Welcome!

Principles of Computer Science
CPS 1
LSRC B101
M, W, F 10:30-11:20

Professor Jeff Forbes

Today’s topics

- What is this course about?
- How are we going to learn that?
- Who is this guy talking to us?
- Where do we go from here?
- An overview of computer science

- Upcoming
  - The World Wide Web and HTML
  - Problem Solving

Course Information

“A survey of the great ideas of computer science along with experience with programming, the theoretical foundations of computer science, how computer systems are organized and work, and the applications of computers including their effect on society.”

- Grading Breakdown

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Weight (approx)</th>
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<tbody>
<tr>
<td>Labs</td>
<td>10%</td>
</tr>
<tr>
<td>Lab Final</td>
<td>5%</td>
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<tr>
<td>In-class</td>
<td>5%</td>
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<tr>
<td>Quiz/Assign</td>
<td>20%</td>
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<tr>
<td>Project</td>
<td>20%</td>
</tr>
<tr>
<td>Midterm</td>
<td>15%</td>
</tr>
<tr>
<td>Final</td>
<td>25%</td>
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- Scores on absolute scale
- No make-ups, no late submissions
- Important Dates
  - Midterm 2/18
  - Projects due 4/19
  - Final 4/27 9am-12
  - Friday Quizzes
- Let me know ASAP if you have any concerns

Administrivia

- Check web pages regularly
  - Course web page
    http://www.cs.duke.edu/courses/spring04/cps001/
  - Read Blackboard web page
    https://courses.duke.edu
  - Read discussion forums
- Reading posted on Blackboard page due by Friday class time
- Lab starts on Monday, Jan. 12

- Seating Chart
  - Pictures of you
  - PRS numbers
- Collaboration policy
- Late policy
Active learning

- In class, we will use the Personal Response System (PRS)
  - Pick up your receiver every day before class
  - ConcepTest: multiple choice questions that highlight an important concept gleaned from the lecture and/or reading
  - It’s OK not to know!
  - Peer instruction: after seeing the results, you will have confer with your neighbor and revote
- Just in Time Teaching
  - Discuss your assignment responses in class
- Class debates
- Why respond?
  - Counts toward inclass work score
  - Effort, participation, and altruism
  - Makes class better!

Frequently Asked Questions

- What is the prerequisite?
  - High school algebra (?)
- How does this course fit into the curriculum?
  - A survey, service course designed for non-majors
  - CPS 6 is more programming oriented
  - Satisfies QID (M) and STS requirements
- Why take this course?
  - Computers are interesting, useful, and ubiquitous
  - Pure entertainment
- I’m computer-phobic. Will I be able to handle this course?
  - Computers rarely bite and the ones you deal with in this course are relatively small and not very mobile

What does this course teach?

- Syllabus
- Why doesn’t this course teach anything practical?
  - Learn how to create a web page?
    - Read a book
  - Learn to how create a web browser?
    - Programming paradigms
    - Networking
    - Security
    - Operating systems and computer architecture
    - Concurrent processing
    - Social effects of computing
    - And many more issues involved

On the subject of questions...

- Did you ask any good questions today?
  - Ideas and Information by Nobel prize winning physicist Arno Penzias
  - Questions which illuminate help nourish ideas
  - Children are born curious
  - Fear of public displays of ignorance prevents learning
- Participate in class
- Go to office hours
- Make study groups with your classmates
Getting help

- **Contact Information**
  - Email: forbes@cs.duke.edu
  - Phone: 660-6550
  - Office Hours in D235 Levine Science Research Center
    - M 2:15-3:45, Th 1:00-2:30
    - When my door is open
    - By appointment
- **TA**
  - Grad TA: Siddhesh Sarvankar (siddhesh@cs)
    - Office hours TBA
    - 03 North Bldg, 660-4003
  - Head UTA: Wai-Ping Chim (wc4@acpub)

- And a whole gang of UTAs

Who are you?

- **Testing out the PRS system**
- **Class**
  - Frosh / Soph / Jun / Sen / Other
- **Major**
  - Fuzzy / Techie / Undecided
- **Box at home?**
  - Mac / PC / Linux / Other
- **Programmed before**
  - Never / HTML / Javascript / Java / C / C++ / Lisp / Other

Stories

- Who is Marc Andreessen and what did he do (21 years old)?
- Who is Claude Shannon and what did he do (21 years old)?
- Who is Linus Torvalds and what did he do (21 years old)?
- Who is Steve Jobs and what did he do (21 years old)?
- Who is Ada Byron and did she do (27 years old)?
- Who is Tim Berners-Lee and what did he do (35 years old)?
- Who is Alan Biermann and what did he do (51 years old)?

Other names: Alan Turing, Edsger Dijkstra,... (more?)

Precise, logical thinking

- **Breaking down a task into unambiguous steps**
- Computers are **deterministic**
  - **Algorithm**: a set of steps that defines how a task is performed
- **Debugging**
  - Programs will rarely work the first time one writes them
  - Systematic approach to detecting, diagnosing, and fixing errors
  - Debugging skills are useful in many parts of life
Creating a Program

- Specify the problem
  - remove ambiguities
  - identify constraints
- Develop algorithms, design classes, design software architecture
- Implement program
  - revisit design
  - test, code, debug
  - revisit design
- Documentation, testing, maintenance of program
- A programming language is a way to describe an algorithm.

The Ice Cream Story

"This is the second time I have written you, and I don't blame you for not answering me, because I kind of sounded crazy, but it is a fact that we have a tradition in our family of ice cream for dessert after dinner each night. But the kind of ice cream varies so, every night, after we've eaten, the whole family votes on which kind of ice cream we should have and Drive down to the store to get it. It's also a fact that I recently purchased a new car and since then my trips to the store have created a problem. You see, every time I buy vanilla ice cream, when I start back from the store my car won't start. If I get any other kind of ice cream, the car starts just fine. I want you to know I'm serious about this question, no matter how silly it sounds: 'What is there about your car that makes it not start when I get vanilla ice cream, and easy to start whenever get any other kind?'"

Quotations about Computer Science

"Computer science has such intimate relations with so many other subjects that it is hard to see it as a thing unto itself"
  - Marvin Minsky, 1979

"It has often been said that a person does not really understand something until he teaches it to someone else"
  - Donald Knuth

"Actually, a person does not really understand something until he can teach it to a computer"
  - Judith Gal-Ezer and David Harel

Algorithms

- Step-by-step process that solves a problem
  - more precise than a recipe
  - eventually stops with an answer
  - general process rather than specific to a computer or to a programming language
- Searching: for phone number of G. Samsa, whose number is 929-9338, or for the person whose number is 489-6569
  - Are these searches different?
- If the phone book has 8 million numbers in it (why are there only 7.9 million phone numbers with area code 212?)
  - How many queries to find phone number of G. Samsa?
  - How many queries to find person with number 929-9338
  - What about IP addresses?
Algorithms as Cornerstone of CS

Representation of information

- What's the difference between
  - Rolex and Timex?
  - VCR tape and DVD?
- What is digital?
- Sampling analog music for CD's
  - 44,100 samples/channel/second * 2 channels * 2 bytes/sample * 74 minutes * 60 seconds/minute = 783 million bytes
- How does MP3 help?

Layers of abstraction

Survey the field

- Artificial intelligence
- Graphics/Multimedia
- Parallel Computation
- Programming Languages
- Systems
- Scientific Computing
- Theory
- User Interfaces
Themes and Concepts of CS

- **Theory**
  - properties of algorithms, how fast, how much memory
  - average case, worst case: sorting cards, words, exams
  - *provable* properties, in a mathematical sense

- **Language**
  - programming languages: C++, Java, C, Perl, Fortran, Lisp, Scheme, Visual BASIC, ML, ...
  - Assembly language, machine language,
  - Natural language such as English

- **Architecture**
  - Main memory, cache memory, disk, USB, SCSI, ...
  - pipeline, multi-processor

What’s more difficult

1. Sketch artist vs. Your dog?
   - Generating a face
   - Recognizing a face

2. Vacation planner vs. Super-librarian?
   - Finding the best route through cities
   - Alphabetize the books in the Library of Congress

- **Fundamental ideas of computer science**
  - Complexity
  - Computability

Complexity: What’s hard, what’s easy?

- What is a prime number?
  - 2, 3, 5, 7, 11, 13, ...
  - Largest prime?

- 4812959837082048697
- 671998030559713968361666935767

- How do we determine if these numbers are prime?
  - Test 3, 5, 7, ...
  - If we can test one million numbers a second, how long to check a 100 digit #?

- Why do we care?

- 671998030559713968361666935767 is not prime, I can prove it but I can’t give you the factors.

- Finding factors is “hard”, determining primality is “easy”
  - What does this mean?
  - Why do we care?

- Encryption depends on this relationship, without encryption and secure web transactions where would we be?

Questions you will be able to answer

- Vendor tries to sell you a system that will check all of your systems and procedures to see if they are correct.
  - A good deal?

- Programmer tells you that to optimize the routing of your sales personnel is beyond the power of today’s computers.
  - Do you believe her?

- Computer consultant demonstrates complicated management system with test data including a handful of employees.
  - Is the performance with this small set of data a good indicator of how the system will perform with all of your company data entered?
What is a computer?

- Turing machine: invented by Alan Turing in 1936 as a theoretical model
- infinite tape, moving tape-reader

A computer is a computer, is a computer, Church-Turing Thesis, all have same “power”

Chips, Central Processing Unit (CPU)

- CPU chips/Microprocessors
  - Pentium (top)
  - G3/4 (bottom)
  - Sound, video, …
- Moore’s Law
  - chip “size” (# transistors) doubles every 12–18 months (formulated in 1965)
  - 2,300 transistors Intel 4004, 42 million Pentium 4

Assignment 0

- Due in your first lab
- What would life be like without computers?
- Pick one 24 hour period over the next week
  1. Write down ALL interactions you have with a computer
  2. What would change in your life if all computers stopped working?
- Question 1 on p. 14 of Brookshear
- Come up with clean computer science related joke

- First question you should be asking is: What is a computer?