Process

Martin Kellogg

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Today’s agenda:

- **Reading Quiz**
- Development methodologies
- Planning, estimation, and risk
- Measuring progress

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  - Why? No one actually follows these procedures to the letter

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- I'm not going to make you memorize the stages of the Waterfall method, or the tenets of Agile, or the like
  - Why? No one actually follows these procedures to the letter
- Instead, my goal in this lecture is to give you an overview of the traditional ways of organizing a software development effort and give you the vocabulary to talk about it

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e.g., the Agile manifesto

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not a guarantee - just a goal

A list of methodologies

- Waterfall
- Spiral
- Agile
- Scrum
- Extreme Programming (XP)
- “wagile”

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We’ll discuss these four - you can look up the others on your own if you’re curious

Why have a methodology at all?

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- Standardization among developers
- Shared language
- Estimation: your boss probably wants to know when you'll be able to ship!
- You implicitly have a process, whether you know it or not (and it might not be very good if you're not paying attention)

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▲

sometimes this is called an ***ad hoc*** methodology

Examples of issues with ad hoc process

- **Requirements**: Mid-project informal agreement to changes suggested by customer or manager.
- **QA**: Late detection of requirements and design issues. Test-debug-reimplement cycle limits development of new features.
- **Defect Tracking**: Bug reports collected informally.
- **System Integration**: Integration of independently developed components at the very end of the project.
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Project scope expands 25-50%

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Release with known defects

Defect cost vs. detection time

- An IBM report gives an average defect repair cost of (2008$):
  - $25 during coding
  - $100 at build time
  - $450 during testing/QA
  - $16,000 post-release

[L. Williamson. IBM Rational software analyzer: Beyond source code. 2008.]

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Bugs forgotten

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Interfaces out of sync

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Project falls further behind

A process hypothesis

- A process can **increase flexibility and efficiency** for software development.
- If this is true, an up-front investment (of resources, e.g., “time”) in process can yield greater returns later on - by avoiding the problems on the previous slide!

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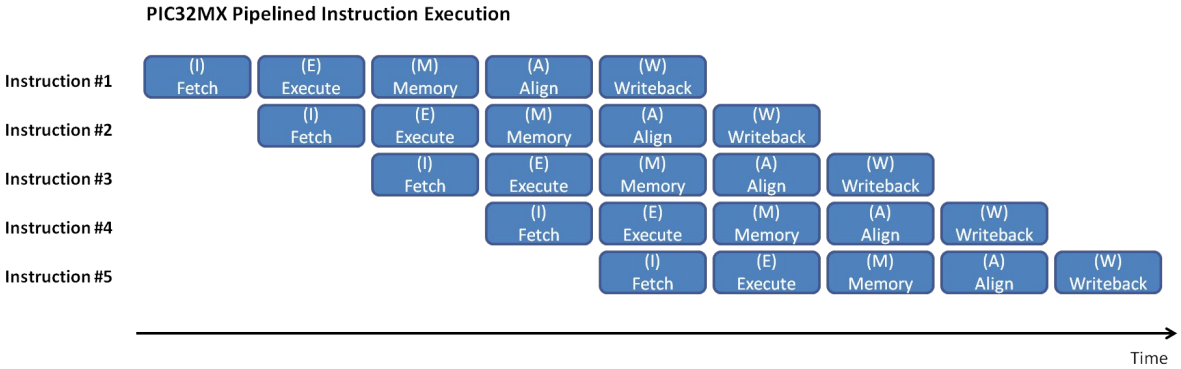
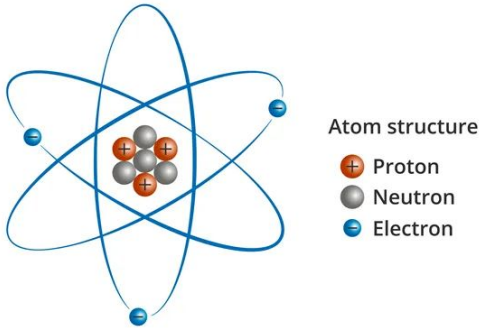
Is this realistic?
Why or why not?

Other lies you've probably been told





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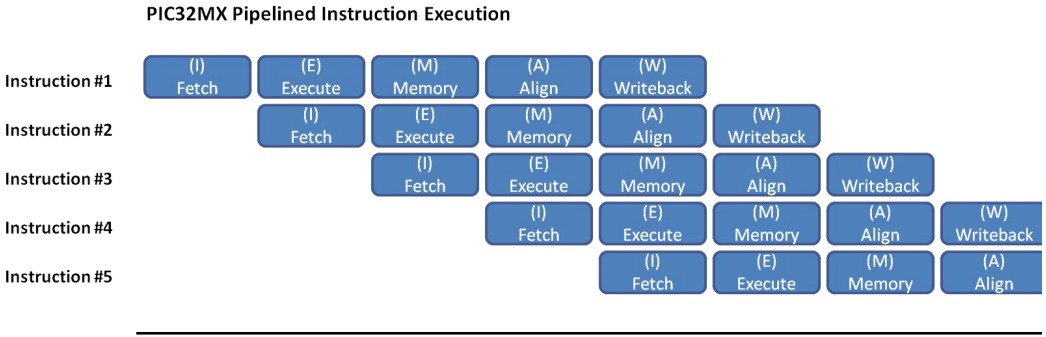
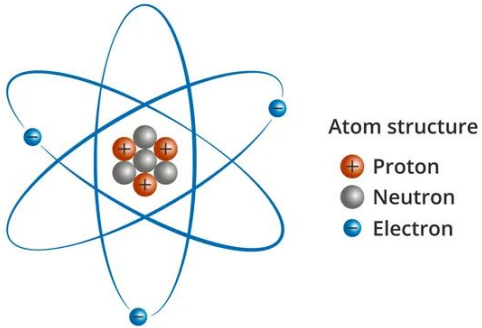
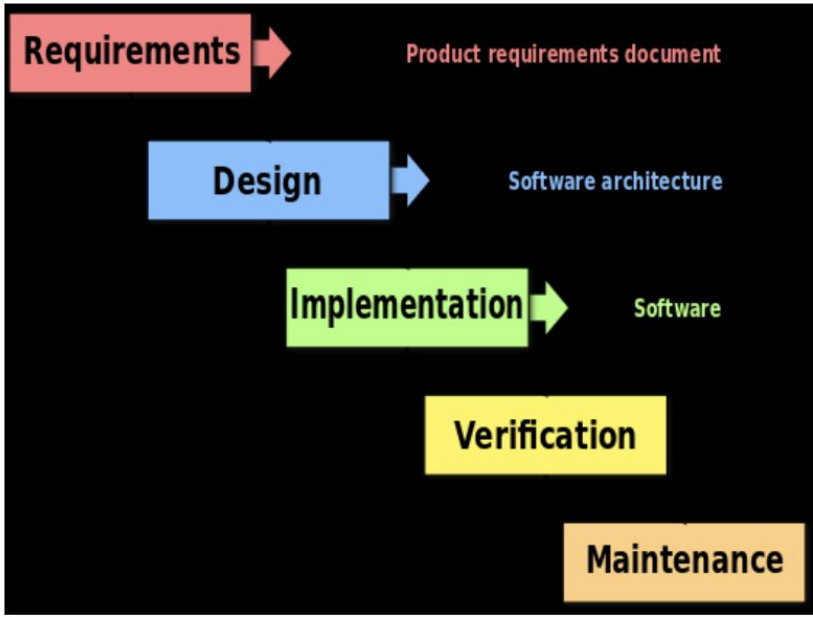






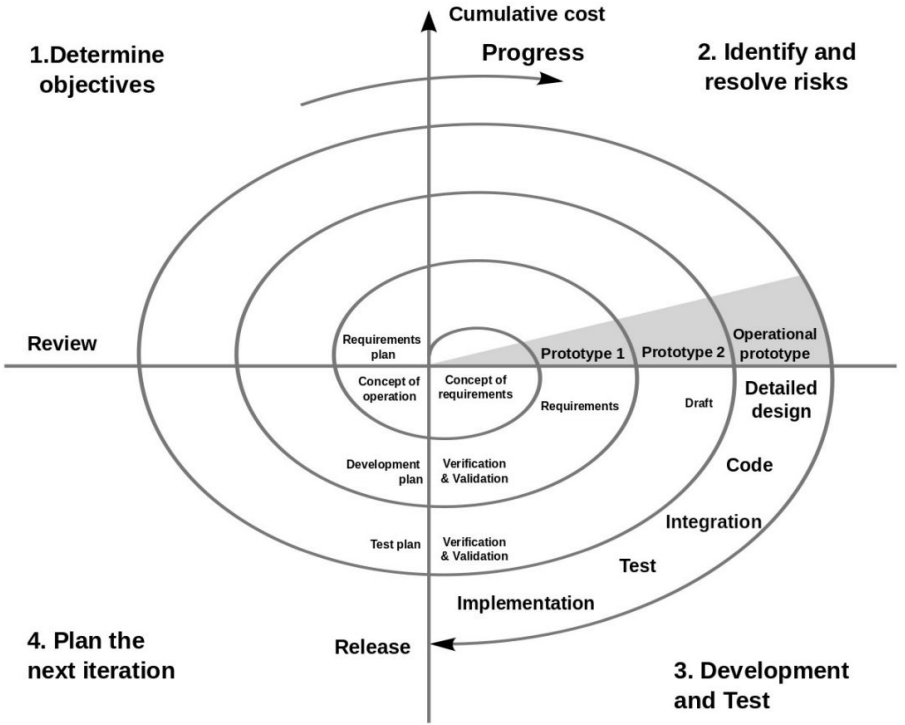
The Waterfall methodology: an idealized model

- Do **NOT** attempt to actually follow the Waterfall methodology in real life
  - you **will** have a bad time

The Waterfall methodology: an idealized model

- Do **NOT** attempt to actually follow the Waterfall methodology in real life
  - you **will** have a bad time
- But, it provides a **useful foundation** for thinking about methodologies:
  - the Waterfall stages do represent real activities you'll do during the development lifecycle
  - you probably won't do them all in the proscribed order

A slightly more realistic model: spiral



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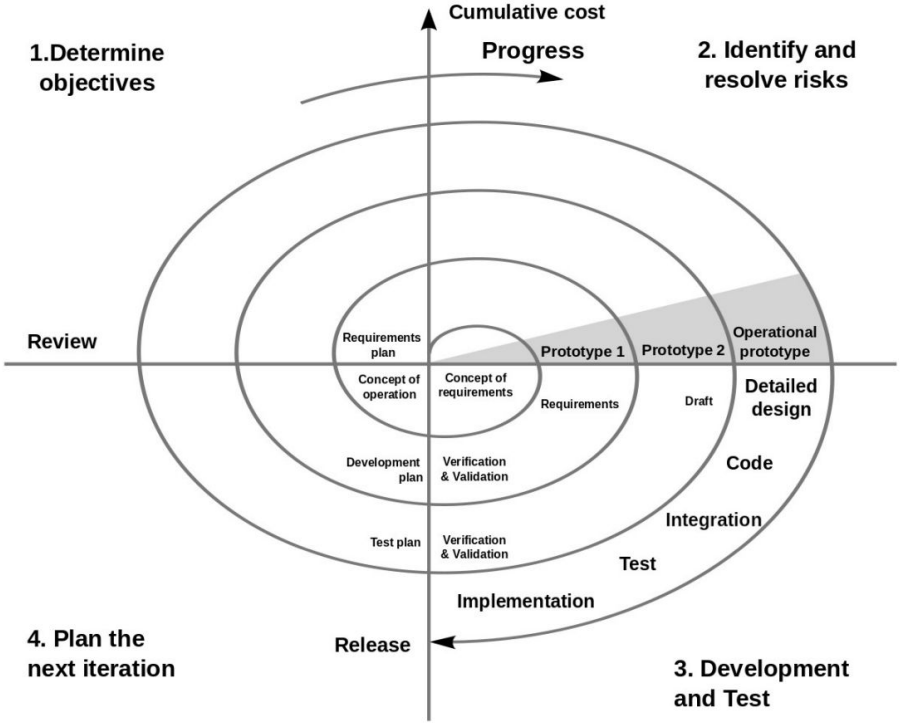
- Key idea: construct a series of increasingly-complete **prototypes**
- Effectively **iterated waterfall**



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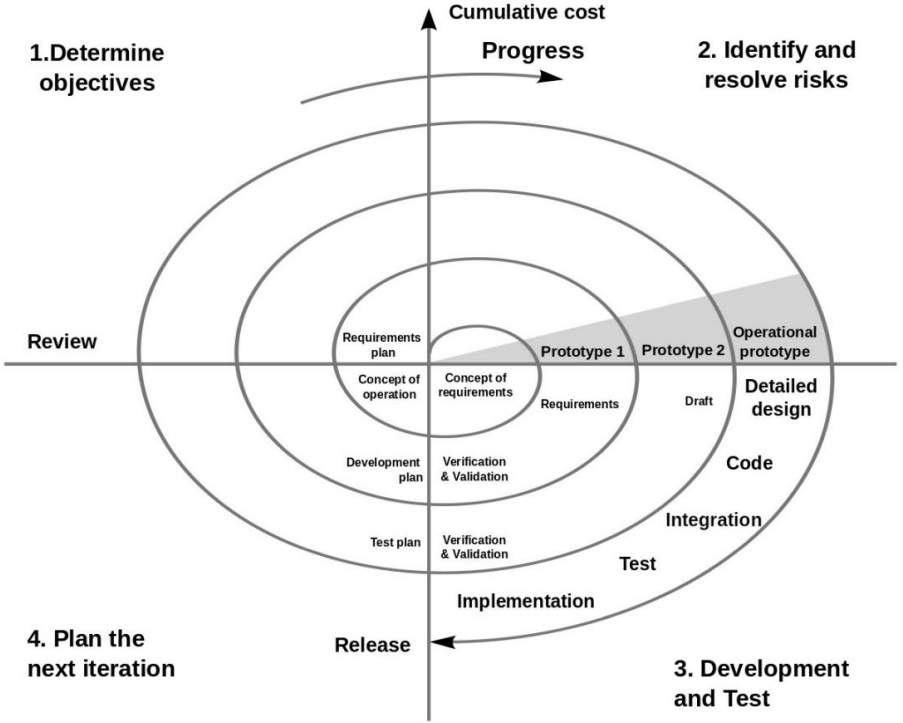

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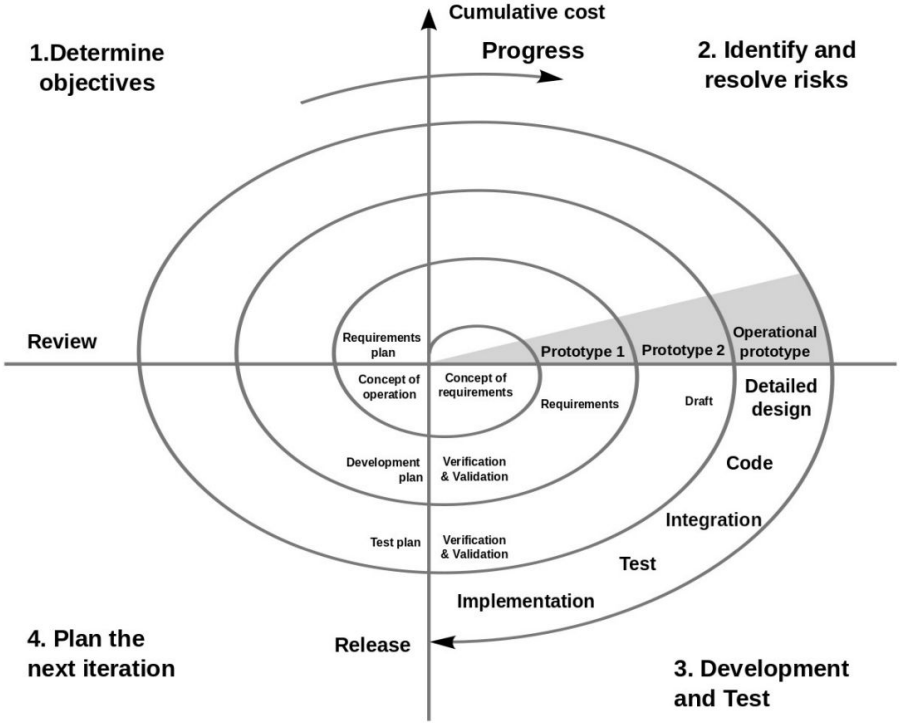
Still not very realistic!



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Agile & Scrum

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- Agile is more a **philosophy** than a methodology in the traditional sense
- Scrum is an **instantiation** of that philosophy as a methodology

Agile Principles

- Individuals and interactions over processes and tools
- Working software over comprehensive documentation
- Customer collaboration over contract negotiation
- Responding to change over following a plan

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Focus on people

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Always have a prototype

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Keep the client involved

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Change requirements as you learn about the problem

The Scrum methodology

- Scrum is one common Agile methodology
- Focused around a “scrum master” who is responsible for process
- Work is divided into ***sprints*** where each team member is responsible for dealing with certain tasks
  - starts with a “sprint planning meeting”: tasks are assigned
  - each day includes a “standup” ceremony
  - at the end of the sprint, a “sprint retrospective meeting” looks back on how the sprint went
  - typically sprints are 1-2 weeks

Common features of Agile methodologies

- Sprint terminology is common, even when not directly using scrum
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- Planning often happens in the form of ***user stories***
  - As a ___, I want to ____
  - E.g., “as a new Covey.Town user, I want to create an account”

We’ll ask you to write user stories and plan in terms of sprints when you propose your group course project

Process

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- Reading Quiz
- Development methodologies
- **Planning, estimation, and risk**
- Measuring progress

Planning

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Planning = estimate +/- risk

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Why is planning a software project difficult?

- Software tends to be **innovative**
  - Cost of copying existing code ≈ 0, so any project you're actually working on probably is different than what came before
  - "It's not research if you know it's going to work"
  - Compare to other kinds of engineering: one highway/bridge/skyscraper/etc isn't that different than the next

Planning: milestones and deliverables

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Definition: A ***deliverable*** is a milestone that’s customer-facing

- sometimes used interchangeably with milestone

Why milestones and deliverables?

- It’s easy to tell when a milestone or deliverable is done
- **Progress** towards milestones and deliverables is hard to measure

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“All I need to do is fix this one bug and then it’ll work, promise.”

Estimation

Two parts:

- How long do you think it will take to reach the next milestone?
- Splitting larger tasks into smaller ones

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Naturally **very fuzzy**: we can’t see the future

Estimation techniques: t-shirt sizing

small = I can do this task in an afternoon

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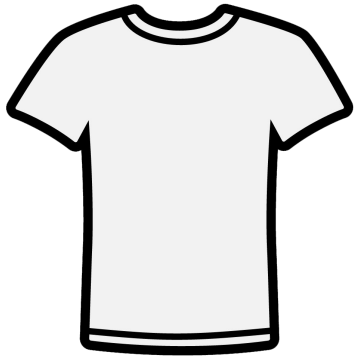

large = too big to estimate how long it will take

- large tasks should usually come with a small task that is breaking the large task up into medium and small tasks

Estimation techniques: story points

- Assign stories 1, 2, 4, or 8 points (these numbers can vary, but the relationship should be exponential)
- Like large t-shirt estimates, high-point-value stories should usually have a smaller task to break them apart

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- Assign stories 1, 2, 4, or 8 points (these numbers can vary, but the relationship should be exponential)
- Like large t-shirt estimates, high-point-value stories should usually have a smaller task to break them apart
- T-shirt estimates and story points are two different ways to quantify the **relative** size of tasks
    - Also lots of other ways!

Estimation techniques: cocomo

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Definition: a ***constructive cost model*** (***cocomo***) is a predictive model of time costs based on project history

- requires experience with similar projects
- rewards documentation of experience
- basically, it's an empirically-derived set of “effort multipliers”. You multiply the time cost by some numbers from a chart:

Cost Drivers	Ratings					
	Very Low	Low	Nominal	High	Very High	Extra High
Product attributes						
Required software reliability	0.75	0.88	1.00	1.15	1.40	
Size of application database		0.94	1.00	1.08	1.16	
Complexity of the product	0.70	0.85	1.00	1.15	1.30	1.65
Hardware attributes						
Run-time performance constraints			1.00	1.11	1.30	1.66
Memory constraints			1.00	1.06	1.21	1.56
Volatility of the virtual machine environment		0.87	1.00	1.15	1.30	
Required turnabout time		0.87	1.00	1.07	1.15	
Personnel attributes						
Analyst capability	1.46	1.19	1.00	0.86	0.71	
Applications experience	1.29	1.13	1.00	0.91	0.82	
Software engineer capability	1.42	1.17	1.00	0.86	0.70	
Virtual machine experience	1.21	1.10	1.00	0.90		
Programming language experience	1.14	1.07	1.00	0.95		
Project attributes						
Application of software engineering methods	1.24	1.10	1.00	0.91	0.82	
Use of software tools	1.24	1.10	1.00	0.91	0.83	
Required development schedule	1.23	1.08	1.00	1.04	1.10	

Risk and uncertainty

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- Any effective plan for software development must take into account common risks, e.g.,:
  - Staff illness or turnover, product is too slow, competitor introduces a similar product, etc.

Strategies for risk management

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- Address risk early
- Selectively innovate to increase value while minimizing risk (i.e., focus risk where needed)
- Use iteration and feedback (e.g., prototypes)
- Estimate likelihood and consequences
  - Requires experienced project leads
  - Rough estimates (e.g., <10%, <25%) are OK
- Have contingency plans

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Mostly your ability to do this will come from **PRACTICE**

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Easy strategy: only track milestones and deliverables

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- Downside: no way to know how close you are to the next one

Measuring progress

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Can we do better? Unfortunately, not really.

Measuring progress: best practices

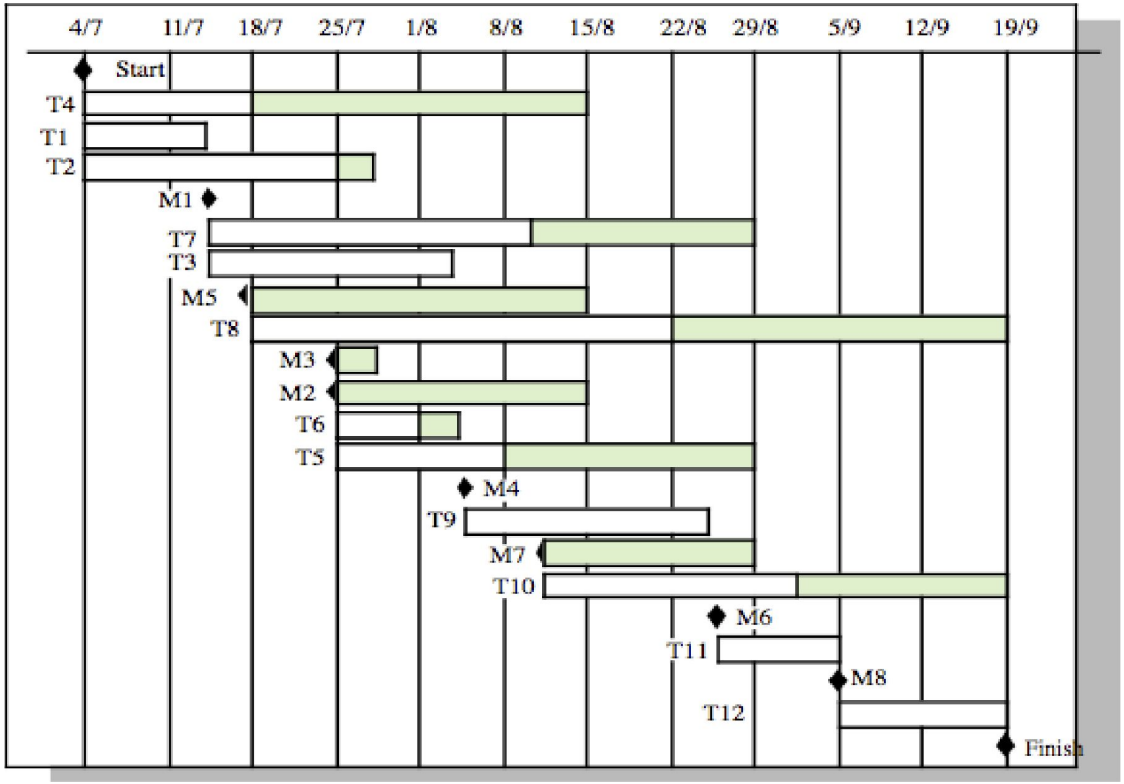
- have many milestones/deliverables
  - think back to Agile: this is a reason to always have a prototype

Measuring progress: best practices

- have many milestones/deliverables
  - think back to Agile: this is a reason to always have a prototype
- avoid relying too heavily on developers' estimates
  - we are bad at estimating
  - "last mile" problem: what seems to be last 10% of the work often takes 40% or more of the development time

Measuring progress: tools

- Gantt chart



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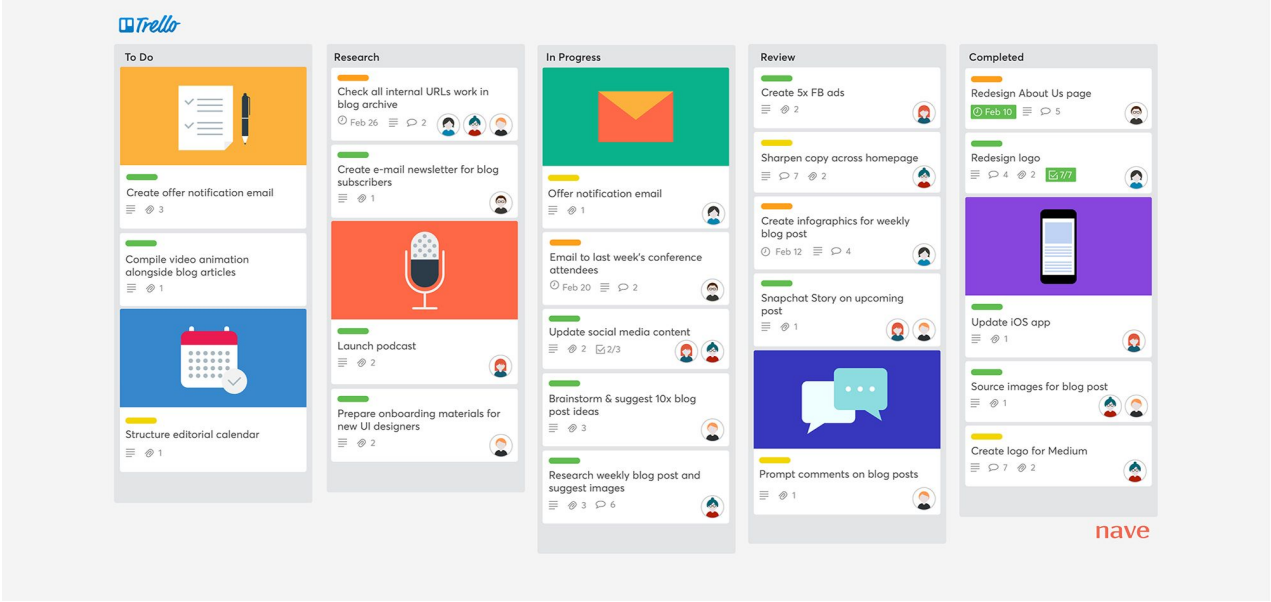
- KanBan board



Measuring progress: tools

- Gantt chart
- KanBan board
- Many others: use what works for you

Takeaways

- Process can save time, but don’t overdo it
- Lots of methodologies: choose what makes sense for you
- Agile philosophy is generally a good one to follow
  - But don’t focus on it at the expense of actually doing your job
- Estimation is hard and you will get it wrong
  - Use rough estimation strategies to avoid over-promising
- Include lots of buffer + risk in your estimates
- Don’t trust developer estimates in general

Action items for next class

- Start IP 1 (due February 2, which is surprisingly soon!)
- Mandatory readings (always 🙂)