CS121: Software Development

Today

• Overview
  - What is "software development?"
  - What is this course about?
• LAC computers/accounts

"Software Development"

Key Processes

• Requirement specification/analysis
• Design
• Implementation
• Testing

Why study software development?

• Society has become increasingly dependent on software systems.
**Example 1**

**Expedia Maps**

I need to go to the airport

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**Output reported in The Risks Digest**

Oct. 1, 1999

Excerpts from Expedia Maps directions:

From: Laurel, Maryland
To: Baltimore-Washington International Airport, Maryland

Driving Distance: 58.65 miles

Time: 9 days 3 hours 22 minutes

Time (hour:minute) Instruction

0:00 Depart Laurel, Maryland
1:01 Entering Delaware
1:17 Entering New Jersey
3:24 Entering New York
3:51 Entering Connecticut
5:51 Entering Massachusetts
7:29 Entering New Hampshire
7:44 Entering Maine
12:20 Entering New Brunswick
20:20 Take the North Sydney-Argentia Ferry
34:32 Entering Newfoundland
36:35 Turn left onto Local road (4543.1 mi)
219:22 Arrive Baltimore-Washington International Airport, Maryland

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**Why study software development?**

- Society has become increasingly dependent on software systems.
- Failures in software systems can be dangerous and costly

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**Example 2**

- 1981: FAA announced plans to modernize air-traffic control.
- 1985: IBM awarded contract. System estimate to have 1.5 million lines of code, cost $2.5 billion, and be deployed by 1991.
- 1994: FAA decided that the project would never be completed, and cancelled it. Net loss $1.5 billion

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**Example 3**

- Linear accelerators create high-energy beams that can destroy tumors with minimal impact on the surrounding healthy tissue.
- Therac 25 was the first linear accelerator with dosage controlled solely by software (as opposed to hardware)

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**1983: Pre-release Safety Analysis**

- Programming errors have been reduced by extensive testing on a hardware simulator and under field conditions on teletherapy units. Any residual software errors are not included in the analysis.
- Program software does not degrade due to wear, fatigue, or reproduction process.
- Computer execution errors are caused by faulty hardware components and by "soft" (random) errors induced by cosmic particles and electromagnetic noise.
Therac-25 History

• 1983: First Therac 25 installed

• 1985-1987: Six massive-overdose accidents due to "software error" are reported. Overdoses caused severe burns and death.

• 1987: Recalled for extensive design changes, including hardware to safeguard against software errors in dosage.

Therac-25 Software Errors

• Bugs in programs modules

• System errors due to misinterpretations of module interfaces

• Errors in users’ guide

Why study software development?

• Society has become increasingly dependent on software systems.

• Failures in software systems can be dangerous and costly

• Software design/development is a very hard problem

Stats on software projects


• 31.1% are canceled before they are finished

• 52.7% overrun their cost estimates by at least 189%

• 33.3% overrun their time estimates by 100%-200%

• 94% of all projects do a "restart"

Large vs. Small Steps: Productivity

![Graph showing productivity vs. project size in KSLOC]

Source: Measures For Excellence, Putnam, 1992. Based on 1,600 systems.

How hard is software development?
What experts say:

[there are] no silver bullets" ... that will do for software productivity, reliability, and simplicity what electronics, transistors, and large-scale integration did for computer hardware.

- Frederick J. Brooks, Jr.  
The Mythical Man-Month

Software is a wicked problem...


Objectives of CS121

• Understand the problems
• Examine possible strategies
• Practice

What is this course about?

The design and development of large software projects
• "Theory"
• Practice

Software Design & Development “Theory”

"Theory" is not well-developed
- relatively new field
- paradigm shifts
- "wicked" problem
- no "silver bullets"
- there are techniques, strategies, and principles that can help

Major Topics

• Software Development
  - managing key processes
  - artifacts
• Software Design
  - principles
  - patterns
  - artifacts
Readings

• Weekly readings assigned on Tuesday
• Suggested questions
• Occasional quiz
• Material will be tested in exams

Reading

• Text: Software Design by David Budgen
  Buy it in the CS office for $60.88.
• Additional readings will be assigned

Software Design & Development Practice

You’ll develop three software projects in this class
- arcade game
- miniature golf game
- computer game of your design

Why games?

They involve a range of problems that rarely show up in a single software project
- User interface design
- Computer graphics and sound
- Simulation and modeling
- Lots of mathematics
- Real-time
- Other possibilities: AI, networking, etc.

What about graphics

• You’ll learn some basic OpenGL that will be more than adequate for your games.
• Yes … you can do a few all-nighters and figure out some cool effects … but that is not required … that is not even recommended.
• This is not a graphics course … If you want to do cool effects take the graphics course.

Major Topics

• Software Development
  - managing key processes
  - artifacts
• Software Design
  - principles
  - patterns
  - artifacts
Software Development Practice

You'll develop three software projects in this class:
- Arcade game
  - Focus: Software development cycle, processes (particularly requirements elicitation/analysis), artifacts of development process
- Miniature golf game
  - Focus: Software design process, design principles & patterns, communication, artifacts
- Computer game of your design
  - Focus: Putting it all together

Misc.

- My email is z@cs.hmc.edu.
- My office is 2341 Olin.
- My office hours MTW 2:45-4:00

More Misc.

- The mailing list is cs-121-l. You need to subscribe if you are off-campus.
- The course web page is www.cs.hmc.edu/~courses/2003/fall/cs121
- The tutor is Ed Heaney. You can find his email addresses on the web page. Tutoring hours will be arranged soon.

Grading

- Projects 75%
  - Breakdown
    - Arcade Game: 15%
    - Golf Game: 25%
    - Final Game: 35%
  - Evaluation
    - Game Grade * Your Contribution Factor
- Two midterms 10% each
- Individual assignments and quizzes 5%
- Class participation 0% (bump factor)

Today's reading assignment

- Budgeon: Chapter 1, 2
- Brooks: "No Silver Bullet" available on course web page

The history of games

Which is borrowed from John Laird at the University of Michigan