CS106E Schedule and Detailed Topic List

Spring 2018

Don't be intimidated by the technological jargon listed, non-technical students can absolutely learn this type of material, and I have over twenty years of experience presenting tough computer science concepts to a non-technical audience.

Some Past Comments from Previous Students

Here are a few comments from my CS105 (Intro to CS for Non-Techies) students:

> *"Even though I have absolutely no background in computer science, he made the course material interesting and worthwhile to learn. I feel like he presented the material in a way that was easy to understand for people of all academic backgrounds."*

> *"I really appreciate his teaching a course like this, which opened my eyes to the awesomeness of computer science and showed me that as a history major I could actually do it, and do it well. Patrick is great at keeping lectures well paced and interesting"*

> *"[He] knows how to TEACH the material to super novice learners in the subject area, and takes a great approach to teaching the class in that he makes it a really positive space with super low intimidation."*

> *"His background in the topic as well as his expertise made the course feel very applicable to what's necessary for even non-tech savvy people in the work force."*

Overview

Date	Week	Monday	Wednesday	Friday
4/2	1	Representation of Information	Representation of Images	Representation of Music
4/9	2	Inside the Computer		The Operating System
4/16	3	Networks and the Internet		The Web
4/23	4	Creating Webpages with HTML and CSS		
4/30	5	Programming Languages	Server-Side Programming	
5/7	6	Databases	**Midterm** Location TBD	Client-Side Programming

5/14	7	Client-Side Programming (cont)	Cloud Computing / The Internet of Things	Software Engineering
5/21	8	Computer Security (Mechanisms)	Computer Security (Attacks)	Computer Security (Defenses)
5/28	9	*Memorial Day (no class)*	Privacy and Big Data	Artificial Intelligence and Machine Learning
6/4	10	Human-Computer Interaction + Mobile Development	Computer Theory and Algorithmic Complexity	**Final** (9:30-11:30am) Location TBD

Detailed Outline

How Computers and the Internet Work

Introduction and How Computers Represent Information

Overview of the Class and Administration
Bits and Bytes
Implications of using Bits
Binary Numbers and the Limitations of Binary Numbers (e.g., Overflow)
ASCII and Unicode

How Computers Represent Images

Pixels
Displaying Colors
Additive Color (RBG for Web) vs. Subtractive Color (CYMK for Print)
Display Resolution (e.g., 480i, 480p, 720p, 1080p, 4k)
Color Resolution 24-bit Color, 32-bit Color with Alpha, HDR
An Example showing Different Image Representations and Compression
Object/Vector representations vs. Bitmap/Raster representations
Dithering and Anti-Aliasing
Bitmap Fonts vs. TrueType Fonts
JPEGs, PNGs, (and GIFs)
JPEG Examples, Compression Artifacts, and Implications
RAW Format
SVG

How Computers Represent Sound and Music

Creation and recording of sounds or music
Representing real world sounds digitally
CD Audio
How and why a CD Audio file is compressed to MP3/AAC/WMA lossy formats.
Psychoacoustics and Huffman Encoding
FLAC and lossless formats
MIDI

How Computers Work (2 Lectures)

CPUs
How a CPU Works
Machine Language and Assembly Languages
RISC vs. CISC
Pipelining, Superscalar and Other Optimizations
Multi-Core CPUs and Multiprocessor Computers
Applications taking advantage of Multiple Processors
GPUs (Graphics Processing Units)
Memory Hierarchy
Virtual Memory
Cache Memory (L1 and L2 Cache)
How Memory is Organized (Memory Addresses)
32-bit Computing vs. 64-bit Computing

Operating Systems

What is an OS?
Processes and Threads
Scheduling
Memory Management and Paging
OS Level Protection
Kernels
Virtual Machines
Multi-Threaded Programming Issues

How the Internet Works (2 Lectures)

Network Hardware: Network Topology and Connection Medium. Internetworks.
Naming Schemes: Physical/MAC Addresses, IP Numbers, Hostnames. Domain Name System (DNS). Ports.
Protocols: What's a Protocol? The Internet Protocol Stack. TCP/IP. IP Packets and their Implications.
Intranets vs. the Internet
SSL (Secure Socket Layer) and TLS (Transport Layer Security)
Packet Switching vs. Circuit Switching. VoIP (Voice over IP) and IP Phones
Lag and Latency

How the Web Works (1 Lecture)

Overview of how the Web works. HyperText Transport Protocol. HyperText Markup Language

Web Development

Creating Webpages with HTML and CSS (2 Lectures)

The Basics of HTML. Tags and Attributes.
The Basics of CSS. Overview of Selectors and Available Properties
Separating Semantics from Presentation
Webpage Layout and Layout Options
HTML Forms

Programming Languages

[Note: while this lecture logically should go in the How Computers and the Internet Work section, I place it here so that students will be thinking about how the computer languages they know compare to the PHP and JavaScript we will be using in CS106E.]

High-Level Languages (e.g., Java, C++, Python, JavaScript) vs. Low-Level Languages (e.g., Intel x86, ARM, MIPS Assembly and Machine Languages)
Compilers and Interpreters. Hybrid Approaches.
JVM Languages, Languages Compiled to JavaScript
Cross Compilation
Strongly Typed Languages vs. Weak Languages. Implications of choice for Software Development.
Managed Languages vs. Unmanaged Languages
Programming Paradigms:
    Imperative Programming, Object-Oriented Programming, Functional Programming

Server-Side Processing (with PHP) (2 Lectures)

Web Servers and Server-Side Languages
What's the difference between Client-Side Processing and Server-Side Processing?
Basics of PHP Programming

Databases (using SQL)

What is a database? What is a relational database?
Introduction to SQL
Accessing SQLite from PHP
NoSQL Databases

Client-Side Processing with JavaScript (2 Lectures)

Introduction to JavaScript
The Document Object Model
Events Handling
Dynamic Content
Client-Side Frameworks (e.g., React, Angular, jQuery, Twitter Bootstrap)

Additional Topics

Software Engineering

Software Engineering vs. Programming
The Traditional Software Engineering Lifecycle
Stages of Software Development
Agile Development (SCRUM, Extreme Programming)
Comparison of Software Development Approaches

Cloud Computing

Grid Computing and Utility Computing Paradigms
Infrastructure as a Service
Platform as a Service
Serverless
Software as a Service

Edge Computing / Fog Computing / Mesh Computing
The Internet of Things
The Industrial Internet of Things
IoT and Security
IoT and Privacy

Human Computer Interaction (HCI)

Why HCI is Important
HCI Successes and Hot Topics
HCI Techniques
Case Study Mobile vs. Desktop Computing

Security (3 Lectures)

Security Issues: Confidentiality, Authentication, Integrity, Non-Repudiation
Symmetric and Asymmetric Encryption
Key Size, Brute Force Attacks, and Cryptanalysis
Certificates and Certification Authorities
SQL Injection, Cross-Site Scripting, Clickjacking, Man in the Middle Attacks
Social Engineering, Phishing and Spear Phishing
Virus, Worms, and Trojan Horses
Adware, Spyware, Bots, Ransomware
Firewalls, Proxy Servers, and Virtual Private Networks (VPNs)
Steps to More Secure Personal Computing

Privacy and Big Data

Customer or Product
Sample Data Breaches: Equifax, Ashley Madison
Totalitarian Governments and Computing. Sesame Credit/Social Credit System
Data Mining
The Three Vs (Volume, Velocity, Variety) + Veracity
Big Data Example: Target Store's Pregnancy Prediction

Artificial Intelligence and Machine Learning

What is Artificial Intelligence?
The Turing Test
Artificial Intelligence Examples
Approaches to Artificial Intelligence
Neural Networks
Deep Learning

Computer Theory and Algorithmic Complexity

Comparing Algorithms
O-Notation
Time and Space Considerations
Undecidable Problems – The Halting Problem
Turing Machines