UNIVERSITY SCHOOL OF INFORMATION, COMMUNICATION AND TECHNOLOGY

Software Project Management

PAPER CODE - IT763

MASTER OF COMPUTER APPLICATIONS
(SOFTWARE ENGINEERING)

UNDER THE GUIDANCE OF;

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SUBMITTED BY:

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11	Draw activity on node for the project given in practical no 9. Draw forward pass and backward pass. Determine early start (ES), latest start (LS), early finish (EF), latest finish (LF) and float for each activity and also calculate the project finish date. Find the critical path using CPM.		30/11/23
12	Explain the term Program Evaluation and Review Technique (PERT) (within 50 words). Using PERT, calculate standard deviation for each activity. Calculate z values for each event by taking some target date for your project.		7/12/23

1.Write problem statement and project charter for your project.

- Problem Statement ➖

The current chess engine landscape lacks an integrated solution, hindering the chess experience for players. Balancing computational efficiency and strategic depth is a challenge. A sophisticated solution combining AI algorithms and optimal move generation is essential. Addressing these limitations is vital for improving the quality and accessibility of computer chess.

General Project Information	
Project Name	**Project ID/Number**
Chess Engine Development	86
	Date Prepared
	2 January 2023
Project Sponsor	
Backrock	
Project Manager	**Program Manager**
David Hussey	Steve Marsh
Team Members	
Kane Neesham Rachin Singh Travis Flimmael John Rock	
Other Key Stakeholders	
Alice Thornton Daniel Rodriguez Eleanor Harper Victor Chang Olivia Patel Sebastian Kim Isabella Santiago	

Scope Statement

Business Need and Problem Statement

To meet the increasing demand for a sophisticated and engaging online chess platform, our business seeks to develop a state-of-the-art Chess Engine. The platform aims to cater to chess enthusiasts, providing an immersive and competitive gaming experience.

Existing online chess platforms lack advanced algorithms and user-friendly interfaces, limiting the gaming experience. The need for a cutting-edge Chess Engine arises to address these shortcomings, offering users a high-quality, feature-rich platform that adapts to varying skill levels and fosters a thriving online chess community.

Project Goals and Objectives (Deliverables)

- **Chess Engine Software:**
  - Functional chess engine with advanced algorithms.
  - User-friendly interfaces for desktop and mobile platforms.
- **Documentation:**
  - Comprehensive technical documentation.
  - User manuals and guides.
- **Testing and Quality Assurance:**
  - Rigorous testing to ensure reliability and performance.
  - Bug-free and optimized software.
- **Training Materials:**
  - Development of training materials for users.
- **Launch and Promotion:**
  - Outreach strategy for promoting the Chess Engine.
  - Launch events and promotional activities.

Benefits

- Enriched user experience for chess enthusiasts.
- Educational value through insightful game analysis.
- Increased engagement with a challenging and competitive platform.

Metrics

- User Engagement
- Performance
- User Satisfaction
- Adoption Rate
- Revenue

Supporting Detail

Cost

- **Development Costs:**
  - Software development and coding: $300,000
  - Algorithmic research and implementation: $150,000
  - User interface design: $100,000
- **Testing and Quality Assurance:**
  - Rigorous testing procedures: $80,000
  - Quality assurance efforts: $70,000
- **Documentation:**
  - Technical documentation: $20,000
  - User manuals and guides: $15,000
- **Training Materials:**
  - Development of training materials for users: $25,000
- **Launch and Promotion:**
  - Outreach strategy: $50,000
  - Launch events and promotional activities: $90,000
- **Contingency:**
  - Buffer for unforeseen challenges and adjustments: $50,000

High-Level Phases *(Project Lifecycle)*

Initiation
Planning
Execution
Monitoring and Control
Closing

Critical Milestone Date(s) – *include desired end date*

- **Project Kickoff:**
  - Date: January 15, 2023
- **Software Development Completion:**
  - Date: April 30, 2023
- **Testing and Quality Assurance Completion:**
  - Date: May 15, 2023
- **Documentation Finalization:**
  - Date: May 30, 2023
- **Training Materials Development:**
  - Date: June 10, 2023
- **Launch and Promotion:**
  - Date: July 1, 2023
- **Project Closure:**
  - Date: July 15, 2023
- **Desired End Date:**
  - Date: July 31, 2023

Constraints/Assumptions

Constraints:

- **Budget Constraint:**

  Fixed budget of $800,000.
- **Time Constraint:**

  Project must conclude by July 31, 2023.
- **Resource Availability:**

  Dependent on availability of skilled professionals.
- **Technology Constraint:**

  Adherence to existing technological frameworks.

Assumptions:

- **Stakeholder Involvement**:

  Active participation and timely feedback.
- **Market Stability:**

  Assumption of a stable market environment.
- **Skillset of Development Team:**

  Assumption of a skilled development team.
- **User Adoption:**

  Anticipation of positive user response.
- **Risk Mitigation Strategies:**

  Assumption that outlined strategies are effective.

Risks

- Technical Challenges.
- Budgetary Constraints.
- Timeline Pressure.
- User Acceptability.
- Market Competition.

Additional Information

Sponsor Responsibilities

- **Financial Oversight:**
  - Ensure adherence to the project budget of $800,000.
- **Approval Authority:**
  - Provide timely approvals for key project milestones.
- **Stakeholder Liaison:**
  - Facilitate communication between project team and stakeholders.
- **Risk Mitigation Support:**
  - Collaborate on strategies to address project risks.
- **Strategic Decision-Making:**
  - Contribute to high-level strategic decisions impacting the project.

Program Manager Responsibilities

- Strategic Planning:
  - Develop and execute project strategies aligned with organizational goals.
- Resource Allocation:
  - Efficiently allocate resources for project tasks and milestones.
- Stakeholder Communication:
  - Ensure clear communication between teams and stakeholders.
- Risk Management:
  - Identify and mitigate risks throughout the project lifecycle.
- Timeline Adherence:
  - Monitor and enforce project timelines for timely completion

We agree that this is a viable project, and we will support it.	
Date:	Date:
Date:	

2. Calculate net present value (NPV) for the below problem with 3 projects A, B and C. (given: annual discount rate 6%, 9%, 11%). Analyse which project is more preferable for each discount rate and why?

	Project		
Year	A	B	C
0	-8500	-8350	-10600
1	4500	1000	2000
2	4000	2050	2000
3	2000	4000	6000
4	1000	3050	2000
5	550	9000	2500
6	500	-6000	2000

Net Present Value (NPV):

NPV is a financial metric that evaluates the profitability of an investment by calculating the present value of expected cash inflows and outflows. It reflects the net value of an investment in today's terms, considering the time value of money. A positive NPV indicates a potentially profitable investment, while a negative NPV suggests a potential loss.

Formula for NPV:

The formula for calculating NPV is as follows :

$$NPV = \sum_{t=0}^{n} \frac{CF_t}{(1+r)^t}$$

Where:

- NPV is the Net Present Value,
- CF_t is the net cash flow during the period t,
- r is the discount rate,
- n is the number of periods.

NPV formula discounts all future cash flows back to their present value and then subtracts the initial investment. A positive NPV indicates that the investment is expected to generate a profit, while a negative NPV suggests that the investment may not meet the required rate of return.

In the context of investment decision-making, if the NPV is positive, the project is generally considered financially viable. If the NPV is negative, it may indicate that the project may not meet the required return rate, and therefore, it might not be a suitable investment.

Calculation of NVP			
Year	A	Discount rate	6%
0	-8500	NVP	₹ 2,540.07
1	4500		
2	4000		
3	2000		
4	1000		
5	550		
6	500		

Calculation of NVP			
Year	B	Discount rate	6%
0	-8350	NVP	₹ 2,687.81
1	1000		
2	2050		
3	4000		
4	3050		
5	9000		
6	-6000		

Calculation of NVP			
Year	C	Discount rate	6%
0	-10600	NVP	₹ 2,966.75
1	2000		
2	2000		
3	6000		
4	2000		
5	2500		
6	2000		

When Discount Rate is 6%, Calculated NPV are :

A = ₹ 2,540.07

B = ₹ 2,687.81

C = ₹ 2,966.75

Conclusion: Project C is most preferable as it has highest NPV and Project A is least preferable as it has lowest NPV.

Calculation of NVP			
Year	A	Discount rate	9%
0	-8500	NVP	₹ 1,903.55
1	4500		
2	4000		
3	2000		
4	1000		
5	550		
6	500		

Calculation of NVP			
Year	B	Discount rate	9%
0	-8350	NVP	₹ 1,814.08
1	1000		
2	2050		
3	4000		
4	3050		
5	9000		
6	-6000		

Calculation of NVP			
Year	C	Discount rate	9%
0	-10600	NVP	₹ 1,785.54
1	2000		
2	2000		
3	6000		
4	2000		
5	2500		
6	2000		

When Discount Rate is 9%, Calculated NPV are :

A = ₹ 1,903.55
B = ₹ 1,814.08
C = ₹ 1,785.54

Conclusion: Project A is most preferable as it has highest NPV and Project C is least preferable as it has lowest NPV.

Calculation of NVP			
Year	A	Discount rate	11%
0	-8500	NVP	₹ 1,515.38
1	4500		
2	4000		
3	2000		
4	1000		
5	550		
6	500		

Calculation of NVP			
Year	B	Discount rate	11%
0	-8350	NVP	₹ 1,281.84
1	1000		
2	2050		
3	4000		
4	3050		
5	9000		
6	-6000		

Calculation of NVP			
Year	C	Discount rate	11%
0	-10600	NVP	₹ 1,082.57
1	2000		
2	2000		
3	6000		
4	2000		
5	2500		
6	2000		

When Discount Rate is 11%, Calculated NPV are :

A = ₹ 1,515.38

B = ₹ 1,281.84

C = ₹ 1,082.57

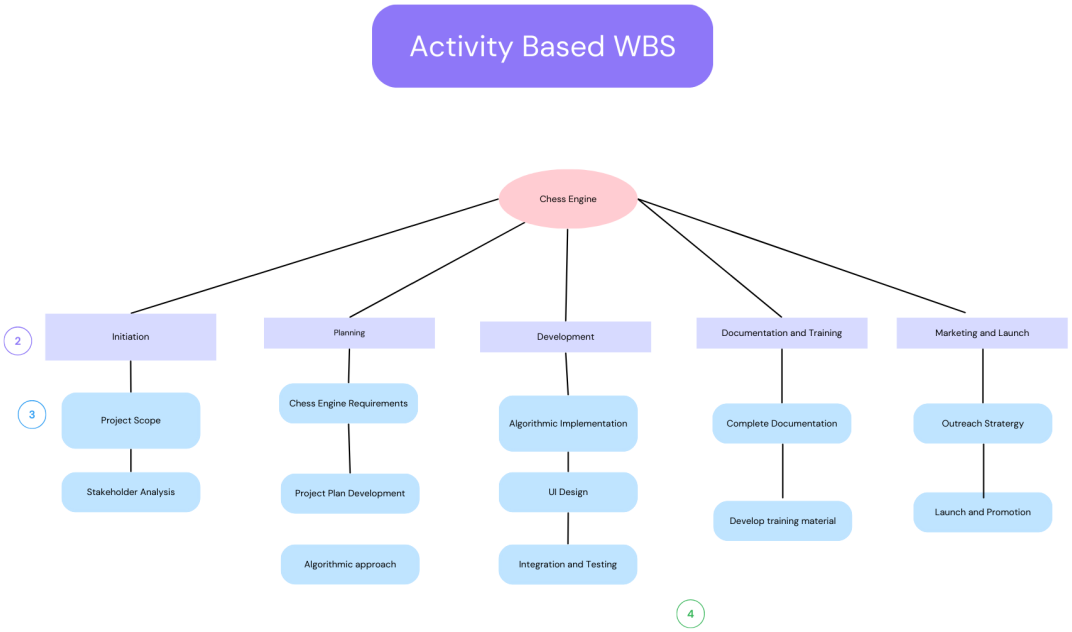
Conclusion: Project A is most preferable as it has highest NPV and Project C is least preferable as it has lowest NPV.

3. Explain Work breakdown (WBS) structure (within 50 words). Discuss different types of WBS. Create activity based WBS for your project.

Work Breakdown Structure (WBS): WBS is a hierarchical decomposition of a project into phases, deliverables, and work packages. It organizes project tasks in a visual and systematic way to facilitate planning, tracking, and control.

Types of WBS:

01. **Phase-Based WBS**: Organizes tasks by project phases.
02. **Deliverable-Based WBS**: Structures tasks around project deliverables.
03. **Organizational-Based WBS**: Groups tasks based on organizational units.
04. **Activity-Based WBS**: Breaks down tasks based on specific activities.



4. List all the activities of the project and allocate resources.

Activity No.	Activity Name	Duration (days)	Start Date	Finish Date	Predecessor	Resource Name
1.	Define Project Scope	5	16-01–2023	20-01-2023	-	Project Manager
2.	Stakeholder analysis	7	23-01-2023	31-01-2023	-	Business Analyst
3.	Chess Engine Requirements	14	01-02-2023	20-02-2023	1,2	Technical Team
4.	Algorithmic Approach	21	21-02-2023	21-03-2023	3	AI Team
5.	Plan Development	10	22-03-2023	04-04-2023	3	Project Manager
6.	UI Design	15	05-04-2023	25-04-2023	5	UI Designers
7.	Algorithm Implementation	30	22-03-2023	02-05-2023	4	Development Team
8.	Integration & Testing	20	03-05-2023	30-05-2023	6,7	QA Team
9.	Documentation	12	31-05-2023	15-06-2023	8	Technical Writers
10.	Training Material	14	31-05-2023	19-06-2023	8	Technical Team
11.	Outreach Strategy	10	20-06-2023	03-07-2023	9,10	Marketing Team
12.	Launch & Promotion	7	04-07-2023	12-07-2023	11	Project manager

5. Explain Gantt Chart (within 50 words). Draw gantt chart for your project.

Gantt Chart: A Gantt chart is a visual representation of a project schedule that illustrates tasks, durations, dependencies, and milestones over time. It provides a clear, chronological overview of project activities, aiding in planning, tracking progress, and managing resources.

Here's the Gantt Chart as per the timeline discussed in question 4 on the next page.

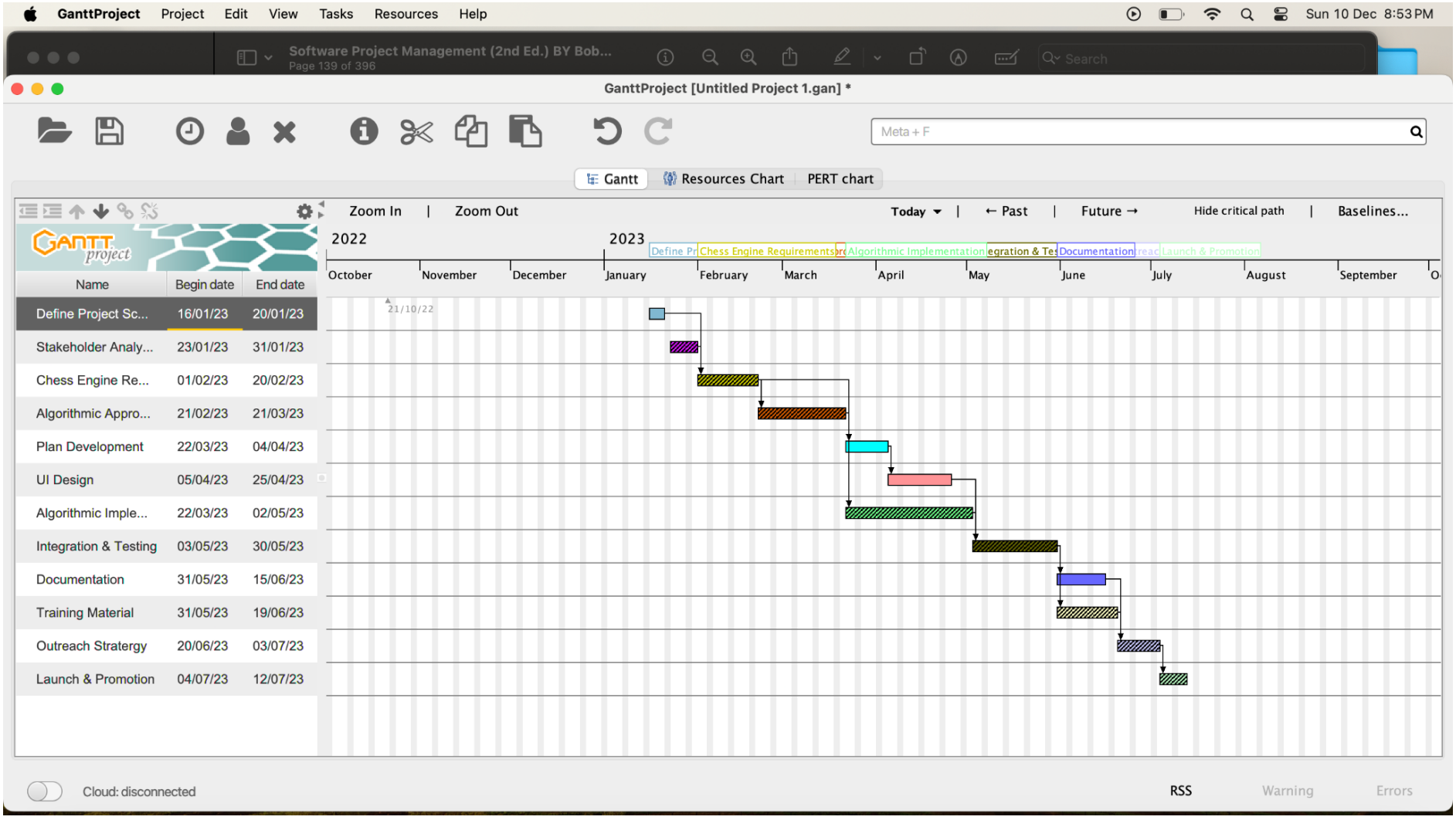


Figure 5.1

We have assumed the fact that weekends are holidays and there is no work done on those days with no in between holidays.

6.Explain network diagram and Critical Path Method (CPM). Draw network diagram for your project using MS Project.

ID	Task Mode	Task Name	Duration	Start	Finish	Predecessors	Resource Names
1		Define Project Scope	5 days	Mon 11-12-2	Fri 15-12-23		Project Manager
2		Stakeholder analysis	7 days	Mon 11-12-2	Tue 19-12-23		Business Analyst
3		Chess Engine Requirements	14 days	Wed 20-12-23	Mon 08-01-24	1,2	Technical Team
4		Algorithmic Approach	21 days	Tue 09-01-24	Tue 06-02-24	3	AI Team
5		Plan Development	10 days	Tue 09-01-24	Mon 22-01-2	3	Project Manager
6		UI Design	15 days	Tue 23-01-24	Mon 12-02-2	5	UI Designers
7		Algorithm Implementation	30 days	Wed 07-02-24	Tue 19-03-24	4	Development Team
8		Integration & Testing	20 days	Wed 20-03-2	Tue 16-04-24	6,7	QA Team
9		Documentation	12 days	Wed 17-04-2	Thu 02-05-24	8	Technical Writers
10		Training Material	14 days	Wed 17-04-2	Mon 06-05-2	8	Technical Team
11		Outreach Strategy	10 days	Tue 07-05-24	Mon 20-05-2	9,10	Marketing Team
12		Launch & Promotion	7 days	Tue 21-05-24	Wed 29-05-2	11	Project Manager

Dec '23

Figure 6.1

Due to issue in the software, we have made this table and diagram from the current date but with same duration.

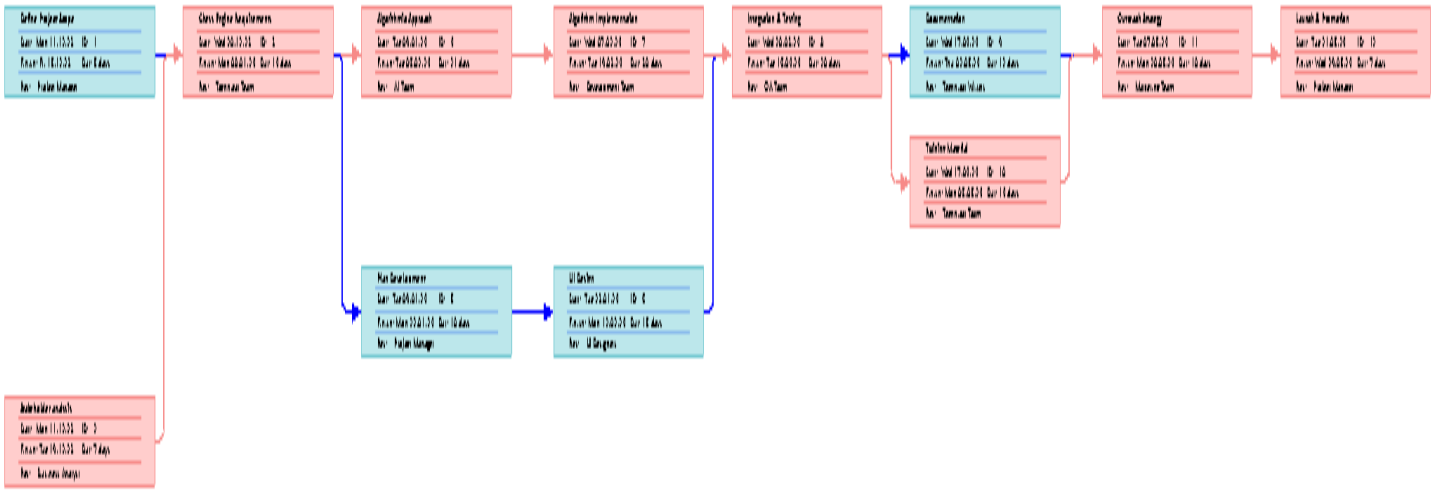


Figure-6.2

7. Draw "activity on node" diagram for your project. Draw precedence network, forward pass and backward pass. Determine early start (ES), latest start (LS), early finish (EF), latest finish (LF) and float for each activity and also calculate the project finish date. Find the critical path using CPM.

Network Diagram: A network diagram is a visual representation of project tasks and their relationships. It displays activities as nodes and depicts dependencies using arrows, creating a comprehensive overview of the project's flow and structure.

Critical Path Method (CPM): CPM is a project management technique that identifies the longest sequence of dependent activities, determining the minimum time required to complete a project. The critical path includes activities with zero slack, meaning any delay in these tasks will directly impact the project's overall duration.

Taks	Activity Name	Duration	Earliest Start	Latest Start	Earliest Finish	Latest Finish	Float
A	Define Project Scope	5	0	0	5	5	0
B	Stakeholder Analysis	7	0	0	7	7	0
C	Chess Engine Requirements	14	7	7	21	21	0
D	Algorithmic Approach	21	21	21	42	42	0
E	Plan Development	10	21	21	31	31	0
F	UI Design	15	31	31	46	46	0
G	Algorithmic Implementation	30	42	42	72	72	0
H	Integration & Testing	20	72	72	92	92	0
I	Documentation	12	92	92	104	104	0

J	Training Material	14	92	92	106	106	0
K	Outreach Strategy	10	106	106	116	116	0
L	Launch & Promotion	7	116	116	123	123	0

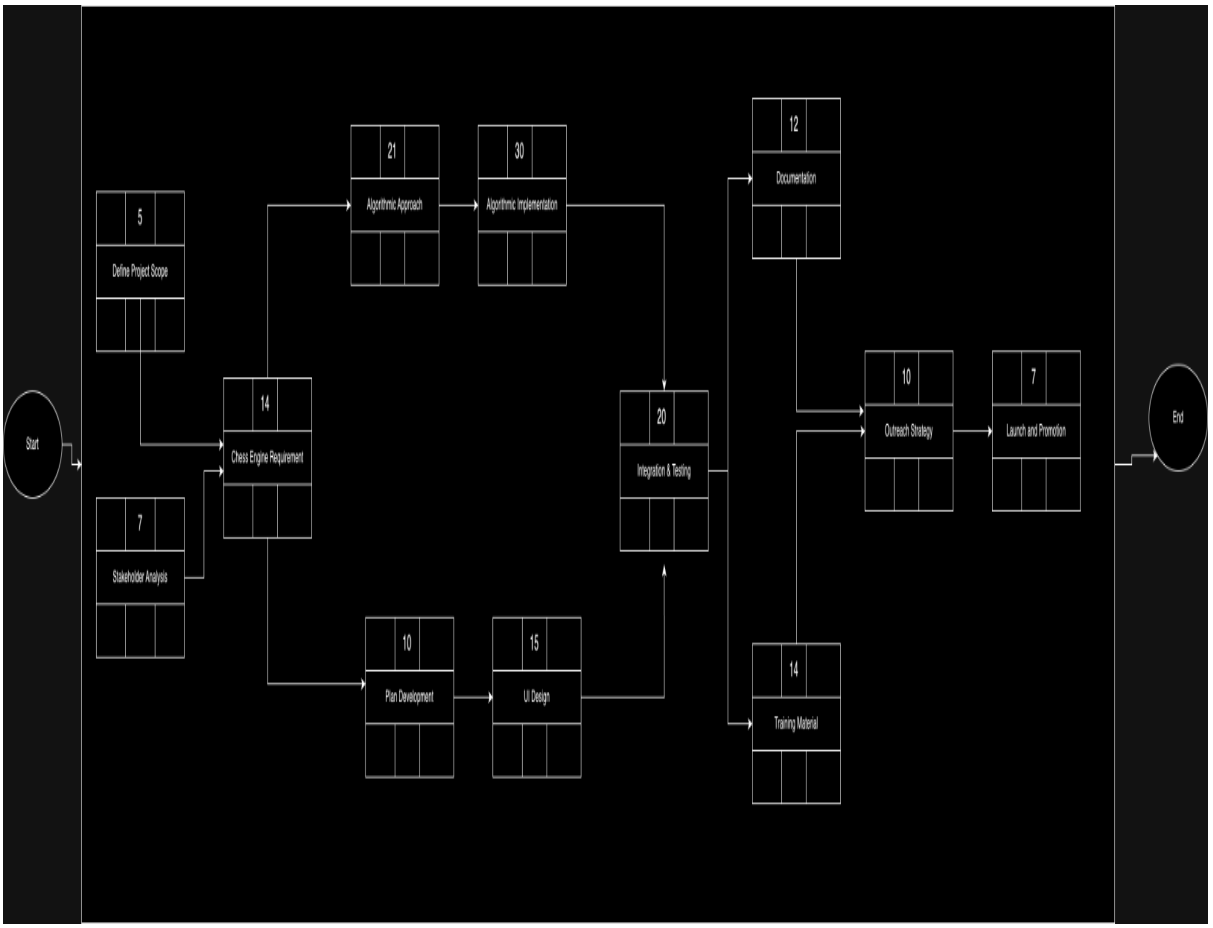


Figure- 7.1 Initial Network

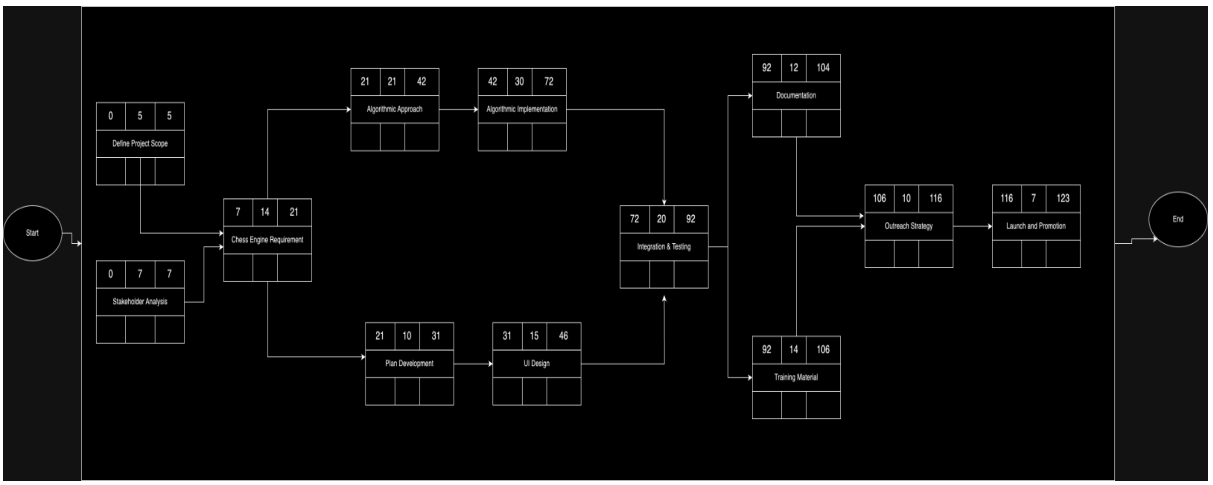


Figure :- 7. 2 Forward Pass

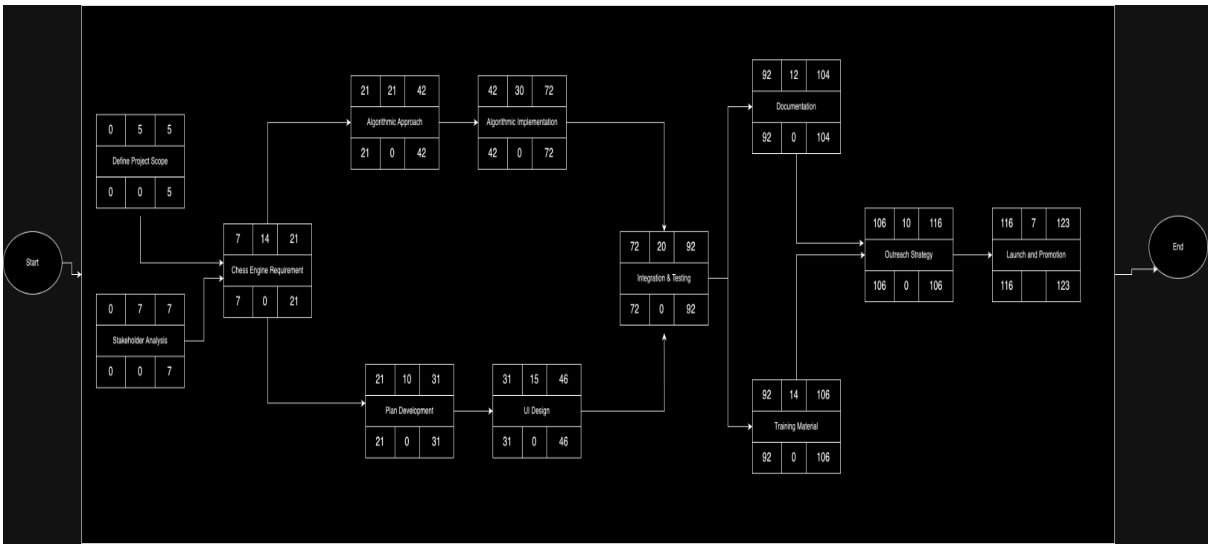


Figure :-7.3 Backward Pass

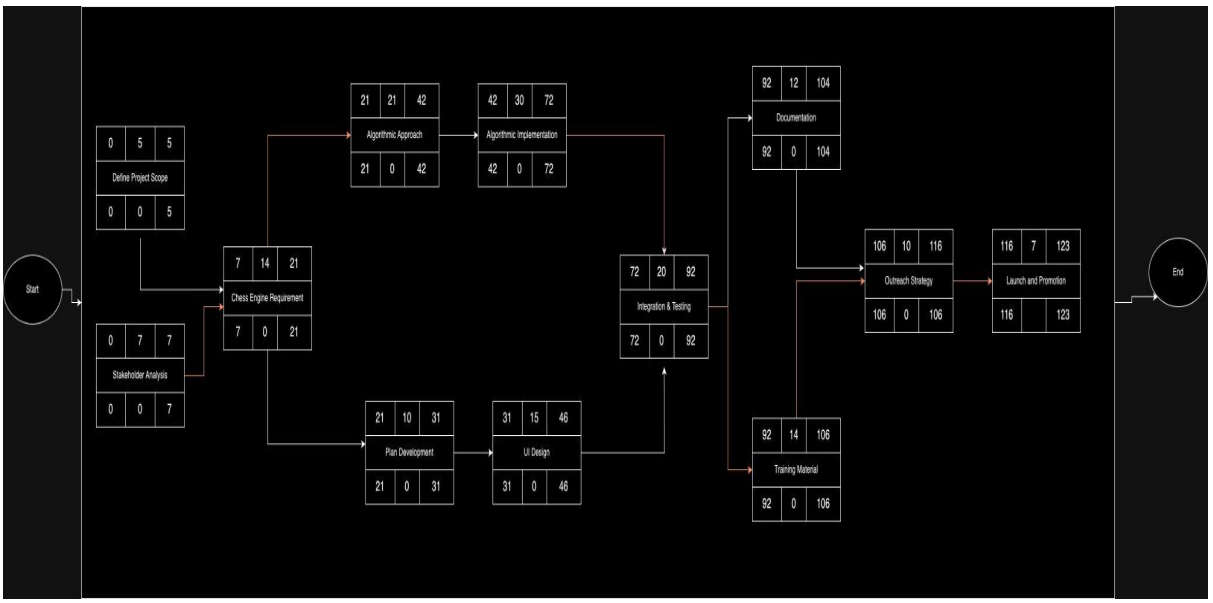


Figure :-7.4 CPM Network with critical path

Critical path is B->C->D->G->H->J->K->L

8. Draw an “activity on arrow” diagram for your project. Draw forward pass and backward pass. Determine earliest date (ED), latest date (LD) and slack for each activity and also calculate the project finish date. Find the critical path using CPM.

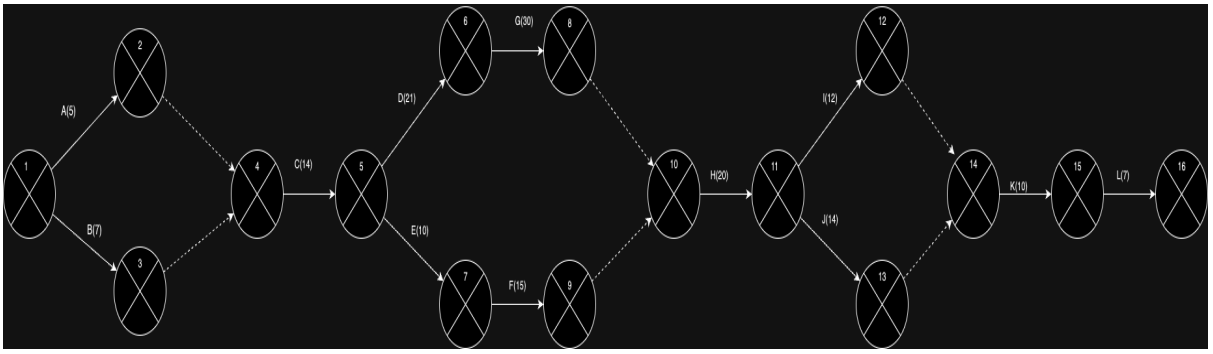


Fig :- 8.1 Initial Network

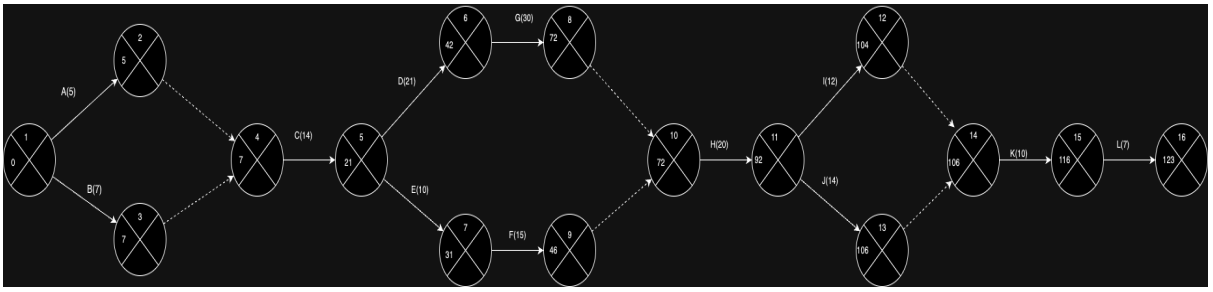


Fig 8.2 Forward Pass

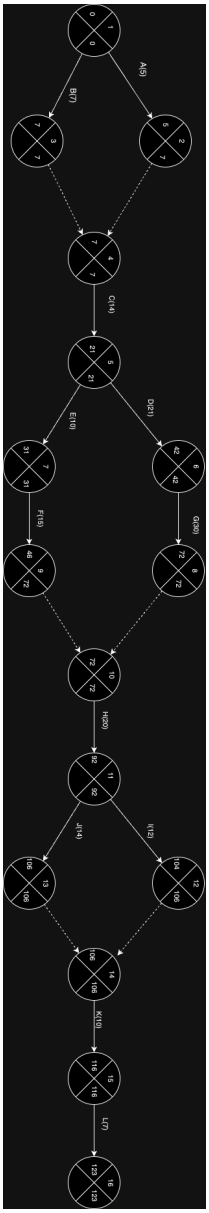


Figure :8.3 backward pass

9. Draw Gantt chart for the below project using "MS Project" software project management tool.

ID	Task Mode	Task Name	Duration	Start	Finish	Predecessors
1		Overall Design	1 wk	Mon 11-12-23	Fri 15-12-23	
2		Specify Module 1	1 wk	Wed 20-12-23	Tue 26-12-23	1
3		Specify Module 2	1 wk	Fri 29-12-23	Thu 04-01-24	2
4		Specify Module 3	1 wk	Tue 09-01-24	Mon 15-01-24	3
5		Copy Module 1	3 wks	Fri 29-12-23	Thu 18-01-24	2
6		Copy Module 3	3 wks	Thu 18-01-24	Wed 07-02-24	4
7		Copy Module 2	4 wks	Tue 09-01-24	Mon 05-02-24	3
8		Integration Testing	1 wk	Fri 16-02-24	Thu 22-02-24	6
9		System Testing	3 wks	Tue 27-02-24	Mon 18-03-24	8

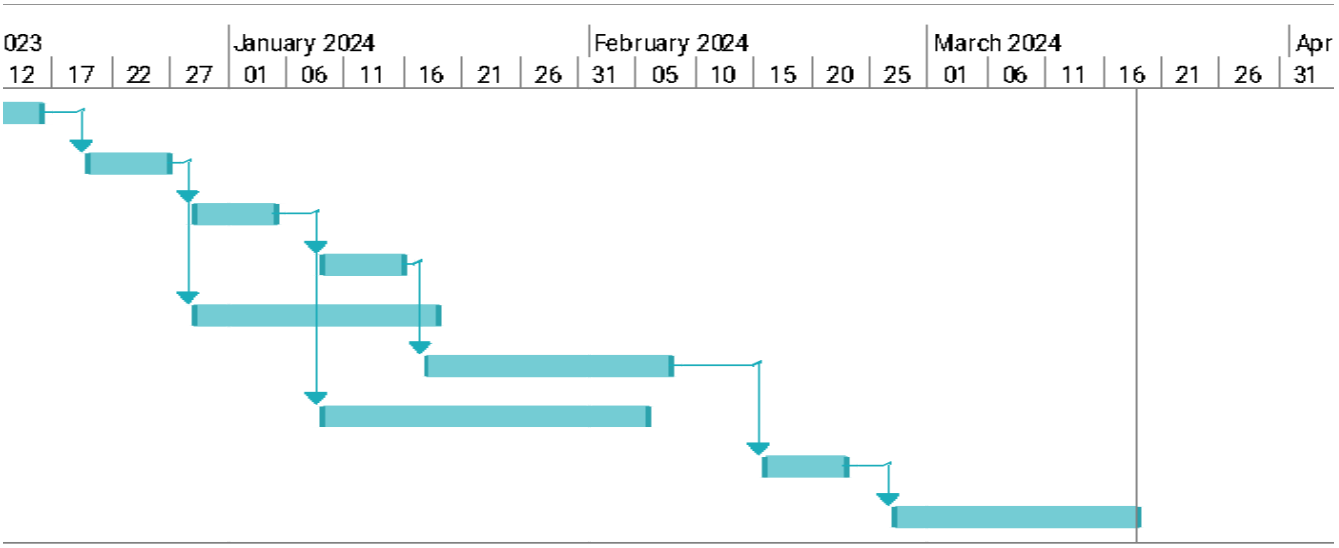


Figure :- 9.1(Gantt Chart)

10.Draw network diagram for the project given in practical 9 using "MS Project" software project management tool.

ID	Task Name	Duration	Start	Finish	Predecessors	Critical
1	Overall Design	1 wk	Mon 11-12-23	Fri 15-12-23		No
2	Specify Module 1	1 wk	Wed 20-12-23	Tue 26-12-23	1	No
3	Specify Module 2	1 wk	Fri 29-12-23	Thu 04-01-24	2	No
4	Specify Module 3	1 wk	Tue 09-01-24	Mon 15-01-24	3	No
5	Copy Module 1	3 wks	Fri 29-12-23	Thu 18-01-24	2	No
6	Copy Module 3	3 wks	Thu 18-01-24	Wed 07-02-24	4	No
7	Copy Module 2	4 wks	Tue 09-01-24	Mon 05-02-24	3	No
8	Integration Testing	1 wk	Fri 16-02-24	Thu 22-02-24	6	No
9	System Testing	3 wks	Tue 27-02-24	Mon 18-03-24	8	Yes

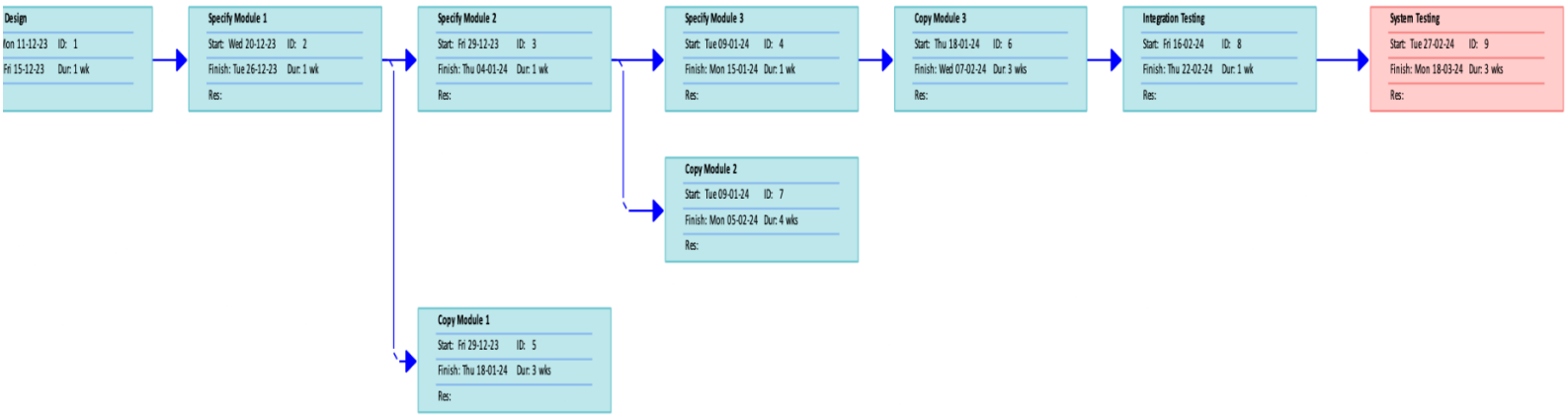


Figure : - 10.1(Network Diagram)

11. Draw activity on node for the project given in practical no 9. Draw forward pass and backward pass. Determine early start (ES), latest start (LS), early finish (EF), latest finish (LF) and float for each activity and also calculate the project finish date.

Tasks	Activity	Duration	Earliest Start Date	Latest Start Date	Earliest Finish Date	Latest Finish Date	Total Float
A	Overall Design	1	0	0	1	1	0
B	Specify Module 1	1	1	1	2	2	0
C	Specify Module 2	1	2	2	3	3	0
D	Specify Module 3	1	3	3	4	4	0
E	Code Module 1	3	2	8	5	11	6
F	Code Module 2	3	4	4	7	7	0
G	Code Module 3	4	3	7	7	11	4
H	Integration Testing	1	7	7	8	8	0
I	System Testing	3	8	8	11	11	0

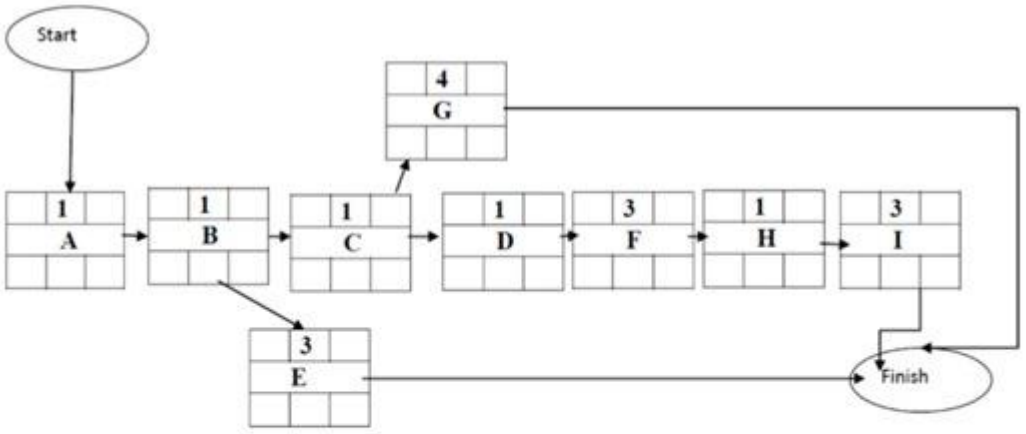


Figure :- 11.1 Initial Network

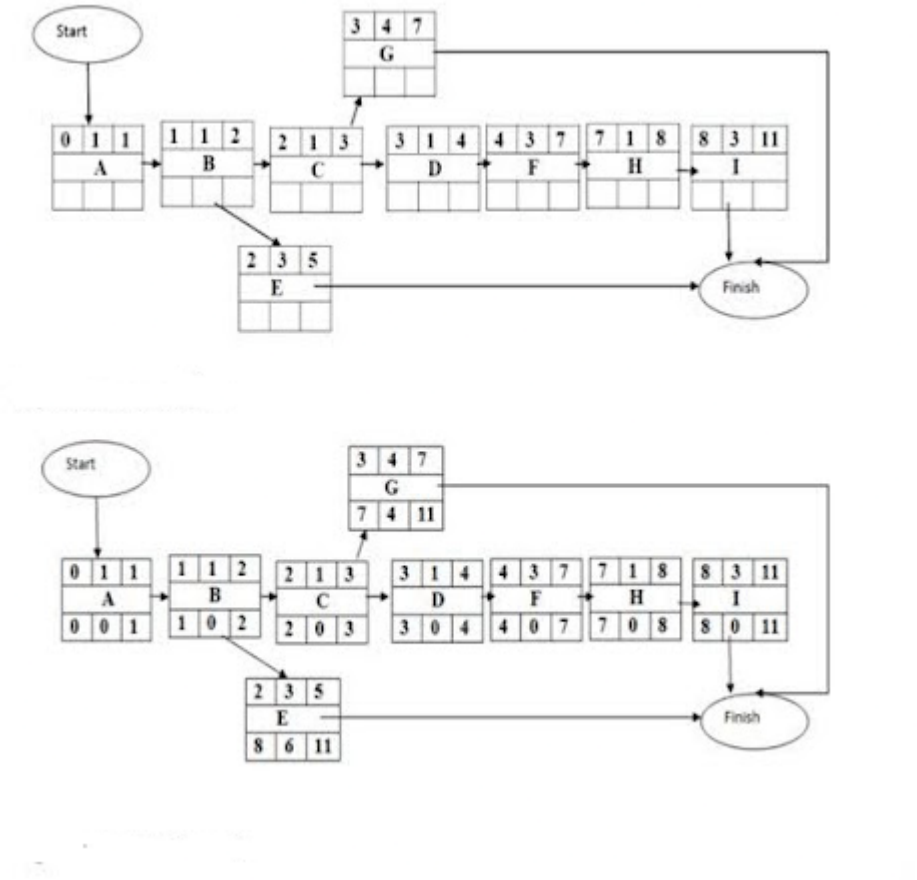


Figure 11.2 Forward Pass and Backward Pass

Fig 9.3: With Critical Path

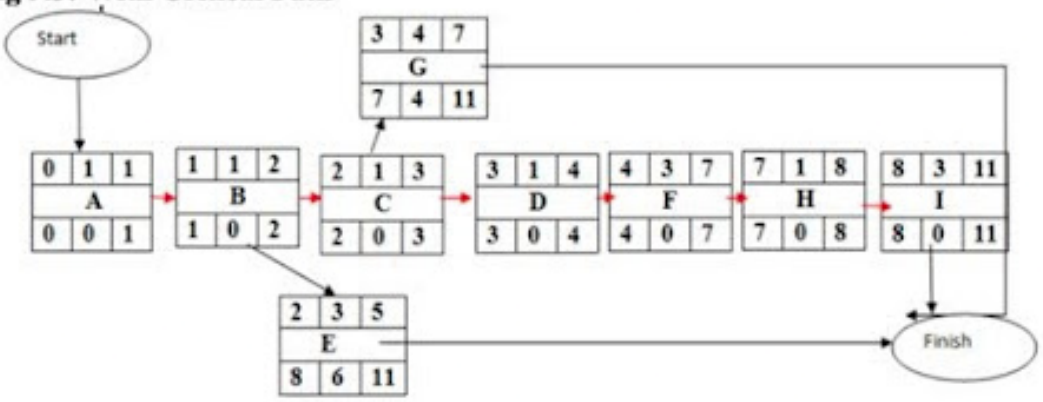


Figure 11.3 with critical path

Observation:

As in the table above, we observed the float value of some nodes was calculated to be zero, which actually indicates that these activities must be completed with the given target date otherwise, they will affect the entire network and therefore, they are depicted and included in critical path, as shown in the above diagram.

CRITICAL PATH:A,B,C,D,F,H,I

12. Explain the term Program Evaluation and Review Technique (PERT) (within 50 words). Using PERT, calculate standard deviation for each activity. Calculate z values for each event by taking some target date

Applying PERT:

Suppose while completing several activities of a project we discover many situations where a task in a project is taking longer than the planned, and also on the other hand, it some tasks are getting complete before the time, so in such situations we can apply a solution, where we need to compensate the uncertainties in order to complete our project within the target or due date.
And for performing such complicated job we need to employ a technique called **PERT** that is **Program Evaluation and Review Technique**.

This technique is quite similar to the CPM technique but, the difference is instead of using the single estimate for the duration of each task, PERT has three kinds of estimates

1. **Most Likely Time**
   It is the normal time to complete a particular task, denoted by m.
2. **Optimistic Time**
   It is the shortest time to complete a task, and is denoted by a.
3. **Pessimistic Time**
   It is the worst possible time to complete a task, denoted by b.

In PERT, these three estimates are combined together to derive out an **expected duration(t_e)**, which can calculated for each activity of our project,

$$t_e = \frac{a+4m+b}{6}$$

Using expected duration, we are then able to draw the forward pass through a network, and to illustrate forward pass we have used activity on arrow diagrams, and the same can be applied and demonstrated with the help of activity on node diagrams also.

Pert chart event labeling convention

Figure 12.1

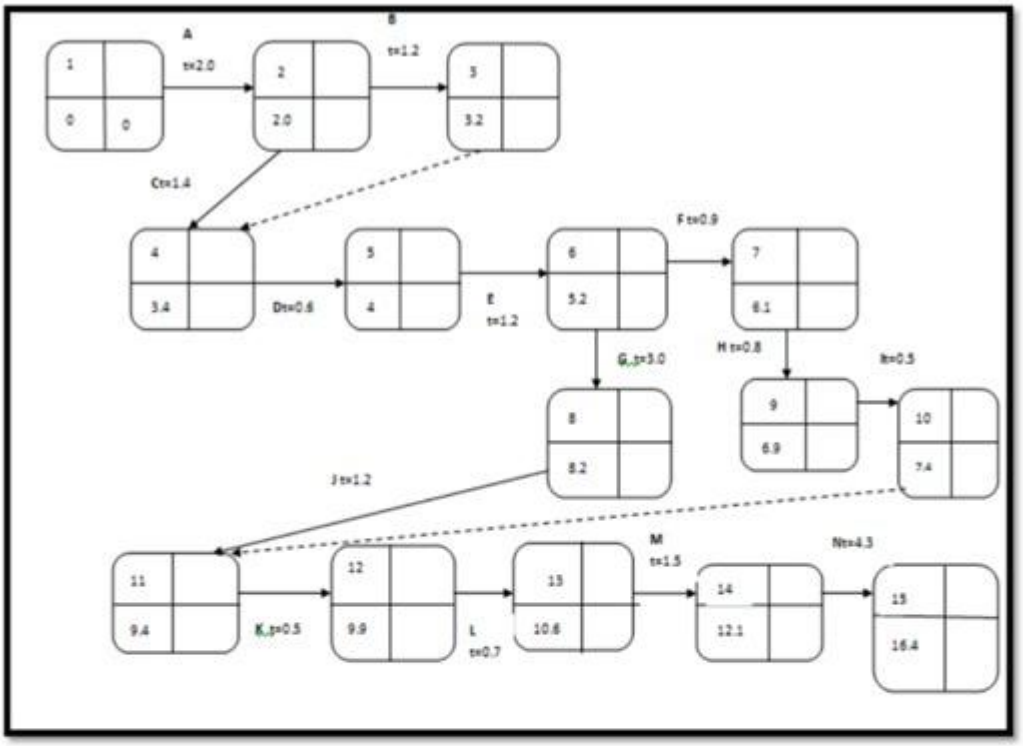


Fig:The PERT network after Forward Pass

After performing forward pass we now need to calculate the standard deviations for each activity, which is a quantitative measure of the degree of uncertainty of an activity duration estimate, denoted by 's'.

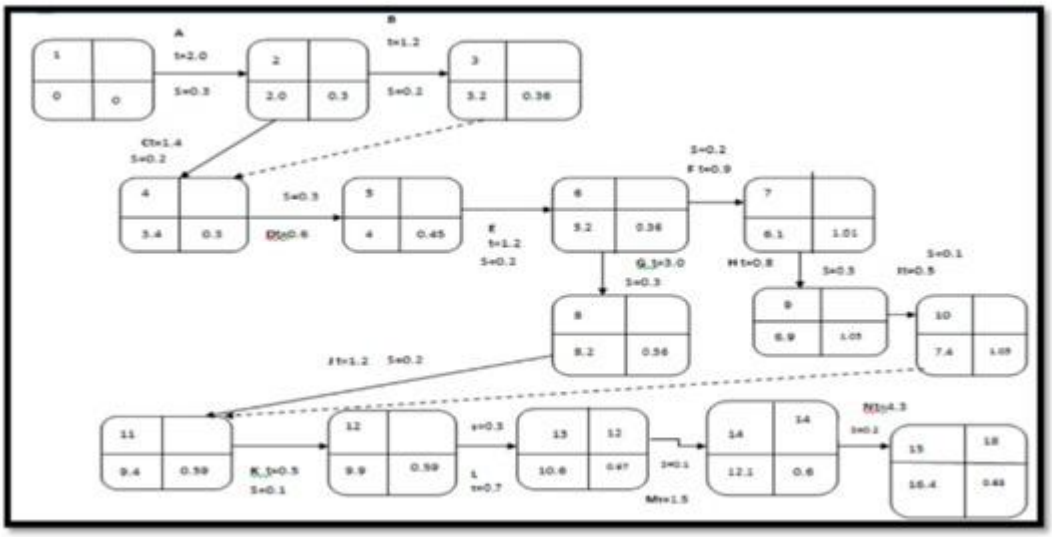
$$s = \frac{b-a}{6}$$

In the following table, we have calculated the expected values and standard deviation for each activities of our project,

Table 3: Calculation of Expected Value and Standard Deviation

Activity	Duration (v	a	m	b	EV	SD
A	2	1	2	3	2.0	0.3
B	1	1	1	2	1.2	0.2
C	1.3	1	1.3	2	1.4	0.2
D	0.28	0.28	0.28	2	0.6	0.3
E	1	1	1	2	1.2	0.2
F	0.7	0.7	0.7	2	0.9	0.2
G	3	2	3	4	3.0	0.3
H	0.5	0.5	0.5	2	0.8	0.3
I	0.4	0.3	0.4	1	0.5	0.1
J	1	1	1	2	1.2	0.2
K	0.4	0.2	0.4	1	0.5	0.1
L	0.5	0.3	0.5	2	0.7	0.3
M	1.4	1.3	1.4	2	1.5	0.1
N	4.2	4	4.2	5	4.3	0.2
	17.68				19.55	2.9

The main advantage of pert technique is that, it provides a facility for estimating the probability of meeting or missing the target dates, so there might be a single target date that is our project's completion date, but we can also set immediate targets, as done in the following diagram,



Now, after all this we will calculate the z-value for only those nodes for which we have set the target dates by applying the formula,

$$z = \frac{T - t_e}{s}$$

Here, the T is the target date.

The z-value is a test statistic for z-tests that measures the difference between an observed statistic and its hypothesized population parameter in units of the standard deviation.

In the above diagram we have target dates for the last activity N, and for the other two more activities that are occurring immediate before the last one, that are L and M.

for N,

z= (18 -16.4)/0.63=2.53

for M,

z=(14-12.1)/0.6=3.16

for L,

z=(12-10.6)/0.67=2.08

According to the probability graph of normal distribution, z value must lie within the range from -3.25 to 3.25, if the z-value lying within this range for the various activities or the entire project then our project is said to be an accepted one.