

## SCI199Y Great Ideas in Computing Fall 2020

### Very ambitious list of possible topics:

- What is a computer? The von Neumann architecture. Digital vs analogue. What were the alternatives? What else is possible (parallel, quantum)?
- The genius of Alan Turing; A precise mathematical definition of computable function. The concept of interpreters. The proof that there exists non computable functions.
- How did computers and computing become a commodity? The amazing advances in hardware (cost, speed, memory size, physical size, power) and communication (cost, capacity and speed). Cost is determined by hardware and also by mass production made possible by demand made possible (in part) by "killer applications" (word processors; email, search engines). History of "early computing" (i.e. late 40's): code breaking, scientific computing, data processing.
- Fortran, the first commercial source level language and compiler. John Backus vs the prevailing view that compiled code would be too slow compared to machine code. The longevity of code vs the brevity of any particular machine; the cost of a machine vs the cost of software developers.
- The internet; packet routing. TCP/IP.
- How search engines work and what they do well and what (if anything) they don't do well. What is the "next generation search engine"?
- A local great idea: NP completeness. What is and what is not *efficiently* computable.
- Complexity based cryptography; public key cryptography; digital signatures. Captchas.
- Another local great idea: deep neural networks and the success of machine learning (ML).
- Computers vs human thought. The Turing test.
- HCI (human computer interaction). The mouse. Menus, click, paste and drag. Visualization.
- Information theory: the genius of Claude Shannon. Error correcting codes; compression.
- Social networks and the spread of information (and false information). Open Source. Wikipedia.
- Linear programming; dynamic programming and combinatorial optimization. How far can one go with conceptually simple algorithms? Dijkstra's algorithm.
- Distributed System primitives : mutual exclusion consensus