

Advanced Software Engineering: Analysis and Evaluation

CMPSCI 521/621
UMass Amherst, Fall 2015

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Today's plan

- Why is software engineering important?
- About 521/621: how to succeed

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

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

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?

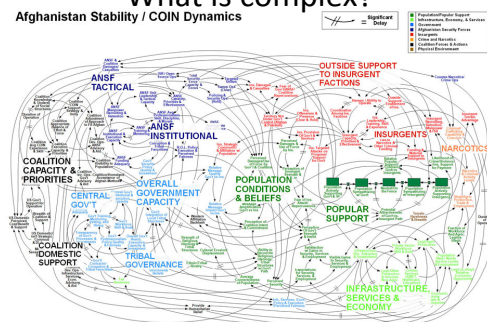
Why bother improving software?

- 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



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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Windows Server 2003: 50 MSLoC
Debian 5.0: 324 MSLoC

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!

Managing software development

- Requirements
- Design
- Implementation
- Testing
- Maintenance

Ad-hoc development

- Creating software without any formal guidelines or process
- Advantage: easy to learn and use!
- Disadvantages?

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.

Why is software engineering important?

- Organizes the work effort
- Improves software quality
- Improves development efficiency
- and many more reasons

Today's plan

- Why is software engineering important?

➤ About 521/621: how to succeed

The bigger picture

- CMPSCI 320: Introduction to software engineering: How to build a software system
- CMPSCI 520/620: Advanced software engineering: process
- CMPSCI 521/621: Advanced software engineering: analysis and evaluation

521/621

- 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!

521/621 website

<http://cs.umass.edu/~brun/class/CS521.621>

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

How are 521 and 621 different?

- 621: Core for PhD students
- 521: Elective for Bachelor's students

If you think you might get a PhD at UMass, you probably want to take 621

How are 521 and 621 different?

- 521:

| Assignment | Grade |
|---------------------------------|-------|
| Midterm | 30% |
| Homework | 35% |
| Paper summary and presentations | 30% |
| Participation | 5% |

- 621:

| Assignment | Grade |
|--------------------------------|-------|
| Midterm | 20% |
| Homework | 35% |
| Paper summary and presentation | 15% |
| Participation | 5% |
| Project | 25% |

521 students can do the research project in lieu of 1 presentation; will get extra credit

Check the website frequently

<http://cs.umass.edu/~brun/class/CS521.621>

Next time

- We will discuss the six main topics covered by this class.
- We will identify possible open problems for research projects.