Advanced Software Engineering: Analysis and Evaluation

CMPSCI 521/621
UMass Amherst, Fall 2013
521/621 staff

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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

OUTSIDE SUPPORT TO INSURGENT Factions

INSURGENTS

NARCOTICS

WORKING DRAFT – V3
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 ⇒ 6.5M pages
- 1K pages/ream ⇒ 6.5K reams
- 2 inches/ream ⇒ 13K inches
- 13K inches ≈ four times the height of this building

- 5 words/LoC @ 50 wpm ⇒ 32M min ≈ 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
  - Midterm: 30%
  - Homework: 35%
  - Paper summary and presentations: 30%
  - Participation: 5%

- **621:**
  - Assignment
  - 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.