CSE 403
Lecture 25

Scheduling and Planning a Large Project

Reading:

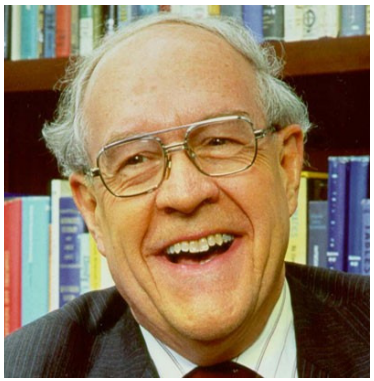
The Mythical Man-Month, Ch. 2, by F. Brooks

slides created by Marty Stepp
http://www.cs.washington.edu/403/

Revisited: Software is hard

- Historically, ~ 85% of software projects "fail." Why?
  - management sets unrealistic expectations; devs don't correct them
  - overestimating the positive impact of shiny new tools and hardware
  - hired developers based on availability despite warning signs
  - personality conflicts between developers
  - changes in rate structure requirements in middle of work
  - one delay causes another (dev delay leads to test delay, etc.)
  - hacks and shortcuts
  - developers end up working "death marches" (6-day, 10-hour weeks)
  - overestimating how nearly done you are ("I'm 90% there!")
  - software written doesn't match the spec
  - developer time taken away by other tasks
  - tons of bugs come out in testing
  - developers don't listen to testers; ignore severity of bugs reported
  - management breaking promises (bonuses, time off, etc.)

Why do projects fail?



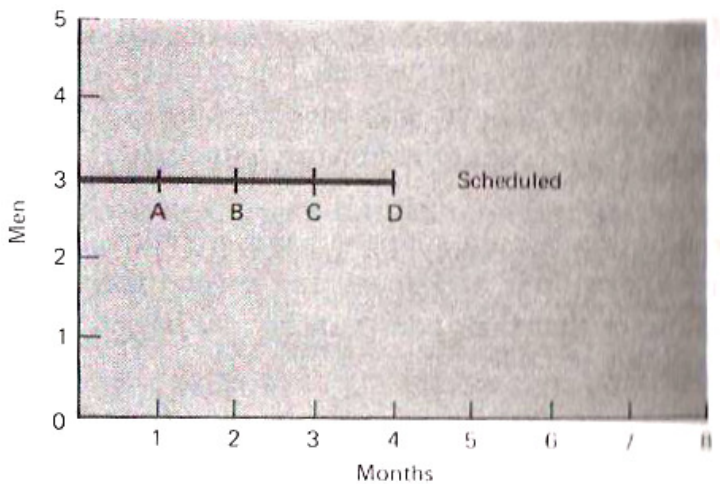
- **Fred Brooks:** Turing Award-winning Harvard professor; expert on software engineering.
  - managed development of IBM System/360
  - author of *The Mythical Man-Month*

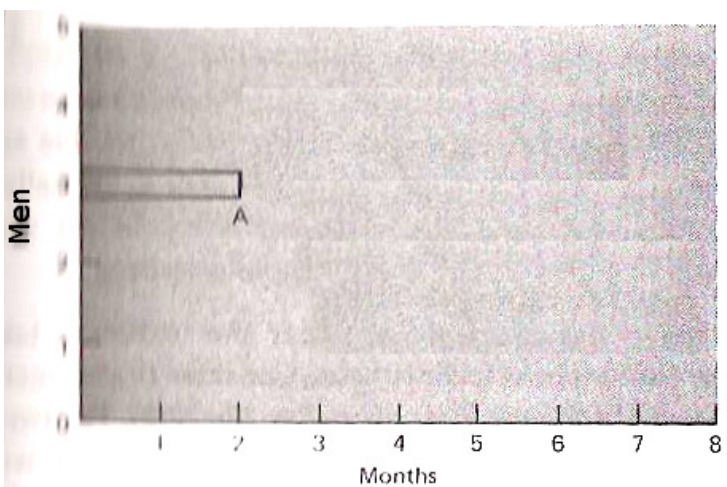
- Brooks: "More programming projects have gone awry for lack of calendar time than for all other causes combined."

- But why do projects finish late?
  - How can we foresee/predict this happening?
  - What (if anything) can we do about it?

A late software project

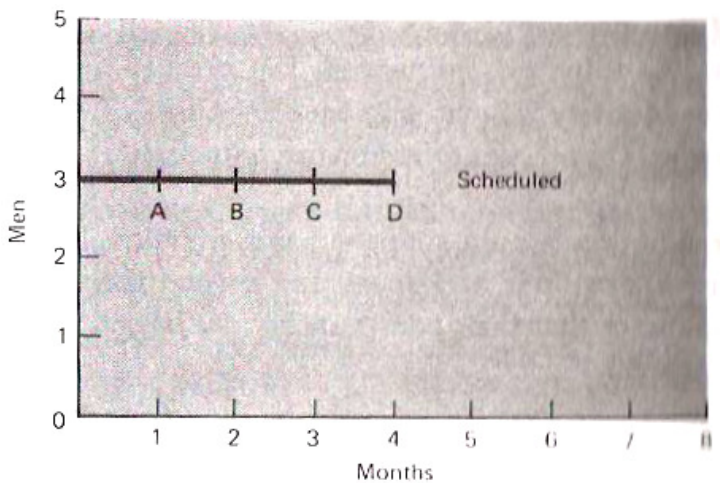
- In the graphs, the project was supposed to reach milestone A in 1 month (left), but in fact it took 2 months (right).
  - How should this delay be interpreted?
  - What are the options facing the project's manager?
  - Should the manager add extra people to the development team to make up for the delay? If so, how many and why?

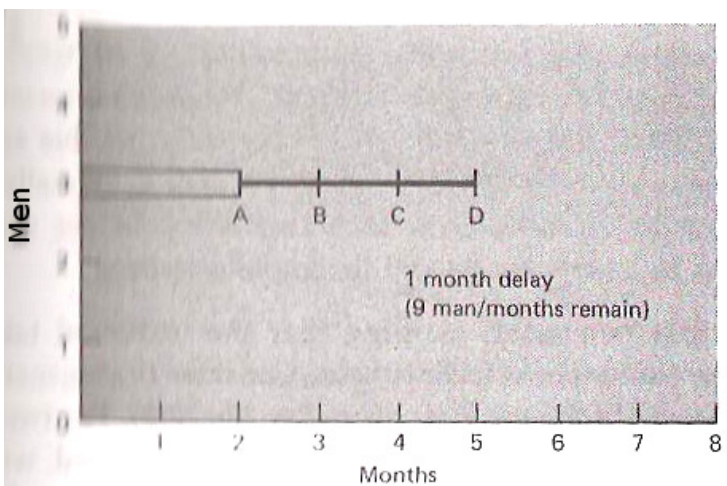




Interpretation #1

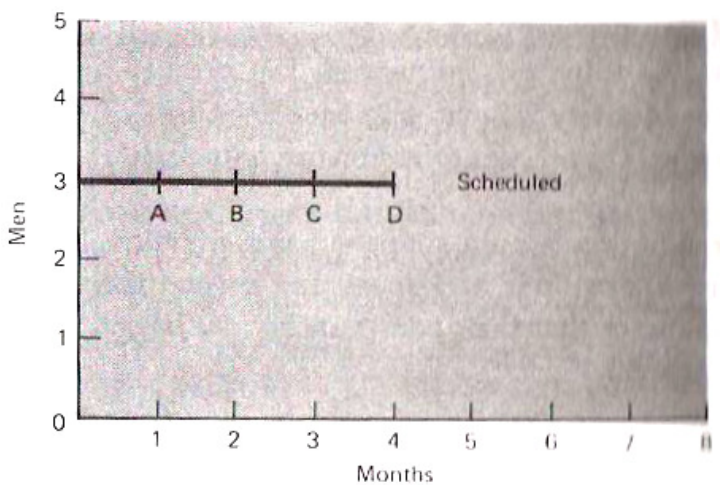
- *Only Part A was misestimated.*
  So the overall project will be 1 month late. (at right)
  - If the assumption is valid:
    - 9 man-months of work remain
    - / 2 actual months remain in which to do it
    - = 4.5 people will need to work each month
    - **so add 2 workers to the existing 3.**

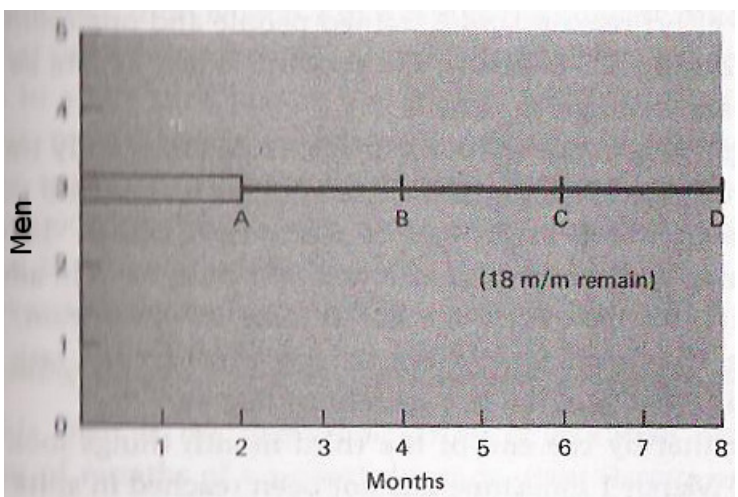




Interpretation #2

- *The whole project estimate was low.*
  So the project will take twice as long as expected. (at right)
  - If the assumption is valid:
    - 18 man-months of work remain
    - / 2 actual months remain in which to do it
    - = 9 people will need to work each month
    - **so add 6 workers to the existing 3.**

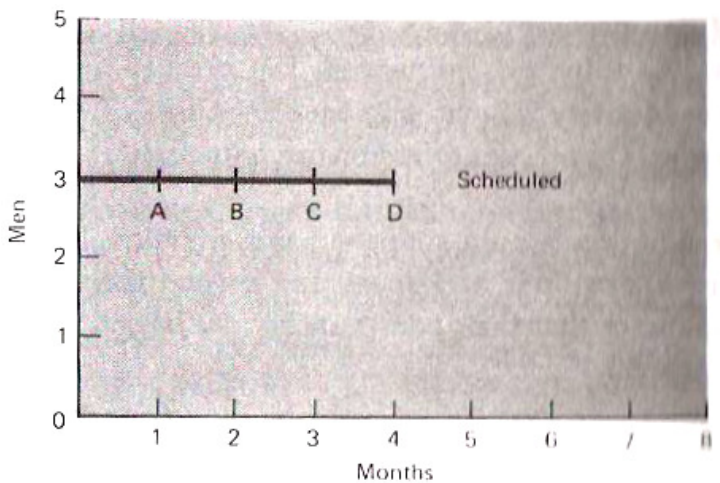


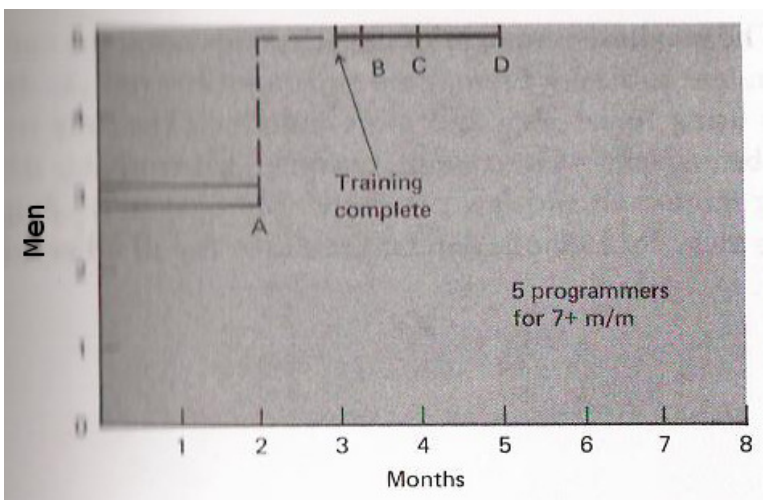


The Mythical Man-Month

- If we assume the interpretation #1 was correct:
  - We must account for delays in training the new workers
  - We must partition the job into 5 pieces, to be integrated later

  What is **"Brooks' Law"**?
  - "Adding manpower to a late software project makes it later."
    -- *The Mythical Man-Month*





Of Months and Men

- Men/women and months are not interchangeable! When you add workers, the following costs occur:
  - must repartition the work
  - must train the new workers
  - must increase intercommunication

- What is Brooks' suggested schedule?
  - 1/3 for design
  - 1/6 for coding
  - 1/4 for unit/component testing
  - 1/4 for system testing

LOC per day

- Pro developers often write **50-100 lines of code** per day.
  - How can it be so low?
  - Does it change based on the programming language used?

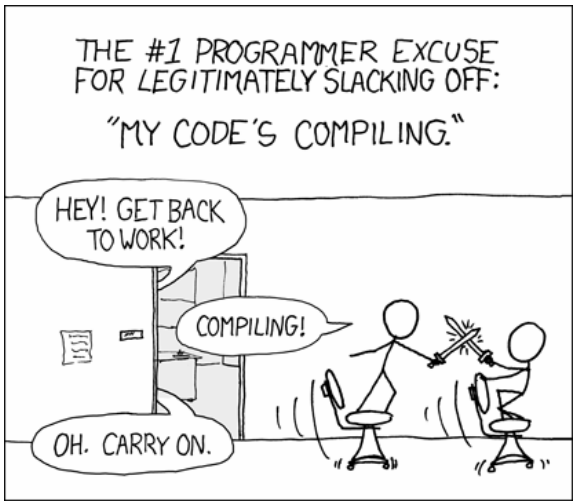
- Factors to consider:
  - Should say, 100 lines of **correct** code per day.
    - Are we counting comments? Blank lines? Modified old lines?
  - The code must be...
    - designed
    - tested
    - code reviewed
    - checked in
    - maintained / updated

Productivity

- Factors that eat up developer time:
  - learning new systems, languages, and code
  - documentation
  - testing
  - debugging (getting stuck!)
  - meetings
  - interpersonal communication
  - code reviews
  - design reviews
  - illness
  - real life (family, pets, flat tire, etc.)
  - distraction (Facebook, etc.)

Measuring productivity

- Ways LoC can be useful:
  - when measured in the same language
  - with the same developer
  - over a long period of time



- Variations
  - Include comments / blank lines in LoC?

- Other ways to measure productivity, besides LoC:
  - LoC per month
  - "function points"
  - "eLoC" - substantive lines
  - check-ins

Why is estimating hard?

Why are we so bad at estimating how long a project will take?

- Programmers are optimists: "All will go well."
  - Programming = creative; building with "thought-stuff"
  - therefore, we do not usually imagine that things will go wrong
- We lack practice at measuring how long tasks will take
  - lose track of time while coding; forget how long it took
  - tend to focus on the time needed to finish "rough" untested code
- We fail to account ahead of time for:
  - bugs; sticking points (sometimes NO progress will be made)
  - design / redesign / refactoring
  - testing and debugging (both our code and others')

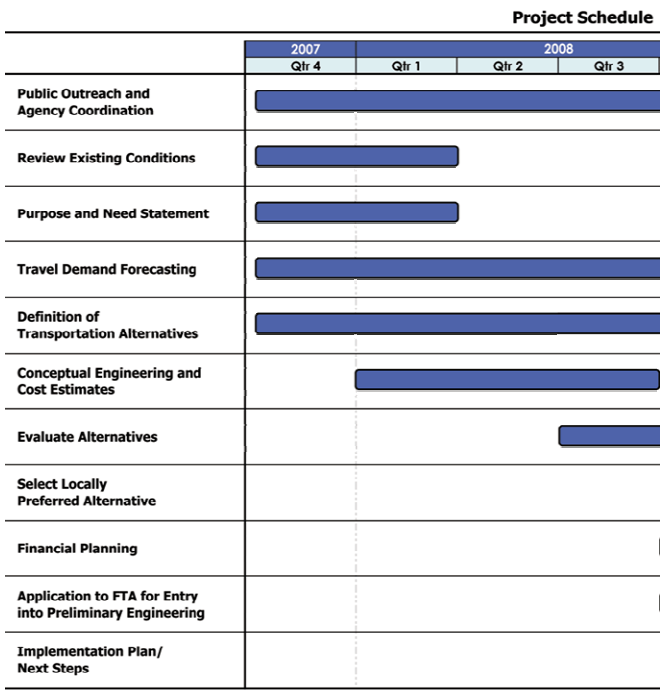
Some estimating tips

- Guess how long you think you'll actually need...
  - Then **double** (or **triple**) it.
  - Use a coarse granularity; days/weeks, not hours.

- Add time to your estimate if:
  - It involves learning any new technologies or systems.
  - It involves collaborating with others.
  - It is user-facing and therefore needs to be very robust/secure.
  - It is concurrent, network-enabled, or long-running.
  - It involves "messy" data or combining data from multiple sources.

Your project schedules

- Looking back on your initial estimated project schedules:
  - How accurate were your initial ideas?
  - In what way are they the most "off" from what you have actually spent your time doing?
  - Do you know something now that would help you to more effectively schedule a large project in the future? If so, what?



Code maintenance

- **maintenance**: Modification or repair of a software product after it has been delivered.

  fix bugs, performance, improve design, add features

- Maintenance is how developers spend much of their time.

- It's harder to maintain code than write your own new code.
  - "house of cards" phenomenon (don't touch it!)
  - must understand code written by another developer, or code you wrote at a different time with a different mindset
  - most developers dislike code maintenance...

Performing maintenance

- Maintenance comprises all phases of the software lifecycle.
  - gather requirements
  - design
  - implement (code)
  - test/debug
  - integrate
  - …

- New versions of your software are subject to all constraints that were placed on the old version, and possibly more.
  - backwards compatibility is often expected / required

Maintenance + new devs

- It is often done as an afterthought.
  - Not enough time allocated in schedule
  - You must think ahead of time how you (or someone) will maintain code later

- Maintenance is often given to junior developers.
  - "This way they'll learn the guts of the system better."
  - Senior developers don't want to work on maintenance.
  - But junior devs don't know the system or how to maintain it.

- Result: brittle code with little conceptual or design integrity; even more maintenance headaches to come.