
    a) Displaying hierarchical data as nested rectangles
    b) Showing trends over time
    c) Comparing proportions of data

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d) Displaying maps with geographical data

12. **Which of the following visualizations would be most appropriate for displaying the relationship between two numerical variables?**
    a) Scatter plot
    b) Column chart
    c) Line chart
    d) Donut chart
13. **What is the purpose of "Conditional Formatting" in Power BI?**
    a) To apply color rules based on the data values
    b) To highlight rows with missing data
    c) To format numbers as currency
    d) To change the font size
14. **What is a "KPI" visual in Power BI?**
    a) Key Performance Indicator, used to display the status of a metric
    b) Key Pivot Indicator, used to summarize data
    c) Known Parameter Indicator, used for filtering data
    d) Key Progress Indicator, used for tracking project completion
15. **What is "Drillthrough" in Power BI?**
    a) A feature to zoom into specific data points for detailed analysis
    b) A method to filter data by date range
    c) A way to navigate to a different report page based on a selected value
    d) A process to calculate running totals
16. **Which of the following is a benefit of using "Slicers" in Power BI dashboards?**
    a) To perform complex data calculations
    b) To provide a way to filter data interactively
    c) To change the underlying data model
    d) To format charts dynamically
17. **Which type of visualization would you use to represent geographic data in Power BI?**
    a) Map
    b) Pie chart
    c) TreeMap

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d) Bar chart

18. **Which Power BI feature allows you to create a dynamic drill-down experience from one visualization to another?**
    a) Drillthrough
    b) Bookmarks
    c) Hierarchy
    d) Conditional formatting
19. **What type of visual should you use to compare categories with multiple measures?**
    a) Stacked column chart
    b) Pie chart
    c) Line chart
    d) Card
20. **What is the purpose of a "Line and Clustered Column Chart" in Power BI?**
    a) To display both line and column charts in a single visual for comparison
    b) To show the trend of data over time
    c) To compare multiple categories against a single measure
    d) To display geographic data on a map
21. **What is a "Calculated Column" in Power BI?**
    a) A column created from an existing column using DAX
    b) A custom column used for slicers
    c) A column created by importing external data
    d) A column used for visual formatting
22. **What is the "ALL" function in DAX used for?**
    a) To return all values in a column, ignoring filters
    b) To remove all columns in a table
    c) To create a total sum of all values
    d) To ignore date filters in a report
23. **Which DAX function would you use to find the average value of a column?**
    a) AVERAGE
    b) SUM
    c) COUNT

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d) MIN

24. **What is a "Many-to-Many" relationship in Power BI?**

a) A relationship between two tables where each row in one table can relate to multiple rows in the other table

b) A relationship where one table has unique values and the other table contains many duplicate values

c) A relationship where one table can have only one corresponding row in the other table

d) A relationship used exclusively for date-based models

25. **What is "Power BI Service" used for?**

a) Data transformation

b) Data visualization and report creation

c) Cloud-based sharing and collaboration of Power BI reports

d) Connecting local data sources to Power BI

26. **Which feature allows you to apply complex data transformations in Power BI before loading data into the model?**

a) Power Query Editor

b) Data View

c) DAX editor

d) Report View

27. **What is a "One-to-Many" relationship in Power BI?**

a) A relationship where each row in the first table corresponds to multiple rows in the second table

b) A relationship where each row in the first table corresponds to one row in the second table

c) A relationship used for data analysis only

d) A relationship where each row in the second table corresponds to multiple rows in the first table

28. **Which feature in Power BI allows you to schedule data refreshes for your reports?**

a) Power Query Editor

b) Power BI Service

c) Power BI Desktop

d) DAX queries

29. **What is the purpose of a "Data Model" in Power BI?**

a) To define the structure and relationships of data tables

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b) To define report page layouts

c) To create visualizations

d) To connect to external data sources

30. **What type of visualization would be best to use when comparing parts to a whole?**

a) Pie chart

b) Line chart

c) Bar chart

d) Scatter plot

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

ACADEMIC YEAR 2023-2024

CERTIFICATE PROGRAM ON "DATA VISUALIZATION WITH POWER BI: ADVANCED DASHBOARD TECHNIQUES"

STUDENTS MARKLIST

DATE: 21.08.2023 to 26.08.2023

S.NO	REG. NO	NAME	MARKS
IV YEAR			
1	731220104001	ABINAYA G	87
2	731220104003	BALU R	96
3	731220104004	CHARLES WILLIAM.L	78
4	731220104005	DEEPAK.S	85
5	731220104006	DEEPIKA.S	89
6	731220104007	DHARANISELVI. M	76
7	731220104009	JAGATHESWARAN.P	89
8	731220104010	KARUNYAA.M	91
9	731220104011	KATHIRESAN.K	80
10	731220104012	KAVIN.M	78
11	731220104014	LOGANATHAN.T	75
12	731220104019	NIRMALRAJ.S	95
13	731220104021	RAMYA.S	92
14	731220104022	ROHITH.R	90
15	731220104023	ROSHMA I	93
16	731220104024	SIVALINGAM.K	84
17	731220104025	SUNDARAGANESAN.K	86
18	731220104028	VIGNESH.M	82
19	731220104029	VINISHA.T	95
20	731220104030	VINITHA.A	96
21	731220104031	VINOTHKUMAR.R	97
22	731220104301	BOOPALAN.M	

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23	731220104302	DHAMODARAN.G	72
III YEAR			
24	731221104001	AADHI SURYA K	95
25	731221104004	ARULMURUGAN S	92
26	731221104005	BABUSHANKAR S	95
27	731221104007	BAMBAVASAN V	94
28	731221104008	CHANDRA PRAKASH K	96
29	731221104009	DHAKSHINA MOORTHI E	75
30	731221104012	DURGA K	88
31	731221104013	GUNASEKARAN P	83
32	731221104014	GUNASEKARAN S	82
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35	731221104022	MADHAN G	86
36	731221104025	MOUSIKA S	95
37	731221104026	NANDHINI P	**48**
38	731221104027	PANDIYARAJ P	79
39	731221104028	PRIYA DHARSHINI S	86
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46	731221104039	VIGNESH M	95
47	731221104040	YAMUNA K	91
48	731221104301	AMUTHAMALAR R	87
49	731221104302	BHARANI DHARAN.M	68
50	731221104303	GAYATHRI R	**45**
51	731221104305	NANDINI M	93
52	731221104306	SNEHA L	95
53	731221104307	SRINIVAS V	82

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54	731221104308	SUBASHINI P	86
55	731221104701	NIKETHA S	96
M.E CSE – I YEAR			
56	731223405001	ADHISESHAN N	92
57	731223405003	MATHIYAZHAGAN M	95
58	731223405004	POORNIMA K	96
59	731223405005	PRIYADHARSINI T	91
60	731223405006	SATHIYAPRIYA M	89
61	731223405007	SNEHALAL T V	90

Note: The students those who have secured above 50 Marks and above are consider eligible for program completion.

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PROGRAM COORDINATOR HOD PRINCIPAL

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

ACADEMIC YEAR 2023-2024

SUMMARY/ OUTCOME REPORT

Name of the Certificate Program : DATA VISUALIZATION WITH POWER BI: ADVANCED DASHBOARD TECHNIQUES

Program Code : 23CSEDVPBIADTCP01

Name of the Program Coordinator : Mr.S.THIRUNAVUKKARASU

Duration : 36 Hours

Number of Students Enrolled : 61

Number of Students Completed : 58

I hereby affirm that the entire Program contents in the Certificate Program **"Data Visualization with Power Bi: Advanced Dashboard Techniques"** listed in the Syllabus have been actually learned by the students as the part of the prescribed co-curricular activities through Certificate Program.

I confirmed that the Certificate Program title as **Data Visualization with Power Bi: Advanced Dashboard Techniques** Work Bench was done by me in the beginning of this semester and Program delivery with attendance of the students were recorded.

I confirmed that all registered students for this Certificate Program were actively attended and learned well throughout the duration of this Program. And all students were successfully completed and eligible to receive the participation certificate.

OUTCOME: Students shall be able to gain the knowledge in

- **Advanced Visualization & Reporting**: Learn to create interactive dashboards with maps, scatter plots, KPIs, and features like bookmarks, drill-through, and slicers.
- **Data Modelling & DAX Expertise**: Build data relationships and use DAX for calculations like measures, calculated columns, and time-based analysis.
- **Data Transformation with Power Query**: Learn to clean and prepare data using Power Query for accurate reporting.
- **Collaboration, Performance, & Security**: Understand how to share reports, improve performance, and apply security like Row-Level Security (RLS) to protect data.

Name : Mr.S.THIRUNAVUKKARASU

Designation: Lead Engineer

PROGRAM COORDINATOR

HOD

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CERTIFICATION OF COMPLETION

This is to certify that Mr./Ms. BALU R of IV-CSE has successfully Completed the Certificate Program titled "DATA VISUALIZATION WITH POWER BI: ADVANCED DASHBOARD TECHNIQUES" Organised by Department of Computer Science & Engineering.

Duration : 21.08.2023 to 26.08.2023.

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CERTIFICATION OF COMPLETION

This is to certify that Mr./Ms. CHARLES WILLIAM.I of IV-CSE has successfully Completed the Certificate Program titled "DATA VISUALIZATION WITH POWER BI: ADVANCED DASHBOARD TECHNIQUES" Organised by Department of Computer Science & Engineering.

Duration : 21.08.2023 to 26.08.2023.

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CERTIFICATION OF COMPLETION

This is to certify that Mr./Ms. DEEPAK S of IV-CSE has successfully Completed the Certificate Program titled "DATA VISUALIZATION WITH POWER BI: ADVANCED DASHBOARD TECHNIQUES " Organised by Department of Computer Science & Engineering.

Duration : 21.08.2023 to 26.08.2023.

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CERTIFICATION OF COMPLETION

This is to certify that Mr./Ms. DEEPIKA S of IV-CSE has successfully Completed the Certificate Program titled "DATA VISUALIZATION WITH POWER BI: ADVANCED DASHBOARD TECHNIQUES" Organised by Department of Computer Science & Engineering.

Duration : 21.08.2023 to 26.08.2023.

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CERTIFICATION OF COMPLETION

This is to certify that Mr./Ms. DHARANISELVI M of IV-CSE has successfully Completed the Certificate Program titled "DATA VISUALIZATION WITH POWER BI: ADVANCED DASHBOARD TECHNIQUES " Organised by Department of Computer Science & Engineering.

Duration : 21.08.2023 to 26.08.2023.

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CERTIFICATION OF COMPLETION

This is to certify that Mr./Ms. JAGATHESWARAN P of IV-CSE has successfully Completed the Certificate Program titled "DATA VISUALIZATION WITH POWER BI: ADVANCED DASHBOARD TECHNIQUES" Organised by Department of Computer Science & Engineering.

Duration : 21.08.2023 to 26.08.2023.

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CERTIFICATION OF COMPLETION

This is to certify that Mr./Ms. KARUNYAA M of IV-CSE has successfully Completed the Certificate Program titled "DATA VISUALIZATION WITH POWER BI: ADVANCED DASHBOARD TECHNIQUES" Organised by Department of Computer Science & Engineering.

Duration : 21.08.2023 to 26.08.2023.

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This is to certify that Mr./Ms. KATHIRESAN K of IV-CSE has successfully Completed the Certificate Program titled "DATA VISUALIZATION WITH POWER BI: ADVANCED DASHBOARD TECHNIQUES" Organised by Department of Computer Science & Engineering.

Duration : 21.08.2023 to 26.08.2023.

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CERTIFICATION OF COMPLETION

This is to certify that Mr./Ms. KAVIN.M of IV-CSE has successfully Completed the Certificate Program titled "DATA VISUALIZATION WITH POWER BI: ADVANCED DASHBOARD TECHNIQUES" Organised by Department of Computer Science & Engineering.

Duration : 21.08.2023 to 26.08.2023.

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CERTIFICATION OF COMPLETION

This is to certify that Mr./Ms. LOGANATHAN T of IV-CSE has successfully Completed the Certificate Program titled "DATA VISUALIZATION WITH POWER BI: ADVANCED DASHBOARD TECHNIQUES" Organised by Department of Computer Science & Engineering.

Duration : 26.08.2023 to 21.08.2023.

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CERTIFICATION OF COMPLETION

This is to certify that Mr./Ms. NIRMALRAJ S of IV-CSE has successfully Completed the Certificate Program titled "DATA VISUALIZATION WITH POWER BI: ADVANCED DASHBOARD TECHNIQUES " Organised by Department of Computer Science & Engineering.

Duration : 21.08.2023 to 26.08.2023.

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CERTIFICATION OF COMPLETION

This is to certify that Mr./Ms. RAMYA S of IV-CSE has successfully Completed the Certificate Program titled "DATA VISUALIZATION WITH POWER BI: ADVANCED DASHBOARD TECHNIQUES" Organised by Department of Computer Science & Engineering.

Duration : 21.08.2023 to 26.08.2023.

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CERTIFICATION OF COMPLETION

This is to certify that Mr./Ms. ROHITH R of IV-CSE has successfully Completed the Certificate Program titled "DATA VISUALIZATION WITH POWER BI: ADVANCED DASHBOARD TECHNIQUES" Organised by Department of Computer Science & Engineering.

Duration : 21.08.2023 to 26.08.2023.

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CERTIFICATION OF COMPLETION

This is to certify that Mr./Ms. ROSHMA I of IV-CSE has successfully Completed the Certificate Program titled "DATA VISUALIZATION WITH POWER BI: ADVANCED DASHBOARD TECHNIQUES" Organised by Department of Computer Science & Engineering.

Duration : 26.08.2023 to 21.08.2023.

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This is to certify that Mr./Ms. SIVALINGAM K of IV-CSE has successfully Completed the Certificate Program titled "DATA VISUALIZATION WITH POWER BI: ADVANCED DASHBOARD TECHNIQUES" Organised by Department of Computer Science & Engineering.

Duration : 21.08.2023 to 26.08.2023.

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This is to certify that Mr./Ms. SUNDARAGANESAN K of IV-CSE has successfully Completed the Certificate Program titled "DATA VISUALIZATION WITH POWER BI: ADVANCED DASHBOARD TECHNIQUES" Organised by Department of Computer Science & Engineering.

Duration : 26.08.2023 to 21.08.2023.

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This is to certify that Mr./Ms. VIGNESH M of IV-CSE has successfully Completed the Certificate Program titled "DATA VISUALIZATION WITH POWER BI: ADVANCED DASHBOARD TECHNIQUES" Organised by Department of Computer Science & Engineering.

Duration : 21.08.2023 to 26.08.2023.

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This is to certify that Mr./Ms. VINISHA.T of IV-CSE has successfully Completed the Certificate Program titled "DATA VISUALIZATION WITH POWER BI: ADVANCED DASHBOARD TECHNIQUES " Organised by Department of Computer Science & Engineering.

Duration : 26.08.2023 to 21.08.2023.

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This is to certify that Mr./Ms. VINITHA.A of IV-CSE has successfully Completed the Certificate Program titled "DATA VISUALIZATION WITH POWER BI: ADVANCED DASHBOARD TECHNIQUES" Organised by Department of Computer Science & Engineering.

Duration : 21.08.2023 to 26.08.2023.

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PROGRAM OBJECTIVES

- Learn Advanced Visualization: Create interactive and complex dashboards using Power BI's advanced features.
- Improve Data Modelling: Build strong data models with advanced DAX functions and optimized data relationships.
- Automate Reporting: Streamline reporting processes and easily share interactive dashboards within your organization.

PROGRAM SCHEDULE:

Day 1(21.08.2023): Power BI: Data Transformation, Advanced Modeling, and Time Intelligence

Day 2(22.08.2023): Advanced Visualizations and Interactivity

Day 3(23.08.2023): Advanced DAX Calculations

Day 4(24.08.2023): Power BI Service and Sharing Dashboards

Day 5(25.08.2023): Performance Optimization Technique

Day 6(26.08.2023): Final Project and Wrap-Up

ABOUT THE PROGRAM

Learn and live

"Anyone who stops learning is old, whether at twenty or eighty. Anyone who keeps learning stays young. The greatest thing in life is to keep your mind young".

The Certificate Program aims to provide additional learner centric graded skill oriented technical training, with the primary objective of improving the employability skills of engineering students.

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ERODE (DT), TAMILNADU
PIN: 638 506

CERTIFICATE PROGRAM IN

"DATA VISUALIZATION WITH POWER BI: ADVANCED DASHBOARD TECHNIQUES"

21.08.2023 to 26.08.2023

Organized by

DEPARTMENT OF CSE

ABOUT THE COLLEGE

J.K.K. Munirajah college of Technology was established in the year 2008 Governed by Annai J.K.K.Sampoorani Ammal Charitable Trust, primarily with the objective of delivering world class quality in Education and Training in a structured and systematic manner J.K.K. Munirajah group of Institutions was founded by J.K.K .Munirajah, who is a reputed industrialist, technocrat, an educationalist par excellence, an avid social worker, a person imbibed in deep spiritual values and a philanthropist. The management has completed 25 years of dedicated service to the people of India and abroad in the field of Education. The Institution has an area of 250 acres of land richly endowed with beautiful Greenland. The college with its state-of- the- art infrastructural facilities and excellent academic records has earned recognition as one of the reputed educational institutions for men and women in India.

ABOUT THE DEPARTMENT

The J.K.K. Munirajah college of Technology has The Computer Science Engineering Department was started in 2008 with the primary objective to disseminate the knowledge above latest technologies in computer technology to the students , Computer technology has become an integral part of our daily life. It is the most important element in the education of students at the present and the future era. Computer Technology has revolutionized society to a great extent. Technological advancements are so rapid in this field that continual learning is essential to keep the skill set of students up to date. Also, the department strives hard in improving the communication skills, technical and analytical skills of our students through various programs, so that they could compete in the global front. We focus on bridging the gap between campus education and industry needs through internships, guest lectures andworkshops.

RESOURCE PERSON

Mr.S.THIRUNAVUKKARASU

PATRON

Dr.K.SRIDHARAN Ph.D,

CONVENOR

Dr.N.SATHYABALAJI

HOD -CSE

COURSE-COORDINATORS

1.Mr.E.ANANTH

AP/CSE

2. Mr.P.SASIREKA

AP/CSE

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COURSE CONTENTS

- Advanced Data Modeling: Learn to create complex data models, use advanced DAX functions, and optimize data relationships for better performance.
- Interactive Dashboards: Design and build dynamic, interactive dashboards with custom visuals, slicers, and drill-through features.
- Automation and Sharing: Automate report generation, set up data refresh schedules, and share dashboards securely with stakeholders via Power BI Service.

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PROJECT,

INTERNSHIP &

INDUSTRIAL VISIT

ACADEMIC YEAR (2023-2024)							
	J.K.K.MUNIRAJAH COLLEGE OF TECHNOLOGY T.N.Palayam(po),Gobi(tk)-638506, Erode(dt).						Metric No 1.3.2
S.No	Name of the course	course code	programme offering	Experiential learning			Number of students
				project work	field work	inplant training	
(2023-2024) Regulation-2017							
1	Project Work	CS8811	COMPUTER SCIENCE AND ENGINEERING	✓			23
2	Software Engineering	CS8494	COMPUTER SCIENCE AND ENGINEERING	✓			23
3	Computer Networks	CS8591	COMPUTER SCIENCE AND ENGINEERING	✓			5
4	Object Oriented Analysis and Design	CS8592	COMPUTER SCIENCE AND ENGINEERING	✓			23
5	Artificial Intelligence	CS8691	COMPUTER SCIENCE AND ENGINEERING	✓			6
6	Mobile Computing	CS8601	COMPUTER SCIENCE AND ENGINEERING	✓			5
7	Cryptography and Network Security	CS8792	COMPUTER SCIENCE AND ENGINEERING	✓			3
8	Cloud Computing	CS8791	COMPUTER SCIENCE AND ENGINEERING	✓			6

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ACADEMIC YEAR (2023-2024)							
		J.K.K.MUNIRAJAH COLLEGE OF TECHNOLOGY T.N.Palayam(po),Gobi(tk)-638506, Erode(dt).					**Metric No 1.3.2**
S.No	**Name of the course**	**course code**	**programme offering**	**Experiential learning**			**Number of students**
				project work	**field work**	**inplant training**	
(2023-2024) Regulation-2021							
1	Problem Solving and Python Programming	GE3151	COMPUTER SCIENCE AND ENGINEERING			✓	32
2	Foundations of Data Science	CS3352	COMPUTER SCIENCE AND ENGINEERING			✓	27
3	Artificial Intelligence and Machine Learning	CS3491	COMPUTER SCIENCE AND ENGINEERING			✓	20
4	Big Data Analytics	CCS334	COMPUTER SCIENCE AND ENGINEERING			✓	28

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COMPUTER SCIENCE AND ENGINEERING

2023-2024

S.NO	REG.NO	STUDENT NAME	PROJECT	INTERNSHIP	FIELD VISIT
1	731220104001	ABINAYA G	✓		✓
2	731220104003	BALU R	✓	✓	✓
3	731220104004	CHARLES WILLIAM.L	✓		
4	731220104005	DEEPAK.S	✓	✓	
5	731220104006	DEEPIKA.S	✓	✓	✓
6	731220104007	DHARANISELVI. M	✓		✓
7	731220104009	JAGATHESWARAN.P	✓		✓
8	731220104010	KARUNYAA.M	✓		✓
9	731220104011	KATHIRESAN.K	✓		✓
10	731220104012	KAVIN.M	✓	✓	
11	731220104014	LOGANATHAN.T	✓		
12	731220104019	NIRMALRAJ.S	✓		
13	731220104021	RAMYA.S	✓		✓
14	731220104022	ROHITH.R	✓		
15	731220104023	ROSHMA I	✓		
16	731220104024	SIVALINGAM.K	✓		
17	731220104025	SUNDARAGANESAN.K	✓		✓

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Erode (Dt) - 638 506.

18	731220104028	VIGNESH.M	✓		
19	731220104029	VINISHA.T	✓	✓	✓
20	731220104030	VINITHA.A	✓	✓	✓
21	731220104031	VINOTHKUMAR.R	✓		✓
22	731220104301	BOOPALAN.M	✓	✓	✓
23	731220104302	DHAMODARAN.G	✓		✓
24	731221104001	AADHI SURYA K		✓	✓
25	731221104004	ARULMURUGAN S		✓	✓
26	731221104005	BABUSHANKAR S		✓	✓
27	731221104007	BAMBAVASAN V		✓	✓
28	731221104008	CHANDRA PRAKASH K		✓	✓
29	731221104009	DHAKSHINA MOORTHI E		✓	✓
30	731221104012	DURGA K		✓	✓
31	731221104013	GUNASEKARAN P		✓	✓
32	731221104014	GUNASEKARAN S		✓	✓
33	731221104015	HARIPRABHA V		✓	✓
34	731221104017	KAMALESH K		✓	✓
35	731221104021	LALITHA T		✓	✓
36	731221104022	MADHAN G		✓	✓
37	731221104025	MOUSIKA S		✓	✓

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Erode (Dt) - 638 506.

38	731221104026	NANDHINI P		✓	✓
39	731221104027	PANDIYARAJ P		✓	✓
40	731221104028	PRIYA DHARSHINI S			✓
41	731221104029	RAVI KUMAR P		✓	✓
42	731221104031	RUBIKA G		✓	✓
43	731221104033	SHYAMKUMAR S		✓	✓
44	731221104034	SENTHILVEL S		✓	
45	731221104035	SUGANYA K		✓	✓
46	731221104036	SURYA S		✓	✓
47	731221104037	SUSHMINA M		✓	✓
48	731221104038	VASANTHKUMAR S		✓	✓
49	731221104039	VIGNESH M		✓	✓
50	731221104040	YAMUNA K		✓	✓
51	731221104301	AMUTHAMALAR R		✓	✓
52	731221104302	BHARANI DHARAN.M		✓	✓
53	731221104303	GAYATHRI R		✓	
54	731221104305	NANDINI M		✓	
55	731221104306	SNEHA L		✓	
56	731221104307	SRINIVAS V		✓	✓
57	731221104308	SUBASHINI P		✓	

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58	731221104701	NIKETHA S		✓	
59	731222104001	ABINAYA P		✓	
60	731222104002	BHARATH KRISHNAN V		✓	
61	731222104003	CHANDRAKALA N		✓	
62	731222104004	CHANDRU K		✓	
63	731222104005	DEEPA T		✓	
64	731222104006	DEVADHARSHINI M		✓	
65	731222104008	ELAKKIYA K		✓	
66	731222104009	GIBSON SHANTHAKUMAR R		✓	
67	731222104010	GOKILA S		✓	
68	731222104012	HAFILA A		✓	
69	731222104013	INIKA C		✓	
70	731222104014	JAYASHREE K		✓	
71	731222104015	JAYASREE D		✓	
72	731222104016	JAYASURYA B		✓	
73	731222104018	JOTHI N		✓	
74	731222104019	JOTHI S		✓	
75	731222104020	KARTHI K		✓	
76	731222104021	KARUNYA K		✓	
77	731222104022	KEERTHIGA V		✓	

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78	731222104023	LAKSHMI B		✓	
79	731222104024	LINGARAJU K		✓	
80	731222104025	NEETHU S		✓	
81	731222104026	NIVETHA P		✓	
82	731222104027	POOMATHI S		✓	
83	731222104029	PUSHPASRI M		✓	
84	731222104030	RAKSHITHA V		✓	
85	731222104031	SAHEER H		✓	
86	731222104032	SANJAIKUMAR S		✓	
87	731222104033	SANJAY V		✓	
88	731222104034	SANJAY KUMAR S		✓	
89	731222104035	SATHIYALAKSHMI M		✓	
90	731222104036	SHAKTHI S		✓	
91	731222104038	SIDHARAJ S		✓	
92	731222104039	SOWDESWARI A		✓	
93	731222104040	SOWNDHAR D		✓	
94	731222104041	SUMITHRA S		✓	
95	731222104302	GOWTHAM A		✓	

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COMPUTER SCIENCE AND ENGINEERING

S.No	Name of the Course that include experiential learning through Project Work/Internship/Field Visit
1	Software Engineering
2	Computer Networks
3	Object Oriented Analysis and Design
4	Artificial Intelligence
5	Mobile Computing
6	Cryptography and Network Security
7	Cloud Computing
8	Problem Solving and Python Programming
9	Foundations of Data Science
10	Artificial Intelligence and Machine Learning
11	Big Data Analytics

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PROJECT

CS8494 **SOFTWARE ENGINEERING** L T P C
3 0 0 3

OBJECTIVES:

- To understand the phases in a software project
- Tounderstandfundamentalconceptsofrequirementsengineeringand AnalysisModeling.
- To understand the various software design methodologies
- To learn various testing and maintenance measures

UNITI SOFTWAREPROCESSANDAGILEDEVELOPMENT **9**

Introduction to Software Engineering, Software Process, Perspective and Specialized Process Models–Introduction to Agility-Agile process-Extreme programming-XP Process.

UNITII REQUIREMENTSANALYSISAND SPECIFICATION **9**

Software Requirements: Functional and Non-Functional, User requirements, System requirements, SoftwareRequirementsDocumentRequirementEngineeringProcess:FeasibilityStudies,Requirements elicitationandanalysis,requirementsvalidation,requirementsmanagement-Classical analysis:Structured system Analysis, Petri Nets-Data Dictionary.

UNITIII SOFTWARE DESIGN **9**

Design process — Design Concepts-Design Model– Design Heuristic — Architectural Design -Architectural styles, Architectural Design, Architectural Mapping using Data Flow- User Interface Design: Interface analysis, Interface Design –Component level Design: Designing Class based components, traditional Components.

UNITIV TESTINGANDMAINTENANCE **9**

Software testing fundamentals-Internal and external views of Testing-white box testing - basis path testing-control structure testing-black box testing- Regression Testing — Unit Testing — Integration Testing— Validation Testing— System Testing And Debugging–Software Implementation Techniques: Coding practices-Refactoring-Maintenance and Reengineering-BPRmodel-Reengineeringprocessmodel-ReverseandForwardEngineering.

9

UNITV PROJECTMANAGEMENT

Software Project Management: Estimation – LOC, FP Based Estimation, Make/Buy Decision COCOMO I & II Model – Project Scheduling – Scheduling, Earned Value Analysis Planning –Project Plan, Planning Process, RFP Risk Management – Identification, Projection - Risk Management-Risk Identification-RMMM Plan-CASETOOLS

TOTAL:45PERIODS

OUTCOMES:

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On Completion of the course, the students should be able to:

- Identify the key activities in managing a software project.
- Compare different process models.
- Concepts of requirements engineering and Analysis Modeling.
- Apply systematic procedure for software design and deployment.
- Compare and contrast the various testing and maintenance.
- Manage project schedule, estimate project cost and effort required.

TEXTBOOKS:

1. RogerS.Pressman, —Software Engineering– APractitioner"s Approachǁ,SeventhEdition,McGraw-HillInternationalEdition,2010.
2. IanSommerville,—SoftwareEngineeringǁ,9thEdition,PearsonEducationAsia,2011.

REFERENCES:

1. RajibMallǁ,—FundamentalsofSoftwareEngineeringǁ,ThirdEdition,PHILearningPrivate Limited,2009.
2. PankajJalote,—SoftwareEngineering,APreciseApproachǁ,WileyIndia,2010.
3. KelkarS.A.,—SoftwareEngineeringǁ,PrenticeHallofIndiaPvtLtd,2007.
4. StephenR.Schach,—SoftwareEngineeringǁ,TataMcGraw-HillPublishingCompanyLimited,2007.
5. http://nptel.ac.in/.

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CS8691	ARTIFICIALINTELLIGENCE	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the various characteristics of Intelligent agents
- To learn the different search strategies in AI
- To learn to represent knowledge in solving AI problems
- To understand the different ways of designing software agents
- To know about the various applications of AI.

UNITI INTRODUCTION 9

Introduction–Definition-FutureofArtificialIntelligence–CharacteristicsofIntelligentAgents–TypicalIntelligentAgents–ProblemSolvingApproachtoTypicalAIproblems.

UNITII PROBLEMSOLVINGMETHODS 9

Problem solving Methods - Search Strategies- Uninformed - Informed - Heuristics - Local SearchAlgorithmsandOptimizationProblems-SearchingwithPartialObservations-ConstraintSatisfactionProblems—ConstraintPropagation-BacktrackingSearch-GamePlaying-Optimal Decisions in Games–Alpha-Beta Pruning-Stochastic Games

UNITIII KNOWLEDGEREPRESENTATION 9

First Order Predicate Logic – Prolog Programming – Unification – Forward Chaining-Backward Chaining – Resolution – Knowledge Representation - Ontological Engineering-Categories and Objects – Events - Mental Events and Mental Objects - Reasoning Systems for Categories -Reasoning with Default Information

UNITIV SOFTWAREAGENTS 9

ArchitectureforIntelligentAgents–Agentcommunication–NegotiationandBargaining–ArgumentationamongAgents–TrustandReputationinMulti-agentsystems.

UNITV APPLICATIONS 9

AI applications – Language Models – Information Retrieval- Information Extraction – Natural Language Processing - Machine Translation – Speech Recognition – Robot – Hardware – Perception—Planning—Moving

TOTAL:45PERIODS

OUTCOMES:

Up on completion of the course, the students will be able to:

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- Use appropriate search algorithms for any AI problem
- Represent a problem using first order and predicate logic
- Provide the apt agent strategy to solve a given problem
- Design software agents to solve a problem
- Design applications for NLP that use Artificial Intelligence.

TEXTBOOKS:

1 S.RussellandP.Norvig,"ArtificialIntelligence:AModernApproach‖,PrenticeHall,ThirdEdition,2009.

2 I.Bratko,—Prolog:ProgrammingforArtificialIntelligence‖,Fourthedition,Addison-WesleyEducationalPublishersInc.,2011.

REFERENCES:

1. M.TimJones,—ArtificialIntelligence:ASystemsApproach(ComputerScience)‖,JonesandBartlettPublishers,Inc.;FirstEdition,2008
2. NilsJ.Nilsson,—TheQuestforArtificialIntelligence‖,CambridgeUniversityPress,2009.
3. WilliamF.ClocksinandChristopherS.Mellish,‖ProgramminginProlog:UsingtheISOStandard‖,Fifth Edition,Springer,2003.
4. GerhardWeiss,—MultiAgentSystems‖, SecondEdition,MITPress,2013.
5. DavidL.PooleandAlanK.Mackworth,—ArtificialIntelligence:FoundationsofComputationalAgents‖,CambridgeUniversityPress,2010.

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CS8791	CLOUDCOMPUTING	L TP C3003

OBJECTIVES:

- To understand the concept of cloud computing.
- To appreciate the evolution of cloud from the existing technologies.
- To have knowledge on the various issues in cloud computing.
- To be familiar with the lead players in cloud.
- To appreciate the emergence of cloud as the next generation computing paradigm.

UNITI INTRODUCTION **9**

Introduction to Cloud Computing — Definition of Cloud — Evolution of Cloud Computing —UnderlyingPrinciplesofParallelandDistributedComputing–CloudCharacteristics– ElasticityinCloud—On-demandProvisioning.

UNITII CLOUDENABLINGTECHNOLOGIES **10**

Service Oriented Architecture – REST and Systems of Systems – Web Services – Publish-Subscribe Model – Basics of Virtualization – Types of Virtualization – Implementation Levels of Virtualization — Virtualization Structures — Tools and Mechanisms — Virtualization of CPU –Memory–I/ODevices–Virtualization Supportand Disaster Recovery.

UNITIII CLOUDARCHITECTURE,SERVICESANDSTORAGE **8**

Layered Cloud Architecture Design – NIST Cloud Computing Reference Architecture – Public,Private and Hybrid Clouds - laaS — PaaS — SaaS — Architectural Design Challenges — CloudStorage–Storage-as-a-Service–AdvantagesofCloudStorage–CloudStorageProviders– S3.

UNITIV RESOURCE MANAGEMENTAND SECURITYIN CLOUD **10**

InterCloudResourceManagement–ResourceProvisioningandResourceProvisioningMethods – Global Exchange of Cloud Resources – Security Overview – Cloud Security Challenges – Software-as-a-Service Security – Security Governance – Virtual Machine Security – IAM –Security Standards.

UNITV CLOUDTECHNOLOGIESANDADVANCEMENTS **8**

Hadoop– MapReduce – Virtual Box -- Google App Engine – Programming Environment for Google App Engine —– Open Stack — Federation in the Cloud — Four Levels of Federation –Federated Services and Applications–Future of Federation.

TOTAL:45PERIODS

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OUTCOMES:

On Completion of the course, the students should be able to:

- Articulatethemainconcepts,keytechnologies,strengthsandlimitationsofcloudcomputing.
- Learn the key and enabling technologies that help in the development of cloud.
- Developtheabilitytounderstandandusethearchitectureofcomputeandstoragecloud,serviceandd eliverymodels.
- Explain the core issues of cloud computing such as resource management and security.
- Be able to install and use current cloud technologies.
- Evaluateandchoosetheappropriatetechnologies,algorithmsandapproachesforimplementationa nduseofcloud.

TEXTBOOKS:

1. KaiHwang,GeoffreyC.Fox,JackG.Dongarra,"DistributedandCloudComputing,FromParallel Processingto theInternetofThings", MorganKaufmannPublishers,2012.
2. Rittinghouse,JohnW.,andJamesF.Ransome,—CloudComputing:Implementation,Managementan dSecurity‖,CRCPress,2017.

REFERENCES:

1. RajkumarBuyya,ChristianVecchiola,S.ThamaraiSelvi,—MasteringCloudComputing‖,TataMcgra wHill,2013.
2. TobyVelte,AnthonyVelte,RobertElsenpeter,"CloudComputing-APracticalApproach‖,TataMcgrawHill,2009.
3. GeorgeReese,"CloudApplicationArchitectures:BuildingApplicationsandInfrastructureintheCloud :TransactionalSystemsfor EC2andBeyond(Theory inPractice)‖,O'Reilly,2009.

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CS8792	CRYPTOGRAPHYANDNETWORKSECURITY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand Cryptography Theories, Algorithms and Systems.
- To understand necessary Approaches and Techniques to build protection mechanisms in order to secure computer networks.

UNITI INTRODUCTION **9**

Securitytrends-Legal,EthicalandProfessionalAspectsofSecurity,NeedforSecurityatMultiple levels, Security Policies - Model of network security – Security attacks, services andmechanisms—OSIsecurityarchitecture—Classicalencryptiontechniques:substitution techniques, transposition techniques, steganography- Foundations of modern cryptography:perfectsecurity–informationtheory–productcryptosystem–cryptanalysis.

UNITII SYMMETRICKEYCRYPTOGRAPHY **9**

MATHEMATICS OF SYMMETRIC KEY CRYPTOGRAPHY: Algebraic structures - Modulararithmetic-Euclid"s algorithm- Congruence and matrices -Groups, Rings, Fields-Finite fields-SYMMETRICKEYCIPHERS:SDES–Block cipher Principle of DES–Strength of DES – Differential and linear cryptanalysis - Block cipher design principles – Block ciphermode of operation – Evaluation criteria for AES – Advanced Encryption Standard - RC4 –Key distribution.

UNITIII PUBLICKEYCRYPTOGRAPHY **9**

MATHEMATICSOFASYMMETRICKEYCRYPTOGRAPHY:Primes–PrimalityTesting–Factorization – Euler's totient function, Fermat's and Euler's Theorem - Chinese Remainder Theorem— Exponentiation and Alogarithm-ASYMMETRIC KEY CIPHERS:RSA cryptosystem – Key distribution – Key management – Diffie Hellman key exchange -ElGamalcryptosystem–Ellipticcurvearithmetic-Ellipticcurvecryptography.

UNITIV MESSAGEAUTHENTICATIONANDINTEGRITY **9**

Authentication requirement – Authentication function – MAC – Hash function – Security ofhashfunctionandMAC–SHA–Digitalsignatureandauthenticationprotocols–DSS-EntityAuthentication: Biometrics, Passwords, Challenge Response protocols-Authenticationapplications-Kerberos,X.509

UNITV SECURITYPRACTICEANDSYSTEMSECURITY **9**

ElectronicMailsecurity—PGP,S/MIME—IPsecurity—WebSecurity-

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SYSTEMSECURITY:Intruders–Maliciousssoftware–viruses–Firewalls.

TOTAL 45 PERIODS

OUTCOMES:

At the end of the course, the student should be able to:

- Understandthefundamentalsofnetworkssecurity,securityarchitecture,threatsandvulnerabilities
- Applythedifferentcryptographicoperationsofsymmetriccryptographicalgorithms
- Apply the different cryptographic operations of public key cryptography
- ApplythevariousAuthenticationschemestosimulatedifferentapplications.
- Understand various Security practices and System security standards

TEXTBOOK:

1. WilliamStallings,CryptographyandNetworkSecurity:PrinciplesandPractice,PHI3rdEditio n,2006.

REFERENCES:

1. C K Shyamala, N Harini and Dr. T R Padmanabhan: Cryptography and Network Security,Wiley IndiaPvt.Ltd
2. BehrouzA.Foruzan,CryptographyandNetworkSecurity,TataMcGrawHill2007.
3. CharlieKaufman,RadiaPerlman,andMikeSpeciner,NetworkSecurity:PRIVATECommun icationinaPUBLICWorld,PrenticeHall,ISBN0-13-046019-2

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CS8601	MOBILECOMPUTING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Tounderstandthebasicconceptsofmobilecomputing.
- Tolearnthe basics ofmobiletelecommunicationsystem.
- Tobefamiliar withthenetwork layer protocolsandAd-Hocnetworks.
- Toknowthe basisoftransportandapplicationlayerprotocols.
- Togainknowledgeaboutdifferentmobileplatformsandapplicationdevelopment.

UNITI INTRODUCTION **9**

Introduction to Mobile Computing – Applications of Mobile Computing- Generations ofMobile Communication Technologies- Multiplexing – Spread spectrum -MAC Protocols –SDMA-TDMA-FDMA-CDMA

UNITII MOBILETELECOMMUNICATIONSYSTEM **9**

IntroductiontoCellularSystems-GSM–Services&Architecture–Protocols–ConnectionEstablishment–FrequencyAllocation–Routing–MobilityManagement–Security–GPRS-UMTS–Architecture–Handover-Security

UNITIII MOBILENETWORKLAYER **9**

MobileIP–DHCP–AdHoc–Proactiveprotocol-DSDV,ReactiveRoutingProtocols–DSR,AODV,Hybridrouting–ZRP,MulticastRouting-ODMRP,VehicularAdHocnetworks(VANET)–MANETVsVANET–Security.

UNITIV MOBILETRANSPORTANDAPPLICATIONLAYER **9**

MobileTCP–WAP–Architecture–WDP–WTLS–WTP–WSP–WAE–WTAArchitecture –WML

UNITV MOBILEPLATFORMSANDAPPLICATIONS **9**

Mobile Device Operating Systems – Special Constraints & Requirements – CommercialMobile Operating Systems – Software Development Kit: iOS, Android, BlackBerry,WindowsPhone–MCommerce–Structure–Pros&Cons-MobilePaymentSystem–Security Issues

TOTAL 45 PERIODS

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OUTCOMES:

At the end of the course, the students should be able to:

- Explain the basics of mobile telecommunication systems
- Illustratethegenerationsoftelecommunicationsystemsinwirelessnetworks
- DeterminethefunctionalityofMAC,networklayerandIdentifyaroutingprotocolforagivenAd hocnetwork
- Explain the functionality of Transport and Application layers
- Develop a mobile application using android/blackberry/ios/Windows SDK

TEXTBOOKS:

1. JochenSchiller,—MobileCommunications‖,PHI,SecondEdition,2003.
2. PrasantKumarPattnaik,RajibMall,—FundamentalsofMobileComputing‖,PHILearningPvt.Ltd,NewDelhi–2012

REFERENCES

1. Dharma Prakash Agarval, Qing and An Zeng, "Introduction to Wireless and Mobilesystems",ThomsonAsiaPvtLtd,2005.
2. UweHansmann,LotharMerk,MartinS.NicklonsandThomasStober,—Principlesof Mobile Computing‖,Springer, 2003.
3. William.C.Y.Lee,—MobileCellularTelecommunications-AnalogandDigitalSystems‖,SecondEdition,TataMcGrawHillEdition,2006.
4. C.K.Toh,—AdHocMobileWirelessNetworks‖,FirstEdition,PearsonEducation,2002.
5. Android Developers:http://developer.android.com/index.html
6. Apple Developer:https://developer.apple.com/
7. Windows Phone DevCenter:http://developer.windowsphone.com
8. Black Berry Developer:http://developer.blackberry.com

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CS8591	COMPUTERNETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the protocol layering and physical level communication.
- To analyze the performance of a network.
- To understand the various components required to build different networks.
- To learn the functions of network layer and the various routing protocols.
- To familiarize the functions and protocols of the Transport layer.

UNIT I INTRODUCTION AND PHYSICAL LAYER 9

Networks — Network Types — Protocol Layering — TCP/IP Protocol suite — OSI Model —Physical Layer: Performance – Transmission media – Switching – Circuit-switched Networks—Packet Switching.

UNIT II DATA-LINK LAYER & MEDIA ACCESS 9

Introduction–Link-Layer Addressing –DLC Services–Data-Link Layer Protocols –HDLC –PPP-MediaAccessControl-WiredLANs:Ethernet-WirelessLANs–Introduction–IEEE802.11,Bluetooth–ConnectingDevices.

UNIT III NETWORK LAYER 9

NetworkLayerServices–Packetswitching–Performance–IPV4Addresses–Forwardingof IP Packets - Network Layer Protocols: IP, ICMP v4 – Unicast Routing Algorithms – Protocols–MulticastingBasics–IPV6Addressing–IPV6Protocol.

UNITIV TRANSPORTLAYER 9

Introduction–TransportLayerProtocols–Services–PortNumbers–UserDatagramProtocol–TransmissionControlProtocol–SCTP.

UNITV APPLICATIONLAYER 9

WWW and HTTP–FTP–Email–Telnet–SSH–DNS–SNMP.

TOTAL: 45 PERIODS

OUTCOMES:

On Completion of the course, the students should be able to:

- Understand the basic layers and its functions in computer networks.
- Evaluate the performance of a network.
- Understand the basics of how data flows from one node to another.
- Analyze and design routing algorithms.
- Design protocols for various functions in the network.
- Understand the working of various application layer protocols

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TEXTBOOK:

1. Behrouz A. Forouzan, Data Communications and Networking, Fifth Edition TMH,2013.

REFERENCES

1. Larry L. Peterson, Bruce S. Davie, Computer Networks: A Systems Approach, Fifth Edition, Morgan Kaufmann Publishers Inc.,2012.
2. William Stallings, Data and Computer Communications, Tenth Edition, PearsonEducation,2013.
3. NaderF.Mir,ComputerandCommunicationNetworks,SecondEdition,Prentice Hall,2014.
4. Ying-Dar Lin, Ren-Hung Hwang and Fred Baker, Computer Networks: An OpenSourceApproach,McGrawHillPublisher,2011.
5. James F. Kurose, Keith W. Ross, Computer Networking, A Top-Down ApproachFeaturingthe Internet, SixthEdition,PearsonEducation,2013.

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CS8592 **OBJECT ORIENTED ANALYSIS AND DESIGN** LTPC

3003

OBJECTIVES:

- To understand the fundamentals of object modeling
- To understand and differentiate Unified Process from other approaches.
- To design with static UML diagrams.
- To design with the UML dynamic and implementation diagrams.
- To improve the software design with design patterns.
- To test the software against its requirements specification

UNITI UNIFIEDPROCESSAND USE CASEDIAGRAMS 9

IntroductiontoOOADwithOOBasics-UnifiedProcess–UMLdiagrams–UseCase–Casestudy –theNextGenPOSsystem,Inception-UsecaseModelling–RelatingUsecases– include,extendandgeneralization–WhentouseUse-cases

UNITII STATIC UML DIAGRAMS 9

Class Diagram— Elaboration – Domain Model – Finding conceptual classes and description classes – Associations – Attributes – Domain model refinement – Finding conceptual classHierarchies–AggregationandComposition-Relationshipbetweensequencediagramsandusecases—WhentouseClassDiagrams

UNITIII DYNAMICAND IMPLEMENTATIONUML DIAGRAMS 9

Dynamic Diagrams – UML interaction diagrams - System sequence diagram – Collaboration diagram – When to use Communication Diagrams - State machine diagram and Modelling– WhentouseStateDiagrams-Activitydiagram–Whentouseactivitydiagrams

Implementation Diagrams - UML package diagram- When to use package diagrams - ComponentandDeploymentDiagrams–WhentouseComponentandDeploymentdiagrams

UNITIV DESIGN PATTERNS 9

GRASP: Designing objects with responsibilities – Creator – Information expert – Low Coupling –High Cohesion—Controller **Design Patterns – creational** – factory method – **structural** – Bridge – Adapter – **behavioural** –Strategy–observer–Applying GoF design patterns–Mapping design to code

UNITV TESTING 9

Object Oriented Methodologies – Software Quality Assurance – Impact of object orientation

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on Testing–Develop Test Cases and Test Plans

TOTAL:45PERIODS

OUTCOMES:

At the end of the course, the students will be able to:

- Expresss of tware design with UML diagrams
- Design software applications using OO concepts.
- Identify various scenarios based on software requirements
- TransformUMLbasedsoftwaredesignintopatternbaseddesignusingdesignpatterns
- Understand the various testing methodologies for OO software

TEXTBOOKS:

1. CraigLarman,—ApplyingUMLandPatterns:AnIntroductiontoObject-OrientedAnalysisandDesignandIterativeDevelopment‖,ThirdEdition,PearsonEducation,2005.
2. AliBahrami-Object Oriented Systems Development -McGrawHillInternationalEdition-1999

REFERENCES:

1. ErichGamma,andRichardHelm,RalphJohnson,JohnVlissides,—Designpatterns:ElementsofReusableObject-OrientedSoftware‖,Addison-Wesley,1995.
2. MartinFowler,—UMLDistilled:ABriefGuidetotheStandardObjectModelingLanguage‖,Thirdedition,Addison Wesley,2003.

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

PROJECT BATCH LIST (2023-2024)

S.NO	REGISTER NO	NAME LIST	GUIDE NAME	PROJECT TITLE
1	731220104001	ABINAYA G	MRS.P.SASIREKA	CREDIT CARD TRANSACTION USING FACE RECOGNITION
2	731220104007	DHARANISELVI. M		
3	731220104023	ROSHMA I		
4	731220104003	BALU R	DR.N.SATHYABALAJI	FARMERS AGRICULTURE ASSISTANCE CHATBOT
5	731220104012	KAVIN.M		
6	731220104005	DEEPAK.S		
7	731220104301	BOOPALAN.M		
8	731220104004	CHARLES WILLIAM.L	DR.N.SATHYABALAJI	A NOVEL HUNGER MANAGEMENT SYSTEM TO AVOID FOOD WASTAGE
9	731220104025	SUNDARAGANESAN.K		
10	731220104031	VINOTHKUMAR.R		
11	731220104006	DEEPIKA.S	MRS.M.C.SAVITHRI	FERTILIZER RECOMMENDATION SYSTEM FOR DISEASE PREDICTION
12	731220104029	VINISHA.T		
13	731220104030	VINITHA.A		

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14	731220104009	JAGATHESWARAN.P	MR.G.TAMILSELVAN	BUS TIMETABLE MANAGEMENT CHATBOT
15	731220104022	ROHITH.R		
16	731220104024	SIVALINGAM.K		
17	731220104010	KARUNYAA.M	MRS.P.SASIREKA	VOICE BASED EMAIL SYSTEM FOR VISUALLY IMPAIRED
18	731220104021	RAMYA.S		
19	731220104011	KATHIRESAN.K	MR.E.ANANTH	REAL TIME DRIVERS' DROWSINESS DETECTION
20	731220104302	DHAMODARAN.G		
21	731220104014	LOGANATHAN.T	DR.N.SATHYABALAJI	AI RESUME ANALYZER USING MACHINE LEARNING AND DEEP LEARNING
22	731220104028	VIGNESH.M		
23	731220104019	NIRMALRAJ.S		

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CREDIT CARD TRANSACTION USING FACE RECOGNITION

A PROJECT REPORT

Submitted by

ABINAYA G	**(731220104001)**
DHARANISELVI M	**(731220104007)**
ROSHMA I	**(731220104023)**

in partial fulfillment for the award of the degree

of

BACHELOR OF ENGINEERING

in

COMPUTER SCIENCE AND ENGINEERING

J.K.K. MUNIRAJAH COLLEGE OF TECHNOLOGY

T.N. PALAYAM, GOBI – 638506

ANNA UNIVERSITY: CHENNAI-600025

MAY 2024

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BONAFIDE CERTIFICATE

Certified that this project report on "**CREDIT CARD TRANSACTION USING FACE RECOGNITION**" is the Bonafide work of "**ABINAYA G (731220104001)** and **DHARANISEVI M (731220104007)** and **ROSHMA I (731220104023)**" who carried out the project work under my supervision.

SIGNATURE

Dr.N.SATHYABALAJI M.E., Ph.D., M.I.S.T.E.,
ASSOCIATE PROFESSOR
HEAD OF THE DEPARTMENT
Dept of Computer Science and Engineering
J.K.K. Munirajah College of Technology
T.N. Palayam.

SIGNATURE

Mrs.P.SASIREKA M.E.,
ASSISTANT PROFESSOR
SUPERVISOR
Dept of Computer Science and Engineering
J.K.K. Munirajah College of Technology
T.N. Palayam.

Submitted for the Viva-Voce examination held on 10.05.2024 (FN)

INTERNAL EXAMINER

EXTERNAL EXAMINER

Principal
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ABSTRACT

The payment modes at Point of Sales (POS) have different modes such as cash on delivery, online transaction, credit card transaction and monthly instalments etc. This project proposes a method for credit card system used in transaction system which will integrate with the face detection. At the time of payment made by the user on portal will be compared to the features from the dataset of the respective user. A method for credit card transaction system which will make use of face recognition and face detection technology, using Neural network. The integration of facial recognition technology in credit card transactions presents a promising avenue for enhancing security and convenience in financial transactions. This paper explores the implementation of facial recognition systems as a means to authenticate credit card transactions. The proposed system leverages advanced facial recognition algorithms to verify the identity of cardholders during payment processes, mitigating the risks associated with traditional authentication methods such as PINs or signatures. Additionally, the system aims to streamline the checkout process, offering a frictionless and user-friendly experience for consumers. Through a comprehensive analysis of the technical feasibility, security considerations, and user acceptance, this paper evaluates the potential benefits and challenges of adopting facial recognition technology in credit card transactions. Moreover, it discusses the implications of regulatory frameworks and privacy concerns, highlighting the importance of robust data protection measures and transparent policies to ensure the ethical and responsible deployment of such systems. Overall, this research contributes to the ongoing discourse on leveraging biometric authentication methods to enhance the security and efficiency of financial transactions in the digital age.

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9. CONCLUSION AND FUTURE ENHANCEMENT

9.1 CONCLUSION

The process of recording details about online shopping is simpler and easier. The system reduces the possibility of errors to a great extent and maintains the data in an efficient manner. User friendliness is the unique feature of this system. The system generates the reports as and when required. The system is highly interactive and flexible for further enhancement. The coding is done in a simplified and easy to understandable manner so that other team trying to enhance the project can do so without facing much difficulty. The documentation will also assist in the process as it has also been carried out in a simplified and concise way.

9.2 FUTURE WORK

This system is developed such a way that additional enhancement can be done without much difficulty. The renovation of the project would increase the flexibility of the system. Also the features are provided in such a way that the system can also be made better and efficient functionality

- In the future extend the project using android application with the admin part of online products shopping.
- Add more products in this application.

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FARMERS AGRICULTURE ASSISTANCE CHATBOT

A PROJECT REPORT

Submitted by

BALU R	**(731220104003)**
DEEPAK S	**(731220104005)**
KAVIN M	**(731220104012)**
BOOPALAN M	**(731220104301)**

in partial fulfillment for the award of the degree

of

BACHELOR OF ENGINEERING

in

COMPUTER SCIENCE AND ENGINEERING

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ANNA UNIVERSITY: CHENNAI-600 025

MAY 2024

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Erode (Dt) - 638 506.

ANNA UNIVERSITY :: CHENNAI 600 025

BONAFIDE CERTIFICATE

Certified that this project report on "**FARMERS AGRICULTURE ASSISTANCE CHATBOT**" is the Bonafide work of "**R. BALU (731220104003), S. DEEPAK (731220104005), M. KAVIN (731220104012), M. BOOPALAN (731220104301)**" who carried out the project work under My supervision.

SIGNATURE

Dr.N. SATHYABALAJI,M.E.Ph.D.,M.I.S.T.E

ASSOCIATE PROFESSOR

HEAD OF THE DEPARTMENT

Dept. of Computer Science and Engineering

J.K.K. Munirajah College of Technology

T.N. Palayam.

SIGNATURE

Dr.N. SATHYABALAJI M.E.Ph.D.,M.I.S.T.E

ASSOCIATE PROFESSOR

SUPERVISOR

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T.N.Palayam, Gobi (Tk),
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ABSTRACT

India is known for the apprehension of global powerhouse of agriculture in the world and has been mainly an agriculture-based economy, in spite of the fact that a lot of farmers and respective individuals face a lot of problems in agriculture due to inadequate knowledge of agriculture production such as poor farming techniques, inadequate materials for the crop, proper crop planning, maintaining of fertilizer balance. This project represents a prototype of a chatbot structure which helps assist individuals or farmers in crop management and predicts the need of the crop.

Prediction such as the fertilizer dosage, nutrients in the crop and assists in providing sufficient knowledge to the individual to work on the basic needs. This structure uses Natural Language Processing and takes feed from the predetermined data to give responses on based queries.

For the Structure to be accurate the chatbot analyzes factors such as past feed and the sources of the data from "The Indian Council of Agricultural Research".

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CHAPTER 15

CONCLUSION & FUTURE ENHANCEMENTS

In conclusion, the implementation of a farmers assistant agribot represents a significant opportunity for improving service delivery, enhancing user experiences, and fostering greater accessibility to scheme-related information and services for citizens. Through meticulous planning, stakeholder engagement, and iterative development, government agencies can develop a chatbot solution that meets the diverse needs of users effectively. By leveraging advanced technologies such as natural language processing, machine learning, and integration with other government systems, the chatbot can offer personalized assistance, streamline processes, and optimize service delivery. Moreover, by prioritizing user-centric design, scalability, and continuous improvement, government agencies can ensure that the chatbot remains relevant, reliable, and impactful in the long term.

Through this project, we've seamlessly integrated diverse datasets, prioritized user-centric experiences, and made strides towards bolstering financial inclusivity and government efficacy. The fruition of Scheme represents more than a mere technological innovation; it signifies a gateway to empowerment and opportunity for individuals across diverse strata of society. By fostering accessibility and transparency, this initiative aims to bridge the gap between citizens and government sponsored financial assistance, ultimately nurturing economic growth and societal well-being it's a continuum of dedication towards refinement, security, and adaptability. We remain steadfast in our commitment to enhancing the Mega Bot, ensuring its enduring impact as a catalyst for empowerment.

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15.1 FUTURE ENHANCEMENTS

Future enhancements and scalability play a pivotal role in ensuring the farmers assistant agribot remains relevant, adaptable, and capable of meeting the evolving needs of users and stakeholders. Firstly, future enhancements may involve expanding the chatbot's functionality to offer additional services, such as personalized recommendations, transactional capabilities, or integration with emerging technologies like voice recognition or augmented reality. These enhancements should be guided by user feedback, market research, and strategic priorities to ensure they address genuine user needs and deliver tangible benefits. Secondly, scalability is essential for accommodating growth in user demand and expanding the chatbot's reach to serve a larger audience effectively. This may involve optimizing the chatbot's infrastructure, implementing load balancing mechanisms, and leveraging cloud-based technologies to handle increased traffic and concurrent user interactions. Scalability considerations should encompass both technical scalability, such as server capacity and performance optimization, as well as operational scalability, such as workforce capacity and support resources. Additionally, future enhancements may focus on improving the chatbot's intelligence and capabilities through advancements in artificial intelligence (AI) and machine learning (ML) technologies. This could include refining natural language processing (NLP) algorithms to better understand user intents and context, enhancing personalization features to deliver more tailored responses, and integrating predictive analytics to anticipate user needs and preferences. Furthermore, ensuring interoperability and integration with other government systems and platforms is essential for maximizing the chatbot's utility and impact.

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A NOVEL HUNGER MANAGEMENT SYSTEM TO AVOID FOOD WASTAGE

A PROJECT REPORT

Submitted by

CHARLES WILLIAM L	**(731220104004)**
SUNDARA GANESAN K	**(731220104025)**
VINOTHKUMAR R	**(731220104031)**

In partial fulfilment for the award of the degree

of

BACHELOR OF ENGINEERING

IN

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BONAFIDE CERTIFICATE

Certified that this project report on **"A NOVEL HUNGER MANAGEMENT SYSTEM TO AVOID FOOD WASTAGE"** is the Bonafide work of **"CHARLES WILLIAM L (731220104004)** and **SUNDARA GANESAN K (731220104025)** and **VINOTHKUMAR R (731220104031)"** who carried out the project work under My supervision.

SIGNATURE

Dr.N. SATHYABALAJI M.E., Ph.D., M.I.S.T.E.,
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INTERNAL EXAMINER

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ABSTRACT

In recent years, the issue of food waste has garnered significant attention due to its environmental, economic, and social implications. Food waste not only contributes to greenhouse gas emissions and environmental degradation but also represents a loss of resources and exacerbates issues of food insecurity and hunger. Addressing this challenge requires innovative solutions that leverage technology to streamline processes and promote sustainable consumption habits. It is a web application designed to facilitate efficient food waste management within households, restaurants, and communities. The application offers a user-friendly interface accessible via web browsers and mobile devices, allowing users to easily track, manage, and minimize their food waste footprint. Inventory Management: Users can create and maintain digital inventories of their food items, including perishables, pantry staples, and leftovers. The application manual input methods to add items, track expiration dates, and receive notifications for approaching expiry. It enables users to plan meals based on available ingredients, reducing the likelihood of purchasing unnecessary items and ensuring optimal utilization of existing resources. The meal planning feature suggests recipes tailored to the user's inventory and dietary preferences, promoting creativity and diversity in meal preparation. By leveraging technology and promoting behavioral change, It aims to empower individuals and communities to adopt more responsible and sustainable food consumption practices. Through effective food waste management, the application contributes to the preservation of resources, reduction of greenhouse gas emissions, and promotion of food security and social equity.

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CHAPTER 13

CONCLUSION AND REFLECTION

13.1 CONCLUSION

In conclusion, this application represents a holistic solution to the pressing challenges of food waste management, sustainability, and healthy eating habits. By harnessing the power of technology, accessibility, and community engagement, this application empowers users to make informed decisions, reduce food waste, and adopt sustainable consumption practices.

Through its intuitive user interface, personalized recommendations, and AI-driven features, This web application addresses the diverse needs and preferences of users, whether they are individuals, businesses, or community organizations. By expanding This web application's reach to other industries, regions, and stakeholders, we can amplify its impact and create a more resilient, equitable, and sustainable food system for the future.

As we continue to innovate and iterate, This web application remains committed to its mission of promoting food waste reduction, fostering environmental stewardship, and improving access to nutritious food for all. Together, we can build a brighter future where every meal matters, every ingredient counts, and every person has the opportunity to thrive.

Join us on this journey towards a more sustainable and delicious future with This web application. Together, we can make a difference, one plate at a time. Thank you for your support and commitment to sustainability.

13.2 RECAP OF KEY FINDINGS

Throughout the development of This web application, several key findings emerged, highlighting the importance of addressing food waste management through technology and community engagement:

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Food Waste is a Significant Issue: Research and literature review revealed the alarming scale of food waste globally, with significant environmental, social, and economic implications.

Need for Efficient Supply Chain Management: Efficient supply chain management is crucial for minimizing food waste at various stages, from production and distribution to consumption and disposal.

Role of Technology in Food Waste Reduction: Technology, including web applications like This web application, can play a vital role in addressing food waste by facilitating inventory management, meal planning, donation coordination, and sustainability tracking.

Importance of User Engagement and Accessibility: User engagement and accessibility are key considerations in the design and development of food waste management solutions.

Opportunities for Expansion and Collaboration: This web application presents opportunities for expansion into other industries, regions, and stakeholder collaborations to amplify its impact and promote sustainability across the food ecosystem.

13.3 IMPLICATIONS FOR AGRI-FOOD WASTE MANAGEMENT

The implications of This web application for agri-food waste management are significant and multifaceted:

Improved Efficiency: This web application streamlines food inventory management, meal planning, and donation coordination processes, leading to reduced inefficiencies and waste at various stages of the agri-food supply chain.

Data-Driven Insights: This web application generates valuable data insights into user behavior. consumption patterns, and food waste metrics, enabling stakeholders in the agri-food industry to make informed decisions and optimize resource allocation.

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Community Engagement: This web application fosters community engagement and collaboration among users, businesses, and organizations involved in agri-food waste management, creating opportunities for knowledge sharing, innovation, and collective action.

Policy Support and Advocacy: This web application can serve as a tool for advocacy and policy support by raising awareness about the importance of food waste reduction and sustainability and advocating for policy changes at the local, regional, and national levels.

Capacity Building and Education: By providing educational resources, training materials, and capacity-building initiatives, This web application equips users and stakeholders with the knowledge and skills needed to address agri-food waste effectively and implement sustainable practices.

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INTERNSHIP

Principal
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T.N.Palayam, Gobi (Tk),
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J.K.K. MUNIRAJAH COLLEGE OF TECHNOLOGY

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Approved by AICTE, New Delhi and Affiliated to Anna University, Chennai.

Accredited by NAAC with "A" Grade

T.N. Palayam (Po), Gobi (Tk), Erode (Dt) – 638 506

INTERNSHIP DETAILS 2023-24

SI. NO	REGISTER NUMBER	STUDENT NAME	NAME OF THE COMPANY	LOCATION	DATE
1	731220104003	BALU R	ICORE SOFTWARE TECHNOLOGIES	COIMBATORE	11.03.2024 TO 16.03.2024
2	731220104012	KAVIN.M			
3	731220104005	DEEPAK.S			
4	731220104301	BOOPALAN.M			

Principal
J.K.K.Munirajah College of Technology
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T.N.Palayam, Gobi (Tk),
Erode (Dt) - 638 506.

Gmail

Internship
1message

MON 04 Feb 2024 at 2.00pm

From: HODCSE<hodcse@jkkmct.edu.in>

Date: MON 04 Feb 2024 at 2.00pm

Subject: Internship-reg

To: ICORE SOFTWARE TECHNOLOGIES <info@icore.net.in>

Dear Sir,

I am requesting to be joining your **ICORE SOFTWARE TECHNOLOGIES.** The requirements are exactly what I have prepared for and hoped to do. I feel confident that I can make a significant contribution to your organization while at the same time learning from your staff.

Additionally, I shall complete all insurance forms for the new intern orientation. I look forward to working with you and your fine team. I appreciate your confidence in me and providing the chance to work with and observe your outstanding staff.

Refer the following students: **BALU R, KAVIN.M, DEEPAK.S, BOOPALAN.M**

Sincerely,

First Year CSE Student,
J K K Munirajah College of Technology,
T.N. Palayam, Erode-638506, Tamilnadu.

Principal
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T.N.Palayam, Gobi (Tk),
Erode (Dt) - 638 506.

Gmail

Internship
1message

THUR 07 Mar 2024 at 3.30pm

From: ICORE SOFTWARE TECHNOLOGIES <info@icore.net.in >
Date: THUR 07 Mar 2024 at 3.30pm
Subject: Internship-reg
To: HODCSE<hodcse@jkkmct.edu.in>

Dear SIR,

I am writing to confirm my acceptance of your internship offer of 11.03.2024 TO 16.03.2024 and to tell you how to be joining my **ICORE SOFTWARE TECHNOLOGIES**. The requirements are exactly what I have prepared for and hoped to do. I feel confident that I can make a significant contribution to your organization while at the same time learning from my staff.

As we discussed, I will report at 8:00 a.m. on Mar 11, 2024 and will be ready to take on my first assignment as an intern from my company. Additionally, I shall complete all insurance forms for the new intern orientation. I look forward to working with you and your fine team. I appreciate your confidence in me and providing the chance to work with and observe my outstanding staff.

Refer the following students: **BALU R, KAVIN.M, DEEPAK.S, BOOPALAN.M**

Sincerely,

HR Manager,
ICORE SOFTWARE TECHNOLOGIES,
Coimbatore.

Principal
J.K.K.Munirajah College of Technology
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ICORE
Solution Begins Here

ICORE SOFTWARE TECHNOLOGIES

DATE :16-03-2024

This is to certify that **Mr./Ms.BALU R (731220104003)** Final year B.E Computer Science and Engineering of **JKK MUNIRAJAH COLLEGE OF TECHNOLOGY,** Erode has attended internship training in our organization from 11-3-2024 to 16-3-2024.During this internship training, he/she has learned the overview concepts of FARMERS AGRICULTURE ASSISTANCE CHATBOT.

AUTHORIZED SIGNATURE

Principal
J.K.K.Munirajah College of Technolog
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ICORE SOFTWARE TECHNOLOGIES

Solution Begins Here

DATE :16-03-2024

This is to certify that **Mr./Ms.KAVIN.M (731220104012)** Final year B.E Computer Science and Engineering of **JKK MUNIRAJAH COLLEGE OF TECHNOLOGY,** Erode has attended internship training in our organization from 11-3-2024 to 16-3-2024.During this internship training, he/she has learned the overview concepts of FARMERS AGRICULTURE ASSISTANCE CHATBOT.

AUTHORIZED SIGNATURE

Principal
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Erode (Dt) - 638 506.

ICORE
Solution Begins Here

ICORE SOFTWARE TECHNOLOGIES

DATE :16-03-2024

This is to certify that **Mr./Ms.DEEPAK.S (731220104005)** Final year B.E Computer Science and Engineering of **JKK MUNIRAJAH COLLEGE OF TECHNOLOGY,** Erode has attended internship training in our organization from 11-3-2024 to 16-3-2024.During this internship training, he/she has learned the overview concepts of FARMERS AGRICULTURE ASSISTANCE CHATBOT.

AUTHORIZED SIGNATURE

Principal
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Erode (Dt) - 638 506.

ICORE
Solution Begins Here

ICORE SOFTWARE TECHNOLOGIES

DATE :16-03-2024

This is to certify that **Mr./Ms.BOOPALAN.M (731220104301)** Final year B.E Computer Science and Engineering of **JKK MUNIRAJAH COLLEGE OF TECHNOLOGY**, Erode has attended internship training in our organization from 11-3-2024 to 16-3-2024.During this internship training, he/she has learned the overview concepts of FARMERS AGRICULTURE ASSISTANCE CHATBOT.

AUTHORIZED SIGNATURE

Principal
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T.N.Palayam, Gobi (Tk),
Erode (Dt) - 638 506.

J.K.K. MUNIRAJAH COLLEGE OF TECHNOLOGY
(AUTONOMOUS)

Approved by AICTE, New Delhi and Affiliated to Anna University, Chennai.

Accredited by NAAC with "A" Grade

T.N. Palayam (Po), Gobi (Tk), Erode (Dt) – 638 506

INTERNSHIP DETAILS 2023-24

SI. NO	REGISTER NUMBER	STUDENT NAME	NAME OF THE COMPANY	LOCATION	DATE
1	731220104011	KATHIRESAN.K	ANJANA INFOTECH	RAJAPALAYAM	22.01.2024 TO 26.01.2024
2	731220104014	LOGANATHAN.T			
3	731220104028	VIGNESH.M			

Principal
J.K.K.Munirajah College of Technology
(Autonomous)
T.N.Palayam, Gobi (Tk),
Erode (Dt) - 638 506.

Gmail

Internship
1message

MON 08 Jan 2024 at 2.30pm

From: HODCSE<hodcse@jkkmct.edu.in>

Date: MON 08 Jan 2024 at 2.30pm

Subject: Internship-reg

To: ANJANA INFOTECH<info@anjanainfotech.in >

Dear Sir,

I am requesting to be joining your **ANJANA INFOTECH.** The requirements are exactly what I have prepared for and hoped to do. I feel confident that I can make a significant contribution to your organization while at the same time learning from your staff.

Additionally, I shall complete all insurance forms for the new intern orientation. I look forward to working with you and your fine team. I appreciate your confidence in me and providing the chance to work with and observe your outstanding staff.

Refer the following students: **KATHIRESAN.K, LOGANATHAN.T, VIGNESH.M**

Sincerely,

Final Year CSE Student,
J K K Munirajah College of Technology,
T.N.Palayam, Erode-638506, Tamilnadu.

Principal
J.K.K.Munirajah College of Technology
(Autonomous)
T.N.Palayam, Gobi (Tk),
Erode (Dt) - 638 506.

Gmail

Internship
1message

FRI 12 JAN 2024 at 3.30pm

From:ANJANA INFOTECH <info@anjanainfotech.in >

Date: FRI 12 JAN 2024 at 3.30pm

Subject: Internship-reg

To: HODCSE<hodcse@jkkmct.edu.in>

Dear SIR,

I am writing to confirm my acceptance of your internship offer of 22.01.2024 TO 26.01.2024 and to tell you how to be joining my **ANJANA INFOTECH**. The requirements are exactly what I have prepared for and hoped to do. I feel confident that I can make a significant contribution to your organization while at the same time learning from my staff.

As we discussed, I will report at 8:00 a.m. on JAN 22, 2024 and will be ready to take on my first assignment as an intern from my company. Additionally, I shall complete all insurance forms for the new intern orientation. I look forward to working with you and your fine team. I appreciate your confidence in me and providing the chance to work with and observe my outstanding staff.

Refer the following students: **KATHIRESAN.K, LOGANATHAN.T, VIGNESH.M**

Sincerely,

HR Manager,
ANJANA INFOTECH,
RAJAPALAYAM..

Principal
J.K.K.Munirajah College of Technology
(Autonomous)
T.N.Palayam, Gobi (Tk),
Erode (Dt) - 638 506.

Anjana Infotech
Your Dream We Display

Date: 26.01.2024

INTERNSHIP TRAINING COMPLETION CERTIFICATE

This is to certify that the internship training entitled Web development submitted by Mr. K. Kathirasan (731220104011) Studying B.E (Computer Science) at, J.K.K Munirajah College of Technology has undergone internship training at our Anjana Infotech Private Limited Rajapalayam, as a collaborative activity from 22.01.2024 to 26.01.2024. He has successfully Completed his Internship under my Guidance and is worthy of consideration for the same.

Thanking you.

Principal
J.K.K.Munirajah College of Technology
(Autonomous)
T.N.Palayam, Gobi (Tk),
Erode (Dt) - 638 506.

Anjana Infotech
www.anjanainfotech.in
9787970633
Rajapalayam - 626 117

For Anjana Infotech

Proprietor

Anjana Infotech
Your Dream We Display

Date: 26.01.2024

INTERNSHIP TRAINING COMPLETION CERTIFICATE

This is to certify that the internship training entitled Web development submitted by Mr. T. Loganathan (731220104014) Studying B.E (Computer Science) at, J.K.K Munirajah College of Technology has undergone internship training at our Anjana Infotech Private Limited Rajapalayam, as a collaborative activity from 22.01.2024 to 26.01.2024. He has successfully Completed his Internship under my Guidance and is worthy of consideration for the same.

Thanking you.

Principal
J.K.K.Munirajah College of Technology
(Autonomous)
T.N.Palayam, Gobi (Tk),
Erode (Dt) - 638 506.

Anjana Infotech
www.anjanainfotech.in
Rajapalayam - 626 117

For Anjana Infotech

Proprietor

Anjana Infotech
Your Dream We Display

Date: 26.01.2024

INTERNSHIP TRAINING COMPLETION CERTIFICATE

This is to certify that the internship training entitled Web development submitted by Mr. M. Vignesh (731220104028) Studying B.E (Computer Science) at, J.K.K Munirajah College of Technology has undergone internship training at our Anjana Infotech Private Limited Rajapalayam, as a collaborative activity from 22.01.2024 to 26.01.2024. He has successfully Completed his Internship under my Guidance and is worthy of consideration for the same.

Thanking you.

Anjana Infotech
www.anjanainfotech.in
97879 70633
Rajapalayam - 626 117

For Anjana Infotech

Proprietor

Principal
J.K.K.Munirajah College of Technology
(Autonomous)
T.N.Palayam, Gobi (Tk),
Erode (Dt) - 638 506.

J.K.K. MUNIRAJAH COLLEGE OF TECHNOLOGY
(AUTONOMOUS)

Approved by AICTE, New Delhi and Affiliated to Anna University, Chennai.

Accredited by NAAC with "A" Grade

T.N. Palayam (Po), Gobi (Tk), Erode (Dt) – 638 506

INTERNSHIP DETAILS 2023-24

SI. NO	REGISTER NUMBER	STUDENT NAME	NAME OF THE COMPANY	LOCATION	DATE
1	731221104007	BAMBAVASAN V	TECHNOFLY SOLUTIONS	BANGALORE	30.07.2024 TO 16.08.2024
2	731221104038	VASANTHKUMAR S			
3	731221104307	SRINIVAS V			

Principal
J.K.K.Munirajah College of Technology
(Autonomous)
T.N.Palayam, Gobi (Tk),
Erode (Dt) - 638 506.

Gmail

Internship
1message

MON 22 Jul 2024 at 2.00pm

From: HODCSE<hodcse@jkkmct.edu.in>

Date: MON 22 Jul 2024 at 2.00pm

Subject: Internship-reg

To: TECHNOFLY SOLUTIONS <info@technofly.in>

Dear Sir,

I am requesting to be joining your **TECHNOFLY SOLUTIONS.** The requirements are exactly what I have prepared for and hoped to do. I feel confident that I can make a significant contribution to your organization while at the same time learning from your staff.

Additionally, I shall complete all insurance forms for the new intern orientation. I look forward to working with you and your fine team. I appreciate your confidence in me and providing the chance to work with and observe your outstanding staff.

Refer the following students: **BAMBAVASAN V, VASANTHKUMAR S, SRINIVAS V**

Sincerely,

Third Year CSE Student,
J K K Munirajah College of Technology,
T.N.Palayam, Erode-638506, Tamilnadu.

Principal
J.K.K.Munirajah College of Technology
(Autonomous)
T.N.Palayam, Gobi (Tk),
Erode (Dt) - 638 506.

Gmail

Internship
1 message

THUR 25 Jul 2024 at 3.30pm

From: TECHNOFLY SOLUTIONS <info@technofly.in>
Date: THUR 25 Jul 2024 at 3.30pm
Subject: Internship-reg
To: HODCSE<hodcse@jkkmct.edu.in>

Dear SIR,

I am writing to confirm my acceptance of your internship offer of 30.07.2024 TO 16.08.2024 and to tell you how to be joining my **TECHNOFLY SOLUTIONS.** The requirements are exactly what I have prepared for and hoped to do. I feel confident that I can make a significant contribution to your organization while at the same time learning from my staff.

As we discussed, I will report at 8:00 a.m. on Jul 30, 2024 and will be ready to take on my first assignment as an intern from my company. Additionally, I shall complete all insurance forms for the new intern orientation. I look forward to working with you and your fine team. I appreciate your confidence in me and providing the chance to work with and observe my outstanding staff.

Refer the following students: **BAMBAVASAN V, VASANTHKUMAR S, SRINIVAS V**

Sincerely,

HR Manager,
TECHNOFLY SOLUTIONS,
Bangalore.

Principal
J.K.K.Munirajah College of Technology
(Autonomous)
T.N.Palayam, Gobi (Tk),
Erode (Dt) - 638 506.

TechnoFly Solutions

Technofly

Internship Certificate

This is to certify that V. BAMBAVASAN a student of J K K MUNIRAJAH COLLEGE OF TECHNOLOGY has completed 3 months/weeks of Internship From 30.07.24 To 16.08.24 in ARTIFICIAL INTELLIGENCE Domain.

We wish you all the best in your future endeavors.

Date : 16.08.24

Principal
J.K.K.Munirajah College of Technology
(Autonomous)
T.N.Palayam, Gobi (Tk),
Erode (Dt) - 638 506.

For TechnoFly Solutions

TECHNOFLY SOLUTIONS Date: Authorized Signature BANGALORE-40

Technofly Solutions, Vijayanagar, Bangalore - 40.
Mob.: 9663476586, 9741150102 | www.technofly.in

TechnoFly Solutions

Internship Certificate

This is to certify that S. VASANTH KUMAR a student of J K K MUNIRAJAH COLLEGE OF TECHNOLOGY has completed 3 months/weeks of Internship From 30.07.24 To 16.08.24 in ARTIFICIAL INTELLIGENCE Domain.

We wish you all the best in your future endeavors.

Date : 16.08.24

Principal
J.K.K.Munirajah College of Technology
(Autonomous)
T.N.Palayam, Gobi (Tk),
Erode (Dt) - 638 506.

For TechnoFly Solutions

TECHNOFLY SOLUTIONS Date: Authorized Signature BANGALORE-40.

Technofly Solutions, Vijayanagar, Bangalore - 40.
Mob.: 9663476586, 9741150102 | www.technofly.in

TechnoFly Solutions

Internship Certificate

This is to certify that V. SRINIVAS a student of JKK MUNIRAJAH COLLEGE OF TECHNOLOGY has completed 3 months/weeks of Internship From 30.07.24 To 16.08.24 in ARTIFICIAL INTELLIGENCE Domain.

We wish you all the best in your future endeavors.

Date : 16.08.24

Principal
J.K.K.Munirajah College of Technology
(Autonomous)
T.N.Palayam, Gobi (Tk),
Erode (Dt) - 638 506.

For **TechnoFly Solutions**

TECHNOFLY SOLUTIONS Date: Sign. Authorized Signature BANGALORE-40.

Technofly Solutions, Vijayanagar, Bangalore - 40.
Mob.: 9663476586, 9741150102 | www.technofly.in

INDUSTRIAL VISIT

J.K.K. MUNIRAJAH COLLEGE OF TECHNOLOGY

(AUTONOMOUS)

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T.N. Palayam (Po), Gobi (Tk), Erode (Dt) – 638 506

COMPUTER SCIENCE AND ENGINEERING

2023-2024

SI. NO	REGISTER NUMBER	STUDENT NAME	NAME OF THE COMPANY	LOCATION	DATE
1	731220104001	ABINAYA G	IROHUB INFOTECH	1st Floor Trust Building, Kayyath Ln Palarivattom,Kochi	28.09.2023
2	731220104003	BALU R			
3	731220104006	DEEPIKA.S			
4	731220104007	DHARANISELVI. M			
5	731220104009	JAGATHESWARAN.P			
6	731220104010	KARUNYAA.M			
7	731220104011	KATHIRESAN.K			
8	731220104021	RAMYA.S			
9	731220104025	SUNDARAGANESAN.K			
10	731220104029	VINISHA.T			
11	731220104030	VINITHA.A			
12	731220104031	VINOTHKUMAR.R			
13	731220104301	BOOPALAN.M			
14	731220104302	DHAMODARAN.G			

Principal
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15	731221104001	AADHI SURYA K	IROHUB INFOTECH	1st Floor Trust Building, Kayyath Ln Palarivattom,Kochi	28.09.2023
16	731221104004	ARUL MURUGAN S			
17	731221104005	BABU SHANKAR S			
18	731221104007	BAMBAVASAN V			
19	731221104008	CHANDRA PRAKASH K			
20	731221104009	DHAKSHINA MOORTHI E			
21	731221104012	DURGA K			
22	731221104013	GUNASEKARAN P			
23	731221104014	GUNASEKARAN S			
24	731221104015	HARIPRABHA V			
25	731221104021	LALITHA T			
26	731221104022	MADHAN G			
27	731221104025	MOUSIKA S			
28	731221104026	NANDHINI P			
29	731221104027	PANDIYARAJ P			
30	731221104028	PRIYA DHARSHINI S			
31	731221104029	RAVIKUMAR.P			

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32	731221104031	RUBIKA G			
33	731221104033	SHYAM KUMAR S			
34	731221104035	SUGANYA K			
35	731221104036	SURYA S			
36	731221104037	SUSHMINA M			
37	731221104038	VASANTH KUMAR S			
38	731221104039	VIGNESH M			
39	731221104301	AMUTHAMALAR R			
40	731221104302	BHARANI DHARAN.M			
41	731221104307	SRINIVAS.V			

Principal
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T.N.Palayam, Gobi (Tk),
Erode (Dt) - 638 506.

J K K MUNIRAJAH
COLLEGE OF TECHNOLOGY

HOD CSE <hodcse@jkkmct.edu.in>

REQUESTING PERMISSION FOR INDUSTRIAL VISIT-Reg

HOD CSE <hodcse@jkkmct.edu.in> 27 September 2023 at 09:57
To: hr@irohub.com

We heard about iroid technologies a software organisation operating in Cochin providing various software development services in the IT sector

JKK munirajah college of technology is situated in erode district and we are accredited with NAAC 'A' grade and as part of our curriculum **our students from computer science & Engineering around 41 students along with faculty members need to visit your concern like yours to get real time exposure and awareness about the software products and their development etc.**

I request you to kindly consider our request for allowing Industrial visit to your esteemed concern in the upcoming week on sep 28 if possible so that our students can utilize the opportunity to get real time exposure

Principal
J.K.K.Munirajah College of Technology
(Autonomous)
T.N.Palayam, Gobi (Tk),
Erode (Dt) - 638 506.

J K K MUNIRAJAH
COLLEGE OF TECHNOLOGY

HOD CSE <hodcse@jkkmct.edu.in>

PERMISSION LETTER FOR INDUSTRIAL VISIT

HR - IROHUB <hr@irohub.com> 27 September 2023 at 11:01
To: hodcse@jkkmct.edu.in
Cc: Amala P M - IROHUB <amala.pm@irohub.com>

Hello Team,

Greetings from iROHUB INFOTECH PVT LTD !!!

We are glad to approve the request of III & IV Year from the Departments of Computer Science & Engineering in JKK munirajah college of technology. You have been considered for an industrial Visit with IROHUB Infotech, Kochi on **28/09/2023 (Thurday)**, 41 students accompanied by **2** Faculty members. You will be provided with training in Android, Flutter, iOS,Mern Stack and Python and also visit the development area.

Note:-

* The timing will be from 10:00am - 11:30am.
* Common Certificate.

About our company

iROHUB Infotech is the research and Training Company is a global IT solutions provider with its headquarters located in Cochin, India. With the backbone of a bunch of experienced professionals in the software industry, we are inspired to diverse our skills in various domains such as Mobile Application Development, Web Development, Branding, SEO, Internet marketing, etc.
Here is a link to our Company Profile and Portfolio to know more about us and our applications.
http://www.irohub.com/

Location details: iROHUB Infotech Pvt Ltd, 2nd Floor-Trust Building, Kayyath Lane, Near Hi Tech Diagnostic Centre, Palarivattom, Cochin.

--

Thanks & Regards,

IROHUB

HR DEPARTMENT

Office: +91 0484 4041114 | Mob : +918129844744 | www.irohub.com

2nd floor, Trust Building, Kayyath Lane,Palarivattom,Cochin-25

Disclaimer: This e-mail and any attachments are confidential and may also be legally privileged and/or copyright material of iROHUB Infotech Pvt Ltd. The information contained herein is confidential information intended only for the use of the individual or entity named above. If the reader of this message is not the intended recipient, or if an attachment is made in error, the reader is hereby notified that any dissemination, distribution or copying of this communication is strictly prohibited. If you have received this transmission in error, please notify the above person by telephone immediately by return e-mail and delete/trash the original message from your system. Thank you for your cooperation.

Principal
J.K.K.Munirajah College of Technology
(Autonomous)
T.N.Palayam, Gobi (Tk),
Erode (Dt) - 638 506.

IROHUB
Infotech Pvt. Ltd.

iRH/2023/1219

Date: 28/09/2023

To Whomsoever It May Concern

This is to certify that ***Ms. G ABINAYA*** from the Department of Computer Science & Engineering, Fourth Year, ***JKK Munirajah College of Technology, Erode, Chennai*** has undergone the industrial visit from ***IROHUB INFOTECH***, Cochin on 28/09/2023 as per the company norms and regulations. During the visit the domains such as Overview of Python, React JS and Android Development details were covered.

For ***IROHUB INFOTECH***

Amala P M

Center Head

IROHUB INFOTECH PVT. LTD. COCHIN-25

Principal
J.K.K.Munirajah College of Technology
(Autonomous)
T.N.Palayam, Gobi (Tk),
Erode (Dt) - 638 506.

1st Floor, Trust building, Kayyath Ln
Palarivattom, Kochi, 682025

+91 484 485 1114

www.irohub.com

IROHUB
Infotech Pvt. Ltd.

IRH/2023/1226

Date: 28/09/2023

To Whomsoever It May Concern

This is to certify that ***Mr. R BALU*** from the Department of Computer Science & Engineering, Fourth Year, ***JKK Munirajah College of Technology, Erode, Chennai*** has undergone the industrial visit from ***IROHUB INFOTECH***, Cochin on 28/09/2023 as per the company norms and regulations. During the visit the domains such as Overview of Python, React JS and Android Development details were covered.

For ***IROHUB INFOTECH***

Amala P M

Center Head

IROHUB INFOTECH PVT. LTD. • COCHIN • PALARIVATTOM •

Principal
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Erode (Dt) - 638 506.

IROHUB
Infotech Pvt. Ltd.

iRH/2023/1231

Date: 28/09/2023

To Whomsoever It May Concern

This is to certify that ***Mr. M BOOPALAN*** from the Department of Computer Science & Engineering, Fourth Year, ***JKK Munirajah College of Technology, Erode, Chennai*** has undergone the industrial visit from ***IROHUB INFOTECH***, Cochin on 28/09/2023 as per the company norms and regulations. During the visit the domains such as Overview of Python, React JS and Android Development details were covered.

For ***IROHUB INFOTECH***

Amala P M

Center Head

IROHUB INFOTECH PVT. LTD. COCHIN-25 PALARIVATTOM

Principal
J.K.K.Munirajah College of Technology
(Autonomous)
T.N.Palayam, Gobi (Tk),
Erode (Dt) - 638 506

IROHUB
Infotech Pvt. Ltd.

iRH/2023/1220

Date 25/09/2023

To Whomsoever It May Concern

This is to certify that ***Ms. S DEEPIKA*** from the Department of Computer Science & Engineering, Fourth Year, ***JKK Munirajah College of Technology, Erode, Chennai*** has undergone the industrial visit from ***IROHUB INFOTECH***, Cochin on 23/09/2023 as per the company norms and regulations. During the visit the domains such as Overview of Python, React JS and Android Development details were covered.

For ***IROHUB INFOTECH***

Amala P M

Center Head

IROHUB INFOTECH PVT. LTD. COCHIN-25 PALARIVATTOM

Principal
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(Autonomous)
T.N.Palayam, Gobi (Tk),
Erode (Dt) - 638 506.

IROHUB
Infotech Pvt. Ltd.

IRH/2023/1232

Date: 28/09/2023

To Whomsoever It May Concern

This is to certify that ***Mr. G DHAMODARAN*** from the Department of Computer Science & Engineering, Fourth Year, ***JKK Munirajah College of Technology, Erode, Chennai*** has undergone the industrial visit from ***IROHUB INFOTECH***, Cochin on 28/09/2023 as per the company norms and regulations. During the visit the domains such as Overview of Python, React JS and Android Development details were covered.

For ***IROHUB INFOTECH***

Amala P M

Center Head

IROHUB INFOTECH PVT. LTD. COCHIN-25

Principal
J.K.K.Munirajah College of Technology
(Autonomous)
T.N.Palayam, Gobi (Tk),
Erode (Dt) - 638 506.

IROHUB
Infotech Pvt. Ltd.

iRH/2023/1221

Date: 28/09/2023

To Whomsoever It May Concern

This is to certify that ***Ms. M DHARANISELVI*** from the Department of Computer Science & Engineering, Fourth Year, ***JKK Munirajah College of Technology, Erode, Chennai*** has undergone the industrial visit from ***IROHUB INFOTECH***, Cochin on 28/09/2023 as per the company norms and regulations. During the visit the domains such as Overview of Python, React JS and Android Development details were covered.

For ***IROHUB INFOTECH***

Amala P M

Center Head

IROHUB INFOTECH PVT. LTD. PALARIVATTOM COCHIN-25

Principal
J.K.K.Munirajah College of Technology
(Autonomous)
T.N.Palayam, Gobi (Tk),
Erode (Dt) - 638 506.

IROHUB
Infotech Pvt. Ltd.

iRH/2023/1227

Date: 28/09/2023

To Whomsoever It May Concern

This is to certify that ***Mr. P JAGATHESWARAN*** from the Department of Computer Science & Engineering, Fourth Year, ***JKK Munirajah College of Technology, Erode, Chennai*** has undergone the industrial visit from ***IROHUB INFOTECH***, Cochin on 28/09/2023 as per the company norms and regulations. During the visit the domains such as Overview of Python, React JS and Android Development details were covered.

For ***IROHUB INFOTECH***

Amala P M

Center Head

Principal
J.K.K.Munirajah College of Technology
(Autonomous)
T.N.Palayam, Gobi (Tk),
Erode (Dt) - 638 506.

IROHUB
Infotech Pvt. Ltd.

iRII/2023/1222

Date: 28/09/2023

To Whomsoever It May Concern

This is to certify that ***Ms. M KARUNYAA*** from the Department of Computer Science & Engineering, Fourth Year, ***JKK Munirajah College of Technology, Erode, Chennai*** has undergone the industrial visit from ***IROHUB INFOTECH***, Cochin on 28/09/2023 as per the company norms and regulations. During the visit the domains such as Overview of Python, React JS and Android Development details were covered.

For ***IROHUB INFOTECH***

Amala P M

Center Head

IROHUB INFOTECH PVT. LTD. * PALARIVATTOM * COCHIN-25

Principal
J.K.K.Munirajah College of Technology,
(Autonomous)
T.N.Palayam, Gobi (Tk),
Erode (Dt) - 638 506.

IROHUB
Infotech Pvt. Ltd.

iRH/2023/1228

Date: 28/09/2023

To Whomsoever It May Concern

This is to certify that ***Mr. K KATHIRESAN*** from the Department of Computer Science & Engineering, Fourth Year, ***JKK Munirajah College of Technology, Erode, Chennai*** has undergone the industrial visit from ***IROHUB INFOTECH***, Cochin on 28/09/2023 as per the company norms and regulations. During the visit the domains such as Overview of Python, React JS and Android Development details were covered.

For ***IROHUB INFOTECH***

Amala P M

Center Head

IROHUB INFOTECH PVT. LTD. COCHIN-25 PALARIVATTOM

Principal
J.K.K.Munirajah College of Technology
(Autonomous)
T.N.Palayam, Gobi (Tk),
Erode (Dt) - 638 506.

IROHUB
Infotech Pvt. Ltd.

iRH/2023/1223

Date: 28/09/2023

To Whomsoever It May Concern

This is to certify that *Ms. S RAMYA* from the Department of Computer Science & Engineering, Fourth Year, *JKK Munirajah College of Technology, Erode, Chennai* has undergone the industrial visit from *IROHUB INFOTECH*, Cochin on 28/09/2023 as per the company norms and regulations. During the visit the domains such as Overview of Python, React JS and Android Development details were covered.

For *IROHUB INFOTECH*

Amala P M

Center Head

IROHUB INFOTECH Pvt. LTD. COCHIN-25

Principal
J.K.K.Munirajah College of Technology
(Autonomous)
T.N.Palayam, Gobi (Tk),
Erode (Dt) - 638 506.

IROHUB
Infotech Pvt. Ltd.

iRH/2023/1229

Date: 28/09/2023

To Whomsoever It May Concern

This is to certify that ***Mr. K SUNDARAGANESAN*** from the Department of Computer Science & Engineering, Fourth Year, ***JKK Munirajah College of Technology, Erode, Chennai*** has undergone the industrial visit from *IROHUB INFOTECH*, Cochin on 28/09/2023 as per the company norms and regulations. During the visit the domains such as **Overview of Python, React JS and Android Development** details were covered.

For ***IROHUB INFOTECH***

Amala P M

Center Head

IROHUB INFOTECH PVT. LTD. COCHIN-25 PALARIVATTOM

Principal
J.K.K.Munirajah College of Technology
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Erode (Dt) - 638 506.

IROHUB
Infotech Pvt. Ltd.

iRH/2023/1224

Date: 28/09/2023

To Whomsoever It May Concern

This is to certify that ***Ms. T VINISHA*** from the Department of Computer Science & Engineering, Fourth Year, ***JKK Munirajah College of Technology, Erode, Chennai*** has undergone the industrial visit from ***IROHUB INFOTECH***, Cochin on 28/09/2023 as per the company norms and regulations. During the visit the domains such as Overview of Python, React JS and Android Development details were covered.

For ***IROHUB INFOTECH***

Amala P M

Center Head

IROHUB INFOTECH PVT. LTD. * PALARIVATTOM * COCHIN-25

Principal
J.K.K.Munirajah College of Technology
(Autonomous)
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Erode (Dt) - 638 506.

1st Floor, Trust building, Kayyath Ln
Palarivattom, Kochi, 682025

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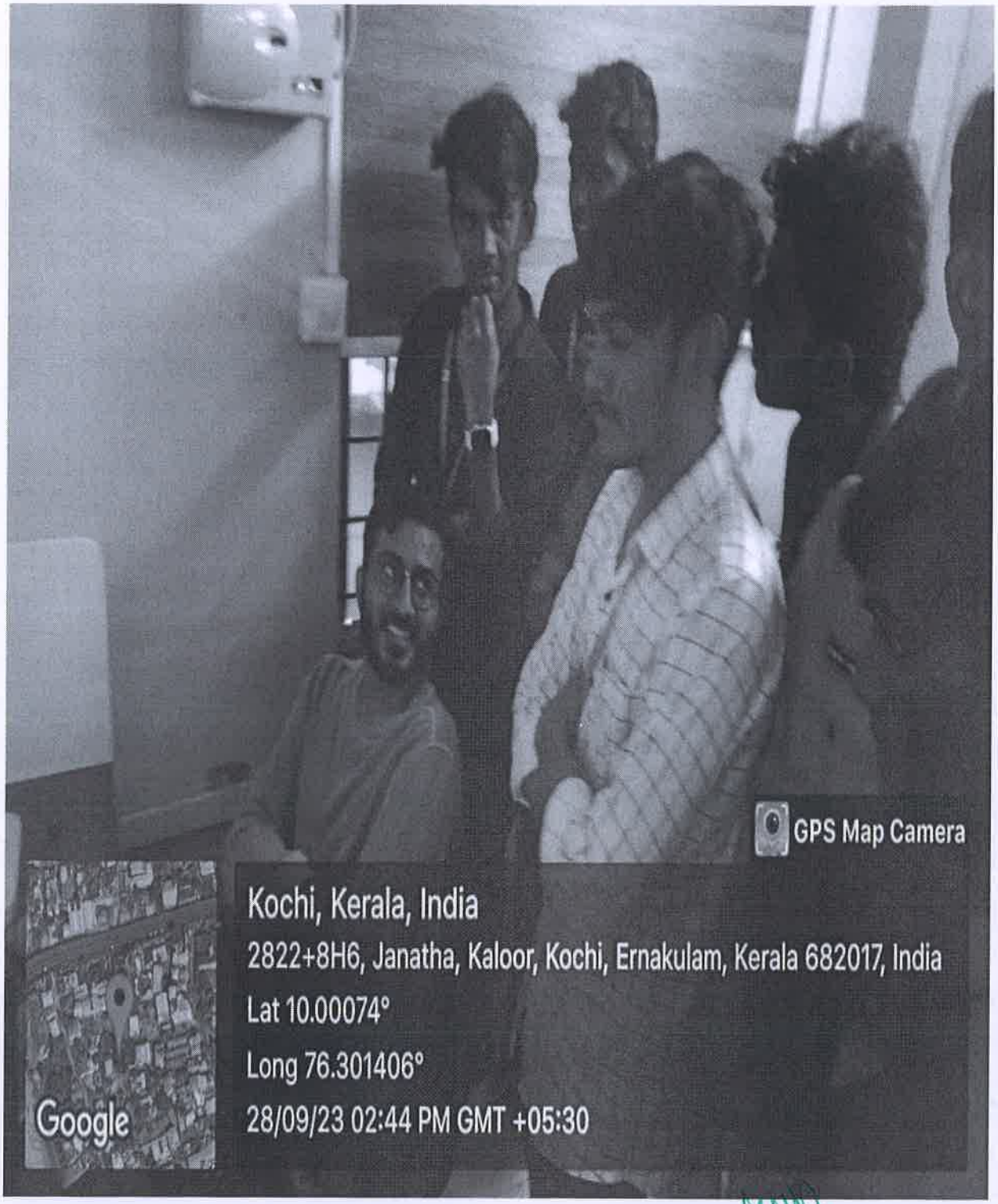
J.K.K. MUNIRAJAH COLLEGE OF TECHNOLOGY

(AUTONOMOUS)

Approved by AICTE, New Delhi and Affiliated to Anna University, Chennai.

Accredited by NAAC with "A" Grade

T.N. Palayam (Po), Gobi (Tk), Erode (Dt) – 638 506



Principal
J.K.K.Munirajah College of Technology
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T.N.Palayam, Gobi (Tk),
Erode (Dt) - 638 506.

J.K.K. MUNIRAJAH COLLEGE OF TECHNOLOGY

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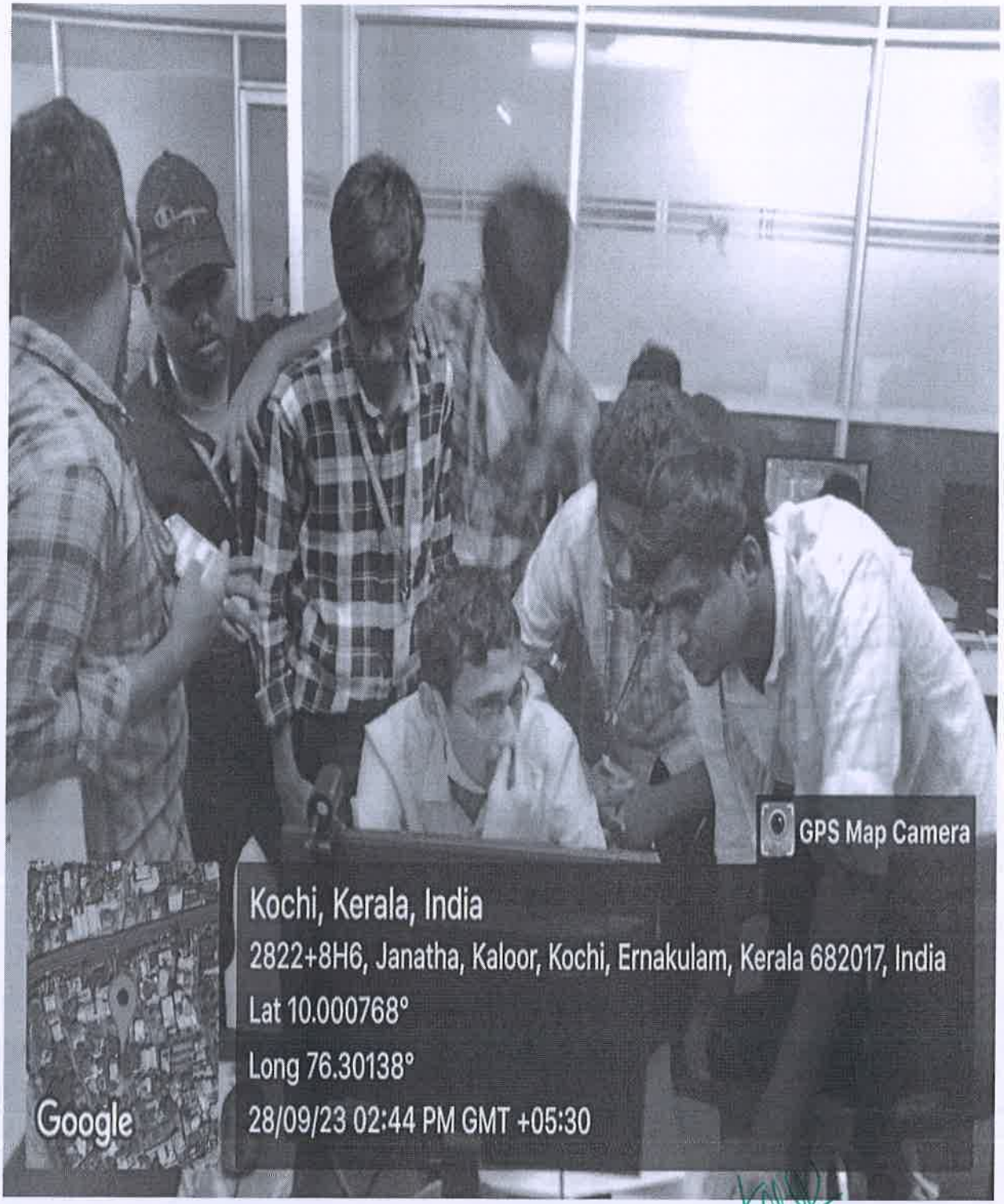

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