CS106E Schedule – Spring 2019

This schedule is tentative. Don't be intimidated by the technological jargon listed, non-engineering 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
4/1	1	Representation of Information	Representation of Images	Representation of Music
4/8	2	Inside the Computer		The Operating System
4/15	3	Networks and the Internet		The Web
4/22	4	Creating Webpages with HTML and CSS		
4/29	5	Databases	Programming Languages	Server-Side Programming
5/6	6	Client-Side Programming	**Midterm** Location TBD	Cloud Computing / The Internet of Things
5/13	7	Software Engineering	Computer Security (Mechanisms)	Computer Security (Attacks)

5/20	8	Computer Security (Defenses)	Privacy and Big Data	Artificial Intelligence and Machine Learning
5/27	9	*Memorial Day (no class)*	Artificial Intelligence and Machine Learning (continued)	Human-Computer Interaction + Mobile Development
6/3	10	Computer Theory and Algorithmic Complexity	Q&A	**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 in Computers (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 (3 Lectures)

CPUs
How a CPU Works
Machine Language and Assembly Languages
Compilers and Interpreters
RISC vs. CISC
Pipelining, Superscalar and Other Optimizations
Multi-Core CPUs and Multiprocessor Computers
Applications taking advantage of Multiple Processors
GPUs (Graphics Processing Units)

How Memory is Organized (Code and Data Segments, Call Stack, Heap)
Memory Hierarchy
Virtual Memory
Cache Memory (L1 and L2 Cache)
32-bit Computing vs. 64-bit Computing

Operating Systems

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

How the Internet Works (2 Lectures)

Network Hardware: Network Topology and Connection Medium. Internetworks.
Lag and Latency
Naming Schemes: Physical/MAC Addresses, IP Numbers, Hostnames. Domain Name System (DNS). Ports.
IPv4 vs. IPv6, DHCP
What's a Protocol? Protocols vs. Programs
The Internet Protocol Stack. TCP/IP.
IP Packets and their Implications.
Packet Switching vs. Circuit Switching. VoIP (Voice over IP) and IP Phones
Intranets vs. the Internet
SSL (Secure Socket Layer) and TLS (Transport Layer Security)

Web Development

How the Web Works (1 Lecture)

Overview of how the Web works.
HyperText Transport Protocol.
Uniform Resource Locators (URLs)
HyperText Markup Language

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

Databases (using SQL)

What is a database? What is a relational database?
What is a Command Line Interface and why do programmers use them
Introduction to SQL
NoSQL Databases

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 examples we'll be looking at in the Web Programming Lectures.]

Programming Paradigms:
    Imperative Programming, Object-Oriented Programming, Functional Programming,
    Logic Programming
Static Typed Languages vs. Dynamic Typed Languages. Implications of choice for Software Development.
Managed Languages vs. Unmanaged Languages
Compilers and Interpreters (Review from Two Weeks Ago). Hybrid Approaches.
JVM Languages, Languages Compiled to JavaScript
Cross Compilation

Server-Side Processing

Front-End vs. Back-End Engineering
What's the difference between Client-Side Processing and Server-Side Processing?
Models used for Server-Side Programming
Server-Side Languages and Frameworks
Development Stacks
Data Formats for Web Services (XML and JSON)

Client-Side Processing

Client-Side Processing Uses
Client-Side Processing Languages
About JavaScript (Origins and Language Characteristics)
The Document Object Model
Ajax
Client-Side Frameworks (e.g., React, Angular, jQuery, Twitter Bootstrap)

Additional Topics

Cloud Computing and Internet of Thing (IoT)

Uses of Term 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
RFIDs
IoT and Security
IoT and Privacy

Software Engineering

Software Engineering vs. Programming
Key Software Engineering Concepts (Modularity, Encapsulation, Interface vs. Implementation)
The Traditional Software Engineering Lifecycle
Stages of Software Development
Agile Development (SCRUM, Extreme Programming)
Comparison of Software Development Approaches

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
Integrity Mechanisms (Error Corect Codes, Checksums, Hashcodes)
Social Engineering, Phishing and Spear Phishing
Virus, Worms, Trojan Horses, Logic Bombs
Adware, Spyware, Bots, Ransomware
SQL Injection, Cross-Site Scripting, Clickjacking, Man in the Middle Attacks
Firewalls, Proxy Servers, Virtual Private Networks (VPNs), Air Gaps
Passwords, Pass Phrases, Password Managers
Steps to More Secure Personal Computing

Privacy and Big Data

Privacy in the Digital Age
    explosion of information available to track, leaving digital footprints
    improved ability to analyze, big data
Legal Issues
    European General Data Proection Regulation
Customer or Product
Sample Data Breaches: Equifax, Ashley Madison, Facebook
Web Beacons/Bugs
TOR
Totalitarian Governments and Computing.
    Sesame Credit/Social Credit System
    CCTVs and Face Recognition
Data Mining
The Three Vs (Volume, Velocity, Variety) + Veracity
Big Data Example: Target Store’s Pregnancy Prediction

Artificial Intelligence and Machine Learning (2 Lectures)

What is Artificial Intelligence?
History of Artificial Intelligence
    The Turing Test
Artificial Intelligence Subfields and Examples
Approaches to Artificial Intelligence
Machine Learning, Linear Regression, Neural Networks, Deep Learning
AI Engineer Considerations (Features and Data)
Ethical Issues and AI
    Privacy Concerns, Dataset Bias Issues, Responsibility for Fairues

Human Computer Interaction (HCI) and Web Design

Why HCI is Important
HCI Successes and Hot Topics
Related Fields (Psychology, Sociology, Ethnography, Graphic Design, Erogonomics)
HCI Techniques (Needfinding; Tasks and Roles; Prototyping, Testing, and Iteration)
Website Design and Branding
Typography and Fonts
Colors (HSB vs. RGB, Color Wheels and Color Schemes)
Navigation Schemes

Computer Theory and Algorithmic Complexity

Comparing Algorithms
    Linear Search, Binary Search, Hash Tables
O-Notation
Time and Space Considerations
Undecidable Problems – The Halting Problem
Turing Machines