CMPS 310 Software Engineering
Fall 2021

Lecture 15

Software Project Management: Planning

Project Needs Planning

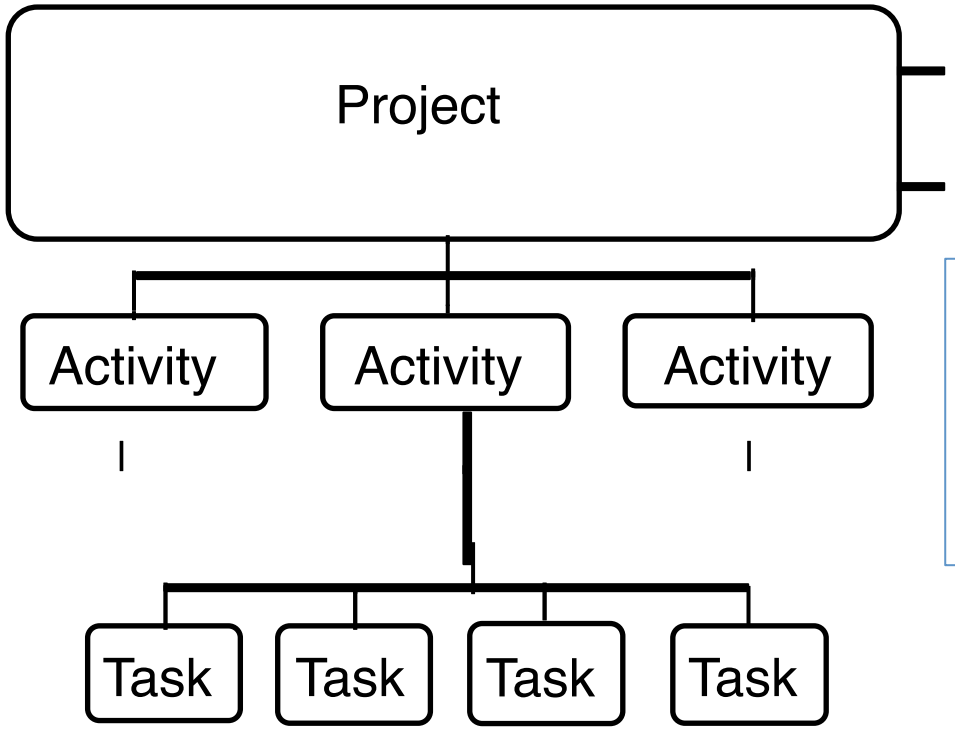
- A plan
- Project teams
- Identification of tasks
- Tasks modelling with various graphs and charts
- Resource analysis
- Organisation structures for software projects
- Budgets and cost control

How to Develop an Initial Project Schedule

- Identify the work (activities/tasks) that needs to be done:
  - » This is the ***Work Breakdown Structure*** (WBS)
- Identify the dependencies between work units (tasks)
  - » Draw a ***dependency diagram*** for all identified activities/tasks and relationships
  - » Dependency diagram represents “depends on” relationships between identified activities/tasks
- Identify the key **milestones**
- Estimate the duration of the work to be done for each work unit (task) and add it to the dependency diagram.
- Analyze the diagram to determine **critical paths** and **slack times** of noncritical paths.

Definitions: Functions, Activities and Tasks

A Project has a duration and consists of **activities** and **tasks**



✧ **Activities**:

- Major unit of work with precise dates
- Based on smaller activities or tasks
- Culminates in project milestone.

- **Tasks**:
  - Major Smallest unit of work subject to management
  - Small enough for adequate planning and tracking
  - Large enough to avoid micro management

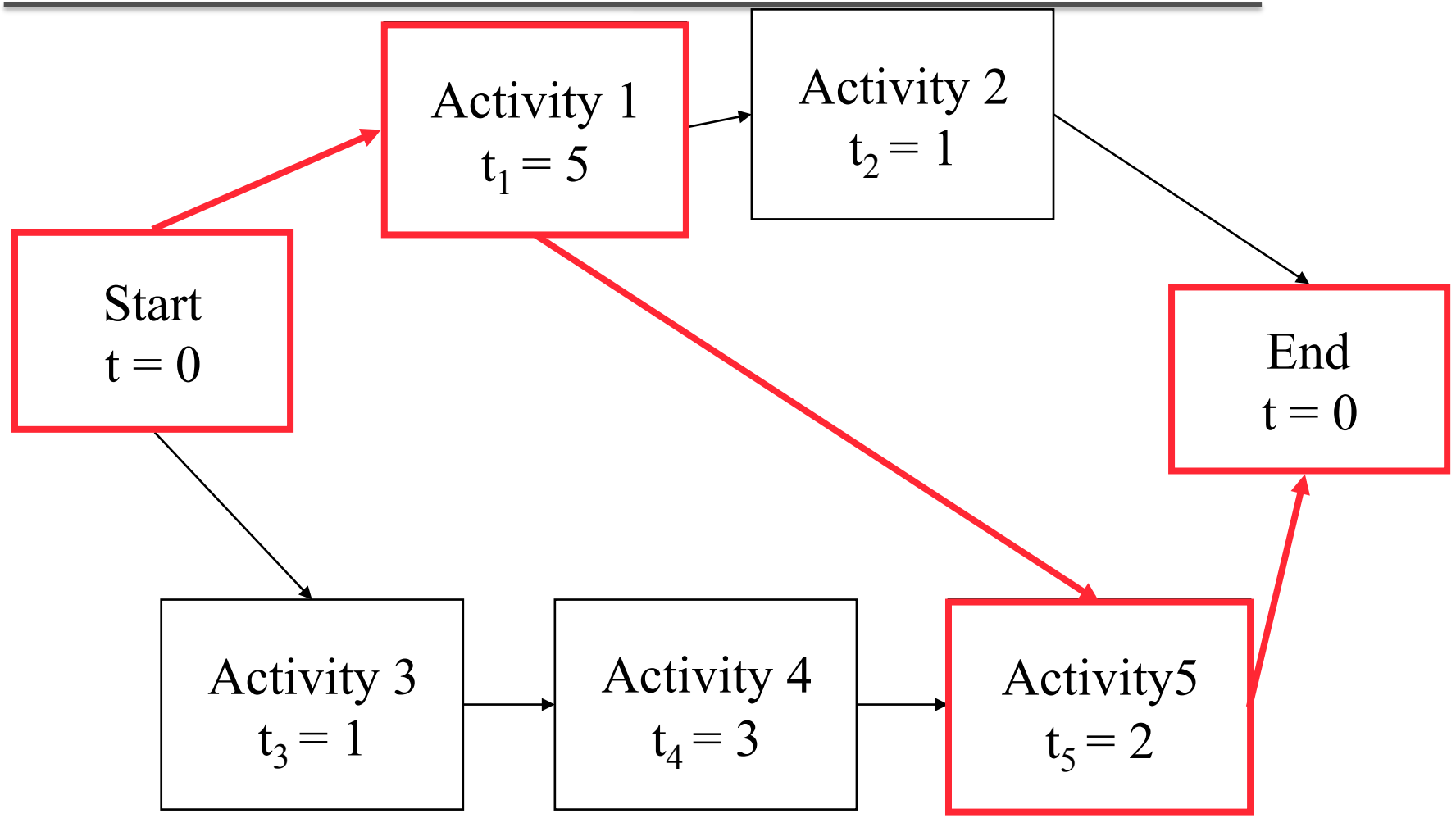
Definitions: Critical Path, Non Critical Path, Slack Time, Person-Month

- **Critical path:**
  - A sequence of activities that take the longest time to complete
  - The length of the critical path(s) defines how long your project will take to complete.
- **Noncritical path:**
  - A sequence of activities that you can delay and still finish the project in the shortest time possible.
- **Slack time:**
  - The maximum amount of time that you can delay an activity and still finish your project in the shortest time possible.
- **Person-Month (Man-Month):**
  - It is the metric for expressing the effort to complete a task.
    - Example: 10 Person-Month means if 10 persons work the work will be complete in one month. If one person works, it will take 10 months to complete. If 5 persons work, it will take 2 months to complete

Map Tasks onto Time

- **Estimate starting times and durations** for each of the activities/tasks in the dependency graph
- **Compute the longest path** through the graph: This is the estimated duration of the project. That is, total project time
- Determination of the **critical path(**s)
- Determination of **slack times**
- **Determine activities** that are critical to ensure a timely delivery
- Analyse the diagrams
  - To find ways to shorten the project duration
  - To find ways to do activities in parallel

Example of a Critical Path



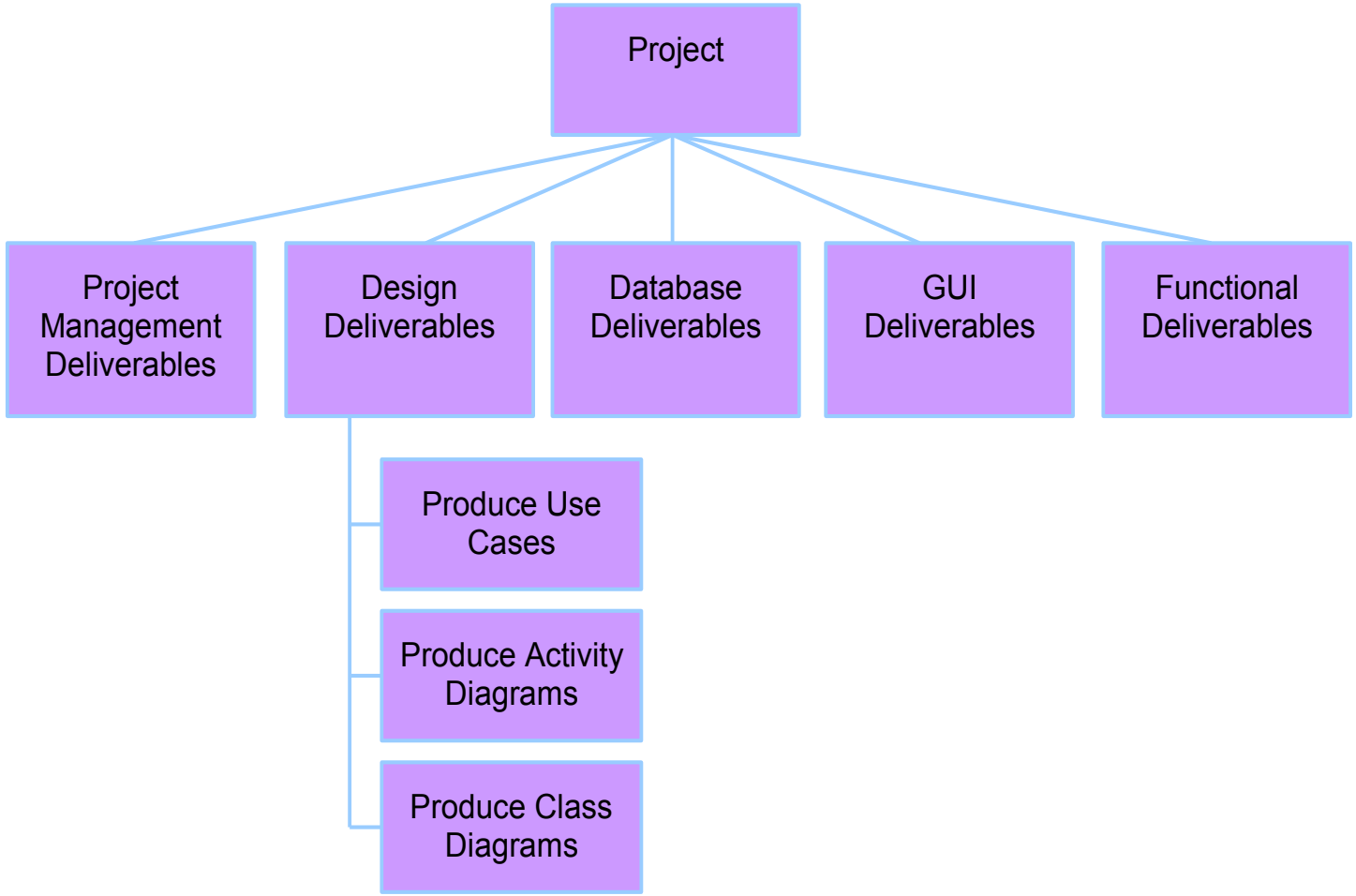
The Project Plan – Simple Form

- How will the project be divided?
  - Work breakdown structure
- When will the work be carried out?
  - Gantt Chart
- Who does what?

Work Breakdown Structure (WBS)

- Work broken down in a hierarchical manner until:
  - Each task is “atomic”
  - Duration can be estimated with reasonable accuracy
  - Can be carried out by one person
- Concentrates on what is to be done, rather than how it is to be done
- Easier to assign quality measures/procedures
- Each task :
  - Has a well defined beginning and end
  - Will consume resources
  - May be dependant on other tasks

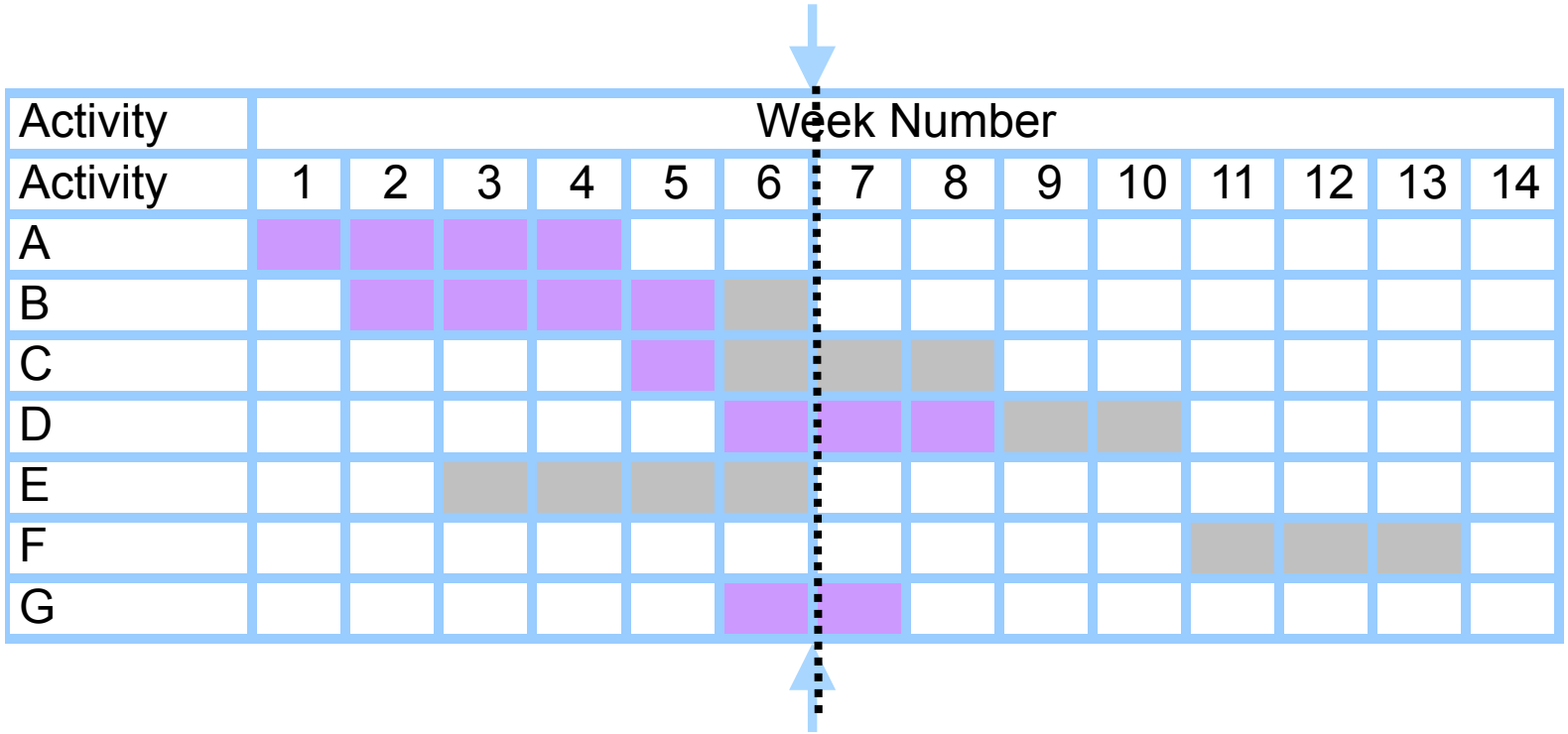
WBS Example


Project
Project Management Deliverables
Design Deliverables
Database Deliverables
GUI Deliverables
Functional Deliverables
Produce Use Cases
Produce Activity Diagrams
Produce Class Diagrams

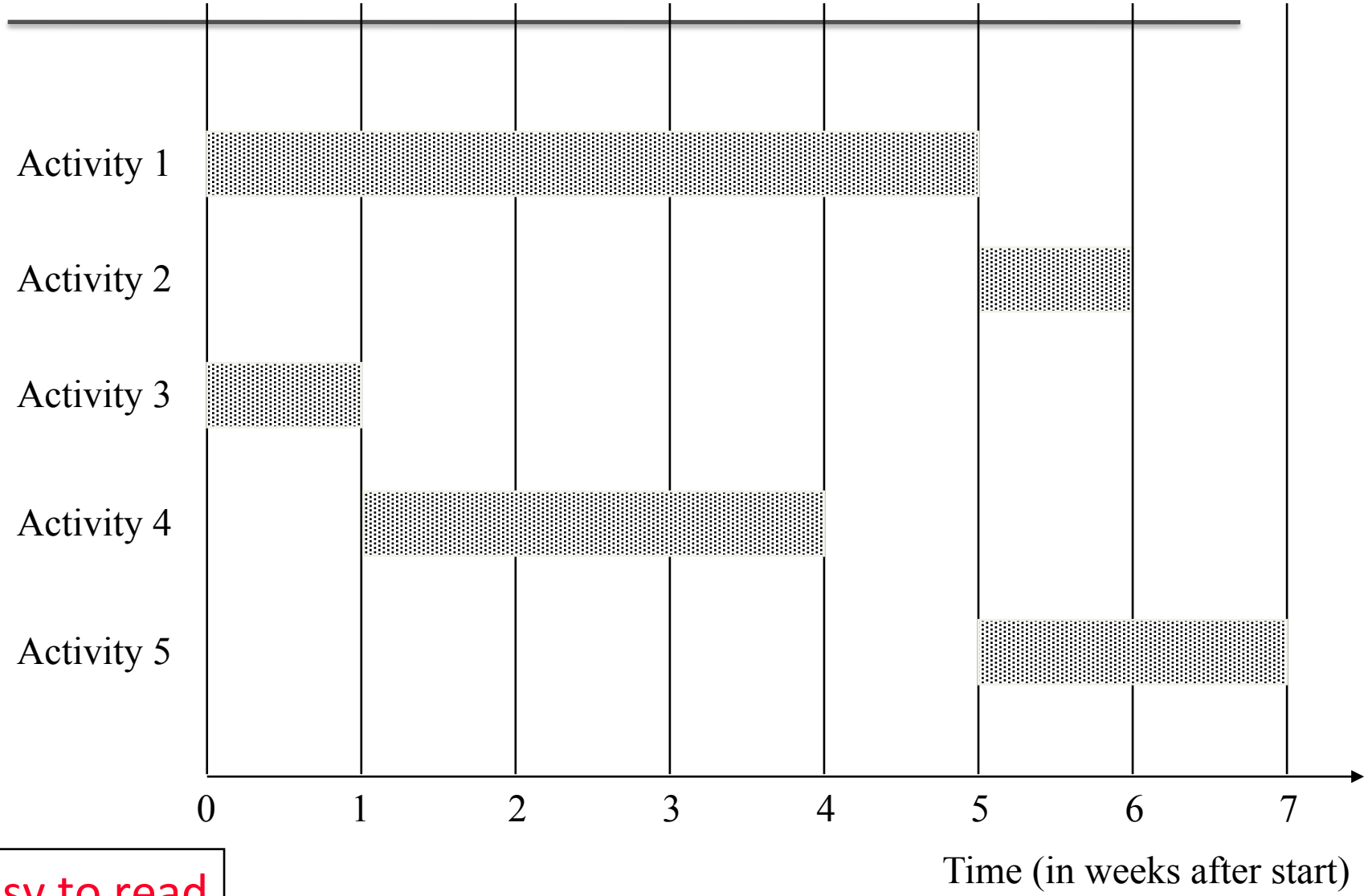
Example Gantt chart

	Week Number													
Activity	1	2	3	4	5	6	7	8	9	10	11	12	13	14
A														
B														
C														
D														
E														
F														
G														

Example Gantt chart



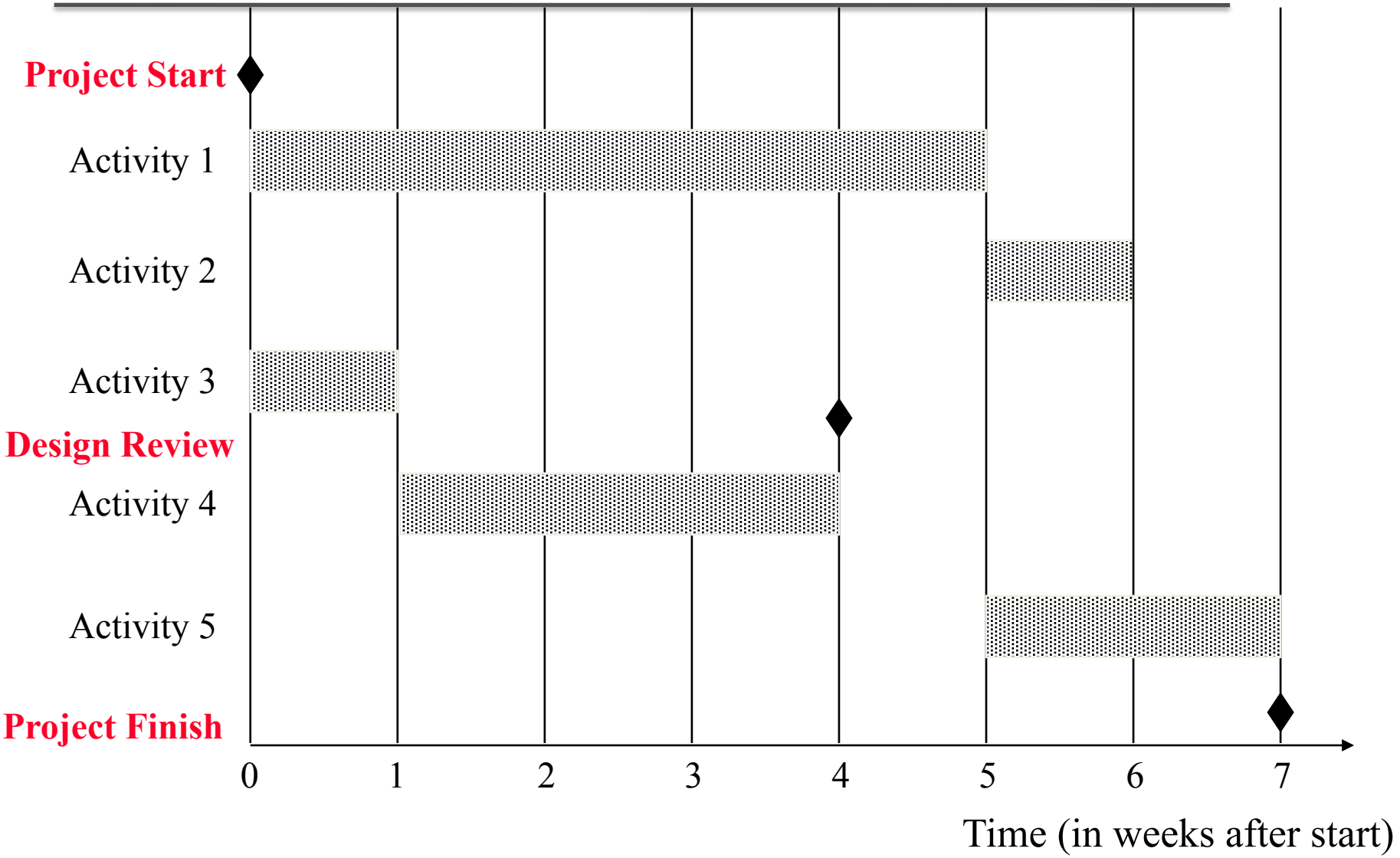
Gantt Chart



Easy to read

Gantt Chart With Milestones

Red texts signify the milestones



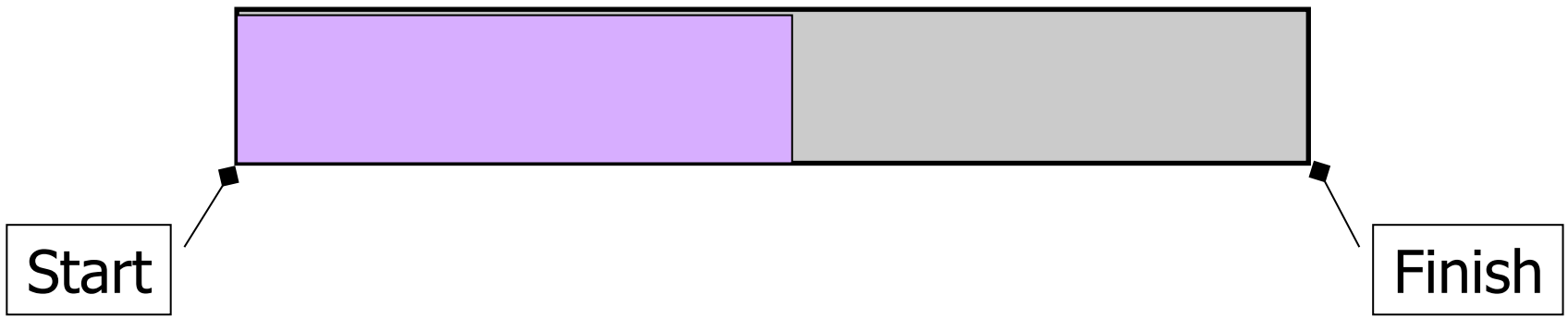
Gantt chart components

An Activity/Task is represented as follows:

The length of the bar is proportional to the duration time of the activity

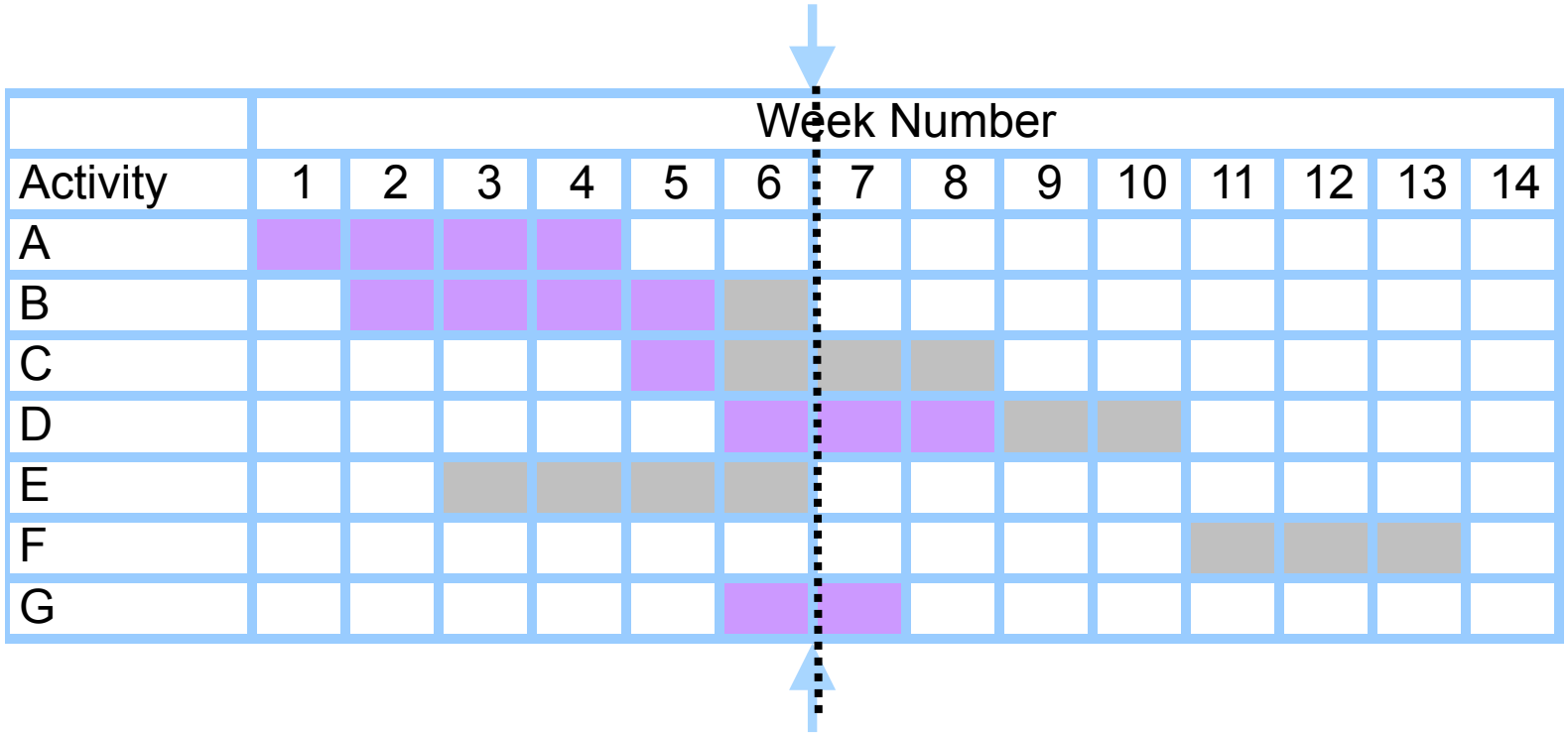
Gantt chart components

Progress on an Activity/Task can be shown as follows:

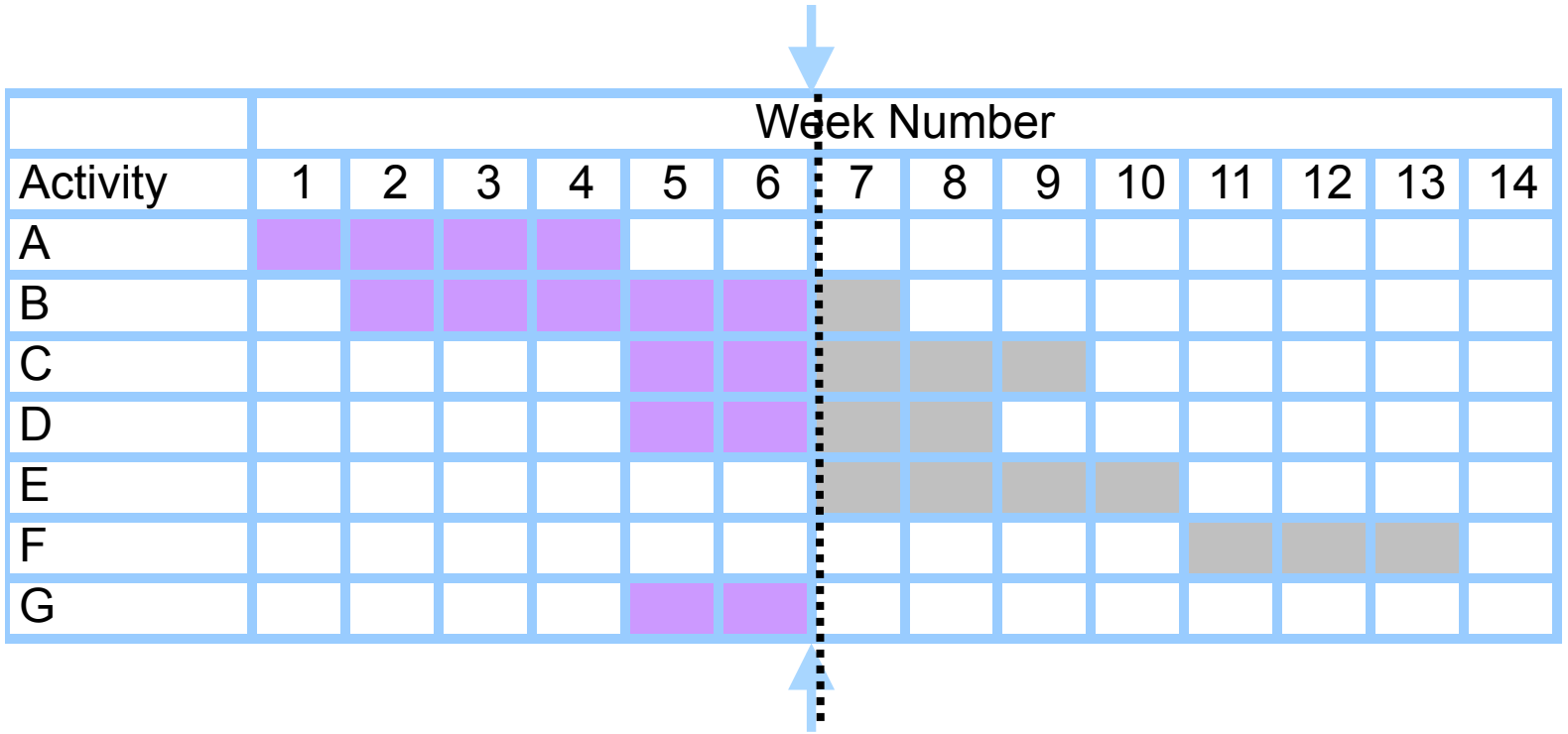


The length of the bar is proportional to the amount of work completed.
This example is approx 50% complete

Example Gantt chart



Example Gantt chart



Exercise

Activity	Start (Week No)	Duration (Weeks)	
A	1	5	
B	2	3	
C	1	8	
D	3	4	
E	5	5	
F	2	4	
G	10	6	
H	6	6	
I	7	2	
J	8	6	

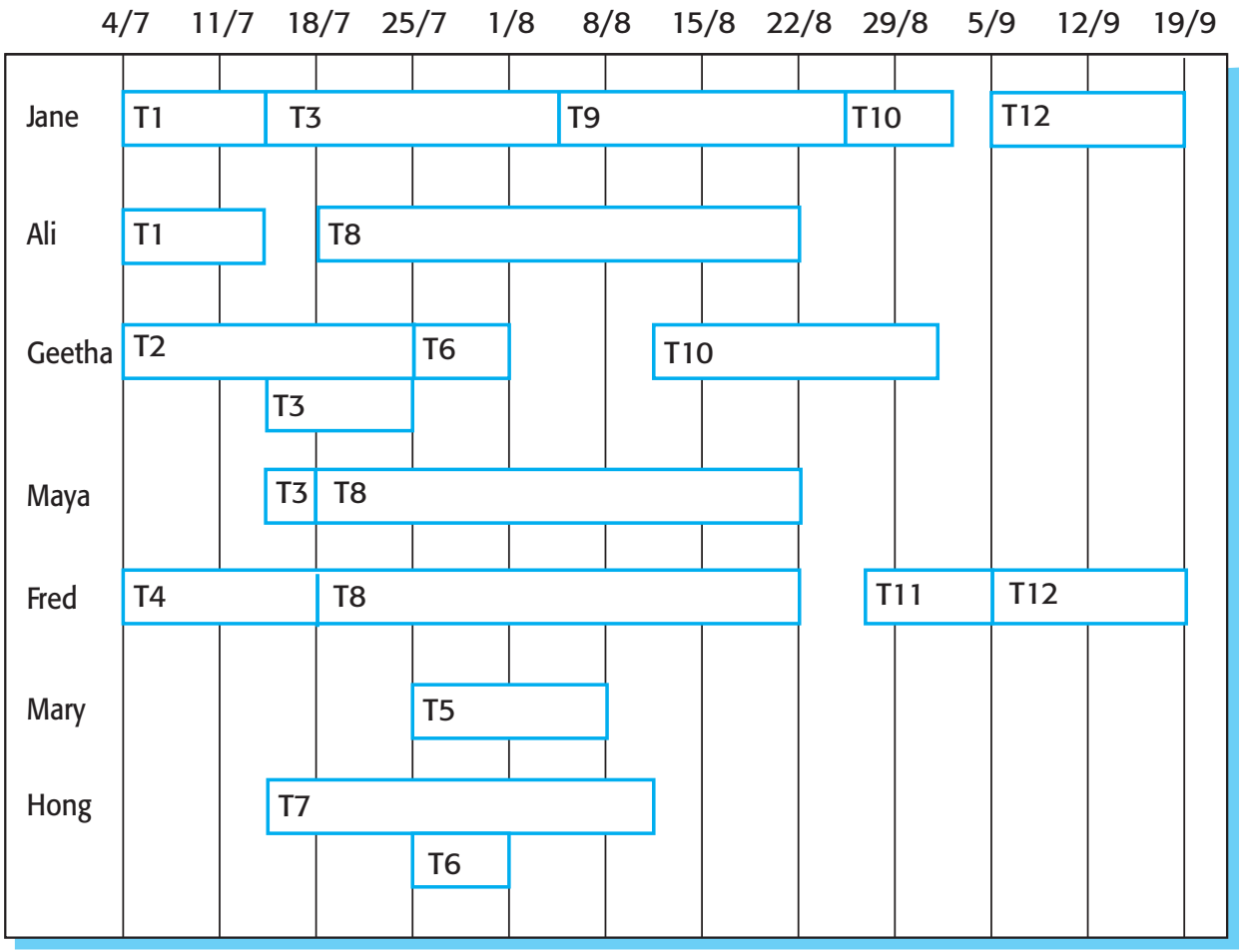
Exercise

Activity	Start (Week No)	Duration (Weeks)	% Complete
A	1	5	100
B	2	3	100
C	1	8	75
D	3	4	100
E	5	5	60
F	2	4	25
G	10	6	0
H	6	6	100
I	7	2	50
J	8	6	50

Example of Dependency Table:
Tasks, Efforts, Durations, and Dependencies

Task/Activity	Effort (person-days)	Duration (days)	Dependencies
T1	15	10	
T2	8	15	
T3	20	15	T1 (M1)
T4	5	10	
T5	5	10	T2, T4 (M3)
T6	10	5	T1, T2 (M4)
T7	25	20	T1 (M1)
T8	75	25	T4 (M2)
T9	10	15	T3, T6 (M5)
T10	20	15	T7, T8 (M6)
T11	10	10	T9 (M7)
T12	20	10	T10, T11 (M8)

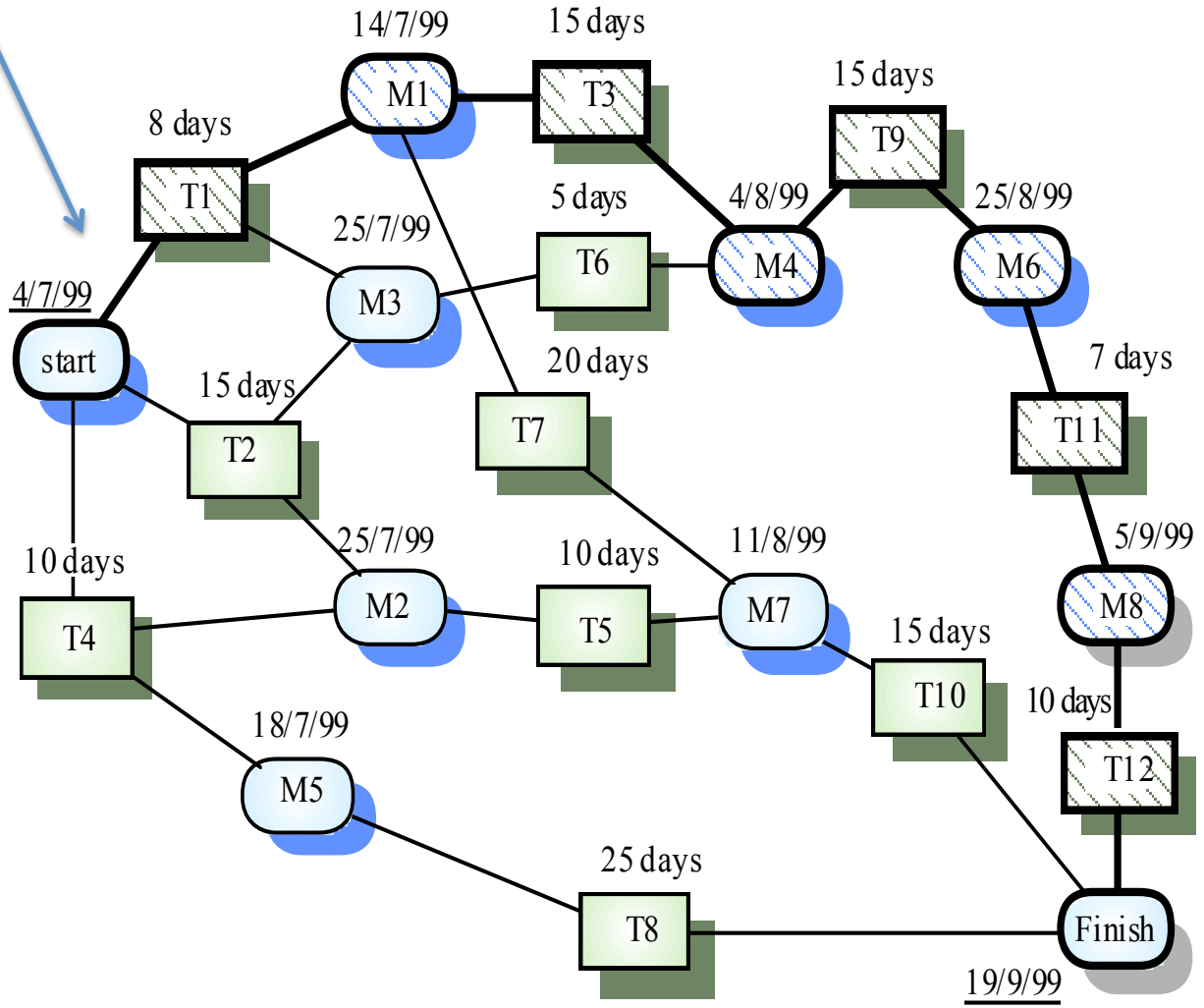
Staff Allocation Chart



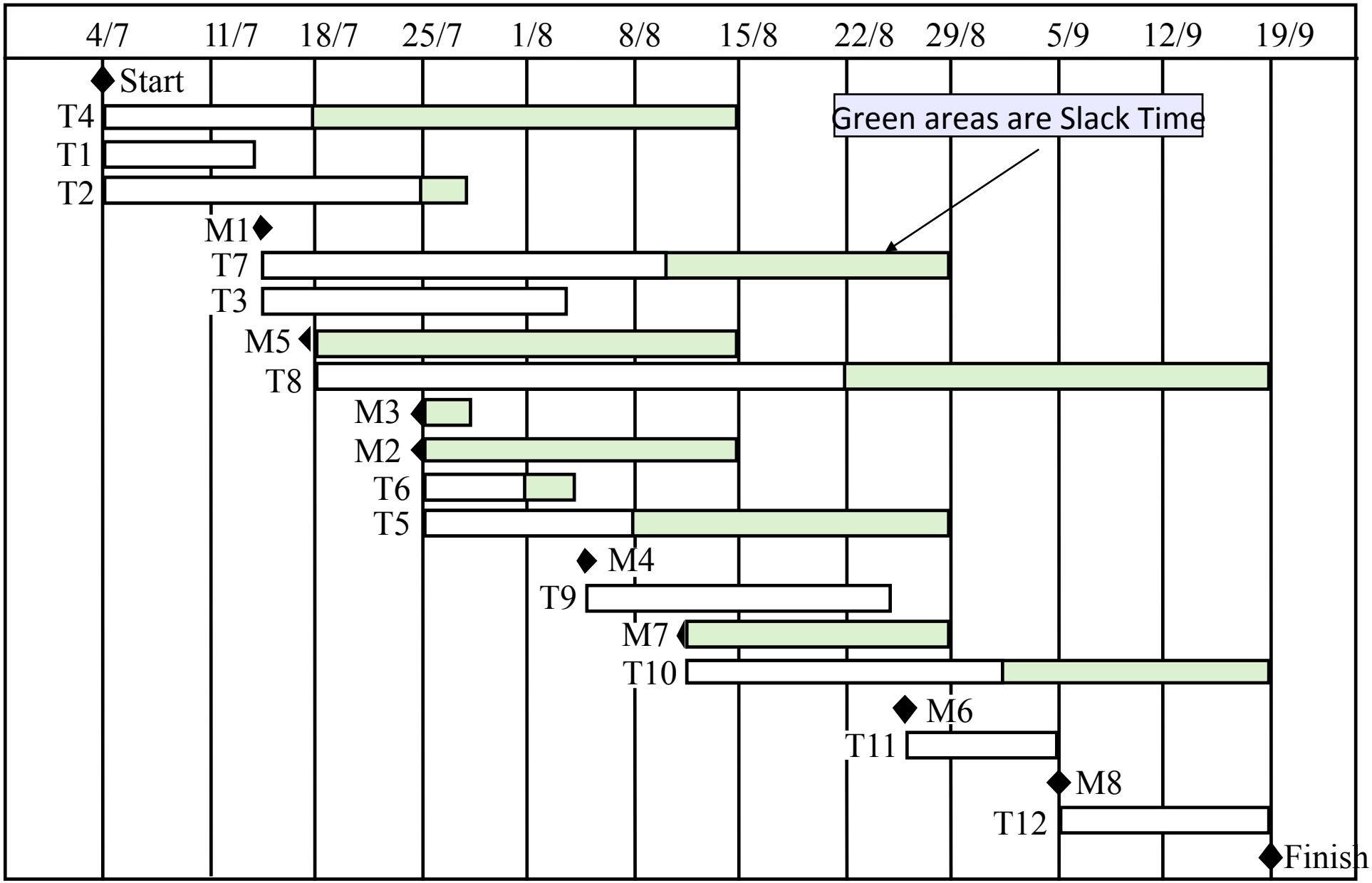
Example: Dependency Graph with Time

Critical path from
start to T1, M1, T3, M4, T9, M6, T11, M8, and T12

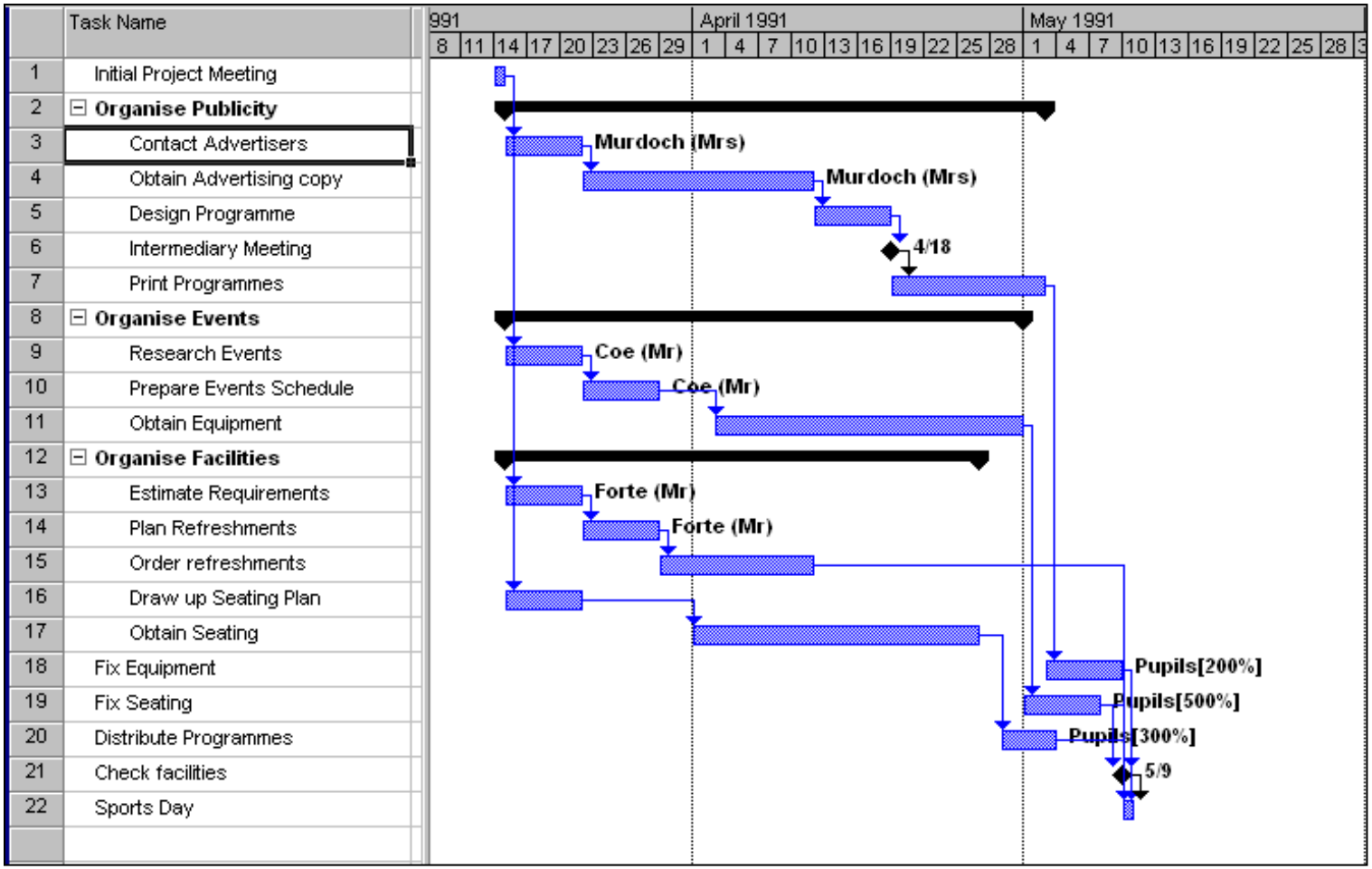
Task	Days	Depends
T1	8	
T2	15	
T3	15	T1 (M1)
T4	10	
T5	10	T2, T4 (M2)
T6	5	T1, T2 (M3)
T7	20	T1 (M1)
T8	25	T4 (M5)
T9	15	T3, T6 (M4)
T10	15	T5, T7 (M7)
T11	7	T9 (M6)
T12	10	T11 (M8)



Activity Bar Chart (Gantt Chart)



MS Project – Gantt Chart



Tools Support for Establishing Schedules

- Tool support for
  - Graphical user interface for entering activity data
  - Automatic computation of critical paths
  - Multiple views (PERT, Gantt, table views) and switching between these views
- Many products available. Examples
  - **Fast Track** (Demo) (http://www.aecsoftware.com/downloads/freedemo)
    - Main view: Gantt Charts
  - **Microsoft Project** (http://www.microsoft.com/office/project/default.asp)
    - PERT Charts, Gantt Charts, combined Milestone/Gantt Charts
- Some Scheduling Tools:
  - Dependency table
  - Activity bar chart (Gantt chart),
  - Staff allocation chart
  - Dependecy graph

Units of resource

- It is desirable when possible to state the work required in units of time. (i.e. person/machine hours)
- Example
  - To design a use case will take one person 12 hours.
  - So one use case = 12 person hours of design
  - One person can complete this in 12 hours.
- How long would it take 12 persons to do the use case?

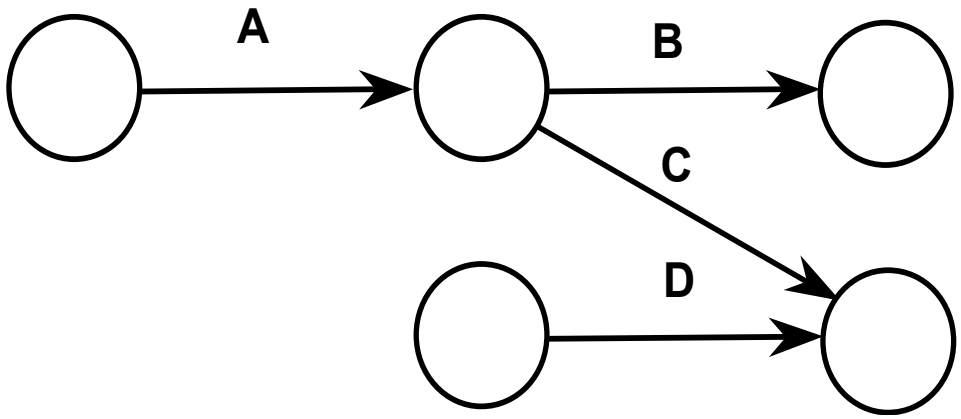
Network Diagrams

- Splits up the decision making process into
  - Method/logic - the order in which tasks have to be completed
  - Time – estimates for the time to completion can be added to each task
  - Resources – these can be added and then analysis carried out
- Two Methods:
  - Activity on Arrow (AoA)
    - Traditionally the preferred method
  - Activity on Node (AoN)
    - More popular these days
    - Supported by most Project Management software tools (i.e. MS Project)

Activity on Arrow (AoA)

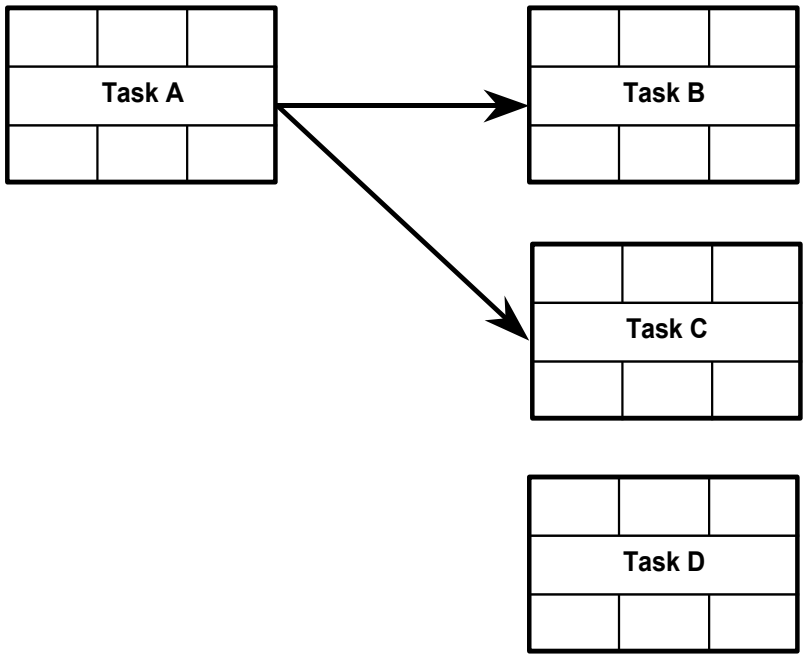
- Arrows are used to represent an activity
- Circles are used to represent the points where activities meet

  i.e. the dependency between activities

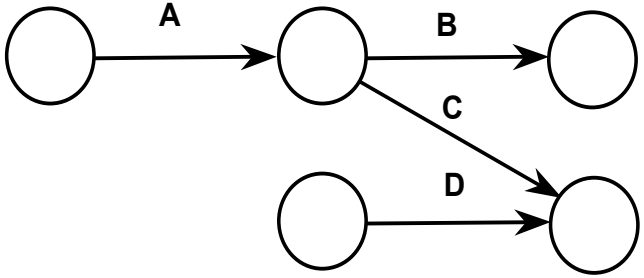


Activity on Node (AoN)

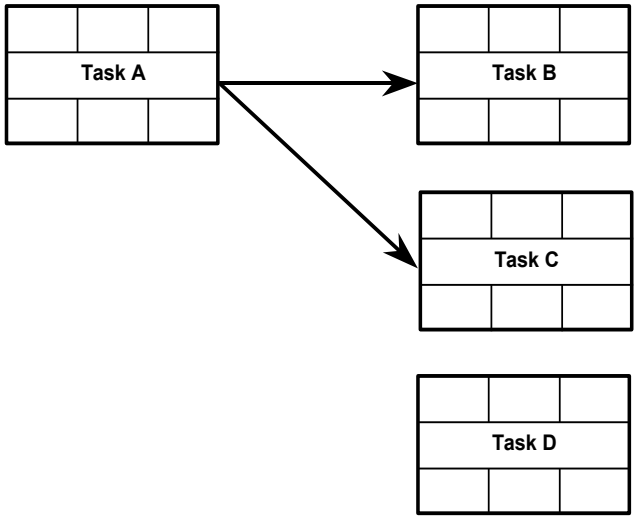
- Activities are represented by boxes
- Dependencies are represented by arrows joining the boxes



Comparison between AoA and AoN



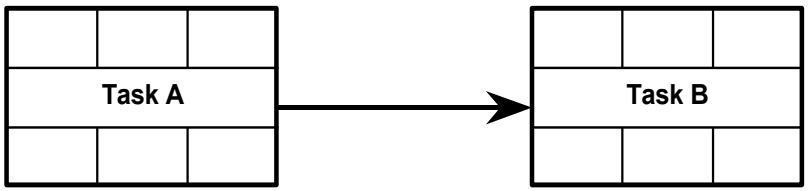
AoA



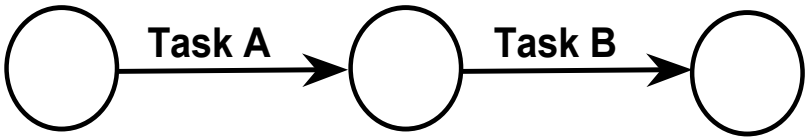
AoN

Dependency Example in AoA and AoN

- Task B cannot start until Task A is complete
  - Activity on Node



  - Activity on Arrow



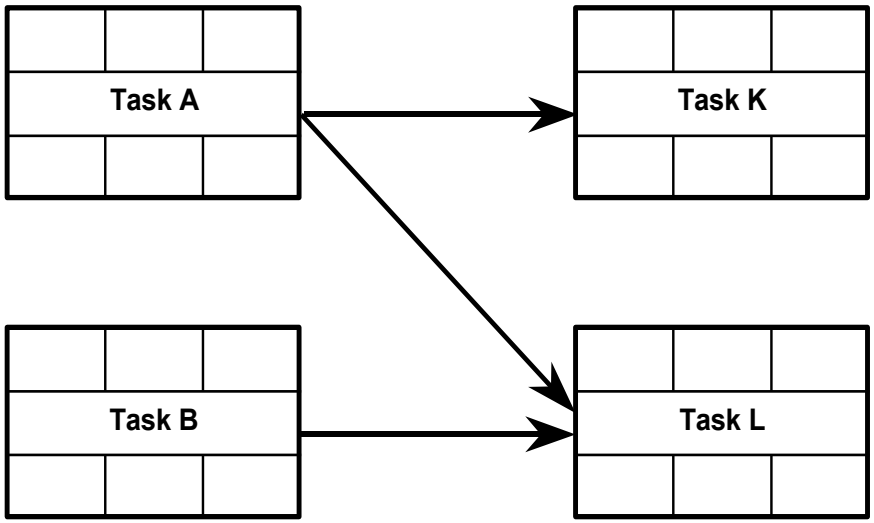
More example

- Four activities/tasks:

  A, B, K, L

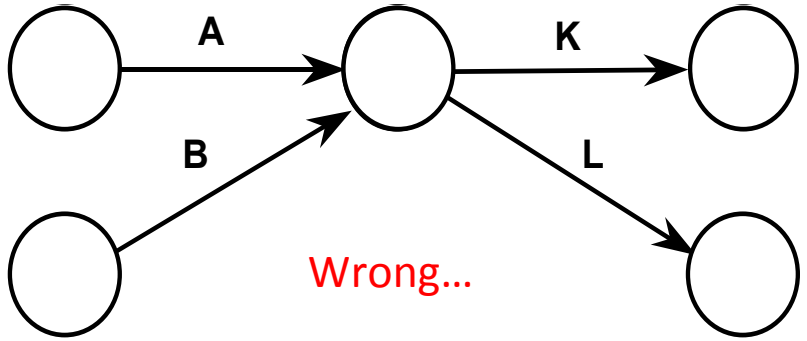
  Activity K is dependent on activity A

  Activity L is dependent on activities A and B



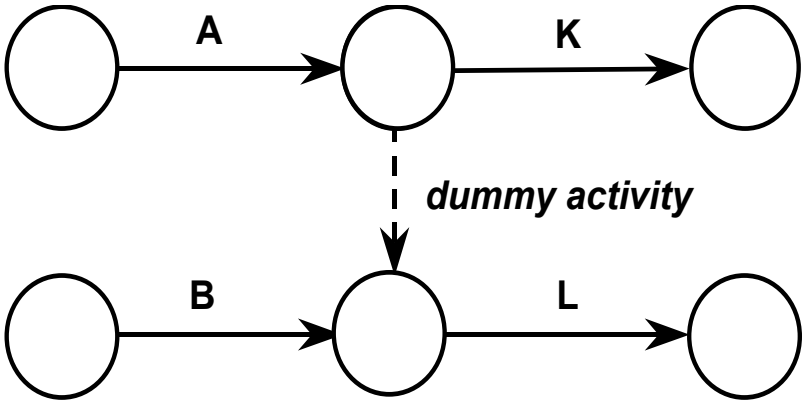
The problem with AoA

- The same example in AoA



Activity K is dependent on activity A

Activity L is dependent on activities A and B



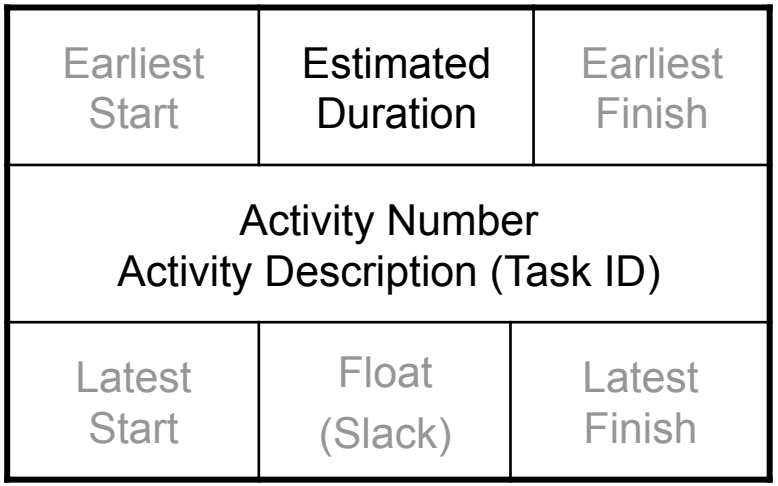
Right

Exercise on AoA

- ✧ Draw the following:
  - Activity K is dependent on activities A and B
  - Activity L is dependent on activities B and C
  - Activity M is dependent on activity B

Drawing the network

- Direction
  - The flow of work is from left to right
- Identifying Tasks
  - Each task is given a unique ID number
  - ID number is often given in WBS
  - Estimated task duration in terms of day/hours/week/month
  - Earliest start date and earliest finish date of each task
  - Latest start date and latest finish date of each task.
- Make dependency
- Identify critical path of the entire project
- Recognize slack time of a task



Exercise – Resource Analysis

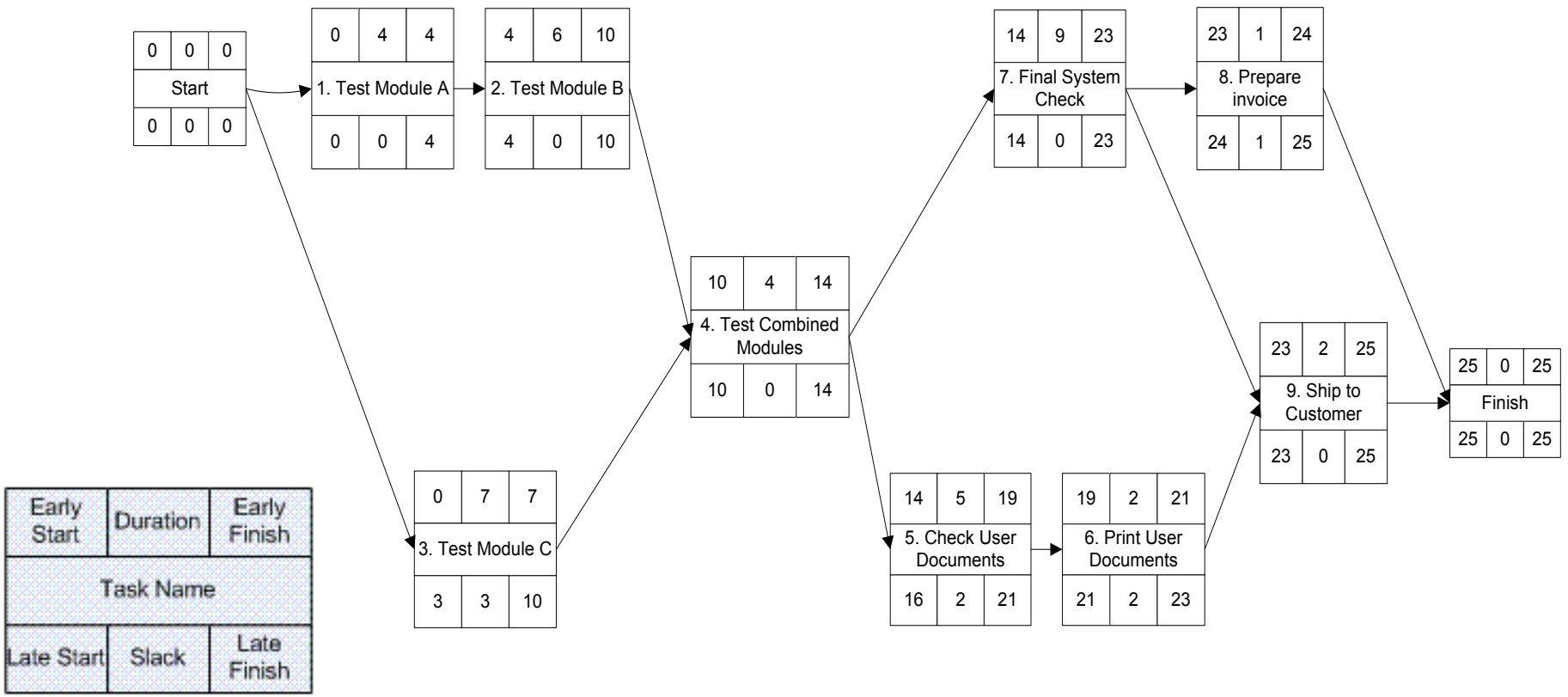
Project 1: Verification of a computer system

The followng table shows the required activities and the associated resources for this project.

Activity ID	Activity	Immediate Predecessor	Duration (Days)	Resource ID
1	Test Module A	none	4	5
2	Test Module B	Test Module A	6	5
3	Test Module C	none	7	10
4	Test Combined Modules	Test Module B, Test Module C	4	15
5	Check User Documents	Test Combined Modules	5	10
6	Print User Documents	Check User Documents	2	5
7	Final Systems Check	Test Combined Modules	9	5
8	Prepare Invoice	Final Systems Check	1	5
9	Ship to Customer	Print User Documents, Final Systems Check	2	5

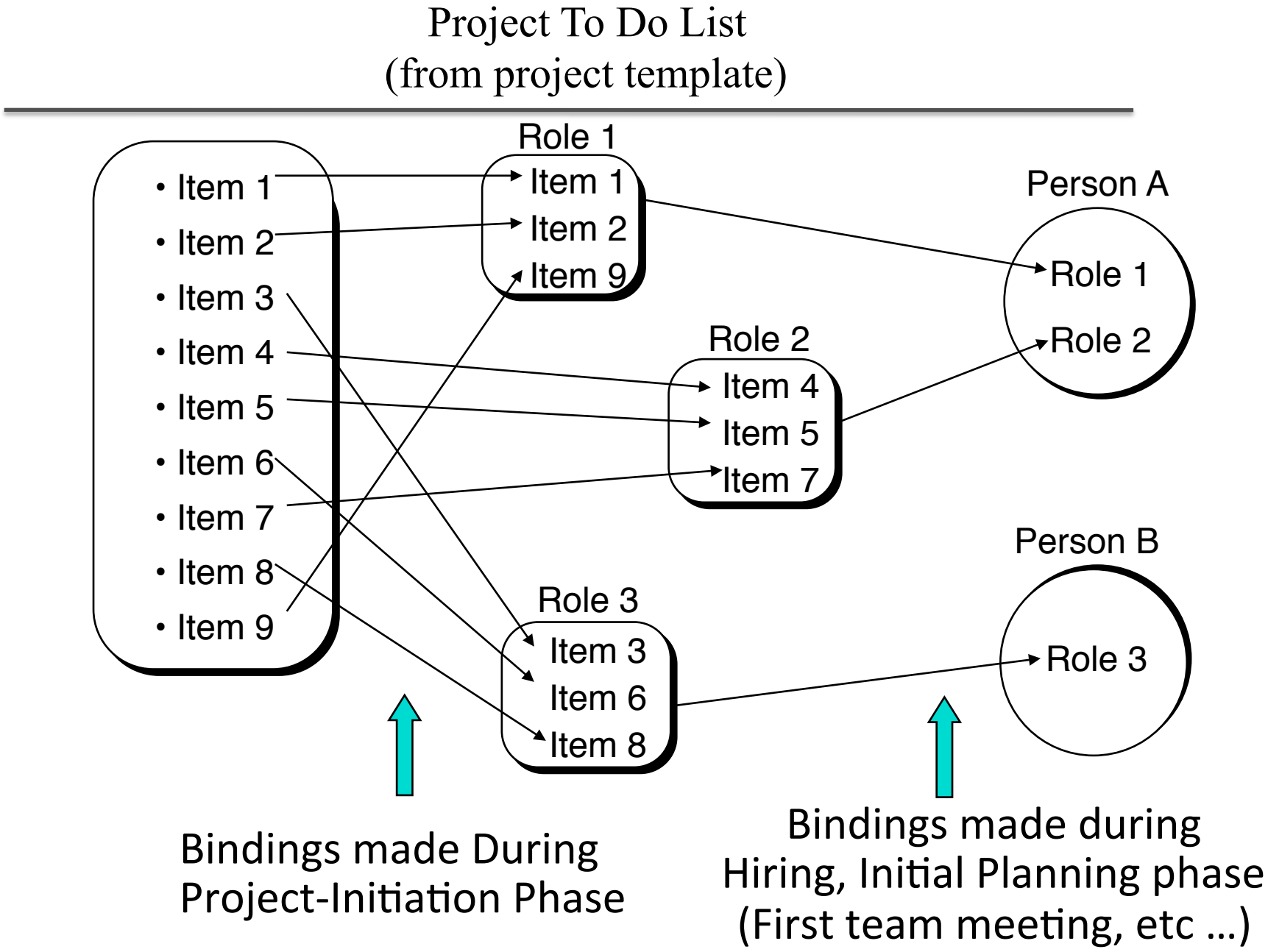
- Example of Resources:
  - ID 5: Testing tool (e.g., JUnit) and test programmer
  - ID 10: Model checker for verification and verifier
  - ID 15: Test programmer

Exercise on AoN



- Resources are not shown in the AoN diagram.
- Draw a Gantt Chart for the resources required by the tasks

Assigning Responsibilities To People Resource



Linear Responsibility Chart

- A **linear responsibility chart** is a matrix that depicts the role that each project participant will play in different activities identified in the work breakdown structure.
- **Rows:** Project activities **Columns:** Roles/Project participants
- **Entries: Type of responsibility**
  - ***P (Primary responsibility)****:* Committed to ensure that the desired result is achieved
  - ***S (Secondary responsibility):*** Committed to some portion of the result
  - ***A (Approval):*** Not doing the work, but will approve work
  - ***R (Review):*** Will review and comment on the work product of an activity
  - ***O (Output):*** Will receive the work product of an activity
  - ***I (Input):*** Will provide input for a task or activity

Example of a Responsibility Chart

	Project Manager	Team Leader	Team Member A	Team Member B
Develop Plan	**P**			
Run weekly meeting		**A**	**P**	**S**
Write SDD	**P**	**S**	**S**	**S**

Legend:
P = Primary responsibility
S = Secondary responsibility)
A = Approval

References

- R. Pressman: Software Engineering: A practitioner's approach
- Hughes and Cotterell: Software Project Management
- Cadle and Yeates: Project Management for Information Systems
- Lockyer and Gordon: Project Management and Project Network Techniques