# CRITICAL PATH

## TIME CALCULATION

LOGO

# LEARNING OUTCOME

**At the end of this lesson, students will be able to:**

- **Understand the concept of Critical Path Method.**
- **Determine the forward and backward pass in a CPM diagram.**
- **Calculate Total and Free Floats.**
- **Determine the critical path for a CPM.**

# INTRODUCTION

- CPM is based on Activity on Arrow (AOA).
- In network schedule, we can determine the time of Early Start, Late Start, Early Finish, Late Finish and Float time by performing forward and backward path computation.
- By performing the forward and backward pass through every path of the schedule, critical path can be establish.

# Calculating Start & Finish Time

- **Network models permit the planner to calculate the total time that a project is projected to take and the times that each activity can and must start in order for the project to be completed in the estimated amount of time.**

# Important Terms :

- **Early Activity Start (ES)**
  - The earliest time that an activity can start as determined by the latest of the early finish times of all immediately preceding activities.

- **Early Activity Finish (EF)**
  - The earliest time that an activity can finish. It is determined by adding the duration of the activity to the early start of that activity.

# Important Terms :

- **Late activity finish (LF)**
  - The latest time that an activity can be finished without delaying the entire project completion. It is equal to the earliest of the late starts of the immediately succeeding activities.

- **Late Activity Start (LS)**
  - The latest time that an activity can start without delaying the project completion. It is determined by subtracting the duration from the late finish of the activity.

# Important Terms :

## Float / Slack

- **It is additional time available to complete an activity beyond the activity's work duration.**
- **Activities on critical path have no float.**
  - Types of float:
    - Total Float
    - Free Float

# Important Terms :

## Total Float

- Total time available to delay the start of an activity without changing the project duration.
- (LF-EF) or (LS-ES) of proceeding activity

## Free Float

- The time available to delay the start of the activity without interfering the early start time of the activities that follows.
- Free float (n)=minimum early start of all successor activities - early finish (n)
- ES proceeding activity – EF current activity

# Important Terms :

## Critical Path

- Represents the path which consist of all activities that have no float time.
- If any critical activities is delayed in their start or finish time, it will affect the overall completion time of the schedule.
- Can also be defined as activities that have the same early start and late start time and so did with the early finish and late finish time.

# Forward Pass

- Is used to find the least time required to complete the project and the earliest time an activity can be started according to the schedule that being developed.

- Made through the network, adding duration times to early start times of activities.

# Forward Pass

- **The earliest time each activity in the network can start and finish.**

- **Early finish (n) = Early start (n) + Duration (n)**

  **n = activity**

# Forward Pass

- If 2 or more activities terminate at a junction or node, pick the larger sum value as the early start time for the activities following.
- Early start and early finish time of project is determined by performing the forward pass computation.

# Forward Pass

| Node | Duration (Days) | ES | Forward Pass Computation | EF |
|---|---|---|---|---|
| 1-2 | 5 | 0 | 0+5=5 | 5 |
| 2-3 | 3 | 5 | 5+3=8 | 8 |
| 3-4 | 1 | 8 | 8+1=9 | 9 |
| 4-5 | 4 | 9 | 9+4=13 | 13 |

# Forward Pass

# Backward Pass Computation

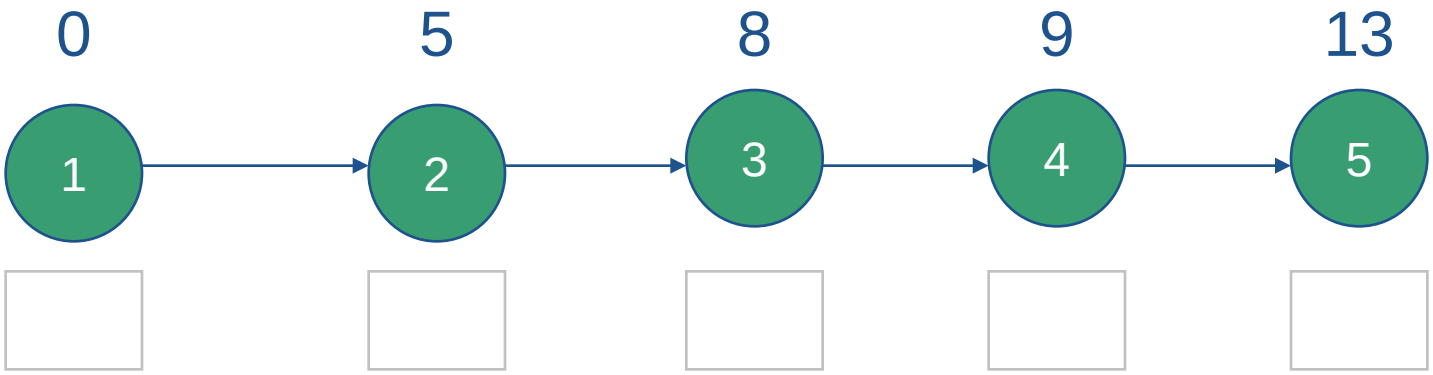
- **Calculated to find the value of latest time an activity may start (LS) or late finish (LF) time without affecting overall project schedule.**

- **Subtract duration times.**

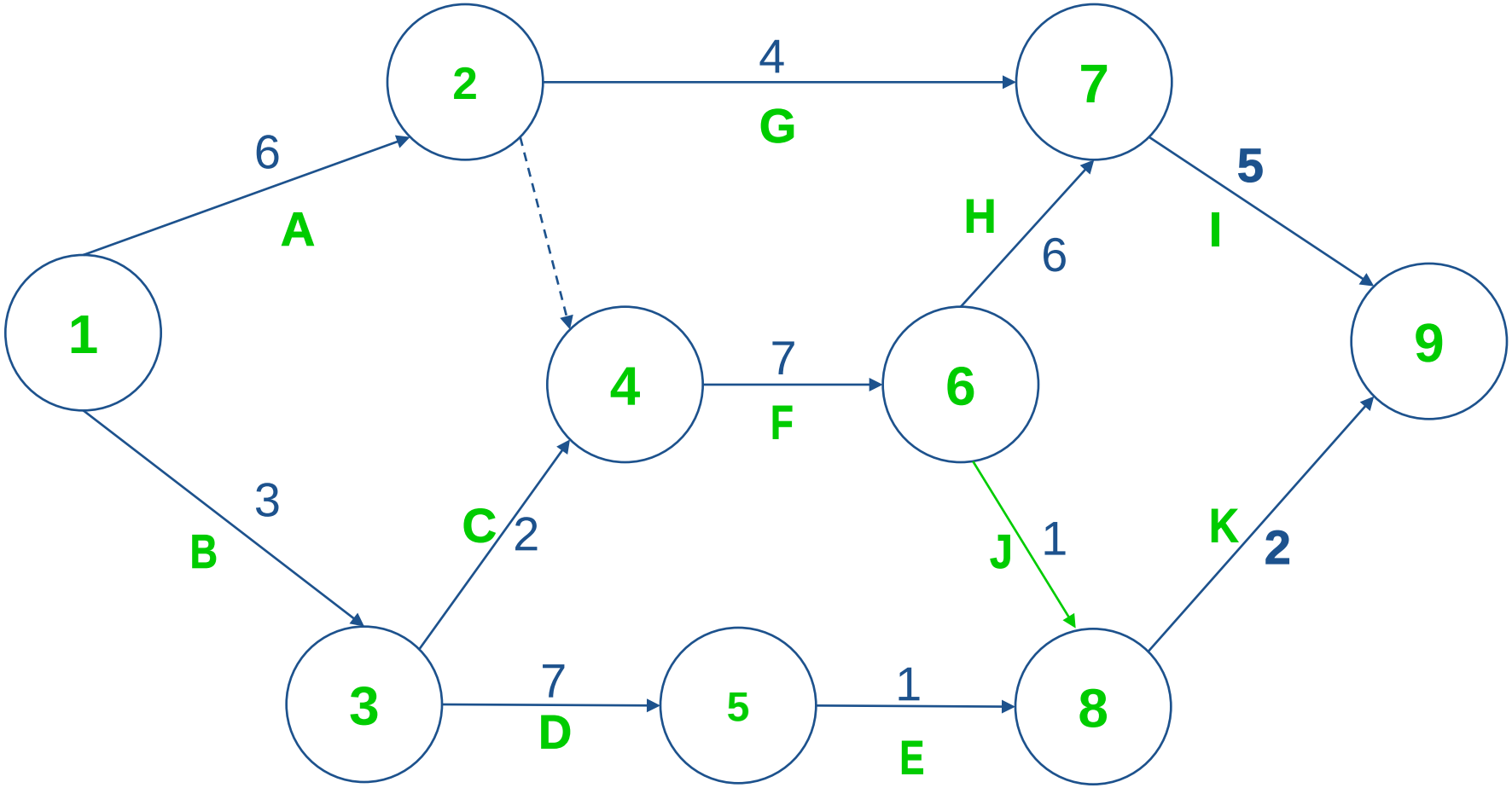
# Backward Pass

| Node | Duration (Days) | LF | Backward Pass Computation | LS |
|---|---|---|---|---|
| 5-4 | 4 | 13 | 13-4=9 | 9 |
| 4-3 | 1 | 9 | 9-1=8 | 8 |
| 3-2 | 3 | 8 | 8-3=5 | 5 |
| 2-1 | 5 | 5 | 5-5=0 | 0 |

# Backward Pass



# Calculate the ES, EF, LS & LF.



# Calculate the TF and FF

- TF = (LS-ES) or (LF-EF)

- FF = (ES of next activity – EF of current activity)

# EXERCISE 1

- Draw an arrow diagram that depicts the proper logic for the activities in Table 1.
- Calculate ES, EF, LS, LF, TF and FF for each activity in the diagram drawn.
- How long will it take for the project to complete?

# TABLE 1

| Activity | Predecessor | Duration |
|---|---|---|
| A | - | 1 |
| B | - | 2 |
| C | - | 2 |
| D | A | 2 |
| E | A,B | 1 |
| F | C | 1 |
| G | E,C | 4 |
| H | F | 3 |
| K | H | 2 |
| I | H | 2 |
| J | D | 2 |
| M | K,G,D | 3 |
| L | M,I,J | 3 |