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# Software Development Project Management

## Part 1

# Software Development Process?

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- 1) Announce availability.
- 2) Order the T-shirts for the Development team.
- 3) Write the code.
- 4) Write the manual.
- 5) Hire a Product Manager.
- 6) Spec the software (Writing the specs after the code helps to ensure that the software meets the specifications).
- 7) Ship.
- 8) Test (the customers are a big help here).
- 9) Identify bugs as potential enhancements.
- 10) Announce the upgrade program.

# Cynical Views or Reality?

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- Projects progress quickly until they are 90% complete. Then they remain at 90% complete forever.
- When things are going well, something will go wrong. When things just can't get worse, they will. When things appear to be going better, you have overlooked something.
- If project content is allowed to change freely, the rate of change will exceed the rate of progress.
- Project teams detest progress reporting because it manifests their lack of progress.

# Project Management Terms

(not universal)

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- **Tasks:** Small units of work
- **Activities:** Major work units
- **Milestones:** When activities are completed
- **Functions:** Pervasive, on-going management activities

# Tasks: Small units of work

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- **Smallest** unit of management accountability
  - Atomic unit of planning and tracking
  - Finite duration, need resources, produce tangible result (documents, code)
- Specification of a task: Work package
  - Name, description of work to be done
  - **Preconditions** for starting, **duration**, required **resources**
  - Work product to be produced, acceptance criteria for it
  - Risk involved
- Completion criteria
  - Includes the acceptance criteria for the work products (deliverables) produced by the task.

# Activities: Major Units of Work

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- Culminates in major project *milestone*:
  - Internal checkpoint should not be externally visible
  - Scheduled event used to measure progress
- Milestone often produces baseline:
  - formally reviewed work product
  - under change control (change requires formal procedures)
- Activities may be grouped into larger activities:
  - Establishes hierarchical structure for project (phase, step, ...)
  - Allows separation of concerns
  - Precedence relations often exist among activities (PERT Chart)

# Examples of Activities

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- Major Activities:
  - Planning
  - Requirements Elicitation
  - Requirements Analysis
  - System Design
  - Object Design
  - Implementation
  - System Testing
  - Delivery
- Activities during requirements analysis:
  - Refine scenarios
  - Define Use Case model
  - Define object model
  - Define dynamic model
  - Design User Interface

# Project "Functions"

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- Examples:
  - Project management
  - Configuration Management
  - Documentation
  - Quality Control (Verification and validation)
  - Training
- Project Functions in the IEEE 1058 standard are called *Integral processes* in the IEEE 1074 standard.

# Organizational Diagrams

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- **Work breakdown structure (WBS):** Shows hierarchy of work products
- **PERT chart:** Shows the order in which activities must be done (a partial order)
- **Gantt Chart or Schedule:** Shows scheduling of work products as a function of time

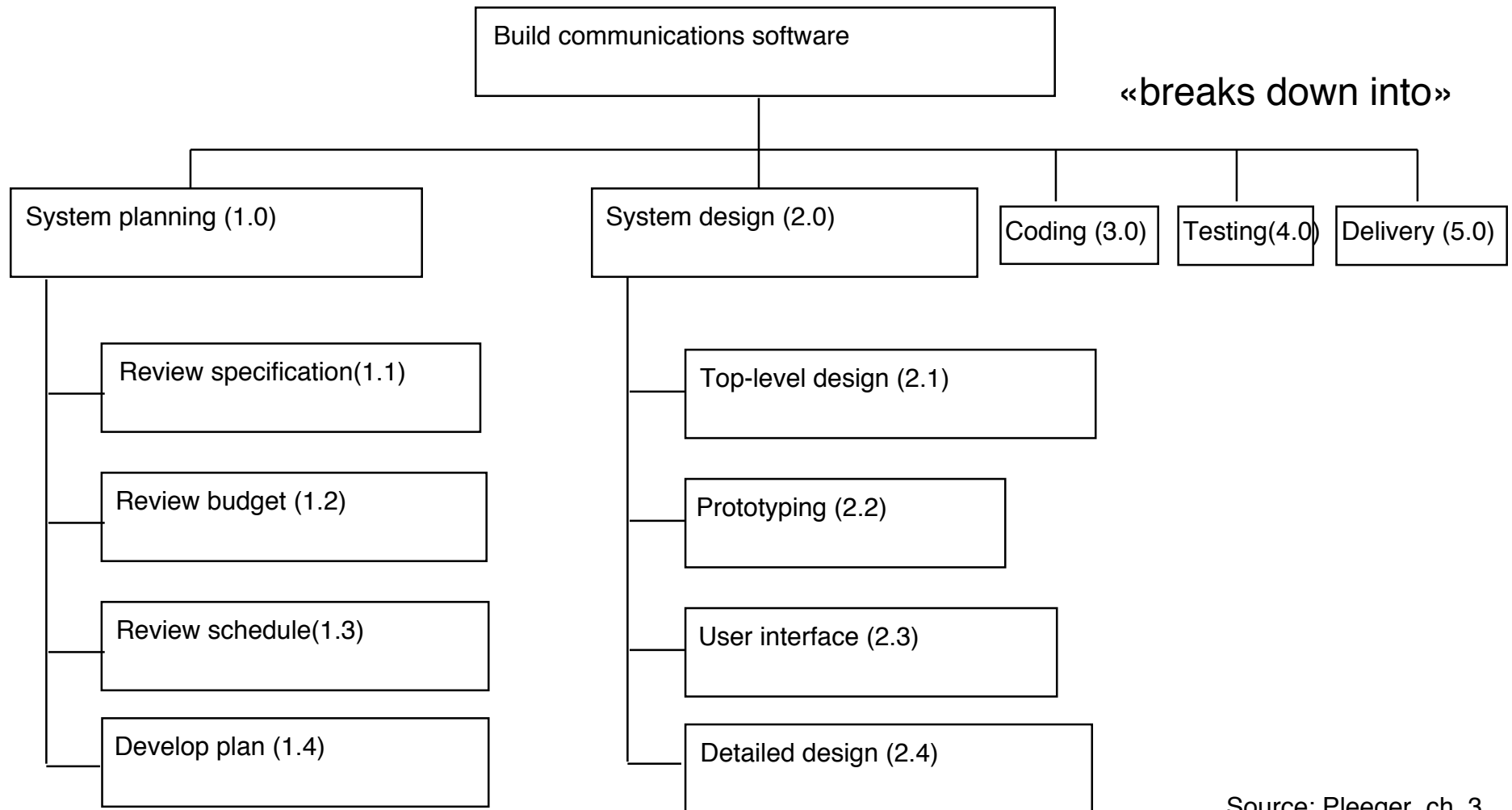
# Creating Work Packages

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- Work Breakdown Structure (WBS)
  - Break up project into **activities** (phases, steps) and **tasks**.
  - *The work breakdown structure does not show the interdependence of the tasks*

# Work Breakdown Structure (WBS) Diagram



Source: Pleege, ch. 3

# WBS Tradeoffs

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- Work breakdown structure influences cost and schedule
- Determination of work breakdown structure may be **incremental** and iterative

# PERT Chart

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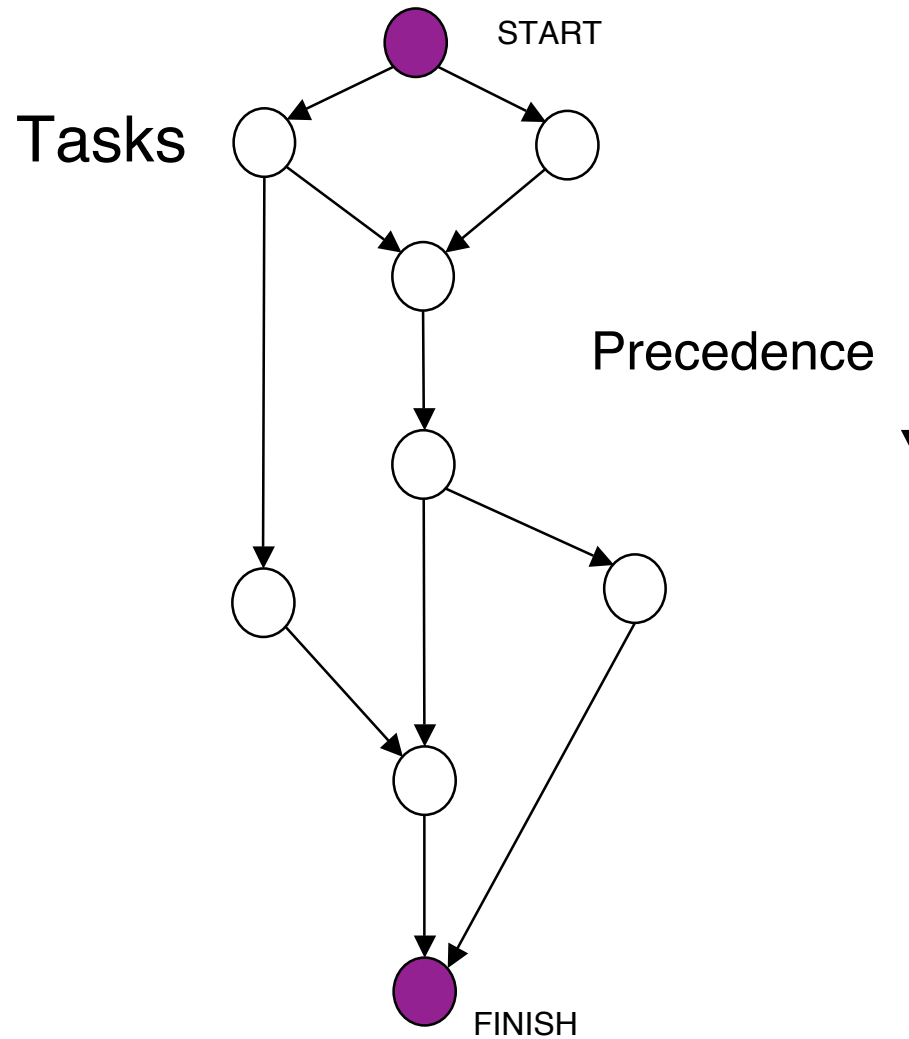
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- "Program Evaluation and Review Technique"
- U.S. Navy, 1957

# PERT chart (Similar to UML Activity Diagram)

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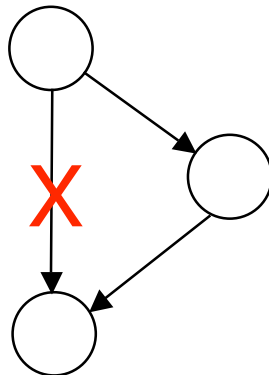


# To Build a PERT chart

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- List all the tasks.
- For each tasks:
  - List the tasks that must (immediately) precede that task
  - Remove *implied* dependencies (called the "transitive reduction" of the graph)



# Tasks in Building a House: What are likely required orders?

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- Install roofing
- Install interior electrical
- Buy materials
- Excavate
- Build outside wall
- Install interior plumbing
- Install exterior siding
- Paint interior
- Install flooring
- Lay foundation
- Obtain permits
- Install exterior electrical
- Install exterior doors and fixtures
- Paint exterior
- Survey land
- Install interior doors and fixtures
- Install wallboard
- Install exterior plumbing

# Task durations and dependencies

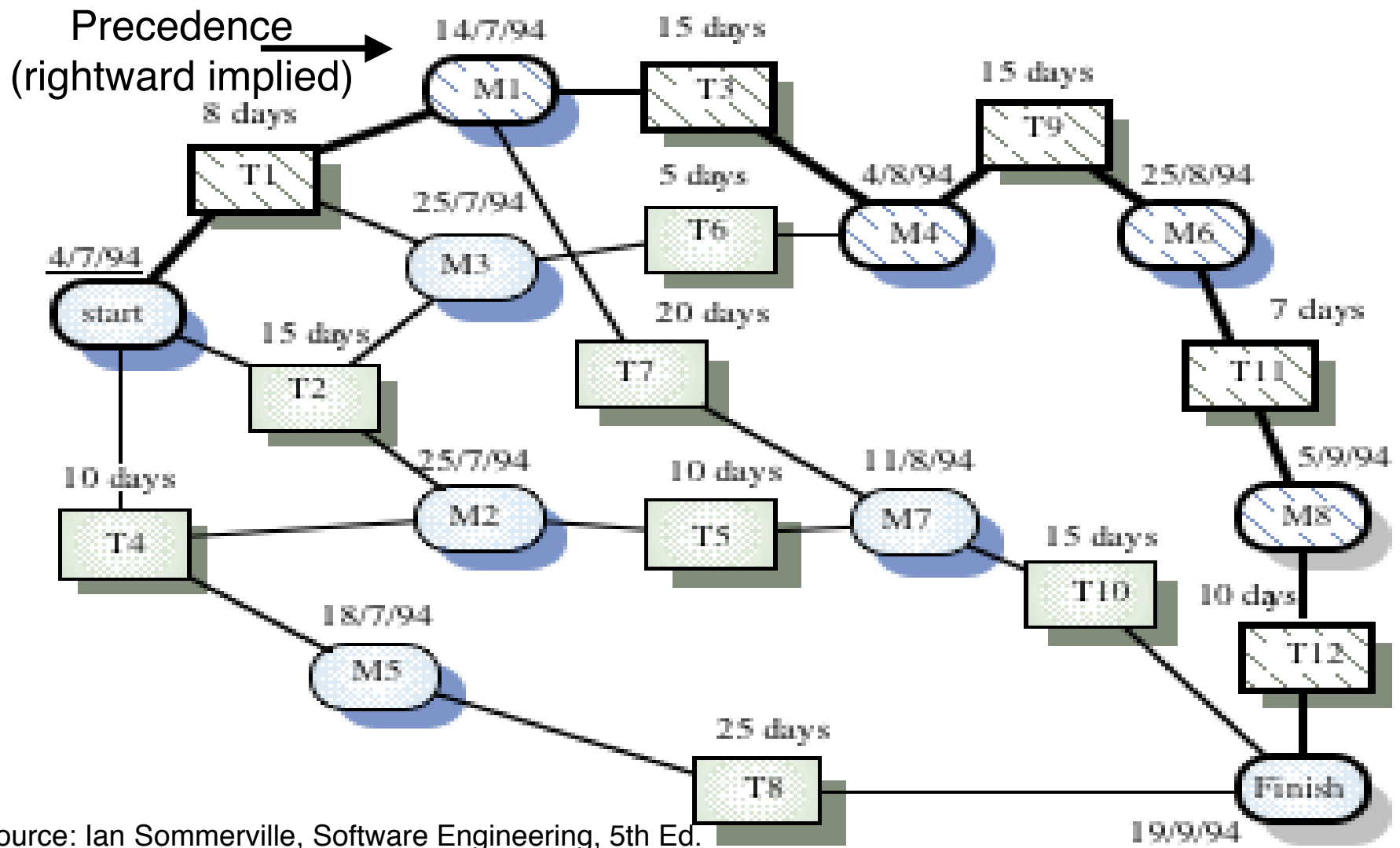
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<b>Task</b>	<b>Duration (days)</b>	<b>Dependencies</b>
T1	8	
T2	15	
T3	15	T1
T4	10	
T5	10	T2, T4
T6	5	T1, T2
T7	20	T1
T8	25	T4
T9	15	T3, T6
T10	15	T5, T7
T11	7	T9
T12	10	T11

source: Ian Sommerville, Software Engineering, 5th Ed.

# Task network with Milestones (ovals)



source: Ian Sommerville, Software Engineering, 5th Ed.

# PERT -> Gantt

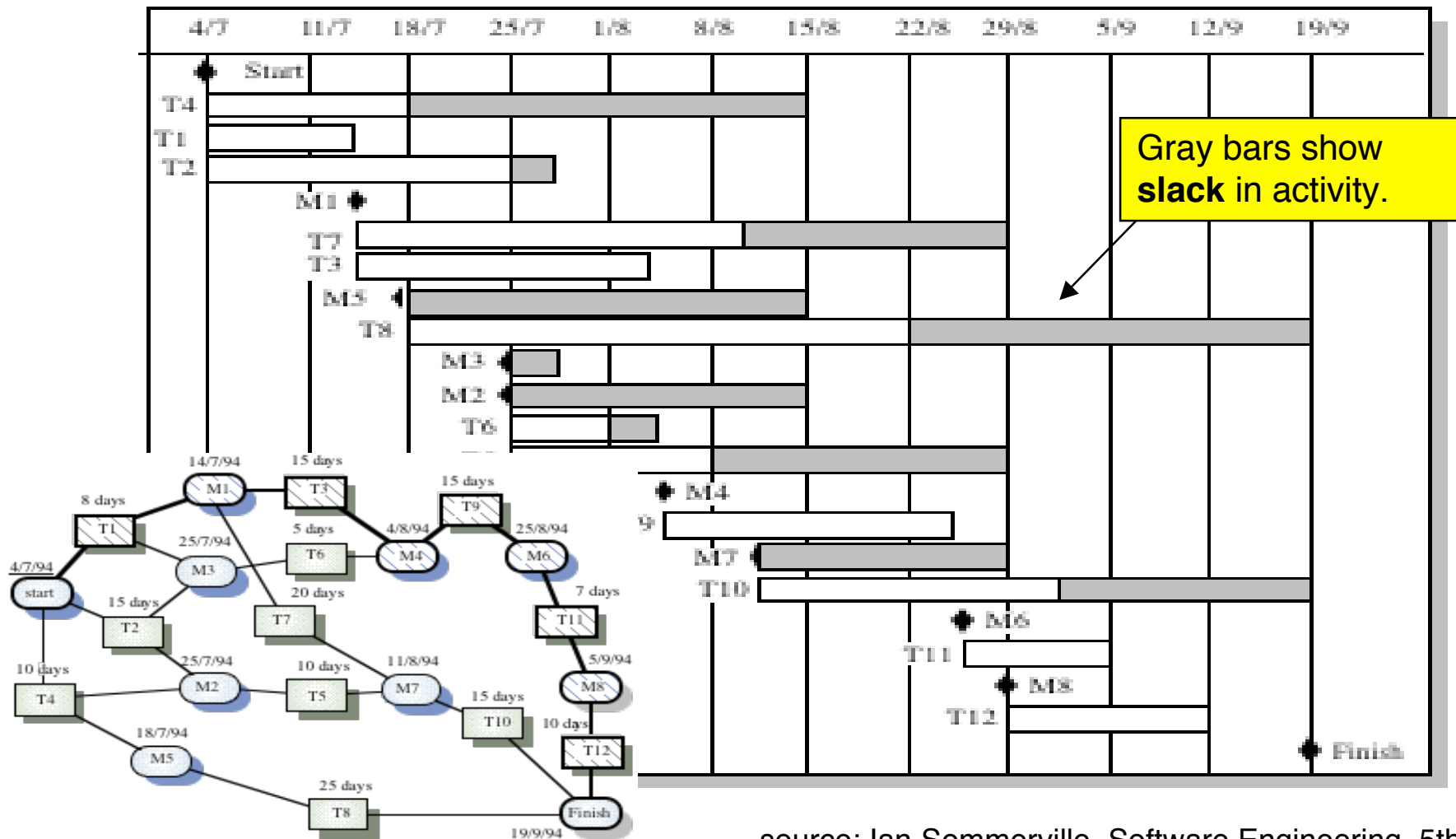
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- As we saw, PERT enforces certain **precedence constraints**.
- Other kinds of constraints:
  - **Staff assignment** (task -> person) and loading constrains number of activities that can go on concurrently.
  - **Resource availability** further constrains time at which various activities can happen.
- The **Gantt chart** (or schedule) shows a **particular** scheduling of the tasks, subject to all of the constraints.

# Gantt Chart from PERT (inset)

(Timeline chart, Timing chart, Schedule)



source: Ian Sommerville, Software Engineering, 5th Ed.



# Henry L. Gantt (1861-1919)

([http://accel-team.com/scientific/scientific\\_04.html](http://accel-team.com/scientific/scientific_04.html))

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- well-known pioneer in the early days of scientific management
- remembered for his humanizing influence on management, emphasizing the conditions that have favorable psychological effects on the worker
- "The Gantt chart for which he will be remembered, is a visual display chart used for scheduling, which is based on time, rather than quantity, volume or weight."

# Critical Path

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- A "critical path" on a PERT chart is one in which the **sum of durations** of the tasks on the path equals the **shortest** overall project-completion time.
- The critical path is shaded on the preceding diagram.
- PERT is also called CPM (Critical Path Method)

## What is the Critical Path in Building your House, given the number of days required as shown?

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- Install roofing (4)
- Install interior electrical (2)
- Buy materials (5)
- Excavate (7)
- Build outside wall (5)
- Install interior plumbing(4)
- Install exterior siding (3)
- Paint interior (2)
- Install flooring (2)
- Lay foundation (2)
- Obtain permits (24)
- Install exterior electrical (3)
- Install exterior doors and fixtures (2)
- Paint exterior (1)
- Survey land (1)
- Install interior doors and fixtures (2)
- Install wallboard (2)
- Install exterior plumbing (1)

# Exercise

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- List as many ways you can for shortening the critical path in a set of tasks.

# Staff Loading & Resources

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- Staff loading and resource constraints are two aspects of scheduling not represented directly on PERT charts.
- Generally they have the effect of providing added sequencing, and therefore lengthening overall project time.

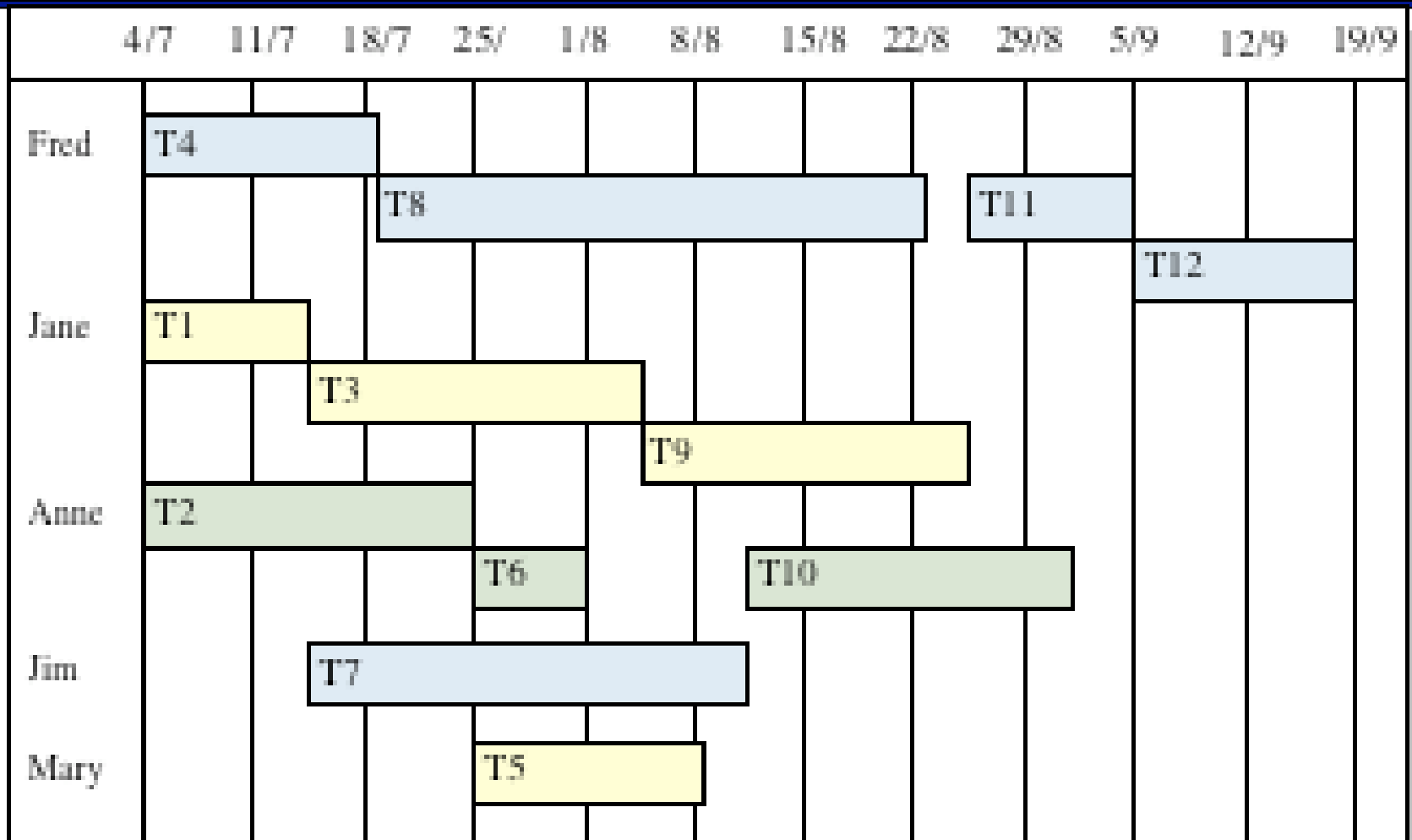
# Staff Loading & Resources

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- Staff loading refers to:
  - Some tasks can be assigned only to certain staff members, based on specialized skills.
  - A given staff member can only do so much at a time.
  - Staff members differ in their productivity on a given task.

# Staff loading



source: Ian Sommerville, Software Engineering, 5th Ed.

# Staff Loading & Resource Constraints

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- Resource constraints refers to certain resources being needed for certain tasks, but being limited in the number of tasks they can support concurrently.
- Resources include:
  - Machines, workstations, storage units
  - Rooms, offices

# Exercise

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- How Do Constraints Differ from Precedence Relationships?