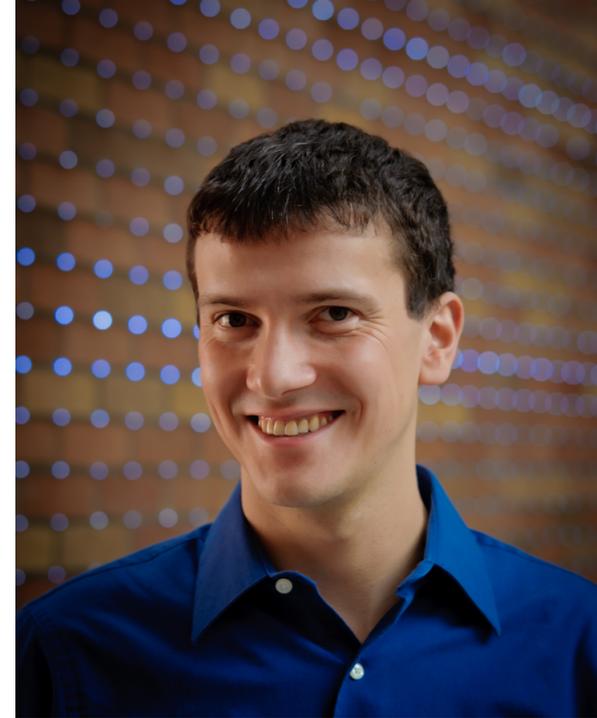# Advanced Software Engineering: Analysis and Evaluation

CMPSCI 521/621

UMass Amherst, Fall 2013

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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

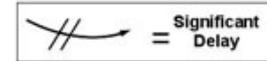# Why bother improving software?

Why bother improving software?

- Software is important: It runs our lives!
  - medical devices
  - cars, airplanes, factories
  - try living a day without software
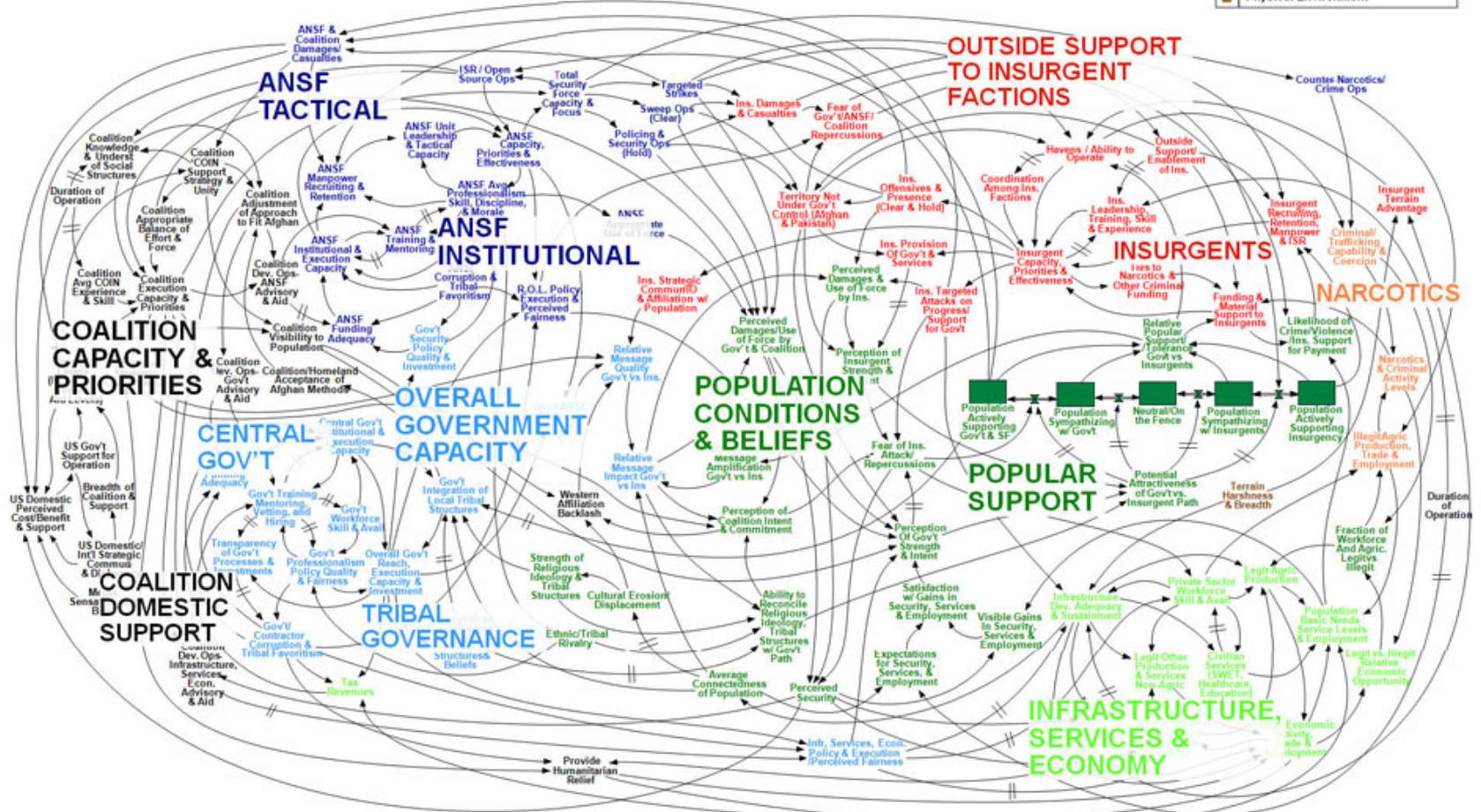- Software is complex, which leads to poor quality systems (e.g., bugs).

How complex is software?

What is complex?

Afghanistan Stability / COIN Dynamics

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

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 $\approx$ 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 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	Grade
Midterm	30%
Homework	35%
Paper summary and presentations	30%
Participation	5%

- 621:

Assignment	Grade
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.