Course Overview

CSCI 5828: Foundations of Software Engineering
Lecture 01 — 08/25/2015

All problems in computer science can be solved by another level of indirection.

David Wheeler

Elliot Loh
@Loh

Follow

Always wanted to travel back in time to try fighting a younger version of yourself?

Software development is the career for you!

RETWEETS 7,077

FAVORITES 3,918

4:51 PM - 12 Dec 2013

Elon Musk

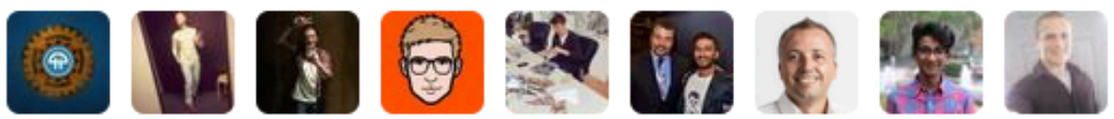
@elonmusk

Following

Almost ready to release highway autosteer and parallel autopark software update

RETWEETS 3,151

FAVORITES 5,118



2:57 AM - 31 Jul 2015

Elon Musk
@elonmusk

Following

Final corner case is dealing with low contrast lane markings (faded white on grey concrete) while driving into the sun at dusk

RETWEETS	FAVORITES
746	1,710

2:58 AM - 31 Jul 2015

Goals

- Present a fundamental introduction to the field of software engineering
  - Present brief history and foundational theory of software engineering
  - Survey software engineering concepts, terminology, and techniques

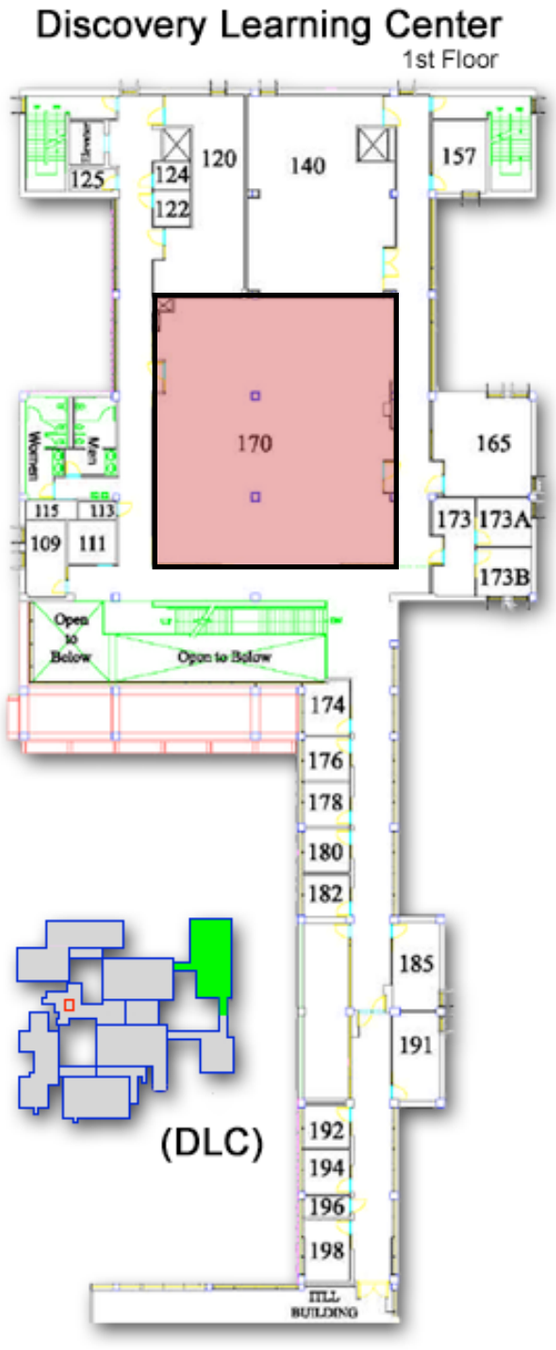
- Take an in-depth look at two important software engineering concepts
  - software development life cycles, with an emphasis on agile methods
  - designing and implementing concurrent software systems
- with your help (more on that later) explore a wide range of software engineering techniques and tools, software frameworks, and more

About Me

- Associate Professor
  - Ph.D. at UC Irvine
  - 17 Years at CU;
    - Start of my 35th Semester!
- 9th time teaching this class
- Research Interests
  - Software & Web Engineering
  - Software Architecture
  - Crisis Informatics

Office Hours

- Fridays, 2 PM to 3 PM, or by appointment
  - DLC 170 (shown in red on right)
- Please send me e-mail to let me know you plan to stop by



Class Website

<http://www.cs.colorado.edu/~kena/classes/5828/f15/>

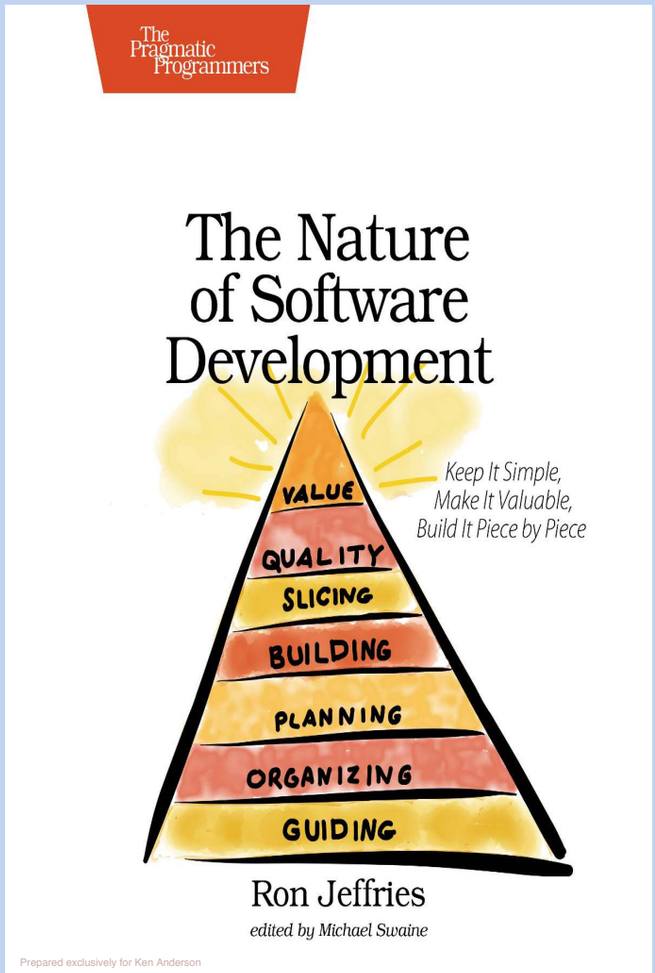
Check the website every day! (I'm serious)

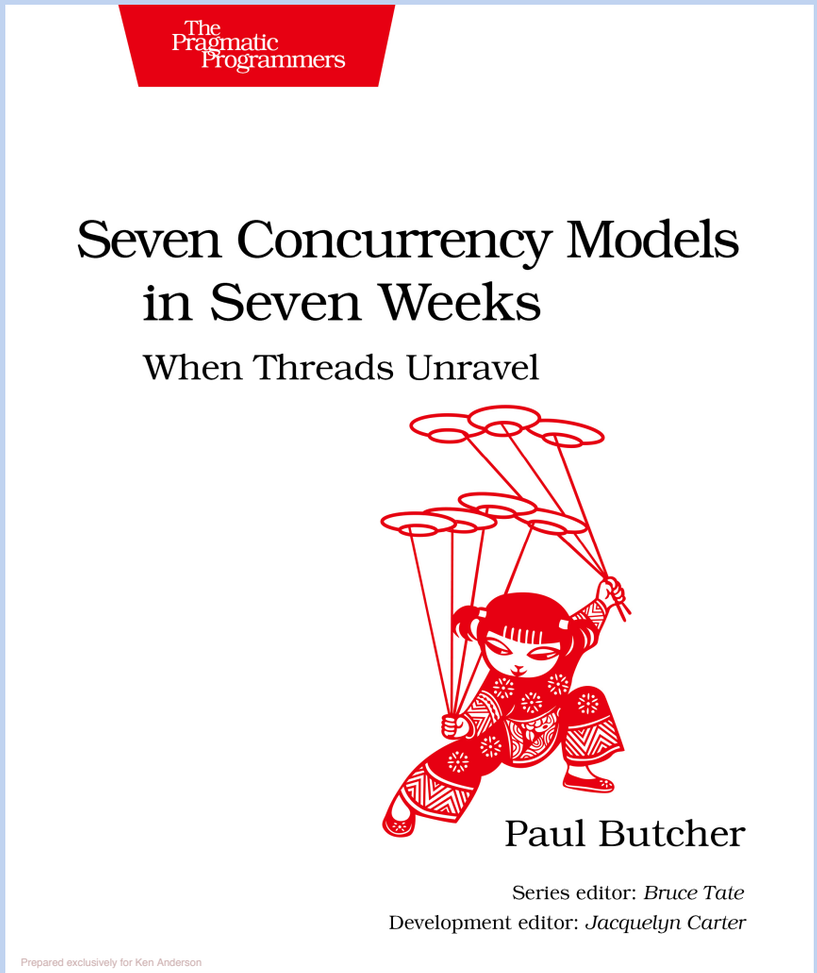
- If you want, the "What's New" page has an RSS feed
  - you can subscribe to that feed to be notified when new posts arrive
- Feed readers are available for all platforms
  - Feedly, NetNewsWire, etc.

- The website is your source for
  - the class schedule, homework assignments, announcements, etc.
- To turn assignments in and to distribute some class materials, I will make use of D2L, which you can access via MyCUInfo.

Textbooks

Available at <https://pragprog.com>





<http://www.cs.colorado.edu/~kena/classes/5828/f15/textbooks.html>

Three Main Topics

- Introduction to Software Engineering
  - Overview, history, concepts, techniques, etc.
- Agile Development
  - Agile is an approach to software development
    - It has many life cycles (Extreme Programming, Kaban, Scrum, etc.)
- Design and Implementation of Concurrent Systems
  - The days of waiting for faster hardware is (long) gone
  - To make software systems that perform efficiently, you need to incorporate concurrency into your system designs
- PLUS: As a class, we will be exploring lots of software engineering techniques, tools, methodologies, etc.

Course Evaluation

- Your grade will be determined by your work on
  - Class Participation and Attendance (5%)
  - Quizzes (10%)
  - Homeworks (35%)
  - Midterm (20%)
  - Presentations (30%)
- Quizzes will be taken on D2L; the presentations will be submitted on GitHub

Midterm

- **The midterm will be held on Tuesday, October 13th**
  - BBA students will need to work with BBA to identify a person to proctor their midterm exam; You will have from October 13th to October 20th (one week) to take your exam and have it sent to me by your proctor

Presentations

- As a class, we are going to perform an in-depth exploration of software engineering topics. You are going to be creating Github repos that provide notes, code, information, and examples of
  - software engineering methodologies
  - software engineering techniques, tools, and frameworks
  - programming languages
  - etc.
- You will be reviewing and critiquing the work of your peers throughout the semester, creating issues and/or pull requests
- You will create **five** of these presentations, one every three weeks
  - I will present an example of what I'm looking for on Thursday

Honor Code

- You are allowed to work together in teams of up to 2 people on
  - the homeworks
  - the presentations
- The quizzes and the midterm are individual work
- The Student Honor Code applies to classes in all CU schools and colleges. You can learn about the honor code at:
  - <http://www.colorado.edu/academics/honorcode/>.

Late Policy

- Assignments submitted late incur a 15% penalty
  - You may submit a homework assignment and presentations up to one week late
    - after that the submission will not be graded and you'll receive 0 points for it
- The quizzes and the midterm may not be submitted late
  - If you discover that you cannot attend the midterm on October 13th, you need to get in touch with me ASAP **before** the midterm to make other arrangements
    - trying to make arrangements **after** the midterm will be very difficult

Syllabus Statements

- The University asks that various policies be presented to students at the start of each semester. These policies include
  - Disability Accommodations
  - Religious Observances
  - Classroom Behavior
  - Discrimination and Harassment
  - Honor Code
- See <http://www.cs.colorado.edu/~kena/classes/5828/f15/syllabus-statements.html> for more details

Programming Languages

- Code examples this semester will be drawn from a number of languages
  - Java, Objective-C, Clojure, Elixir, C, Ruby, Python, possibly more!
- In general, I'm agnostic on programming languages used for assignments
  - However, some of your homework assignments will require a specific language in order to make use of a specific concurrency framework
    - Take a look at your concurrency textbook to get an idea of the range of languages and frameworks we'll be looking at

What do you know about Software Engineering?

- Fire up your web browsers and head to
  - http://bit.ly/1NQcQIq
- Let's spend some time finding out what people in the class know about software engineering
- then we'll look at some of my definitions and perspectives

What is Software Engineering

- **Software**
  - Computer programs and their related artifacts
    - e.g. requirements documents, design documents, test cases, UI guidelines, usability tests, …
- **Engineering**
  - The application of scientific principles in the context of practical constraints
- Consider: **Chemist versus Chemical Engineer**
  - Software engineers have a similar relationship with computer scientists
  - Software engineering has a similar relationship with computer science

Emphasizing the Point

- Consider this story on Slashdot from 2012:
  - IBM Shrinks Bit Size To 12 Atoms
- From the story:
  - “IBM researchers say they've been able to shrink the number of iron atoms it takes to store a bit of data from about one million to 12… Andreas Heinrich, who lead the IBM Research team on the project for five years, said the team used the tip of a scanning tunneling microscope and unconventional antiferromagnetism to change the bits from zeros to ones… That **solved a theoretical problem** of how few atoms it could take to store a bit; **now comes the engineering challenge**: how to make a mass storage device perform the same feat as a scanning tunneling microscope.

What is Software Engineering

- What is **Engineering**?
  - Engineering is a sequence of well-defined, precisely-stated, sound steps, which follow a method or apply a technique based on some combination of
    - theoretical results derived from a formal model
    - empirical adjustments for unmodeled phenomenon
    - rules of thumb based on experience
- This definition is **independent of purpose**
  - i.e. engineering can be applied to many disciplines

What is Software Engineering

- Software engineering is that form of engineering that applies…
  - a systematic, disciplined, quantifiable approach,
  - the principles of computer science, design, engineering, management, mathematics, psychology, sociology, and other disciplines…
- to creating, developing, operating, and maintaining cost-effective, reliably correct, high-quality solutions to software problems. (Daniel M. Berry)

- With respect to disciplined
  - Consider: Difference between professional musician and amateur musician

What is Software Engineering?

- Issues of Scale
    - Software engineers care about developing techniques that enable the construction of large scale software systems
- Issues of Communication
    - Consider the set of tools provided by sites like Rally, Fogbugz, or Assembla.com
- Issues of Regulation
    - Other engineering disciplines require certification; should SE?
- Issue of Design
    - dealing with integration of software/hardware/process

Types of Software Development

- Desktop Application Development
- Contract Software Development / Consulting
- Mobile Application Development
- Web Engineering (Development of Web Applications)
- Military Software Development
- Open Source Software Development
- Others??
  - These categories are not orthogonal!

Jobs related to Software Engineering

- Software Developer
- Software Engineer
- SQA (Software Quality Assurance) Engineer
- Usability Engineer
  - requires strong HCI/CSCW background
- Systems Analyst
  - professional requirements gather and/or designer
- DBA
- System administrator / DevOps
- Software Architect
- Software Consultant
- Web Designer
- Build Manager / Configuration Management Engineer
- Systems Engineer
- Computer Graphics Animator

Core Principles (What I call “The Big Three”)

- **Specification**
  - Software engineers specify **everything**
    - requirements, design, code, test plans, development life cycles
    - What makes a good specification?
- **Translation**
  - The work of software engineering is one of **translation**, from one **specification** to another; from one level of **abstraction** to another; from one set of **structures** to another (e.g. problem/design decomposition)
- **Iteration**
  - The work of software engineering is done iteratively; step by step until we are “done”

These Core Principles are Everywhere

- You will find these principles in all things related to software engineering
  - its techniques & tools
  - its development life cycles
  - its practices
- And the most important part of software engineering?
  - The people who perform it
- Ultimately, software engineering comes down to the people involved
  - the customers, the developers, the designers, the testers, the marketers, etc.; You'll find the best development projects are **conversations**

Our primary tool?

- Abstractions
  - When it comes down to it, software engineers solve problems by
    - **developing abstractions** that break the problem down into something that is understandable
    - and/or
      - by **using abstractions** developed by others
- The file system? An abstraction. A database? An abstraction. Twitter's API? An abstraction. Your own Employee class? An abstraction.
  - It's abstractions all the way down…

Emphasizing the Point: Conversation is Key

- How do we understand the problem we're trying to solve?
  - Conversations with users and domain experts
- How do we understand an abstraction that someone else wrote?
  - Conversations on-line with other developers or "with" the documentation
- How do we understand what abstraction we should write?
  - Design Conversations
- How do we know if our abstraction is working?
  - Testing ("Conversations with test cases")
- etc.

Software Engineering is Hard

- No doubt about it: software engineering **is hard**
  - Projects are late, over budget, and deliver faulty systems
- See 1995 Standish Report for one summary of the problem
- Why?
- For insight, we will take a look at an article by Fred Brooks called No Silver Bullet
- **Please read it by Thursday's lecture**
  - Paper is available on IEEE Digital Library: No Silver Bullet
  - It is also available on the D2L website for this class

Questions?

Coming Up Next

- Lecture 2: No Silver Bullet, Homework 1 (Due next Tuesday)