Advanced Software Engineering: Analysis and Evaluation

CMPSCI 521/621
UMass Amherst, Fall 2014

521/621 staff

• Instructor: Prof. Yuriy Brun
  Office: CS 346
  Office hours: Monday 12PM–1PM
  brun@cs.umass.edu

• Teaching assistant: Armand Halbert
  Office: CS 207
  Office hours: Wednesday 12PM–1PM
  ahalbert@cs.umass.edu

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?
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

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?

<table>
<thead>
<tr>
<th>Assignment</th>
<th>Grade</th>
<th>521</th>
<th>621</th>
</tr>
</thead>
<tbody>
<tr>
<td>Midterm</td>
<td>30%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Homework</td>
<td>30%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paper summary and presentations</td>
<td>30%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Participation</td>
<td>5%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Assignment</th>
<th>Grade</th>
<th>521 students can do the research project in lieu of 1 presentation; will get extra credit.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Midterm</td>
<td>20%</td>
<td></td>
</tr>
<tr>
<td>Homework</td>
<td>35%</td>
<td></td>
</tr>
<tr>
<td>Paper summary and presentation</td>
<td>13%</td>
<td></td>
</tr>
<tr>
<td>Participation</td>
<td>5%</td>
<td></td>
</tr>
<tr>
<td>Project</td>
<td>25%</td>
<td></td>
</tr>
</tbody>
</table>
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.