Advanced Software Engineering: Analysis and Evaluation

COMPSCI 621
UMass Amherst, Spring 2023

1

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621 staff

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2

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Office hours: Monday 9-10AM, 2:30-3:30PM
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3

Today's plan

- Why is software engineering important?

- About 621: how to succeed

4

What is software engineering?

- The process of developing software systems
- From eliciting requirements to producing a software system that meets those requirements
- May involve (among other activities)
  - eliciting and formalizing requirements
  - designing the system architecture
  - developing prototypes
  - testing
  - implementation
  - validation
  - verification
  - maintenance

5

What is analysis?

- This semester, we will focus on analysis:
  Identifying program properties to verify and validate the system.

  The goal of analysis is to improve system correctness, quality, safety, and reliability by *analyzing* system source code and executions

6

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How can we analyze software to improve it?

How can we analyze software to improve it?

- static analysis looks at the source code to prove properties about the software

- dynamic analysis looks at the executions to infer properties about the software

- testing examines executions for correctness

Why bother improving software?

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7   8   9

Why bother improving software?

- Software is important: It runs our lives!
  - medical devices
  - cars, airplanes, factories
  - try living a day without software
- Software is complex, which leads to poor quality systems (e.g., bugs).
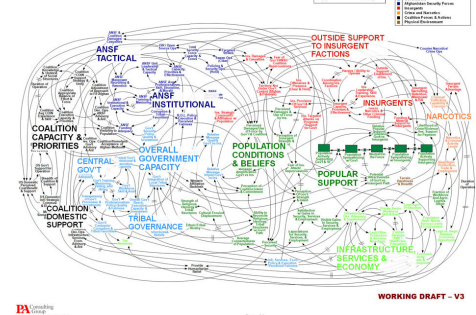

How complex is software?

What is complex?

Afghanistan Stability / COIN Dynamics

WORKING DRAFT – V3

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10   11   12

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

13

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

14

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 $\approx$ four times the height of this building

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

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

15

Managing software development

- Requirements
- Design
- Implementation
- Testing
- Maintenance

16

Ad-hoc development

- Creating software without any formal guidelines or process

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

17

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.

18

Why is software engineering important?

- Organizes the work effort

- Improves software quality

- Improves development efficiency

- and many more reasons

19

Today's plan

- Why is software engineering important?

➢About 621: how to succeed

20

The bigger picture

- CMPSCI 320: Introduction to software engineering: How to build a software system

- CMPSCI 520: Theory and Practice of Software Engineering

- CMPSCI 620: Advanced software engineering: Process

- CMPSCI 621: Advanced software engineering: Analysis and evaluation

21

621

- Focus on state-of-the-art techniques for program analysis
- State-of-the-art means exploring research
- Students will learn the latest techniques in improving software quality
- Students will advance the state-of-the-art by developing their own techniques!

22

621 website

http://cs.umass.edu/~brun/class/CS621

- Schedule, all logistics information, assignments, etc.
- Assignment submission and grades will be done via Moodle: http://moodle.umass.edu

23

The Work

Assignment	Grade
Midterm	25%
Homework	32%
Paper summary and presentation	15%
Participation	3%
Project	25%

25

Check the website frequently

http://cs.umass.edu/~brun/class/CS621

26

Next time

- We will discuss the six main topics covered by this class.

- We will identify possible open problems for research projects.

27