Advanced Software Engineering: Analysis and Evaluation

CMPSCI 521/621
UMass Amherst, Fall 2012

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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 term, 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

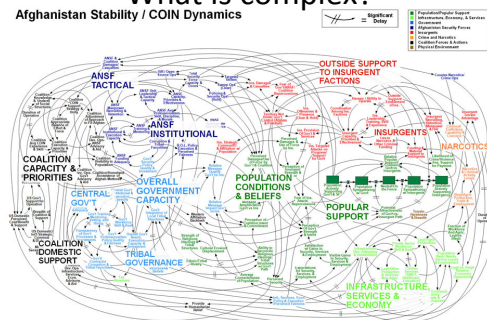## Why bother improving software?

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?

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 complex is software?

- Measures of complexity:
  - lines of code   Windows Server 2003: 50 MSLoC
  - number of classes   Debian 5.0:   324 MSLoC
  - 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 $\approx$ twice the height of the Allen Center

- 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://people.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

Homework 0: Research Areas Definitions

- Due this Thursday, before class (9AM), via Moodle

http://people.cs.umass.edu/~brun/class/CS521.621/hw0.pdf

- If you experience technical Moodle difficulties, email me the assignment at brun@cs.umass.edu

Next time

- We will discuss the six fields.

- We will identify possible open problems for research projects.

Why do a great job on the project?

Why do a great job on the project?

- Pride

- Help software engineers everywhere

- St. Petersburg is beautiful

ESEC FSE 2013, St. Petersburg, Russia

- ESEC FSE =
European Software Engineering Conference and
ACM SIGSOFT Symposium on the
Foundations of Software Engineering
- Deadline: March 1, 2013
- Best 521/621 projects may be extended and submitted for publication.
- If accepted, I will pay for one author to attend ESEC FSE in St. Petersburg, Russia!

Why do a great job on the project?

ESEC/FSE 2013
Saint Petersburg, Russia   August 19–23

9th joint meeting of
the European Software Engineering Conference and
the ACM SIGSOFT Symposium
on the Foundations of Software Engineering