CS 520

Theory and Practice of Software Engineering
Fall 2018

Course introduction

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The CS 520 team

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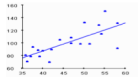
Today

- What is Software Engineering?
- Why is Software Engineering important?
- Your expectations
- Course overview
- Our expectations
- Logistics

What is Software Engineering?

What is Software Engineering?

- Developing in an IDE and software ecosystem?
- Coding and debugging?
- Deploying and running a software system?
- Empirical evaluations?
- Modeling and designing?



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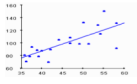

All of the above -- much more than just writing code!

What is Software Engineering?

More than just writing code

The complete process of specifying, designing, developing, analyzing, deploying, and maintaining a software system.

- Common Software Engineering tasks include:
  - Requirements engineering
  - Specification writing and documentation
  - Software architecture and design
  - Programming
  - Software testing and debugging
  - Refactoring

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  - Requirements engineering
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  - Programming — Just one out of many important tasks!
  - Software testing and debugging
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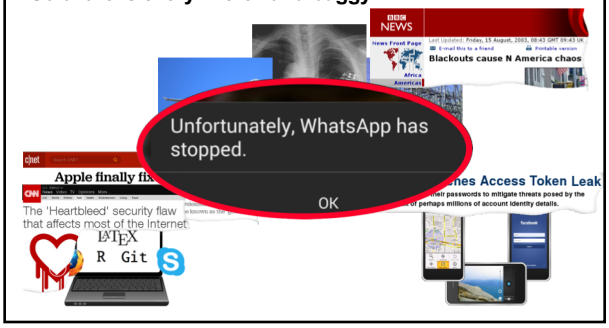


Why is Software Engineering important?

Software is complex!

- Aircraft: ~15 million lines of code

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; Debian 5.0: 324 MSLoC
  - 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

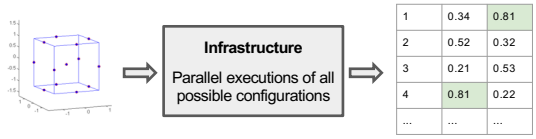
- 5 words/LoC @ 50 wpm ⇒ 32M min ≈ 61 years

And we don't just want random words, we want compiling code!

Why is Software Engineering important?

Infrastructure is software, too!

Example: Design space exploration



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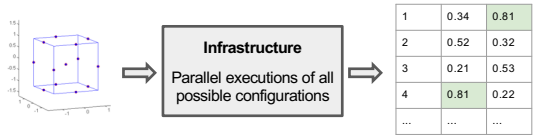
Example: Design space exploration



- 150 configurations, 1000+ benchmarks
- 1-85 hours per execution
- 200,000+ CPU hours (~23 CPU years)

Summary: Software Engineering

What is Software Engineering?

The complete process of specifying, designing, developing, analyzing, deploying, and maintaining a software system.

Why is it important?

- Software is everywhere and complex.
- Software defects are expensive (and annoying).

Goals

- Decompose a complex engineering problem.
- Organize processes and effort.
- Improve software reliability.
- Improve developer productivity.

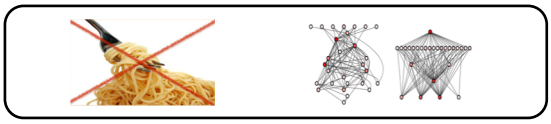
Your expectations

Introduction and a brief (5 minute) survey

- Why are you taking this course?
- What do you expect from this course?
- What are your learning goals (theory and practice)?

Course overview: the big picture

- **Software architecture and design**
  - Software modelling and UML crash course.
  - Best practices and OO design principles.
  - Architecture and Design patterns.
  - Very brief intro to functional programming.



Goal: no more spaghetti code!

Course overview: the big picture

- **Software architecture and design**
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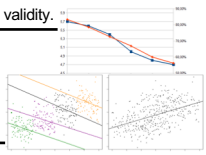
- **Empirical Software Engineering**
  - Reasoning about experimental designs and studies.
  - Understanding and reasoning about threats to validity.

Anything wrong with the following conclusions?

- **Not using Internet Explorer** makes the world a safer place/**reduces murder rates**.
- **Spending more time on learning** a programming language **makes** you a **worse programmer**.



Goal: properly reason about research studies and findings

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- **Empirical Software Engineering**
  - Reasoning about experimental designs and studies.
  - Understanding and reasoning about threats to validity.
- **Software testing, debugging, and repair**
  - Learning about cutting-edge research.
  - Hands-on experience, using testing and debugging techniques.
- **Class project**
  - Design, development, and testing of a research prototype, etc.

Course overview: the big picture

- **Software architecture and design** 1 homework
  - Software modelling and UML crash course. 1 in-class exercise
  - Best practices and OO design principles.
  - Architecture and Design patterns.
  - Very brief intro to functional programming.
- **Empirical Software Engineering** 2 paper reviews
  - Reasoning about experimental designs and studies.
  - Understanding and reasoning about threats to validity.
- **Software testing, debugging, and repair** 3 in-class exercises
  - Learning about cutting-edge research. 1 homework
  - Hands-on experience, using testing and debugging techniques.
- **Class project** 2-month group project
  - Design, development, and testing of a research prototype, etc.

opportunities for extra credit

Course overview: rough timeline

September
- Software architecture and design

October
- Empirical Software Engineering
- Software testing
- Class project

November
- Software debugging and repair
- Collaboration and teamwork
- Class project

December
- Reasoning about programs
- Class project

Exposure to cutting-edge research

- We will have 4 guest lectures on research
  - These will be held out of class, most likely at 4PM. Videos will be available.
- We might have 1 guest lecture on what it's like to work in industry.

Course overview: grading

Grading
- **30%** Class project
- **30%** In-class exercises
- **30%** Homework and paper reviews
- **10%** Participation

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Questions?

Our expectations

- Programming experience.
- Familiarity with an OO programming language (e.g., Java, C++, etc.)
- Reading and reviewing 2 research papers.
- Active participation in discussions and group work.

Logistics

- ISB 221, Tuesday and Thursday, 10am – 11:15am.
- Lectures, tutorials, and in-class exercises.
- Course material, policies, and schedule on web site: http://people.cs.umass.edu/~brun/class/CS520/
- Submission of assignments via Moodle: https://moodle.umass.edu/course/view.php?id=49403