Project Time Management: Critical Path Analysis

Project Time Management Processes

- **Activity definition**: Identifying the specific activities that the project team members and stakeholders must perform to produce the project deliverables.
- **Activity sequencing**: Identifying and documenting the relationships between project activities.
- **Activity resource estimating**: Estimating how many resources a project team should use to perform project activities.
- **Activity duration estimating**: Estimating the number of work periods that are needed to complete individual activities.
- **Schedule development**: Analyzing activity sequences, activity resource estimates, and activity duration estimates to create the project schedule.
- **Schedule control**: Controlling and managing changes to the project schedule.

Activity Definition

- An **activity** or **task** is an element of work normally found on the WBS that has an expected duration, a cost, and resource requirements.
- Project schedules grow out of the basic documents that initiate a project.
  - The project charter includes start and end dates and budget information.
  - The scope statement and WBS help define what will be done.
- Activity definition involves developing a more detailed WBS and supporting explanations to understand all the work to be done, so you can develop realistic cost and duration estimates.

work breakdown strucuture

Activity Lists and Attributes

- An **activity list** is a tabulation of activities to be included on a project schedule. The list should include:
  - The activity name
  - An activity identifier or number
  - A brief description of the activity
- **Activity attributes** provide more information about each activity, such as predecessors, successors, logical relationships, leads and lags, resource requirements, constraints, imposed dates, and assumptions related to the activity.

Milestones

- A **milestone** is a significant event that normally has no duration.
- It often takes several activities and a lot of work to complete a milestone.
- Milestones are useful tools for setting schedule goals and monitoring progress.
- Examples include completion and customer sign-off on key documents and completion of specific products.

Activity Sequencing

- Involves reviewing activities and determining dependencies.
- A **dependency** or **relationship** relates to the sequencing of project activities or tasks.
- You *must* determine dependencies in order to use critical path analysis.

Critical Path Analysis

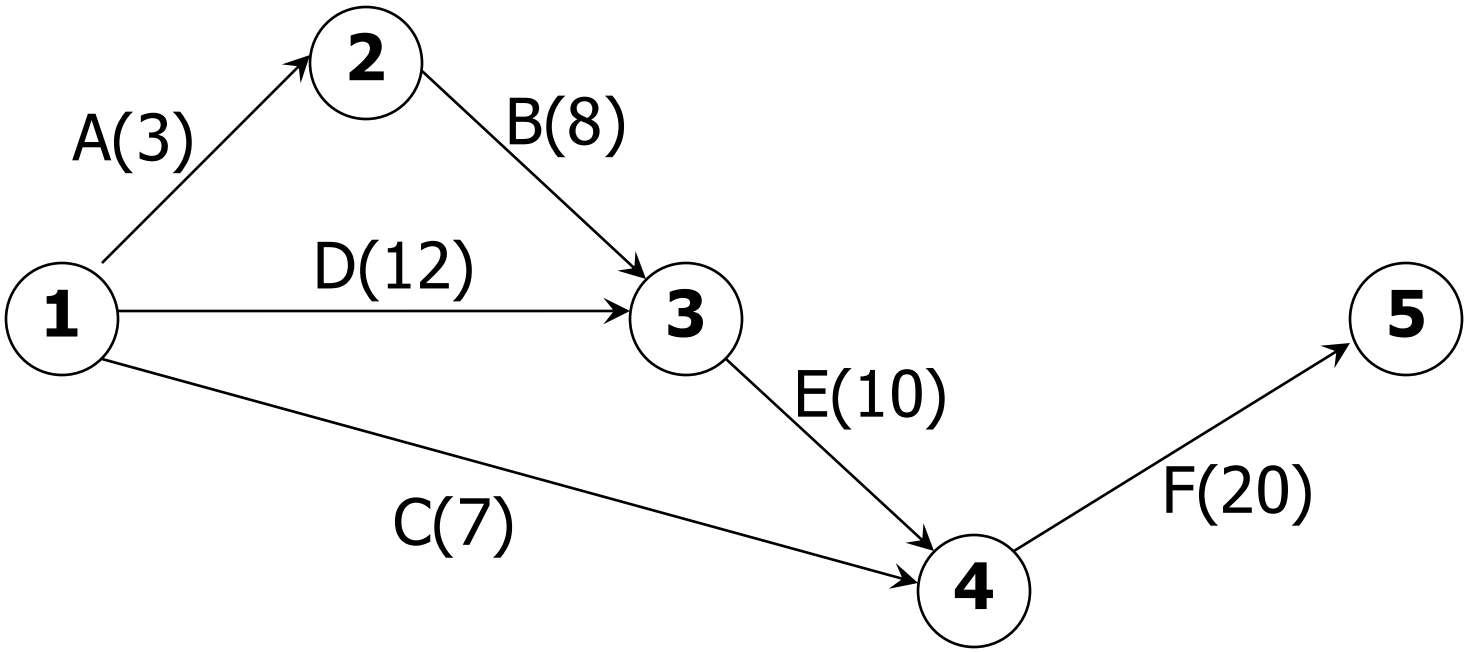
	Activity		**duration**
	Shower		3
	Dry hair		8
	Fetch car		7
	Iron clothes		12
	Dress and make-up		10
	Drive to interview		20

Precedence table

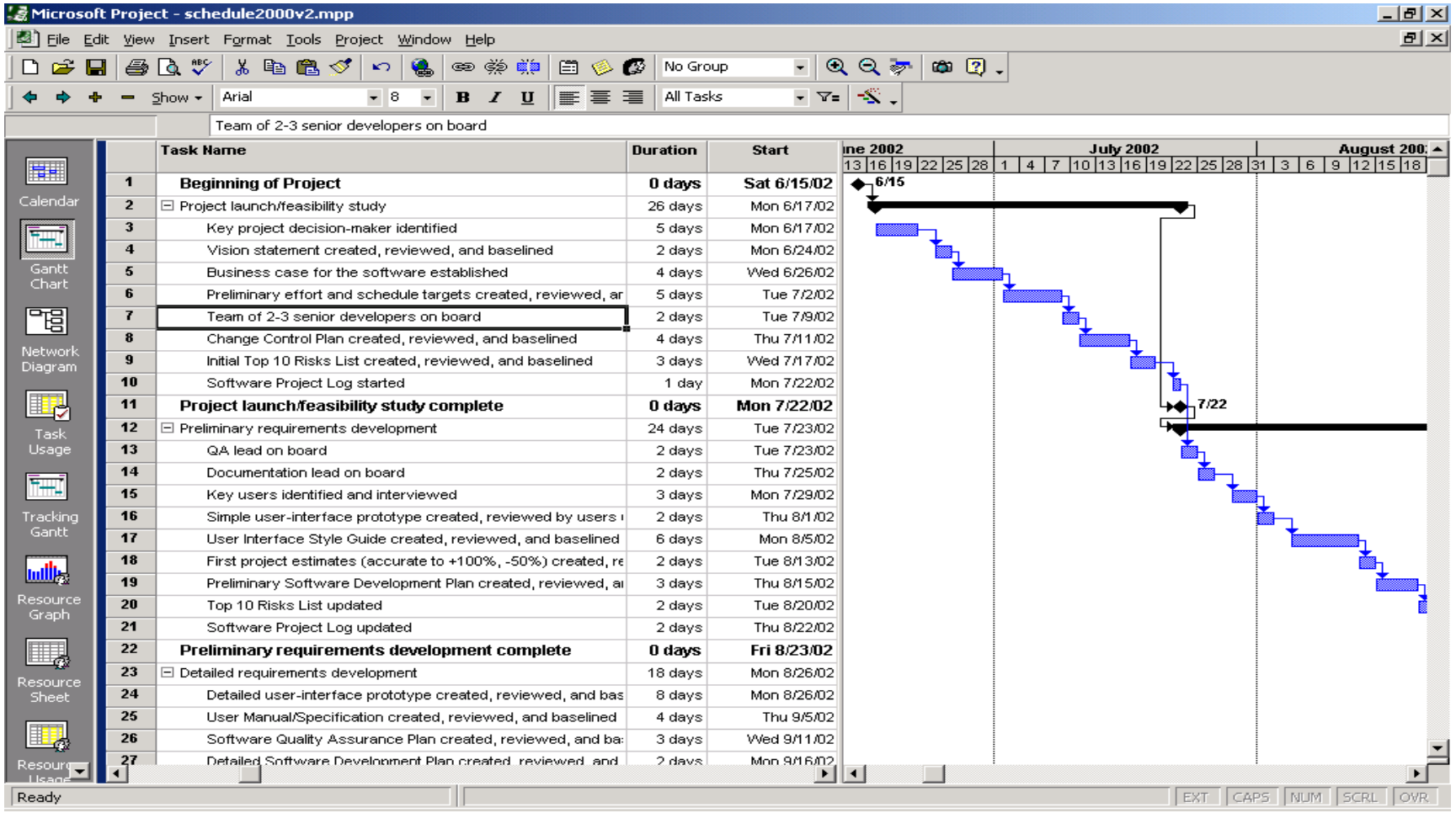
The last activities that must be completed before an activity can begin

	Activity	Immediately preceding activities	duration
A	Shower	-	3
B	Dry hair	A	8
C	Fetch car	-	7
D	Iron clothes	-	12
E	Dress and make-up	B,D	10
F	Drive to interview	C,E	20

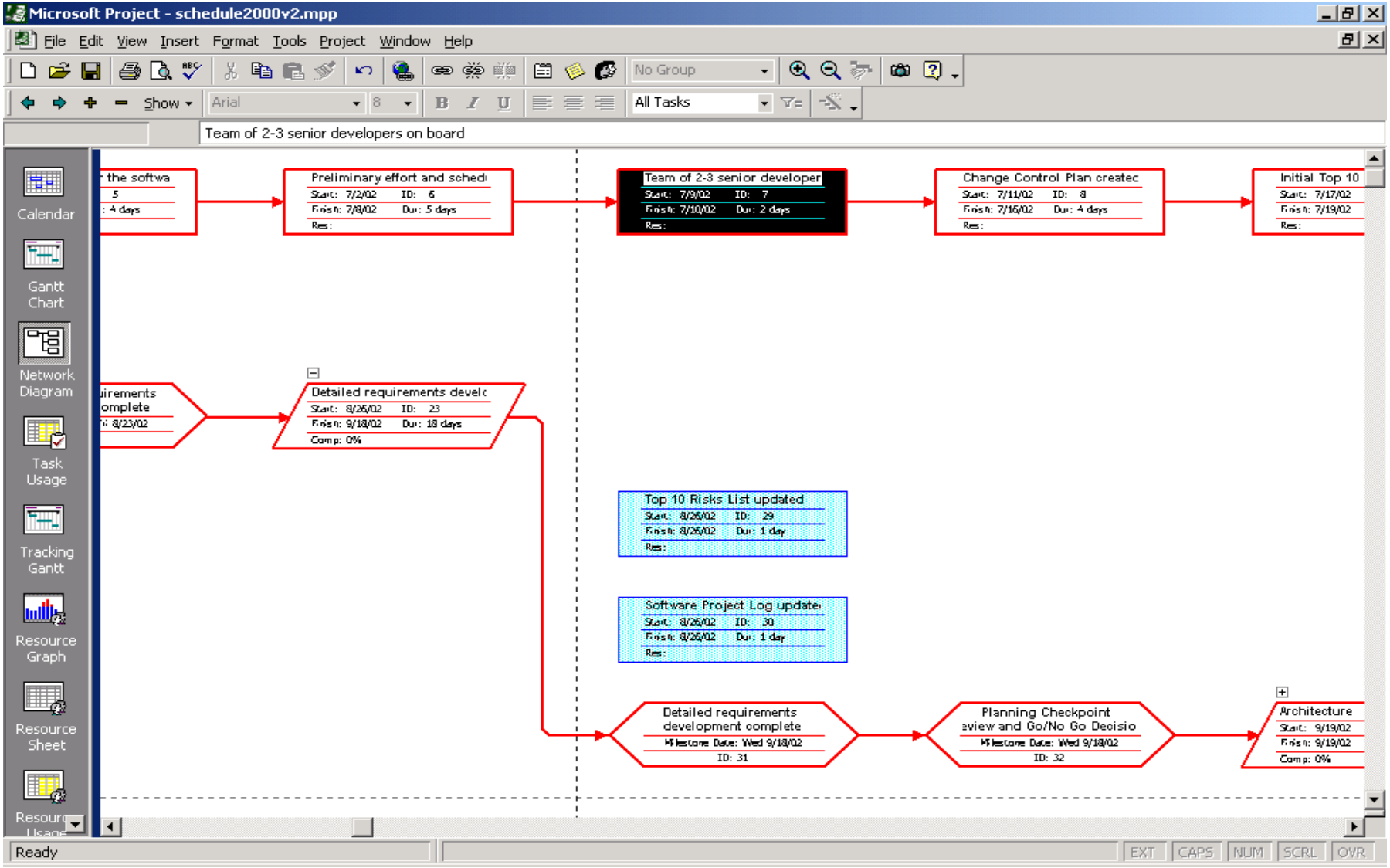
Activity on Arc Network



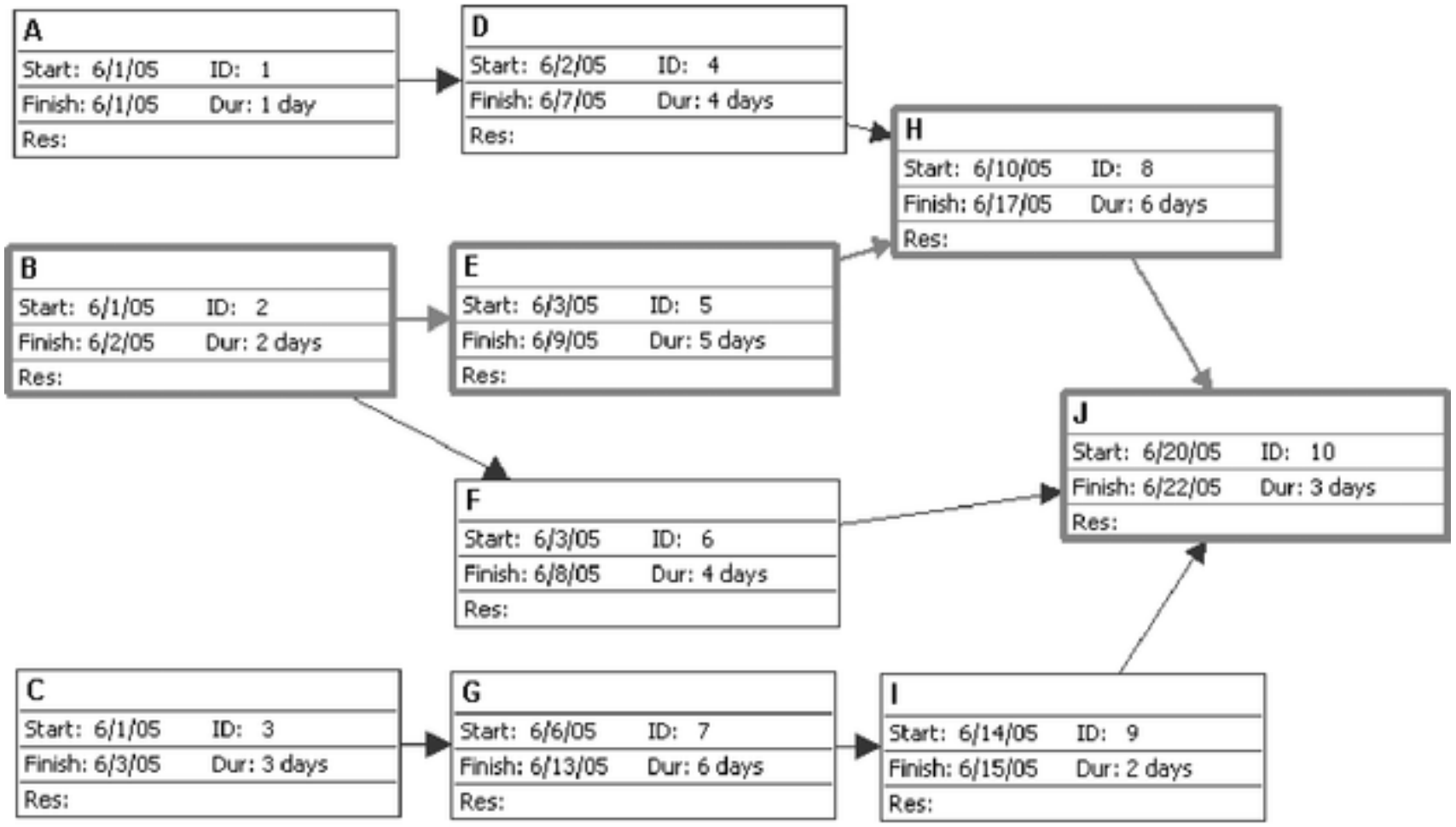
Microsoft Project Example



Microsoft Project Example



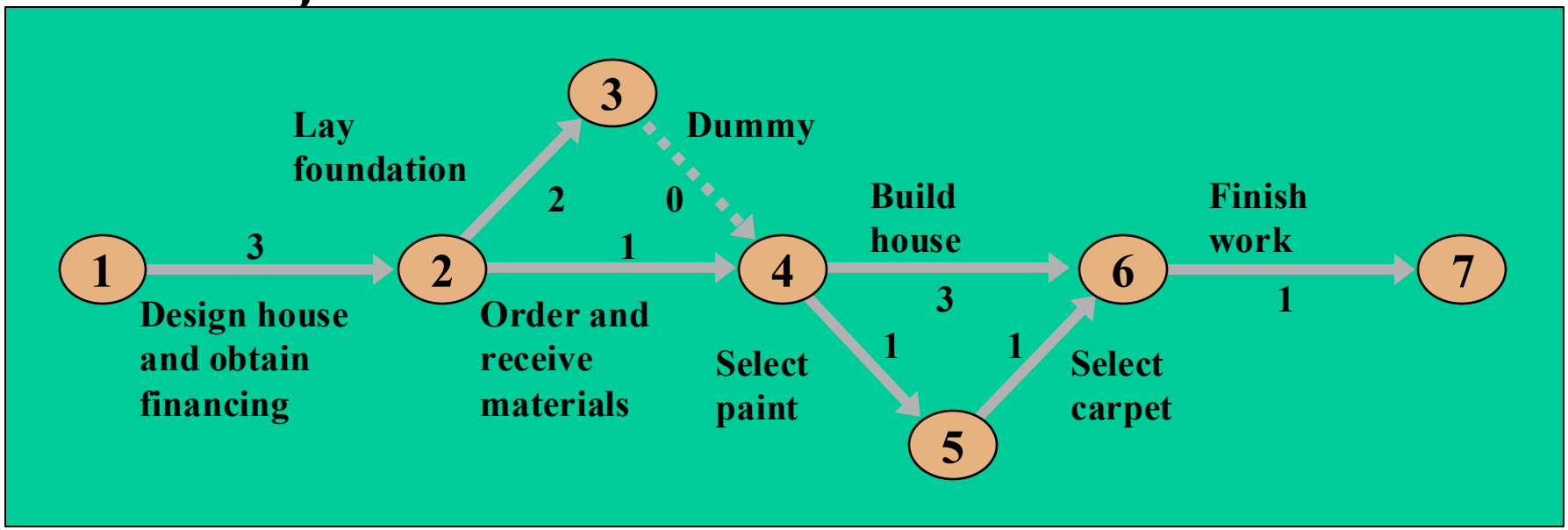
Sample Network Diagram



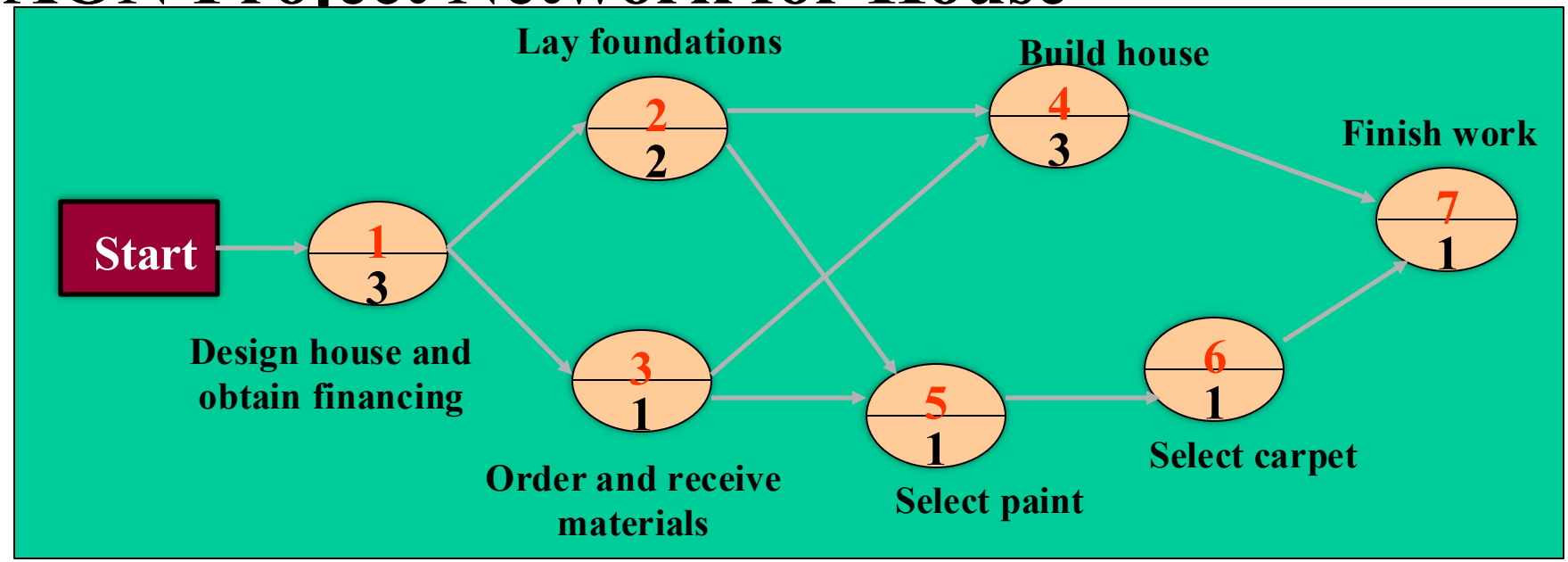
Network Diagrams

- **AOA** consists of
  - Circles representing Events
    - Such as ‘start’ or ‘end’ of a given task
  - Lines representing Tasks
    - Thing being done ‘Build UI’
  - **a.k.a. Arrow Diagramming Method (ADM)**
- **AON**
  - Tasks on Nodes
    - Nodes can be circles or rectangles (usually latter)
    - Task information written on node
  - Arrows are dependencies between tasks
  - **a.k.a. Precedence Diagramming Method (PDM)**

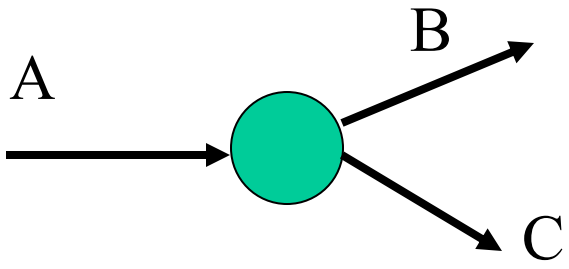
AOA Project Network for House



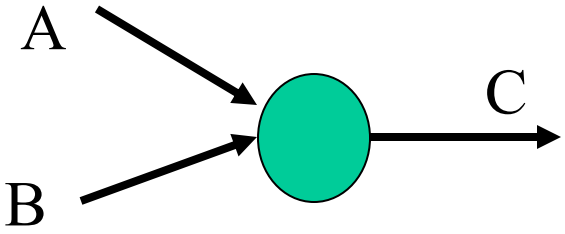
AON Project Network for House



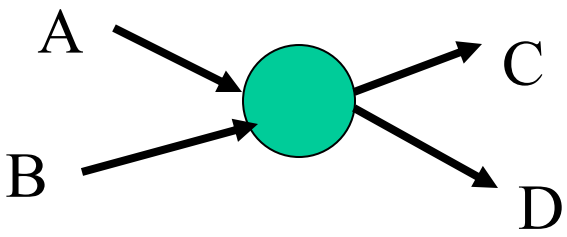
Situations in network diagram



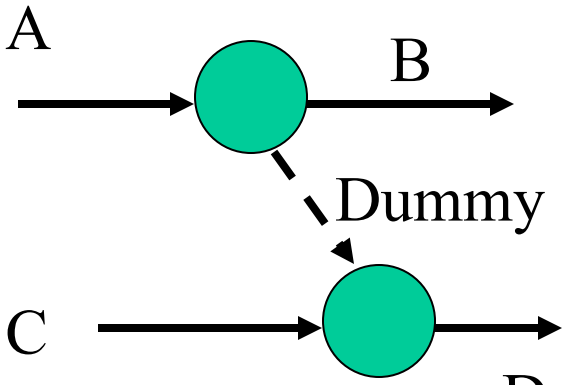
A must finish before either B or C can start



both A and B must finish before C can start



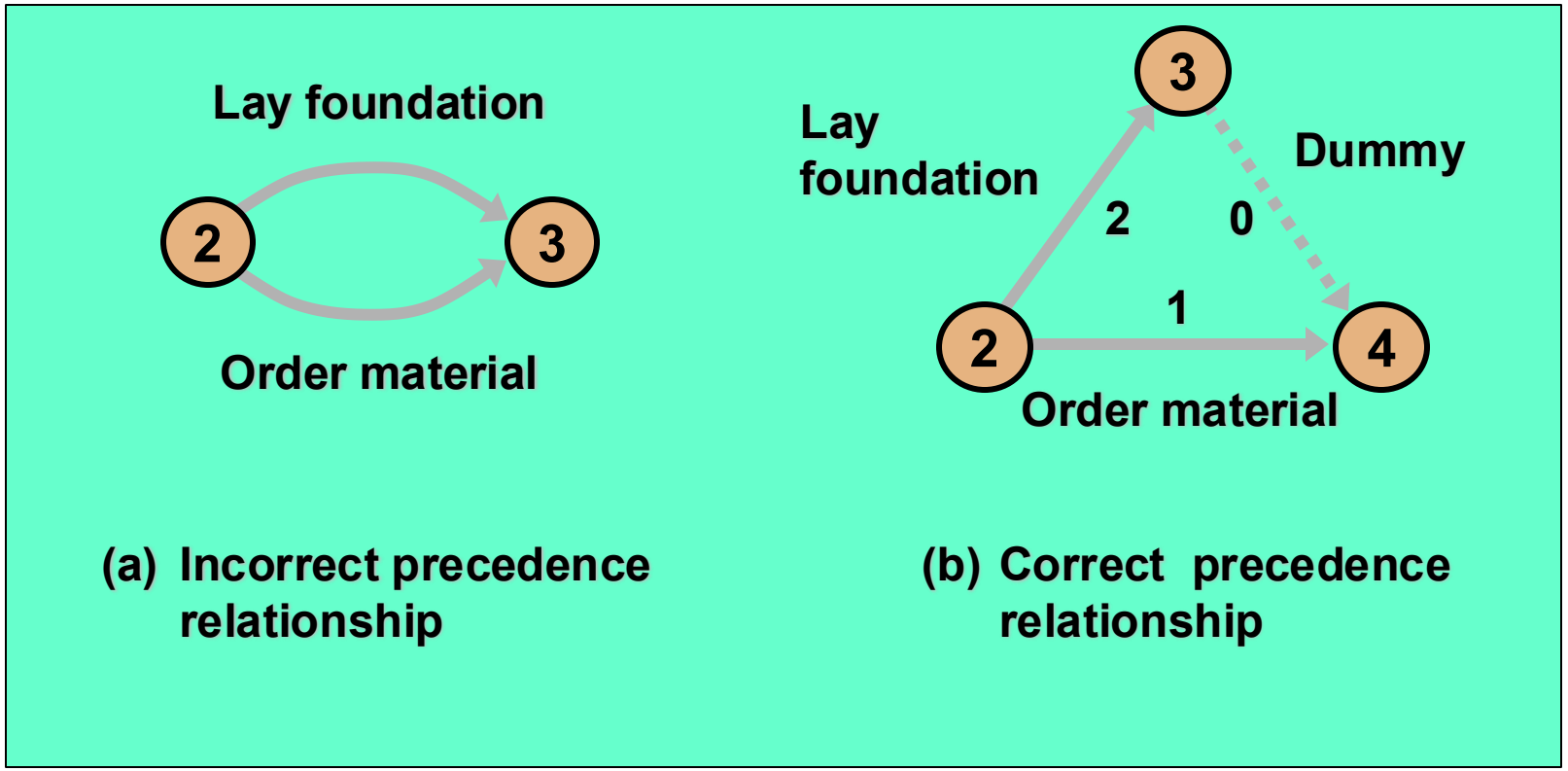
both A and B must finish before either of C or D can start



A must finish before B can start

both A and C must finish before D can start

Concurrent Activities



Critical Path Method (CPM)

- **CPM** is a network diagramming technique used to predict total project duration.
- A **critical path** for a project is the series of activities that determines the *earliest time* by which the project can be completed.
- The critical path is the *longest path* through the network diagram and has the least amount of slack or float.
- **Slack** or **float** is the amount of time an activity can be delayed without delaying a succeeding activity or the project finish date.

Forward Pass

Earliest Start Time (ES)

earliest time an activity can start

ES = maximum EF of immediate predecessors

Earliest finish time (EF)

earliest time an activity can finish

earliest start time plus activity time

$$EF = ES + t$$

Backward Pass

- Latest Start Time (LS)

  Latest time an activity can start without delaying critical path time

  $$LS = LF - t$$

- Latest finish time (LF)

  latest time an activity can be completed without delaying critical path time

  LS = minimum LS of immediate predecessors

CPM analysis

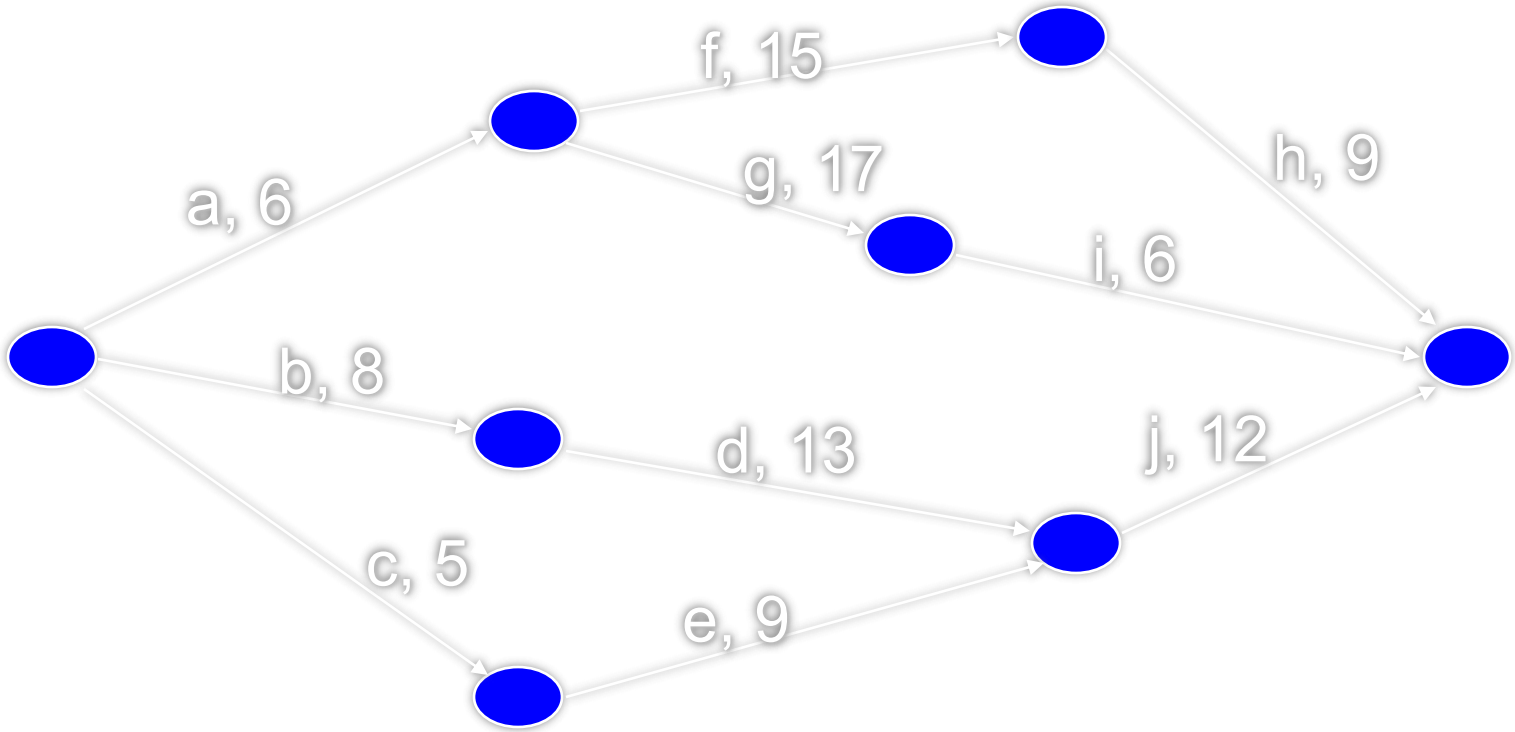
- Draw the CPM network
- Analyze the paths through the network
- Determine the float for each activity
  - Compute the activity's float

    $$\text{float} = LS - ES = LF - EF$$

  - Float is the maximum amount of time that this activity can be delay in its completion before it becomes a critical activity, i.e., delays completion of the project
- Find the critical path is that the sequence of activities and events where there is no "slack" i.e.. Zero slack
  - Longest path through a network
- Find the project duration is minimum project completion time

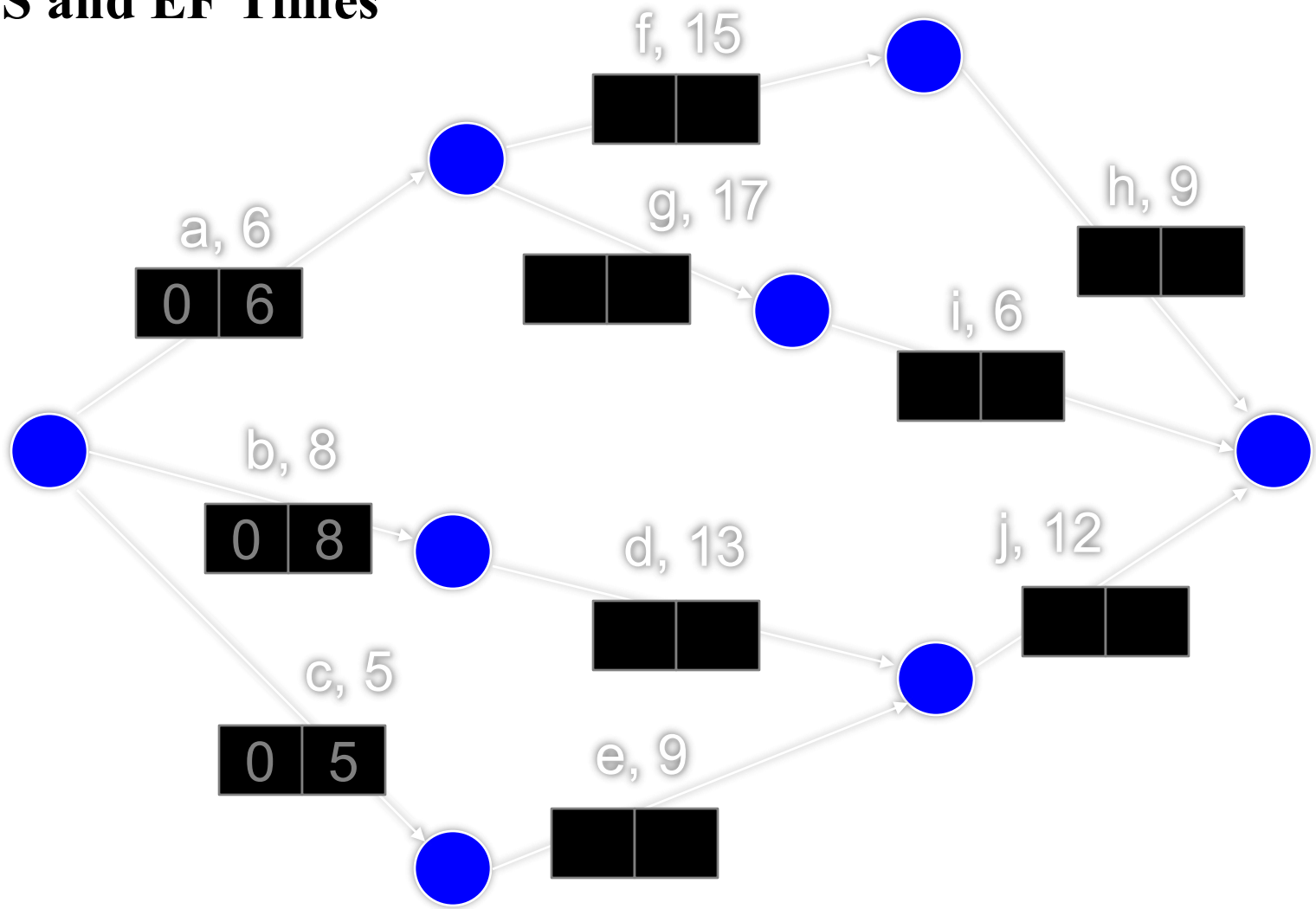
CPM Example:

- **CPM Network**



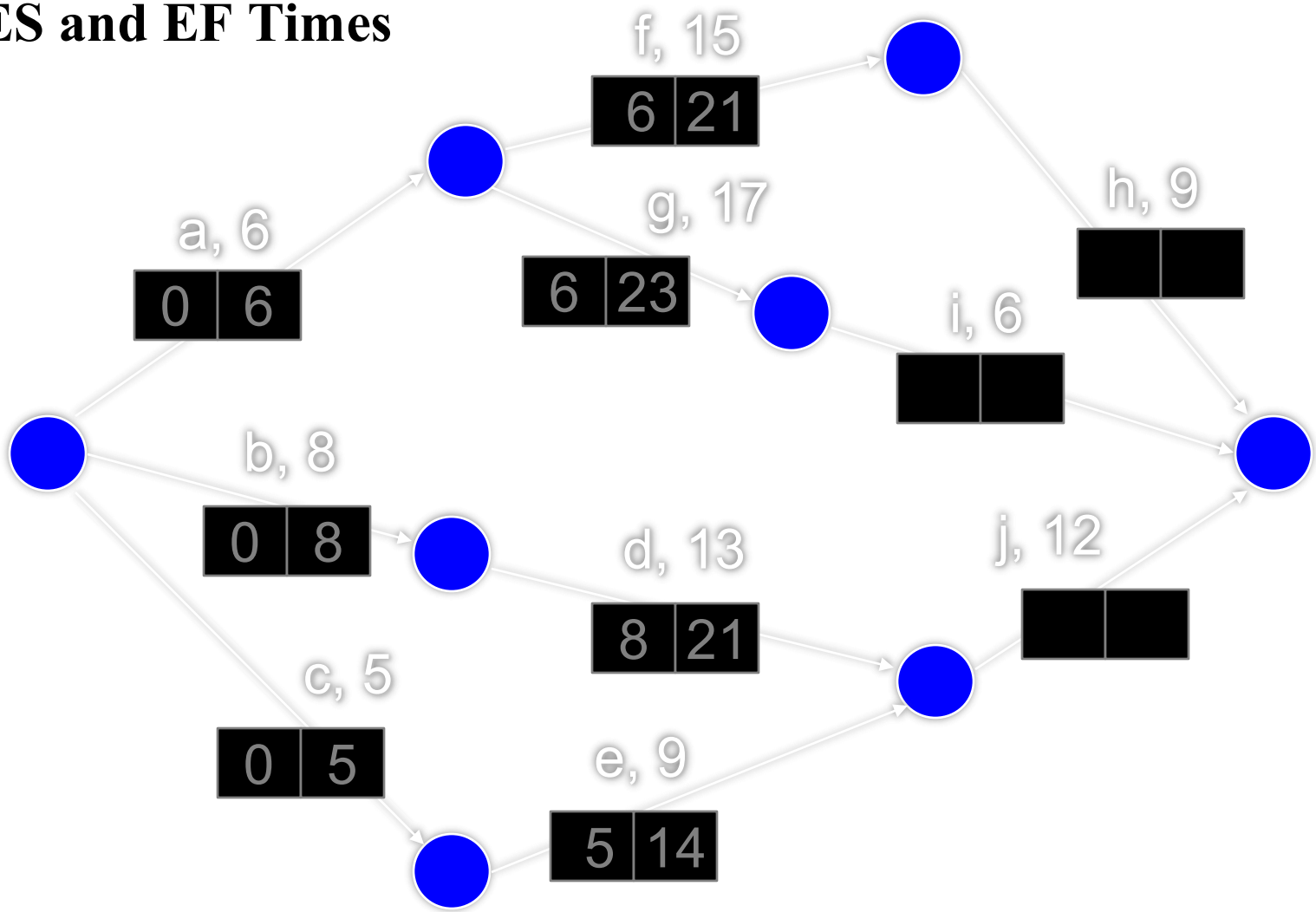
CPM Example

- **ES and EF Times**



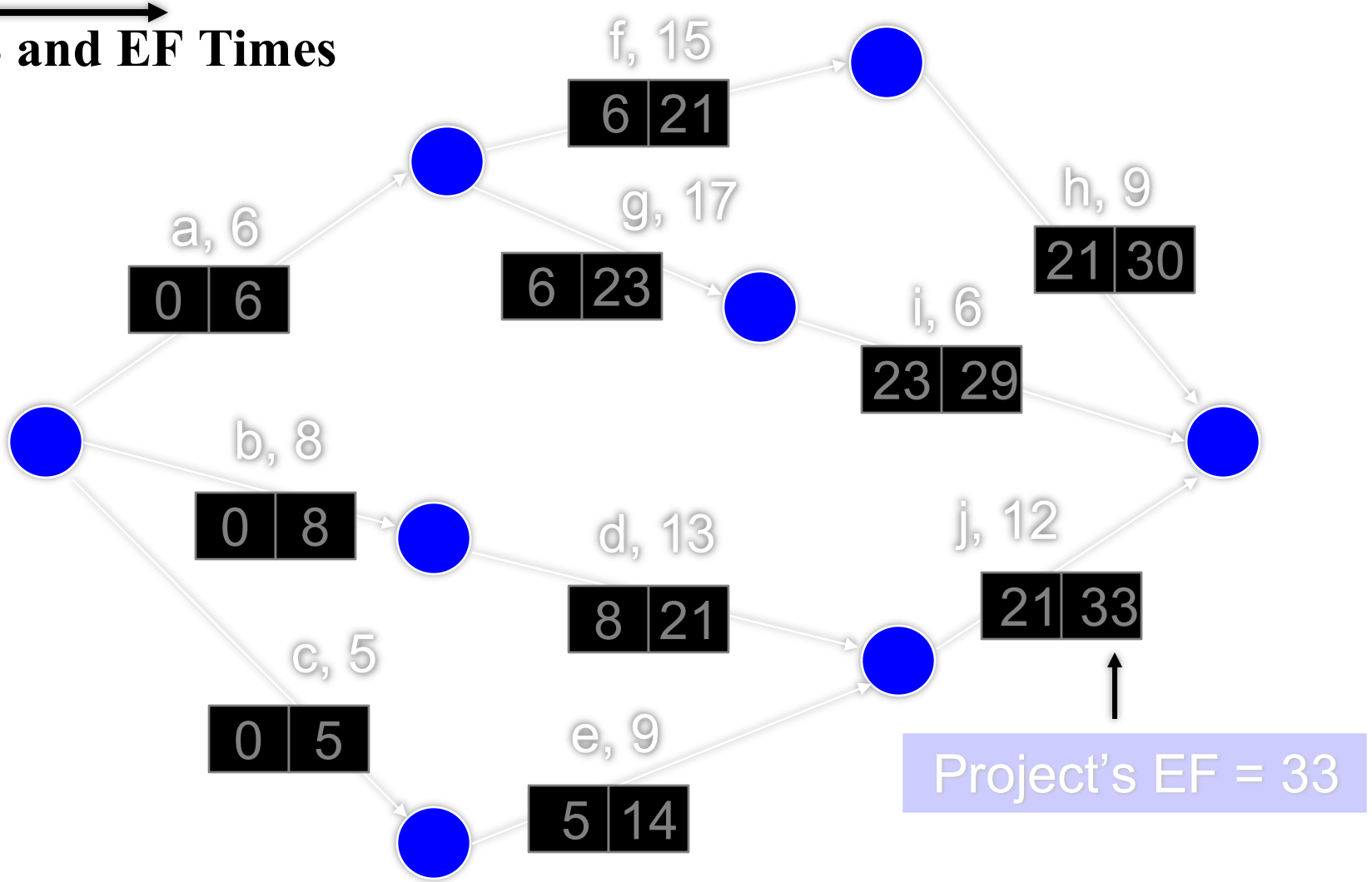
CPM Example

- **ES and EF Times**



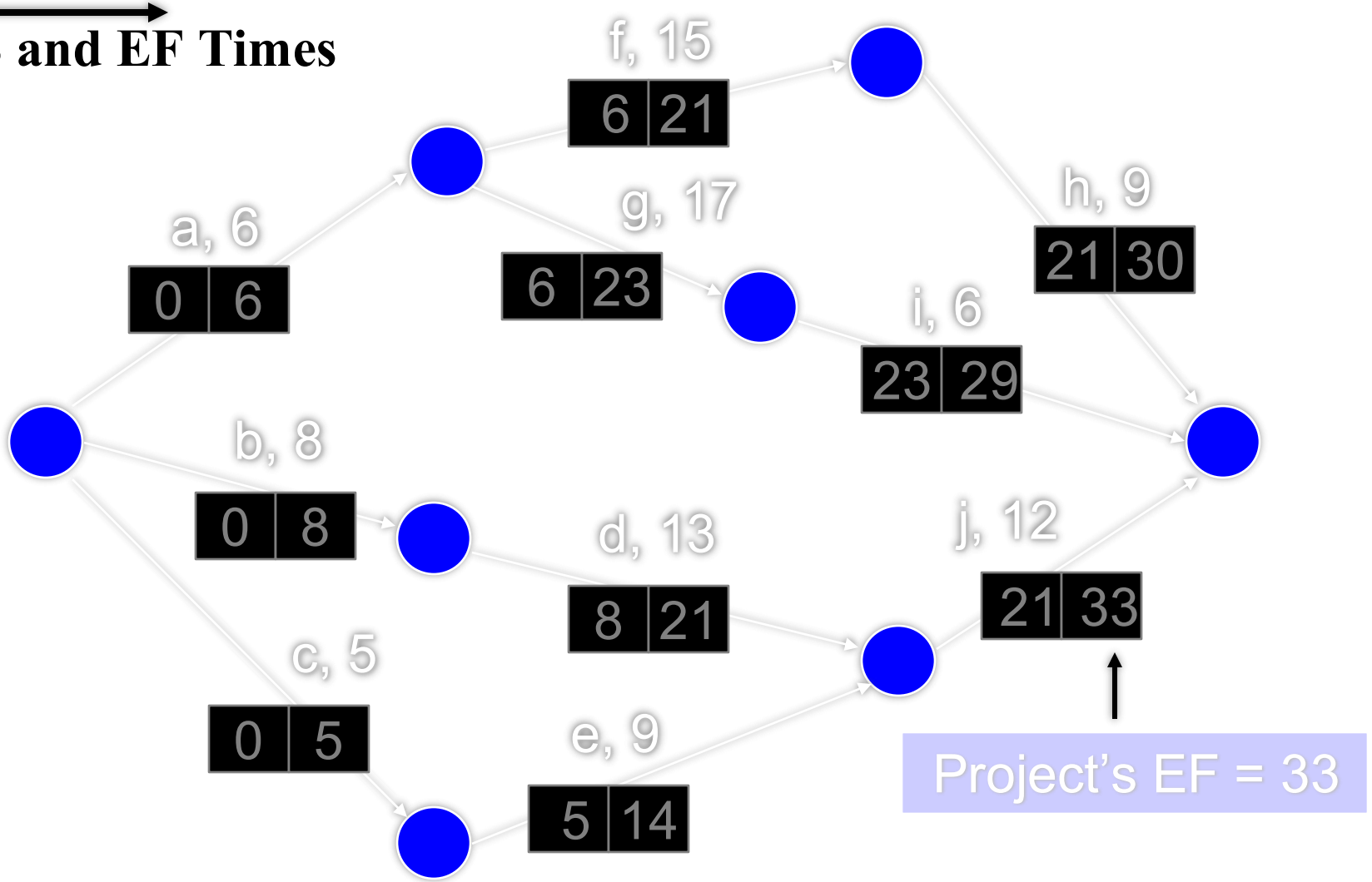
CPM Example

- **ES and EF Times**



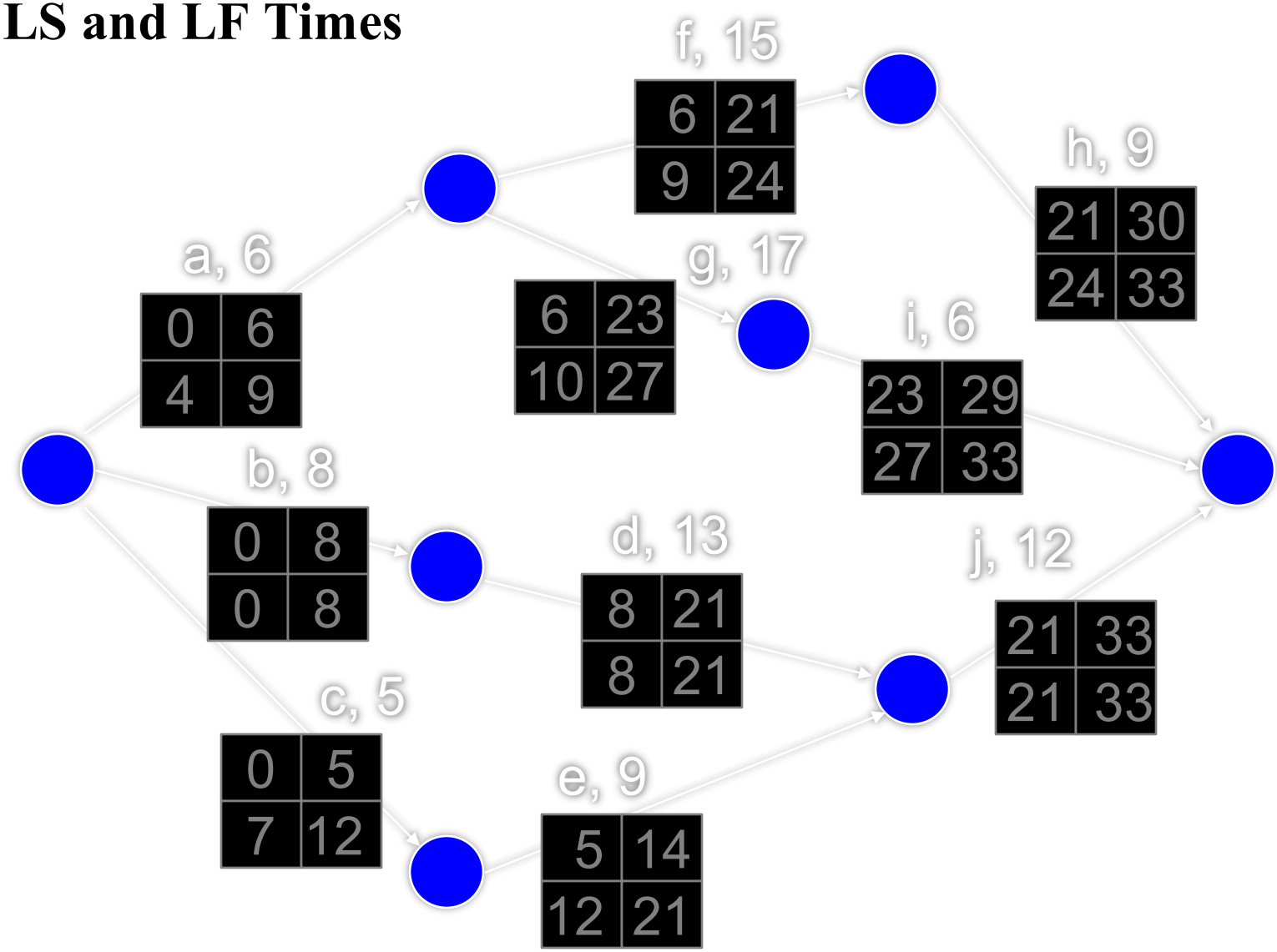
CPM Example

- **ES and EF Times**



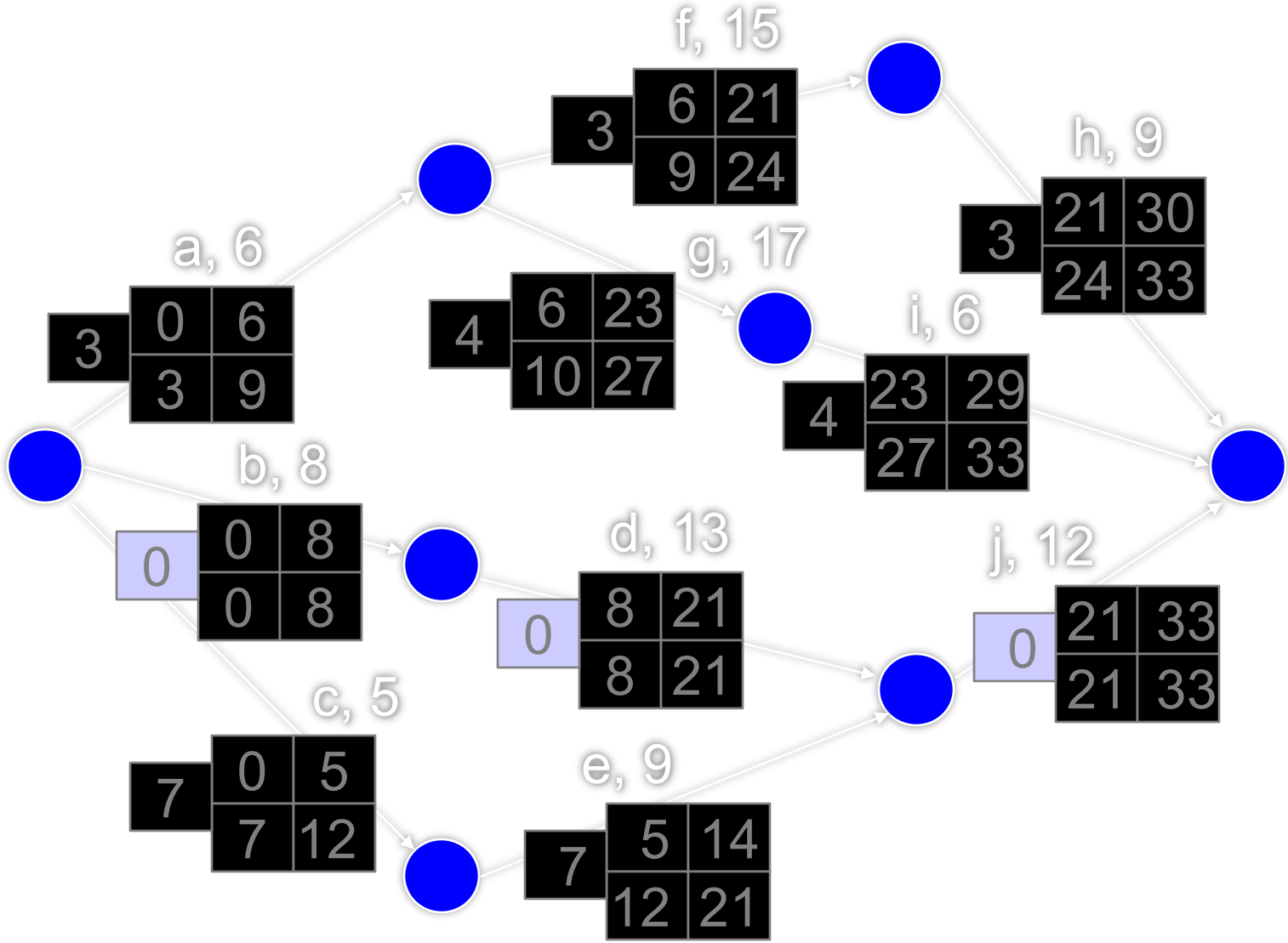
CPM Example

- **LS and LF Times**



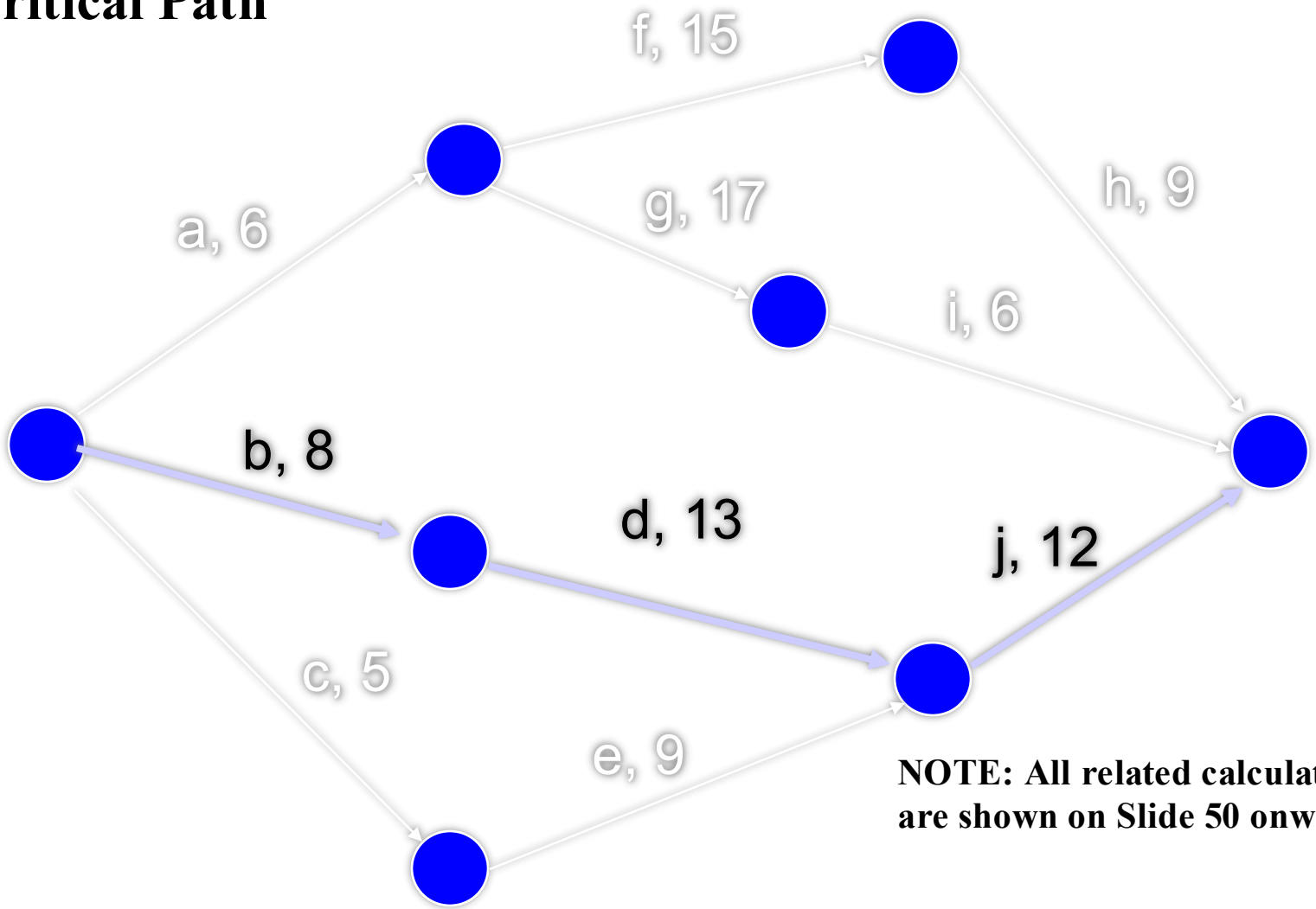
CPM Example

- **Float or Float**



CPM Example

- **Critical Path**



NOTE: All related calculations are shown on Slide 50 onwards.