### Advanced Software Engineering: Analysis and Evaluation

**CMPSCI 521/621**  
UMass Amherst, Spring 2017

### 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?

- 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).

What is complex?

- Measures of complexity:
  - lines of code
  - number of classes
  - number of modules
  - module interconnections and dependencies
  - time to understand
  - # of authors
  - ... many more
How complex is software?

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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

Why is software engineering important?

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

The later a problem is found in software, the more costly it is to fix.
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
  – masters students’ mission can fit into either 521 or 621

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

How are 521 and 621 different?

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<tr>
<th>Assignment</th>
<th>Grade</th>
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<tr>
<td>Midterm</td>
<td>30%</td>
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<tr>
<td>Homework</td>
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<tr>
<td>Paper summary and presentations</td>
<td>30%</td>
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<td>Participation</td>
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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.