Advanced Software Engineering: Analysis and Evaluation

COMPSCI 621
UMass Amherst, Spring 2023

621 staff

• Instructor:
  Prof. Yuriy Brun
  Office: CS 302
  Office hours: TBA
  brun@cs.umass.edu

• Teaching assistants:
  Qizheng Yang and Rachana Ponagandla

Teaching assistants

• Qizheng Yang
  qizhengyang@umass.edu

• Rachana Ponagandla
  rponagandla@umass.edu

Office hours: Monday 9-10AM, 2:30-3:30PM
  Thursday 4-5PM

Today’s plan

• Why is software engineering important?

• About 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?

• 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).

How complex is software?

What is complex?
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 \(\Rightarrow\) 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 621: how to succeed

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

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!

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

The Work

<table>
<thead>
<tr>
<th>Assignment</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Midterm</td>
<td>25%</td>
</tr>
<tr>
<td>Homework</td>
<td>32%</td>
</tr>
<tr>
<td>Paper summary and presentation</td>
<td>15%</td>
</tr>
<tr>
<td>Participation</td>
<td>3%</td>
</tr>
<tr>
<td>Project</td>
<td>25%</td>
</tr>
</tbody>
</table>
Check the website frequently

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

Next time

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

• We will identify possible open problems for research projects.