Course Overview

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CSCI 5828 — Lecture 1 — 01/13/2009

Goals

- Survey software engineering concepts, terminology and techniques
  - Emphasis on Agile Design Methods
    - Will supplement with traditional/historical material as needed
- Take an in-depth look at **model-based** software engineering techniques for dealing with
  - concurrency
  - software abstractions

CAETE Announcements

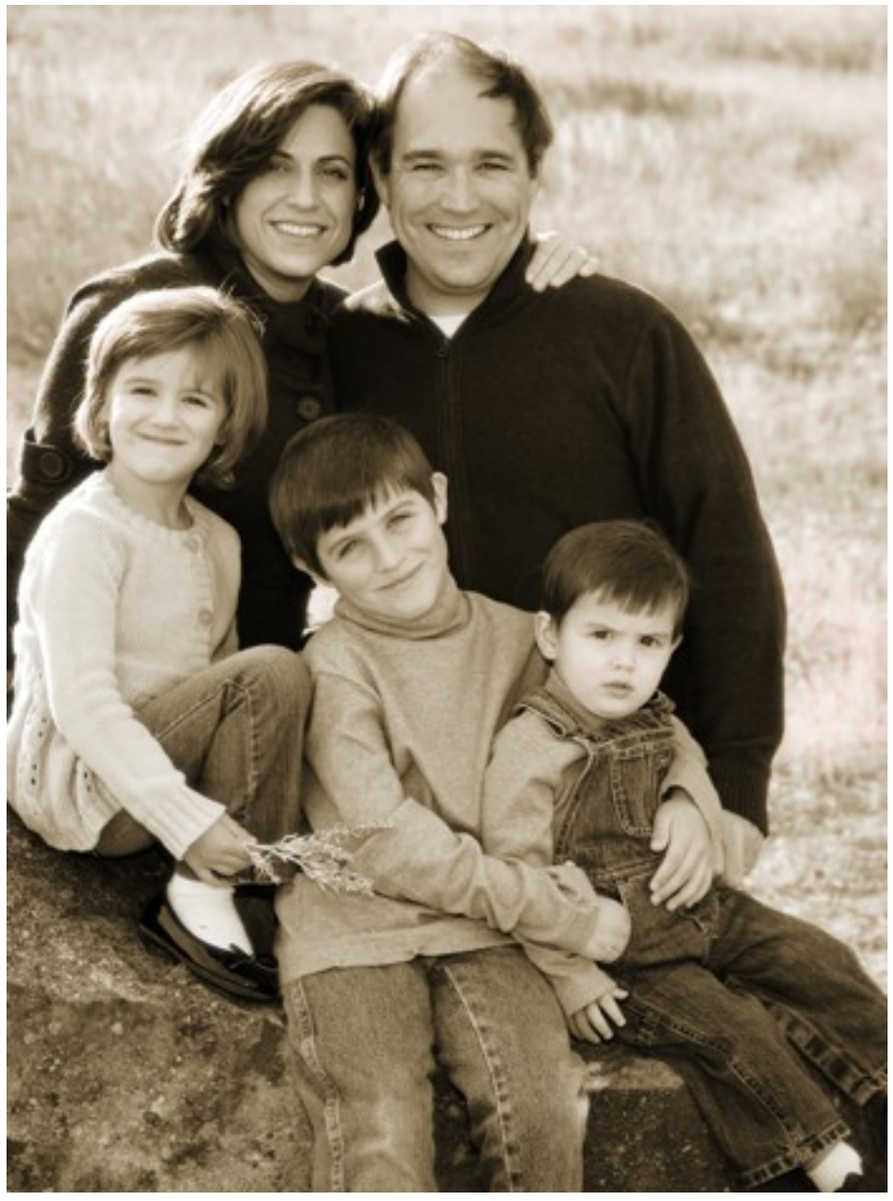
- In-Class Students
  - CAETE has a busy studio schedule
    - Be sure to exit promptly so next class can begin
  - Food and drink are not technically allowed!
    - They are tolerated as long as you keep the studio clean!
- Distance Students
  - Textbooks can be ordered from the CU Bookstore
    - Call 303-492-6411 or 800-255-9168
      - Or order on-line at <http://cubooks.colorado.edu/>

Due Dates

- In the past, due dates for CAETE students were one week behind the due dates for in-class students
  - However, now that lectures are being made available to you in a timely fashion, both in-class and distance students will have the same due dates
- CAETE students need to have a “test proctor” to administer the midterm for them
  - If you don’t know who your test proctor is, contact CAETE to find out (Do this during the first week of classes!)

A bit about me…

- Associate Professor
  - At CU since July 1998
- Ph.D. at UC Irvine
- Research Interests
  - Software Engineering
  - Hypermedia and the Web
  - Web Engineering
  - REST-based Web Services



A little bit more…

- 22nd semester at CU (!!)
- 5th time teaching CSCI 5828
- Software Development Experience
  - Approximately 16 systems, 30K — 100K LOC each
  - Some industry experience with IBM & Unisys
  - Experience with academic / industry collaboration

Class Participation

- I welcome contributions to the class by students
  - both in lecture and off-line
- Feel free to interrupt me during lecture to ask questions!
  - “Stupid questions” — No such thing!
  - Engage in discussion otherwise we get the “silent tomb” effect — Boring for you and me!
- If I’m speaking too fast, stop me and ask me to slow down

Office Hours

- By appointment
  - Send me e-mail at <kena@cs.colorado.edu>
  - Will most likely meet with students in ECCS 127
    - or in the faculty lounge on the 7th floor of the ECOT

Class Website

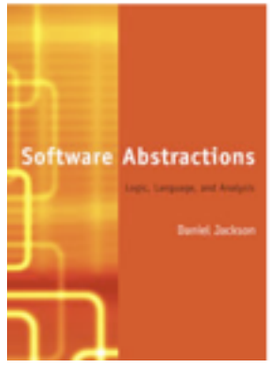
Has a What's New page with an RSS feed that you can use to stay current with all course announcements!

Textbooks

There are two required textbooks for 5828 this semester and one optional textbook.

Pilone and Miles's book "Head First Software Development" is another entry in O'Reilly's excellent set of Head First books. We will use this book to introduce the basic concepts and practices of modern software development including life cycles, planning, requirements, design, development, testing, and configuration management. I will supplement this material with material from other "more academic" sources such as Fred Brook's No Silver Bullet article and past textbooks used from previous versions of this class. Between our textbook and this other material, you will gain a comprehensive look at the software engineering field both past and present.

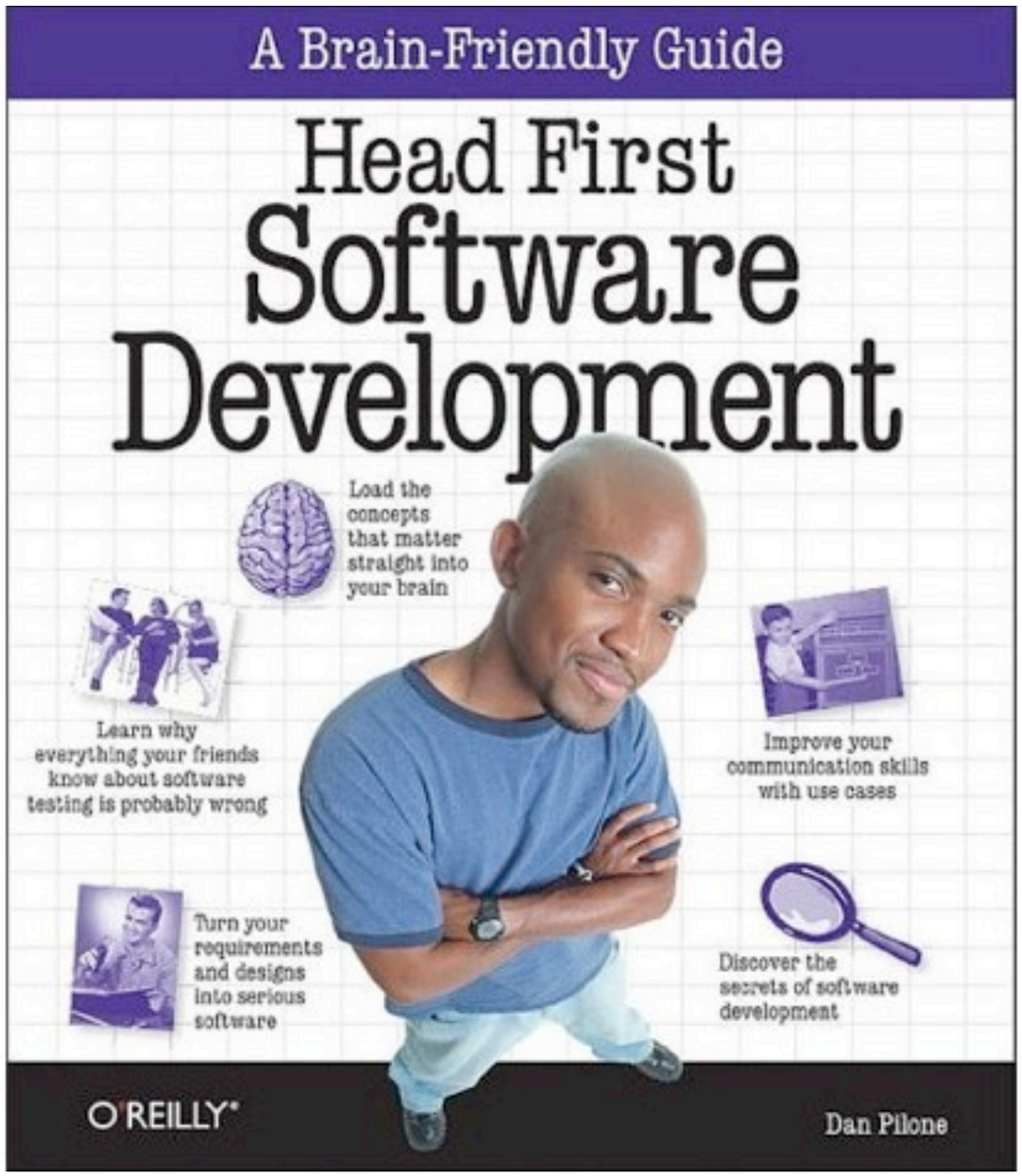
Magee and Kramer's book "Concurrency: State Models & Java Programming" is in its second edition and presents a model-based approach to designing and implementing multi-threaded systems. It shows students the utility of software models and how such models can be implemented. Finally, it provides software that allows us to construct, analyze, and visualize models of concurrent behavior for multi-threaded systems. Students will get a chance to use this software to iteratively construct software models of concurrent systems as well as to model the concurrent behavior of the systems they construct for their semester projects.



Daniel Jackson's book "Software Abstractions" presents another example of using model-based software engineering to tackle another difficult issue that arises in the design and development of large software systems, namely software abstractions. Or, put another way, what interface is your software system providing to the external world? This textbook is backed by a powerful set of software tools that will again allow students to apply the techniques learned in lecture to real-world modeling problems, including to issues that will arise in the design of their semester projects. This textbook is optional as Prof. Anderson will present all the information you need to make use of the associated tools that come with this book in lecture. However, I highly recommend buying it as it formalizes an aspect of software engineering that is treated informally in practically all software engineering textbooks!

<http://www.cs.colorado.edu/~kena/classes/5828/s09/>

Textbooks



Head First Software Development

Dan Pilone & Russ Miles

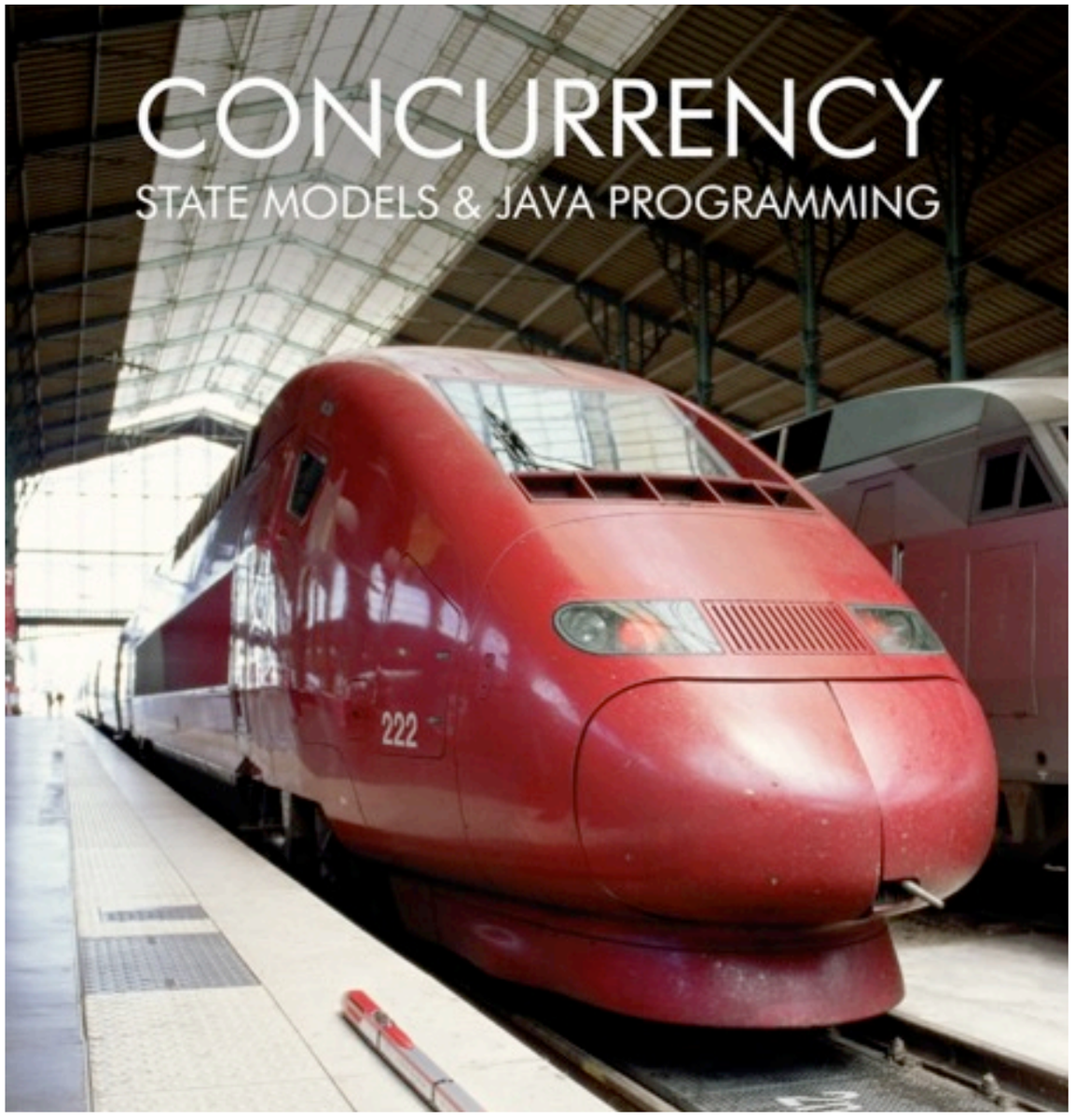
First Published: Jan 2008

Published by O'Reilly

Lots of great examples; decidedly non-academic feel but covers all the essentials

Will supplement with other material throughout semester

Textbooks



Concurrency by Magee and Kramer (aka “The Two Jeffs”)

Every developer needs to understand concurrency

This book does an excellent job covering this topic with a software engineering perspective

Textbooks

Software Abstractions

Daniel Jackson

<softwareabstractions.org/>

This book introduces a novel way of thinking about software abstractions and introduces the Alloy toolset for defining/analyzing them

Book is optional but highly recommended!

Structure of Semester

- The course will switch between the first two topics
  - providing an introduction to software engineering one day
  - and looking at issues of concurrency the next
- We'll switch to looking at software abstractions later in the semester
- May also look at additional topics later in the semester
  - (Additional) agile design methods, Web engineering, …

Course Evaluation

- Your grade will be determined by your work on
  - Reviews (simple questions to make sure you do the reading)
    - One a week, with possible grades of “+”, “✔”, or “-”
  - Homeworks (typically problems from Concurrency textbook)
  - Midterm (Tuesday, March 3rd)
  - Class Project (Due at last class session; student teams)

- NO FINAL!

Honor Code

- I encourage collaboration in this class via the reviews and the class project
  - I'd like, however, for the homeworks and midterm to be worked on individually
- 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 20% penalty
  - Assignments can be handed in up to two weeks after the initial due date (except for the final assignment of the class project)
    - after that you are out of luck…
- This does not apply to reviews. They are due each Saturday by 11:55 PM
  - If you don’t submit a review, it counts as a “-” (minus)

What is Software Engineering?

- The computer science discipline concerned with developing large applications. Software engineering covers not only the technical aspects of building software systems, but also management issues, such as directing programming teams, scheduling, and budgeting

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

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)

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 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 Dev.

- 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!

SE-related Jobs

- Software Developer
- Software Engineer
- SQA Engineer
- Usability Engineer
  - requires strong HCI/CSCW background
- Systems Analyst
  - professional reqs. gatherer/ professional designer
- DBA
- Sysadmin
- Software Architect
- Software Consultant
- Web Designer
- Build Manager / Configuration Management Engineer
- Others??

The Big Three

Specification

Software Engineers specify everything
code, requirements, design, process
What makes a good specification?

Translation

Iteration

The Big Three

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
(aka decomposition)

Iteration

Specification

The Big Three

Iteration

The work of software engineering is done **iteratively**
step by **step**
task by **task**
sub-process by **sub-process**
until we are **“done”**

Specification Translation

The Big Three

Specification

Translation **Iteration**

The Big Three

Specification

Translation **Iteration**

Are Supported by Many Things

Principles, Techniques & Tools
Planning, Estimates & Process
PEOPLE

```python
import random

class atts(object):

    def __init__(self, name):
        self.name = name
        self.atts = {}

    def __len__(self):
        return len(self.atts)

    def __contains__(self, key):
        return key in self.atts

    def __iter__(self):
        return iter(sorted(self.atts.keys()))

    def __getitem__(self, key):
        return self.atts[key]

    def __setitem__(self, key, value):
        self.atts[key] = value

    def __delitem__(self, key):
        del self.atts[key]

    def __str__(self):
        result = "Name: %s" % self.name
        for key in self.atts:
            result = "    %s : %s" % (key, self.atts[key])
        return result

    def get_name(self):
        return self.name

    def keys(self):
        return sorted(self.atts.keys())

    def return_random_key(self):
        position = random.randint(1, 20)
        return self.atts.keys()[position]
```

Code written by a programmer

Would a software engineer produce the same code?

Just by looking at it, can we see anything wrong with it?

No documentation?
No tests?
Is this under version control?
What sort of code coverage has been achieved?

How to Fix?

- How would we fix the code on the previous side?
  - One step at a time!
    - Place under version control (or configuration management)
    - Add comments
    - Add tests
    - Check for coverage (for python, see: <coverage.py>
- A software engineer would want at least this level of engineering surrounding all components in their system
  - Why? Is this enough?

SE 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
  - Text is available here: No Silver Bullet

Coming Up

- Lecture 2: No Silver Bullet
- Lecture 3: Chapter 1 of HFSD Textbook
- Lecture 4: Chapter 1 of Concurrency Textbook