Summary

- **Critical path** is the longest path through the project network; the activities on the path are the critical activities, therefore any delay in their completion must be avoided to prevent delay in project completion

- The objective of critical path analysis is to estimate the total project duration and to assign starting and finishing times to all activities involved in the project. This helps to check the actual progress against the schedule duration of the project

- The duration of individual activities may not be uniquely determined (in case of CPM) nor may involve the three time estimates (in case of PERT), out of which the expected duration of an activity is computed

- Having one this, the following factors should be known in order to prepare the project scheduling.
    1. Total completion time of the project
    2. Earlier and latest start time of each activity
    3. Critical activities and critical path
    4. Float for each activity, that is the amount of time by which the completion of a non-critical activity can be delayed, without delaying the total project completion time

- For calculating the earliest occurrence and latest allowable times of events the following two methods namely **forward pass method** and **backward pass method** are used

- **Forward pass method (for earliest event time):**
  In this method, calculations begin from the initial event 1, proceed through the events in an increasing order of event numbers and end at the final event, say N. At each event we calculate its earliest occurrence time (E) and earliest start and finish time for each activity that begins at that event. When calculations end at the final event N, its earliest occurrence time gives the earliest possible completion time of the entire project

- **Backward Pass Method (for latest allowable Event Time):**
  In this method calculations begin from the final event N. Proceed through the events in the decreasing order of event numbers and end at the initial event 1. At each event, we calculate the latest occurrence time (L) and latest finish and start time for each activity that is terminating at that event and this procedure continues till the initial event

- **Float (slack) of an Activity and Event:**
  The float (slack) or free time is the length of time in which a non-critical activity and/or an event can be delayed or extended without delaying the total project completion time

- **Slack of an Event:** the slack(s) also called float of an event is the difference between its latest occurrence time (L_i) and its earliest occurrence time (E_i). That is: Event float is equal to L_i minus E_i. It is a measure of how long an event can be delayed without increasing the project completion time. (a) if $L = E$ for certain events, then such events are called critical events. (b) if $L \neq E$ for certain events, then the slack on these events can be negative ($L<E$) or positive ($L > E$)

- **Slack of an activity:** It is the amount of time that an activity can be delayed without delaying project completion; it is calculated as the difference between the latest finish time and the earliest finish time for the activity. In other words the computation of activity floats tell us how long an activity time may be increased without increasing the project completion time. Mainly three types of floats are defined for each non-critical activity of the project

- **Total float:** This the length of time by which an activity can be delayed when all preceding activities are completed at their earliest possible time and all successor activities can be delayed until their latest permissible time. The time within which an activity must be scheduled is computed from L_S and E_S values for each activity's start event and end event

- That is, for each activity (I, j) the total float is equal to the latest allowable time for the event at the end of the activity minus the earliest time for an event at the beginning of the activity minus the activity duration. That is total float (TF_{ij}) = (Lj – Ei) $–t_{ij}$ = LS_{ij} – ES_{ij} = LF_{ij} – EF_{ij}

- **Free float:** For calculating the total float, only a particular activity was considered with respect to its tail and head event occurrence times or by considering latest start and finish time of an activity with respect to its earliest start and finish time. However, we may need to know how much an activity's completion time may be delayed without causing any delay in its immediate successor activities. Thus the free float of a non-critical activity is defined as the time by which the completion of an activity can be delayed without causing any delay in its immediate succeeding activities. Free float values for each activity (I, j) are computed as follows: Free float (FF_{ij}) = (E_j $–E_i$) – t_{ij} = Min { ES_{ij}, for all immediate successors of activity (I, j)} – EF_{ij}

- **Independent float:** This is the amount of acceptable delay in the completion of an activity so that it neither affects its predecessor nor the successor activities. Thus, independent float is the amount of time available when preceding activities are completed at their latest permissible times and all the following activities can still be completed at their earliest possible time. Independent float values for each activity are computed as follows: independent float (IF_{ij}) = (E_j – L_i) – tij = {ES_{ij} – LS_{ij}} – t_{ij}. The negative value of independent float is considered to be zero