

## CS121: Software Development

## Today

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

## "Software Development"



## Key Processes

- Requirement specification/analysis
- Design
- Implementation
- Testing

## "Software Development"

- Requirement specification/analysis
- Design
- **Implementation** (focus of CS70)
- Testing

## Why study software development?

- Society has become increasingly dependent on software systems.

Expedia Maps:  
I need to go to the airport



## 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: 5865.1 miles

Time: 9 day(s) 3 hour(s) 22 minute(s)

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(s) (4543.1 mi)
219:22	Arrive Baltimore-Washington International Airport, Maryland

## Why study software development?

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

## Therac-25

- 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)

## 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 alpha particles and electromagnetic noise.

## and then ...

- 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 program modules **UNIT TEST**
- System errors due to misinterpretations of module interfaces **INTEGRATION TEST**
- Errors in users' guide **ACCEPTANCE TEST**

## 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 hard problem

## FAA

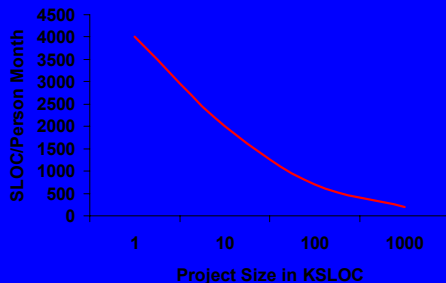
- 1981: FAA announced plans to modernize air-traffic control.
- 1985: IBM awarded contract. System estimate to have 1.5 million lines of code, cost \$2.5 billion, and be deployed by 1991.
- 1987: Revised cost \$4.3 billion, deployment slipped to 1995.
- 1994: FAA decided that the project would never be completed, and cancelled it. Net loss \$1.5 billion

## Stats on software projects

J. Johnson, "Creating Chaos," American Programmer, July 1995

- 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



Source: Measures For Excellence, Putnam, 1982. Based on 1,000 systems.

[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

"Wicked problems are problems that are fully understood only after they are solved the first time."

Rittel and Webber, Dilemmas in a general theory of planning, 1983

Software is a wicked problem...

DeGrace and Stahl, "Wicked Problems, Righteous Solutions, A Catalogue of Modern Software Engineering Paradigms.", Prentice-Hall 1980

software's chronic crisis quiz

## Is there hope?

Software engineering:  
tools, techniques, and principles to  
promote software quality

software engineering is an evolving field

## Objectives of CS121

- Understand the problems
- Understand the tools, techniques, and principles that can help
- Practice

## Major Topics

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

## 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?

Games 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.

## Software Design & 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

## Grades

- 10% individual assignments
- 20% exams (midterm and final)
- 70% projects:
  - 15% arcade game
  - 25% miniature golf
  - 30% final project

## Texts

- UML Distilled by Fowler
- Design Patterns by Gamma, Helm, Johnson, Vlissides

## More course info

- The mailing list is cs-121-l.
- The grutors are Brian Bentow, Ed Heaney, and Michael Tuck-Lee.

## Assignments

Reading assignments are given on the course schedule page.  
Other assignments will be announced in class and shown on the course schedule page.

Web page:

[www.cs.hmc.edu/~courses/2004/spring/cs121](http://www.cs.hmc.edu/~courses/2004/spring/cs121)

Schedule:

[www.cs.hmc.edu/courses/2004/spring/cs121/schedule.html](http://www.cs.hmc.edu/courses/2004/spring/cs121/schedule.html)

## My info

- My email [z@cs.hmc.edu](mailto:z@cs.hmc.edu)
- My office is 2341 Olin, X78360
- My office hours MTW 2:45-4:00 and by appointment

## Assignment

1. Intro survey -- due TODAY
2. Arcade game review -- due next class