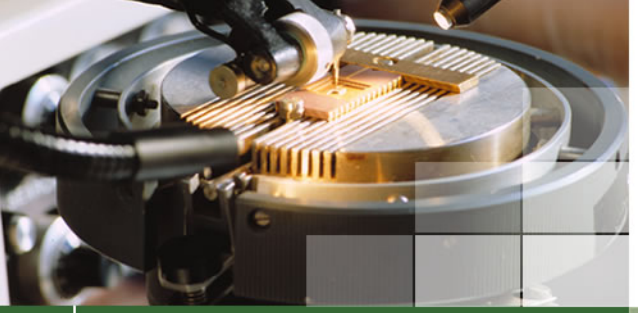

POLITECNICO DI MILANO

Dipartimento di
Elettronica e Informazione

Planning and Managing Software Projects 2013-14

Class 11

Scheduling (Practice)

Fundamentals, Techniques, Optimization

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Credits

- This slides are partially based on CEFRIEL's slides for PMI Certification and largely based on Prof. John Musser class notes on "Principles of Software Project Management"
- Original slides are available at http://www.projectreference.com/
- Reuse and republish permission was granted

Today

- **Class 7 and 8 Review**
- Critical Path Method
- Mythical Man-Month

Class 7 and 8 Review

- WBS
- Estimation

WBS

- Types: Process, Product, Hybrid
- Formats: Outline or graphical organizational chart
- High-level WBS does not show durations and dependencies
- WBS becomes input to many things, esp. schedule
- What hurts most is what's missing → 100% Rule:
  - the sum of the work on the children must be equal to 100% of the work referred by the parent
  - All work inside the scope of the project is in the WBS
  - No work outside the scope of the project is in the WBS

Estimation

- Estimation is the process of determining the effort and the duration of activities

- Setting realistic expectations is the single most important task of a project
- "Unrealistic expectations based on inaccurate estimates are the single largest cause of software failure."
  - Futrell, Shafer, Shafer, "Quality Software Project Management"

Estimation

- Use multiple methods if possible
  - This reduces your risk
  - If using “experts”, use two
- History is your best ally
  - Especially when using Function Points, LOC (Lines of Code), …
- Get buy-in
  - Involve who will do the work in the estimation process
- Remember: estimation is an iterative process!
  - Esteems must be updated during project execution
    - First esteems are usually very wrong w.r.t real effort spent during the project execution
    - Last esteems are usually more accurate
- Know your “presentation” techniques
  - Provide esteems ranges where possible
  - Provide different esteems with different probabilities

Estimation

- Bottom-up
  - More work to create but more accurate
  - Often with Expert Judgment at the task level (buy-in)
- Top-down
  - Used in the earliest phases
  - Usually as is the case with Analogy or Expert Judgment
- Analogy
  - Comparison with previous project: formal or informal
- Expert Judgment
  - Via staff members who will do the work
  - Most common technique along with analogy
  - Best if multiple ‘experts’ are consulted
- Parametric Methods
  - Know the trade-offs of: LOC & Function Points

Today

- Class 7 and 8 Review
- **Critical Path Method**
- Mythical Man-Month

Critical Path Method (CPM)

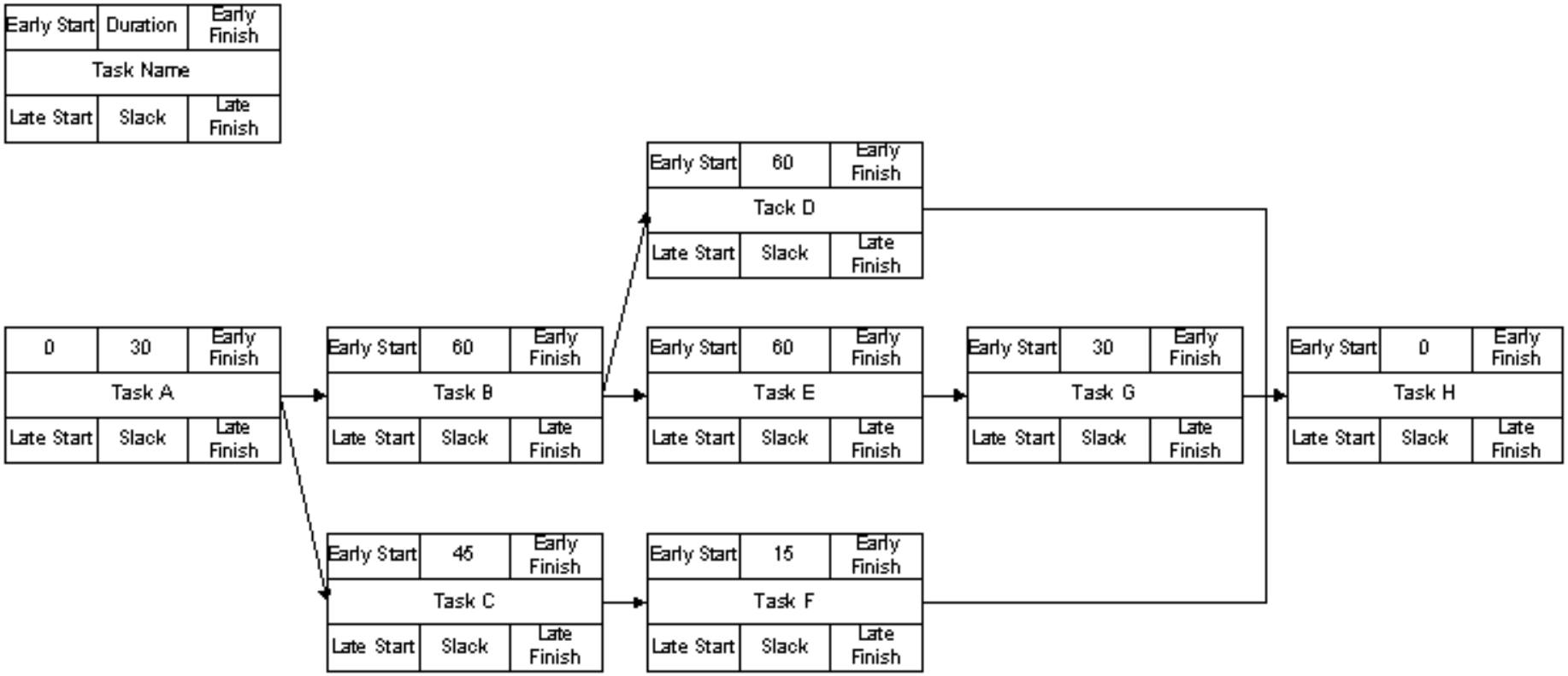
- The process for determining and optimizing the critical path
- Should be done in conjunction with the project manager & the functional manager
- Based upon a **2-passes approach**
  - **Forward Pass** and **Backward Pass**
- As result of the 2-passes, the critical path becomes evident

(This exercise is part of course exams!)

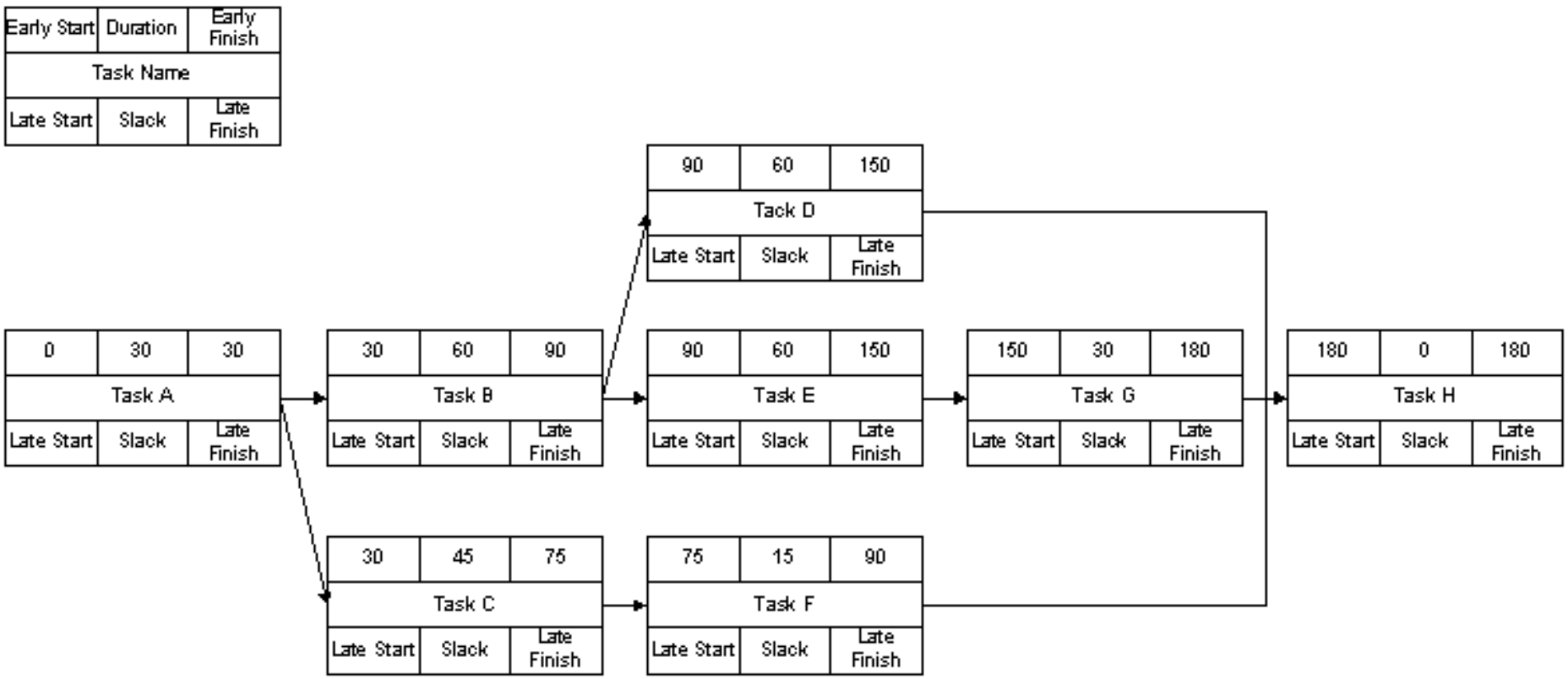
CPM: Forward Pass

- Used to determine early start (ES) and early finish (EF) times for each task
- Work from left to right
- Adding times to each node and each path
- Rule: when several tasks converge, the ES for the next task is the **largest** of preceding EF times

CPM: Example: Forward (part 1)



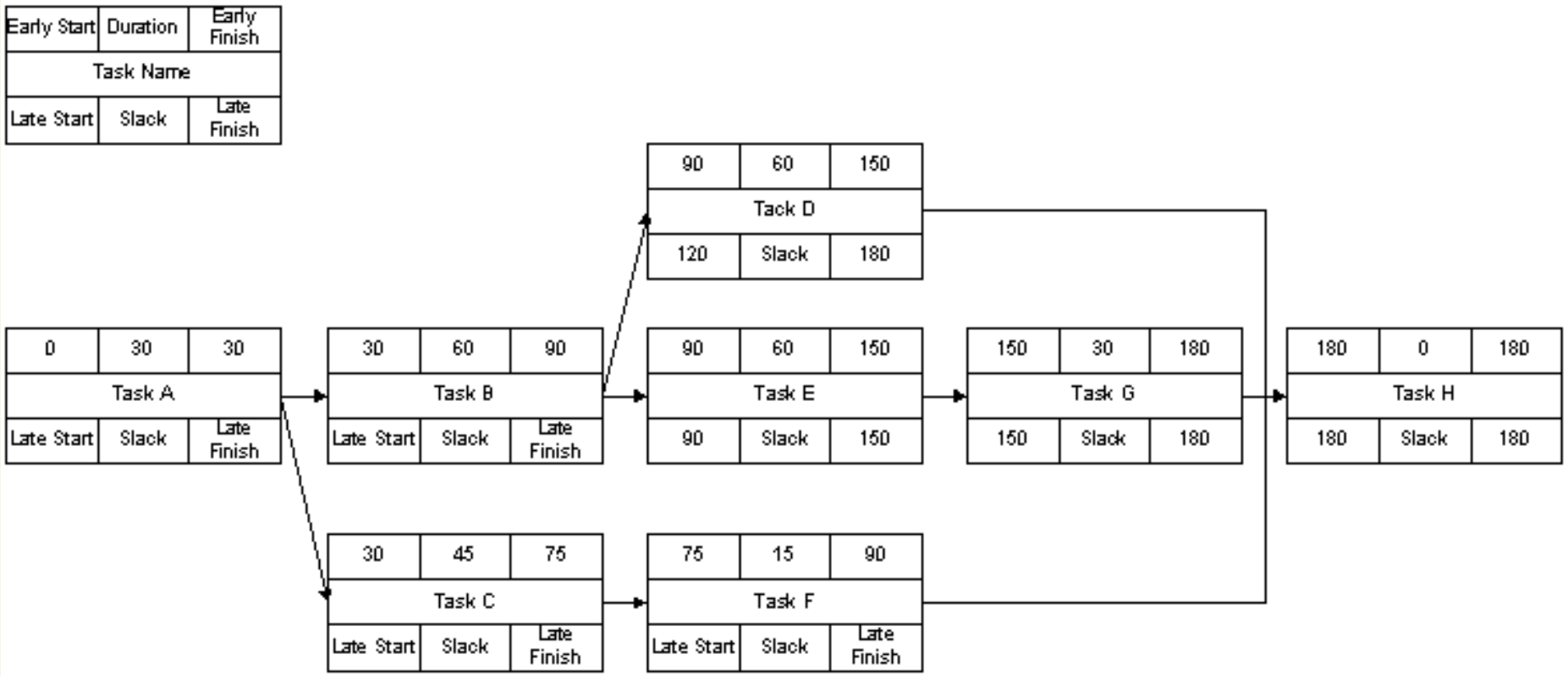
CPM: Example: Forward (part 2)



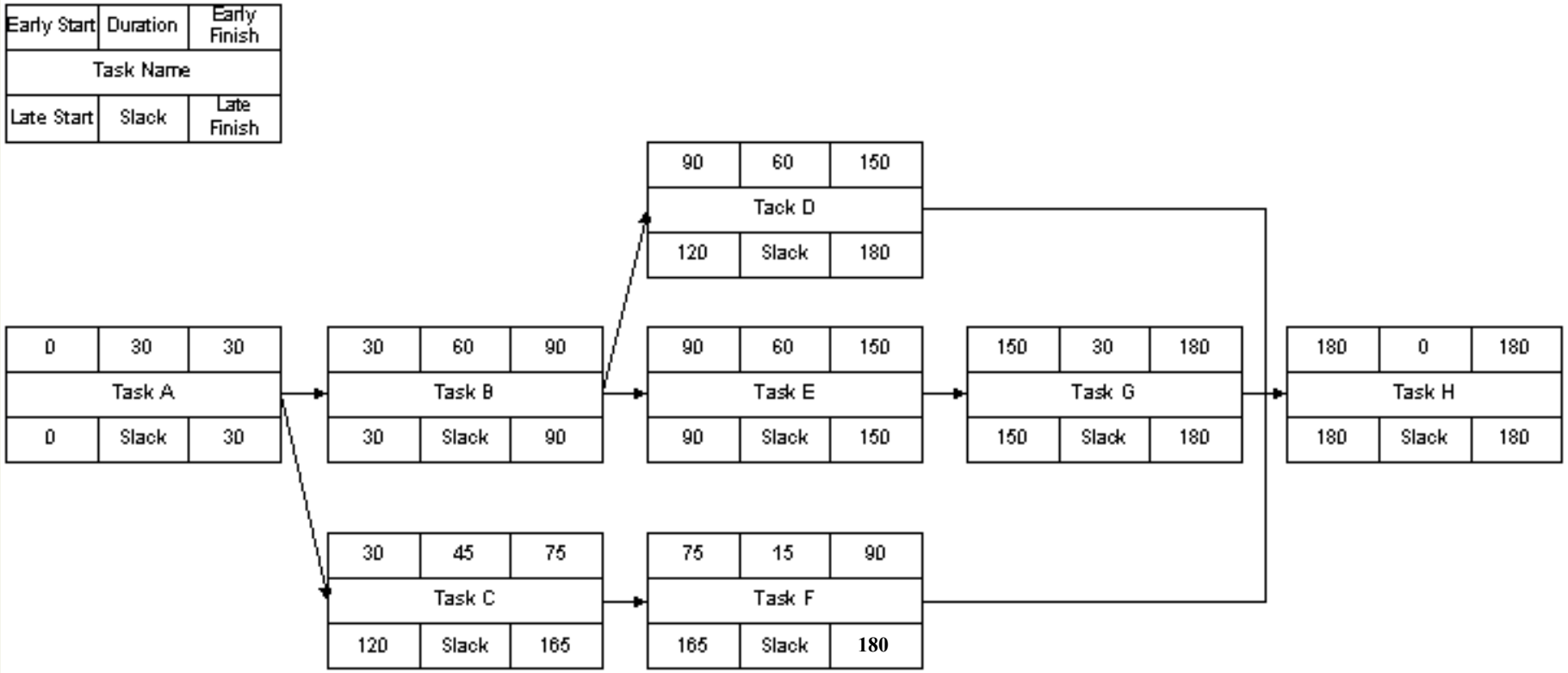
CPM: Backward Pass

- Used to determine the late finish (LF) and late start (LS) times
- Start at the end node and move backward left
- Subtract duration from connecting node's earliest start time
- Rule: when several tasks converge, the last finish for the previous task is the **smallest** of following last start times

CPM: Example: Backward (part 1)



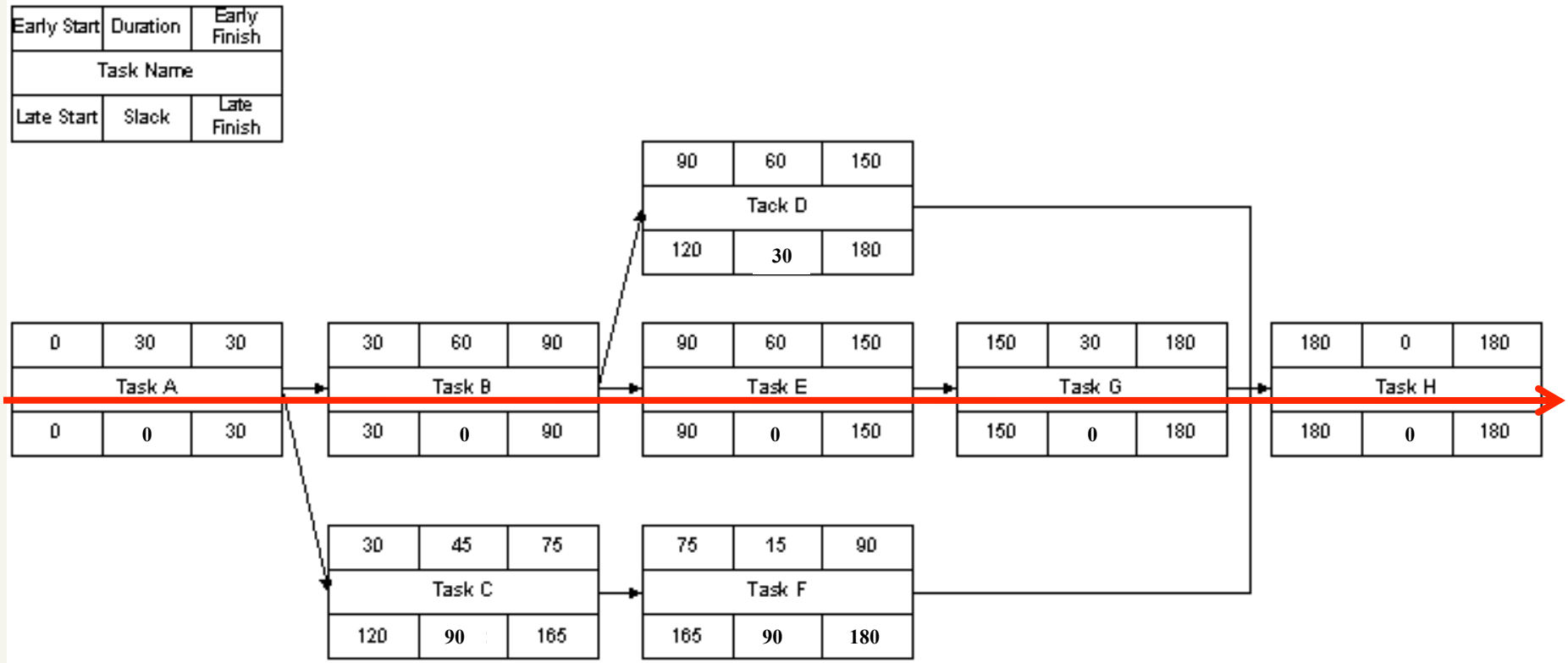
CPM: Example: Backward (part 2)



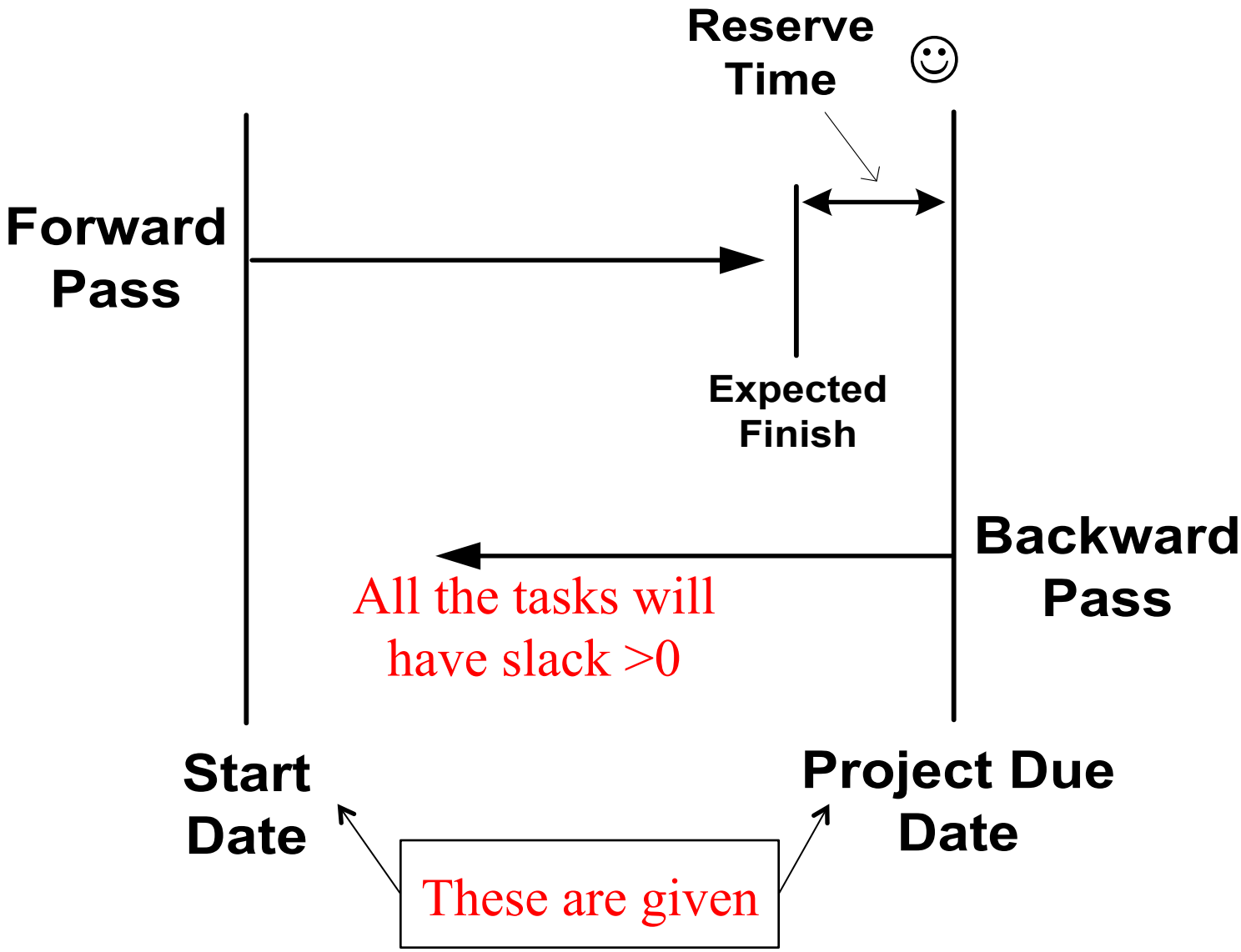
CPM: Example: Compute Slacks and Identify Critical Paths

Slack = Late Finish – Early Finish = Late Start – Early Start

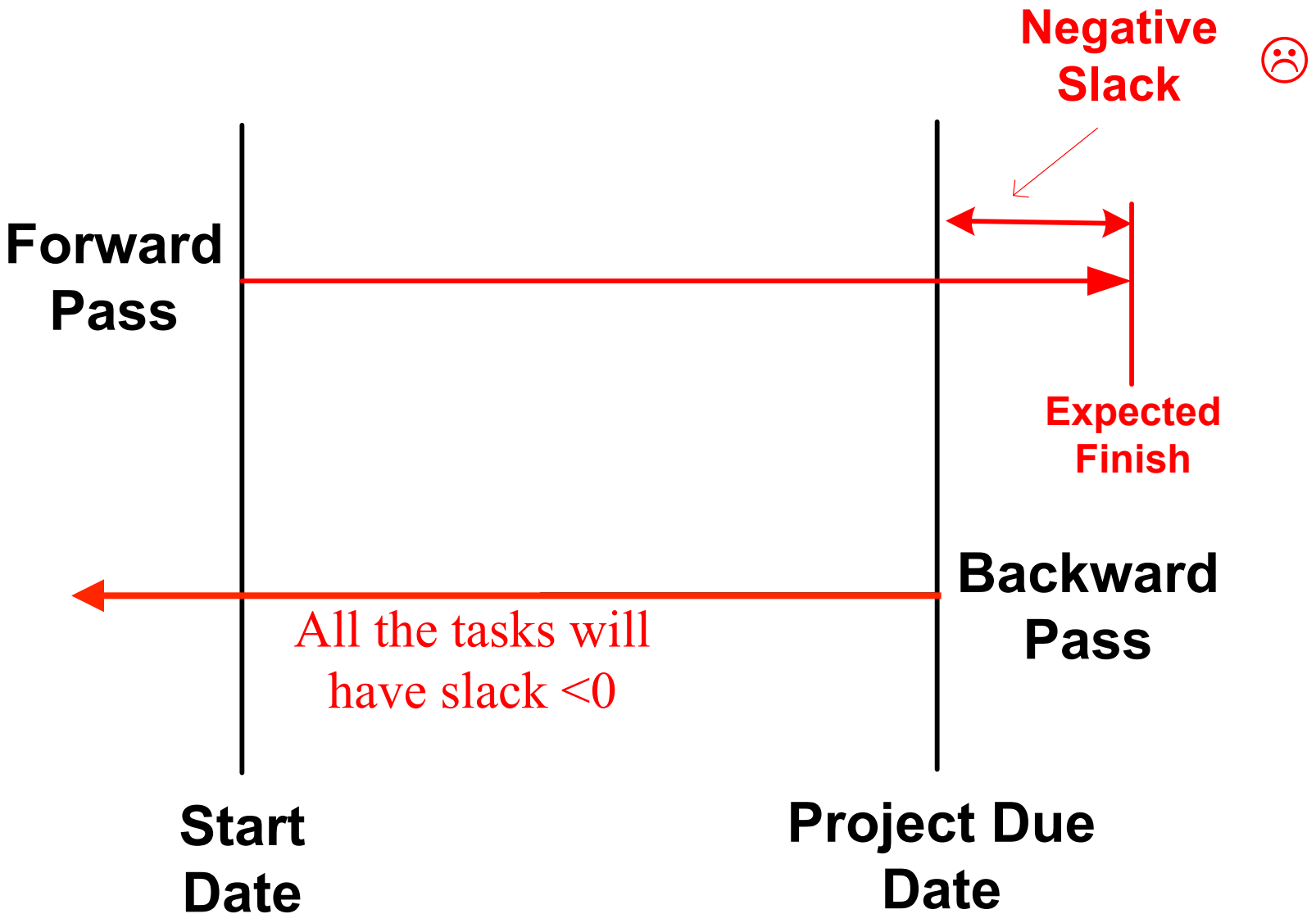
Critical Path: all tasks with slack = 0



CPM and Slack & Reserve



CPM and Slack & Reserve



CPM: Advantages and Disadvantages

- Advantages
  - Show precedence well
  - Reveal interdependencies not shown in other techniques
  - Ability to calculate critical path
  - Ability to perform "what if" exercises

- Disadvantages
  - Default model assumes resources are unlimited
    - You need to incorporate this yourself (Resource Dependencies) when determining the "real" Critical Path
  - Difficult to draw and to read on large projects

PERT

- **P**rogram **E**valuation and **R**eview **T**echnique
- Based on idea that estimates are uncertain
  - Therefore uses duration ranges
  - And the probability of falling to a given range
- First is done on each task, then at project level

For each task:

1) Start with 3 estimates for each task
   - Optimistic
     - Would likely occur 1 time in 20
   - Most likely
     - Modal value of the distribution
   - Pessimistic
     - Would be exceeded only one time in 20

PERT Formula

2) Calculate the expected time of each task:

$$t_e = \frac{a + 4m + b}{6}$$

where

t_e = expected time

a = optimitistic time estimate

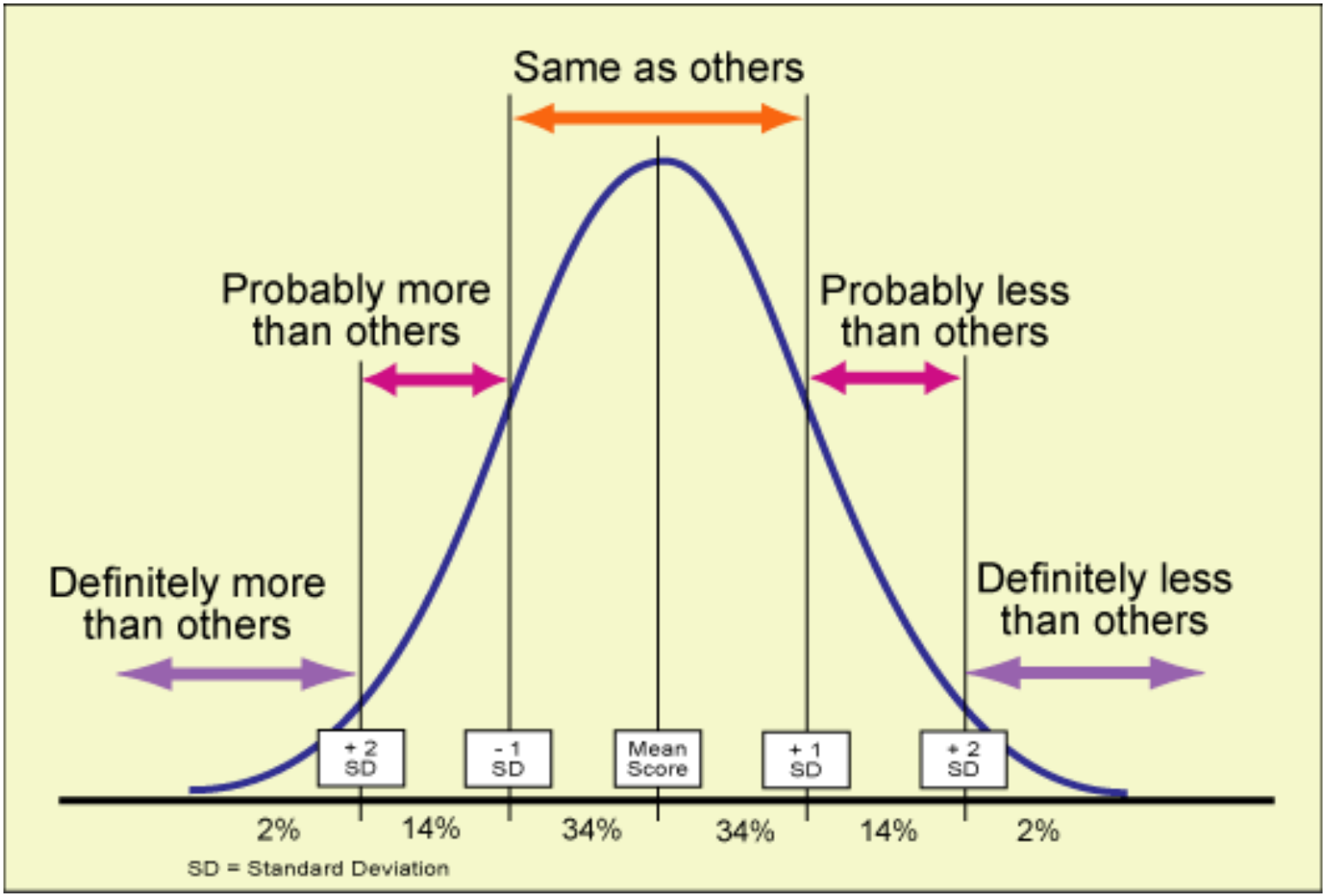
m = most likely time estimate

b = pessimistic time estimate

3) Calculate the standard deviation of each task:

$$s_i = \frac{b_i - a_i}{6}$$

MEMO: bell curve (normal distribution)



[source : http://www.fontys.nl/lerarenopleiding/tilburg/engels/Toetsing/bell_curve2.gif]

PERT Example on a single task

- Planner 1 (P1) and Planner 2 (P2) are asked to estimate m, a and b for a given task

	Planner 1	Planner 2
m	10d	10d
a	9d	9d
b	12d	20d

- Calculate estimated time and standard deviation

	Planner 1	Planner 2
PERT time	10.2d	11.5d
Std. Dev.	0.5d	1.8d

- With the (34%+34%=) 68% of probability
  - Planner 1 says that task will last between 9.7 to 10.7 days
  - Planner 2 says that task will last between 9.7 to 13.3 days

PERT Formula

For the whole project:

1) Update the network diagram with the expected time of each task

2) Calculate the critical path with the CPM method

→ Result is the expected time of the whole project

3) For each task in the critical path, calculate the standard deviation of the project as:

$$s_{cp} = \sqrt{s_1^2 + s_2^2 + \ldots + s_n^2}$$

PERT: Advantages and Disadvantages

- Advantages
  - Accounts for uncertainty
- Disadvantages
  - Time and labor intensive
  - Assumption of unlimited resources is big issue
  - Lack of functional ownership of estimates
  - Mostly only used on large, complex project
- Get PERT software to calculate it for you

CPM vs. PERT

- Both use Network Diagrams
- CPM: deterministic
- PERT: probabilistic
- CPM: one estimate, PERT, three estimates
- PERT is infrequently used

Today

- Class 7 and 8 Review
- Critical Path Method
- **Mythical Man-Month**

Mythical Man-Month

- Book: "The Mythical Man-Month"
  - Author: Fred Brooks
  - http://www.amazon.com/exec/obidos/ASIN/0201835959/qid%3D1022856693/sr%3D1-1/ref%3Dsr%5F1%5F1/103-4280067-9687806
  - http://my.safaribooksonline.com/0201835959
- "The classic book on the human elements of software engineering"
- First two chapters are full of terrific insight (and quotes)

Mythical Man-Month

- "Cost varies as product of men and months, progress does not"
- "Hence the man-month as a unit for measuring the size of job is a dangerous and deceptive myth"
- "Good cooking fakes time. If you are made to wait, it is to serve you better, and to please you - Menu of Restaurant Antoine, New Orleans -"

Mythical Man-Month

- Why is software project disaster so common?
  1. Estimation techniques are poor & assume things will go well (an ‘unvoiced’ assumption)
  2. Estimation techniques fallaciously confuse effort with progress, hiding the assumption that men and months are interchangeable
  3. Because of estimation uncertainty, managers lack courteous stubbornness of Antoine's chef
  4. Schedule progress is poorly monitored
  5. When schedule slippage is recognized, the natural response is to add manpower. Which, is like dousing a fire with gasoline

Mythical Man-Month

- Optimism
  - "All programmers are optimists"
  - 1st false assumption: "all will go well" or "each task takes only as long as it 'ought' to take"
  - **The Fix: Consider the larger probabilities**
- Cost (overhead) of communication (and training)
  - Overhead: n(n-1)/2
  - How long does a 12 month project take?
    - 1 person: 12 month
    - 2 persons = 12/2 + 2(2-1)/2 = 6+1 = 7
      - 2 man-month extra
    - 3 persons = 12/3 + 3(3-1)/2 = 4 + 3 = 7
      - 9 man-months extra
    - 4 persons = 12/4 + 4(4-1)/2 = 3 + 6 = 9
  - **The Fix: don't assume adding people will solve the problem, add people in well-separated tasks**

Mythical Man-Month

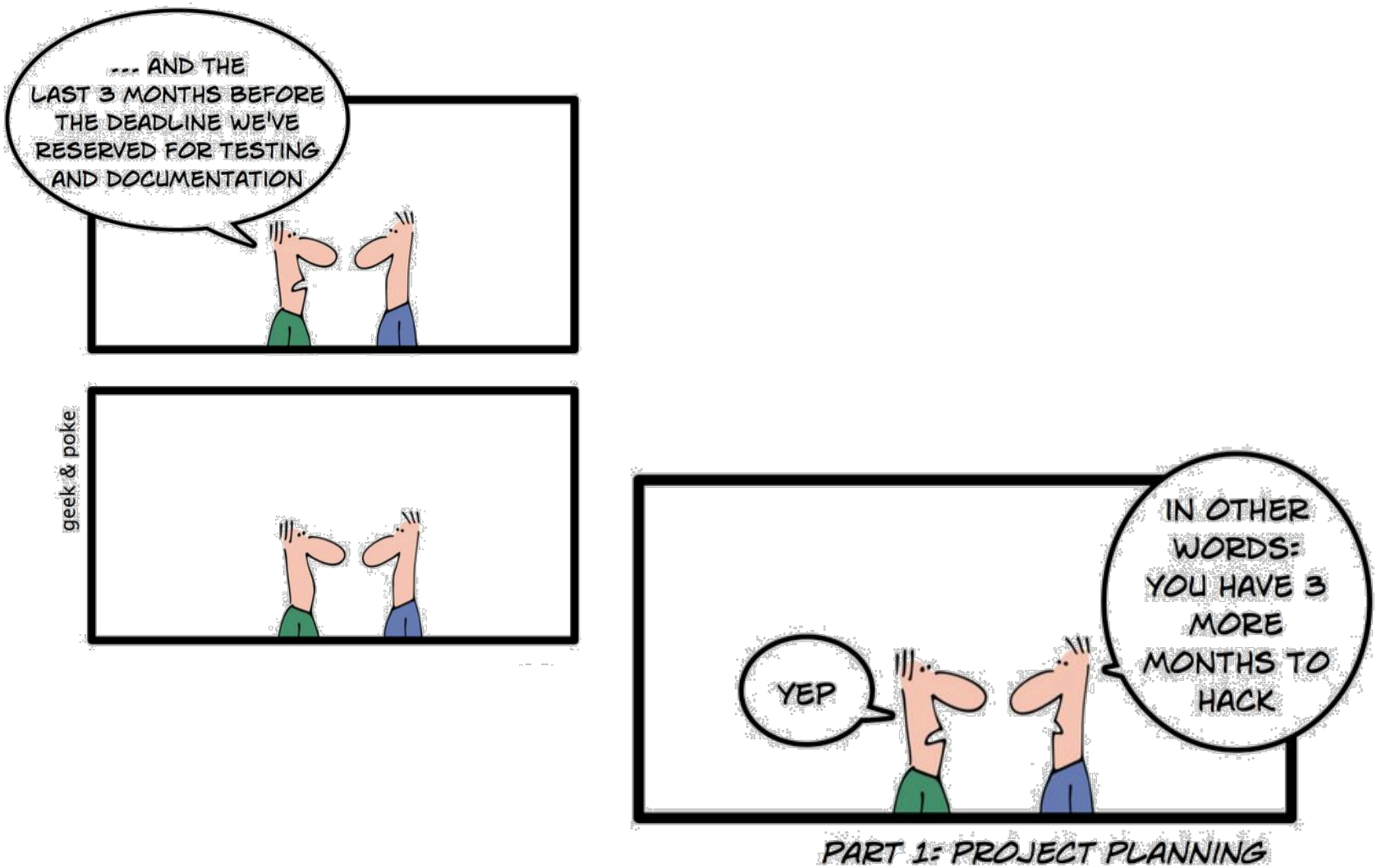
- Sequential nature of the process
  - "The bearing of a child takes nine months, no matter how many women are assigned"
- What is the most mis-scheduled part of process?
  - Testing
- Why is this particularly bad?
  - Occurs late in process and without early-warning
  - Higher costs
- **The Fix: Allocate more test time**
  - **Understand task dependencies, test and fix before use**

Mythical Man-Month

- Reliance on hunches and guesses
  - What is 'gutless estimating'?
    - Urgency of Client causes Optimistic Estimates
      - E.g., omelet and chef analogy
      - http://my.safaribooksonline.com/0201835959/ch02lev1sec4
    - Regardless of Urgency, tasks require the same amount of time
- The myth of additional manpower
  - Brooks Law
  - "Adding manpower to a late project makes it later"
    - http://en.wikipedia.org/wiki/Brooks%27s_law

Mythical Man-Month

- Q: "How does a project get to be a year late"?
  - A: "One day at a time"
- Studies
  - Each task: twice as long as estimated
  - Only 50% of work week is real coding
    - The rest 50% is communication, negotiation, documentation, debugging, …
- **The Fixes**
  - Consider the 50% not-coding time
  - Define clearly measurable milestones
    - No "fuzzy" milestones
  - Reduce the role of conflict among persons
  - Identify the "true status" of a task
    - It's impressive how much effort is needed to move a 90% done task to a 100% done task


--- AND THE LAST 3 MONTHS BEFORE THE DEADLINE WE'VE RESERVED FOR TESTING AND DOCUMENTATION
geek & poke
YEP
IN OTHER WORDS: YOU HAVE 3 MORE MONTHS TO HACK
PART 1: PROJECT PLANNING

Questions?