last time: Product idea proposal!

- First assignment: Due at 9 PM, Feb 12
http://www.cs.umass.edu/~brun/class/2024Spring/CS320/productIdea.pdf
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Does everyone have a 1–2 person group?
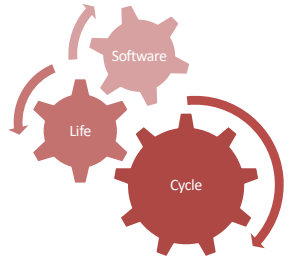
1

This Thursday, Feb 8

material will be on quiz

- Madeline Endres
- February 8, noon, CS150
- Pizza!
- Software Productivity and Wellbeing: From Tools and Types to Cognition and Medicine

https://www.cics.umass.edu/event/20240208/software-productivity-and-wellbeing-tools-and-types-cognition-and-medicine

2

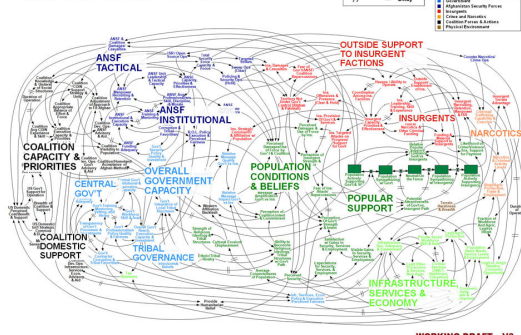## Software Development Lifecycle

thinking about the process

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How complex is software?

4

What is complex?

5

How complex is software?

- Measures of complexity:
  – lines of code
  – number of classes
  – number of modules
  – module interconnections and dependencies
  – time to understand
  – # of authors
  – … many more

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How complex is software?

- Measures of complexity:
  - lines of code   Windows Server 2003: 50 MSLoC
  - number of classes   Debian 5.0:   324 MSLoC
  - number of modules
  - module interconnections and dependencies
  - time to understand
  - # of authors
  - ... many more

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How big is 324 MSLoC?

- 50 lines/page $\Rightarrow$ 6.5M pages
- 1K pages/ream $\Rightarrow$ 6.5K reams
- 2 inches/ream $\Rightarrow$ 13K inches
- 13K inches $\approx$ taller than the Prudential

- 5 words/LoC @ 50 wpm $\Rightarrow$ 32M min $\approx$ 61 years

> And we don't just want random words,
> we want compiling code!

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Managing software development

- Requirements
- Design
- Implementation
- Testing
- Maintenance

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Outline

- Why do we need a lifecycle process?
- Lifecycle models and their tradeoffs
  - code-and-fix
  - waterfall
  - spiral
  - staged delivery
  - agile (scrum)
  - ... there are many others

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Ad-hoc development

- Creating software without any formal guidelines or process

- Advantage: easy to learn and use!
- Disadvantages?

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Ad-hoc development disadvantages

- Some important actions (testing, design) may go ignored
- Unclear when to start or stop each task
- Scales poorly to multiple people
- Hard to review or evaluate one's work

> The later a problem is found in software, the more costly it is to fix.

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What makes a lifecycle?

- Requirements
- Design
- Implementation
- Testing
- Maintenance

How do we combine them?

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Benefits of using a lifecycle

- provides a work structure

- forces thinking about the "big picture"

- helps prevent decisions that are individually on target but collectively misdirected

- assists management and progress control
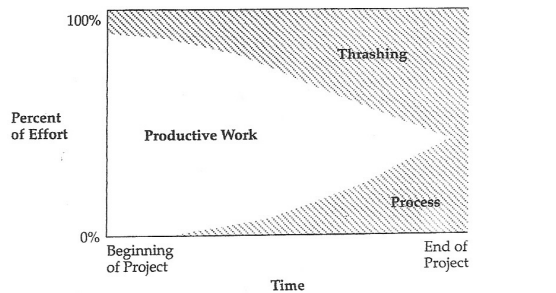
14

What are some drawbacks?

15

Are there analogies outside of SE?

Consider the process of building the Prudential
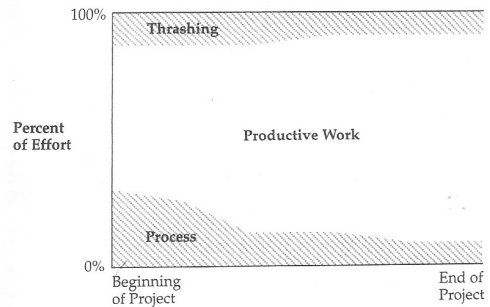

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Project with little attention to process

Survival Guide:
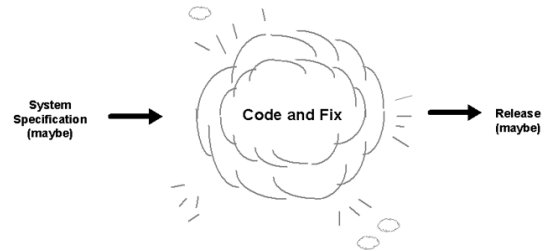McConnell p24

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Project with early attention to process

Survival Guide:
McConnell p25

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Let's talk about some lifecycle models

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Code-and-fix model

System Specification (maybe) → Code and Fix → Release (maybe)

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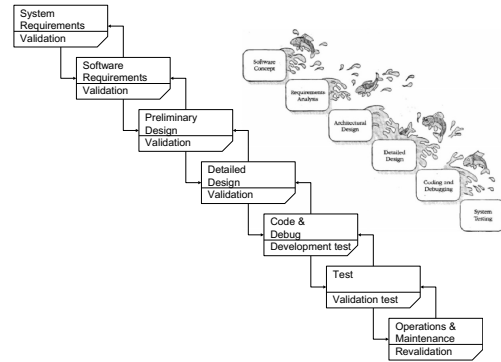## Code-and-fix model

- Advantages
  - Low overhead
  - Applicable to small, short-lived projects

- Dangers
  - No way to assess progress and manage risks
  - Hard to accommodate changes
  - Unclear what and when will be delivered
  - Hard to assess quality

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Waterfall model

System Requirements Validation

Software Requirements Validation

Preliminary Design Validation

Detailed Design Validation

Code & Debug Development test

Test Validation test

Operations & Maintenance Revalidation

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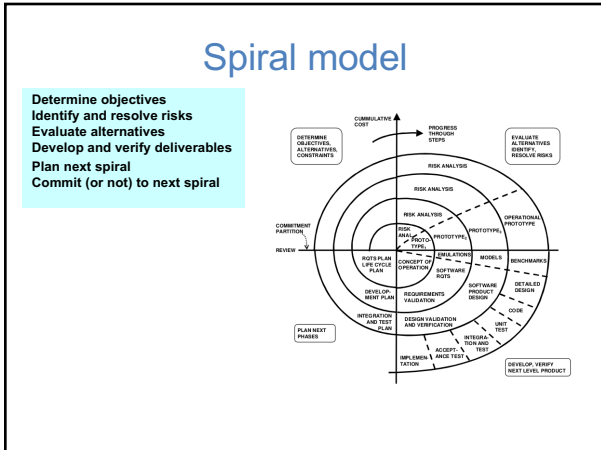## Waterfall model advantages

- Works well for well-understood projects
  - tackles all planning upfront
  - no midstream changes leads to efficient software development process

- Supports experienced teams
  - Orderly, easy-to-follow sequential model
  - Reviews help determine readiness to advance

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Waterfall model limitations

- Difficult to do all planning upfront
- No sense of progress until the end
- Integration occurs at the very end
  - Defies the "integrate early and often" rule
  - Without feedback, solutions are inflexible
  - Final product may not match customer's needs
- Phase reviews are massive affairs
  - It takes a lot of inertia and $ to make changes

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Spiral model

Determine objectives
Identify and resolve risks
Evaluate alternatives
Develop and verify deliverables
Plan next spiral
Commit (or not) to next spiral

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Barry Boehm, a "Living Legend" in Systems and Software Engineering, Dies at 87

Caitlin Dawson | September 1, 2022

A pioneer in the field of computer science with a career spanning six decades, USC Viterbi Professor Emeritus Barry Boehm "defined an era in software engineering."

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Spiral model

- Oriented towards phased reduction of risk

- Take on the big risks early
  – are we building the right product?
  – do we have customers for this product?
  – is it possible to use existing technology?
    • tomorrow's technology?
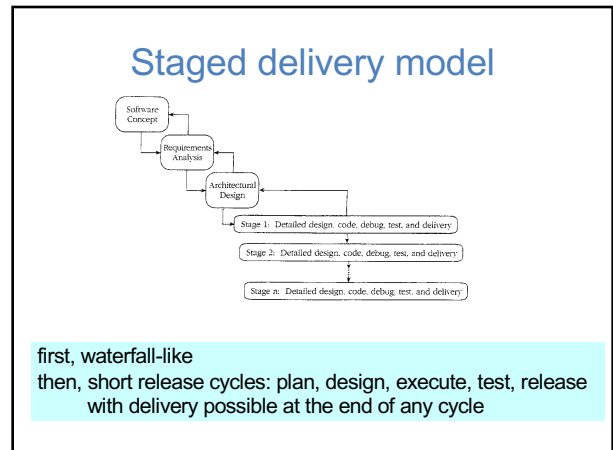
- Progresses carefully toward a result

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Spiral model advantages

- Especially appropriate at the beginning of the project, allowing requirement fluidity
- Provides early indication of unforeseen problems
- Allows for change
- As costs increase, risks decrease!

Addresses the biggest risk first

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Spiral model disadvantages

- A lot of planning and management

- Requires customer and contract flexibility

- Developers must be able to assess risk

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Staged delivery model

first, waterfall-like
then, short release cycles: plan, design, execute, test, release
with delivery possible at the end of any cycle

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Staged delivery model advantages

- Can ship at the end of any release cycle
- Intermediate deliveries show progress, satisfy customers, and lead to feedback
- Problems are visible early (e.g., integration)
- Facilitates shorter, more predictable release cycles

Very practical, widely used and successful

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Staged delivery model disadvantages

- Requires tight coordination with documentation, management, marketing
- Product must be decomposable
- Extra releases cause overhead

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What's the best model?

Consider
- The task at hand
- Risk management
- Quality / cost control
- Predictability
- Visibility of progress
- Customer involvement and feedback

Aim for good, fast, and cheap.
But you can't have all three at the same time.

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Tomorrow's discussion session

- Optional
- Can use time to work on Product Idea Slides with your partner

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