An Introduction to Computer Science
For Everyone

Topic List

This essay is intended to be done by groups of two students. Each pair of students will write a 10-page (single spaced, 12pt or smaller) essay on a topic within Computer Science.

Please contact the TA, Steve Tarzia, with your choice of partner as soon as possible. Also, if you are looking for a partner, please contact Steve and he will do matchmaking.

The topics in this list include variants of the "big questions" that we started out with in the class, and a grab bag of areas/subareas of computer science, and interesting historical developments/trends (to the present).

"Big Questions"

- Why doesn't software development scale to large projects (or can it)? The idea here is to read more deeply about software engineering, software project management, and software development, form an opinion on the question, and then write an essay defending your point of view.

- When will the exponential growth laws end and what will happen next? We talked about the exponential growth in transistor density (Moore's Law), communication bandwidth (Gilder's Law), and storage density (Arreal density law) and their profound effects. Investigate these "laws" more deeply, forecast when they will stop, and how computer science may have to change then.

- Is P=NP ? Investigate this discussion more deeply, form an opinion, and defend it.

- How does quantum computing (or quantum communication) change the mathematical and physical limits of computation (or communication)? Investigate this topic more deeply and summarize what is known.

- Will we ever be able to build a useful quantum computer?

- Investigate the principle of Turing equivalence more deeply and write about it, either in the context of computational machines or programming languages

- Read more deeply about the kinds of languages (such as regular languages, context-free languages, and general rewrite grammars) and their relationship to

computational machines (such as finite state automata, push-down automata, and Turing machines). Summarize and comment.

- Read more deeply about the history of programming languages and their current issues. Summarize and comment. Why are there so many?

- Learn about and summarize the differences and similarities in what is known about parsing and understanding formal languages (like programming languages) and human languages.

- Is software creation an art, a science, or an engineering discipline?

- Read more deeply about the history of human-computer interaction (and computer graphics) and its current issues. Summarize and forecast what a human interface in 2017 will be like.
- Read about computer-generated or computer-mediated art, literature, and/or music. Summarize and comment.

- Read more deeply about the history and current state of artificial intelligence, particularly the "strong AI" position. Summarize and comment.

- Are human beings computational entities? Take a position and defend it using the literature.

- Would it be useful to build a mindful robot? Read about Hans Moravec and his critics. Summarize and an comment.

- What are the implications for society off the fact that a computer can process any information and making copies of information is essentially free?

- Is the universe a simulation? Read more of Wolfram and Bostrom and their critics. Summarize, comment, and take a position.

CS Areas/Subareas (selected)

- Discrete Mathematics
- Propositional Logic
- Predicate Logic
- Graph Theory
- Theory of Computation
- Theory of Communication (Shannon)
- Complexity theory
- Combinatorics
- NP-Completeness
- Algorithms

- Approximation Algorithms
- Numerical Methods
- VLSI CAD
- Data structures
- Formal language theory / Automata theory
- Programming language design / semantics
- Computer architecture
- Operating systems
- Compilers and interpreters
- Database theory / Data modeling
- Database systems
- Computer networking
- Distributed systems
- Parallel systems
- Software engineering
- Formal methods / proving programs correct
- Computer graphics
- Image processing
- Human-computer interaction
- Artificial intelligence
- Machine learning
- Robotics
- Genetic algorithms / Genetic programming
- Computer vision
- Computer security
- Intrusion detection
- Cryptography
- Public key cryptography
- Cryptographic computation
- Quantum computing
- DNA computing

Historical Topics / Trends / Other stuff (selected)

- Building the first computers
- The rise of programming languages
- The rise of operating systems
- The rise of the PC
- The rise of the graphical user interface (GUI)
- The rise of the Web
- The rise of the Internet
- Ubiquitous computing
- Sensor networks / smart dust
- Multicore computing and parallelism
- Controversy over the Shor factoring algorithm and quantum computing

- Electronic voting machine controversy
- Strong AI versus weak AI position
- Hacker culture
- Cracker ("Black Hat") culture
- Free software and open source software movements
- EFF culture
- Great software successes
- Great software failures
- "Worse is better" / Unix Philosophy
- Software patent controversy
- Peer-to-peer computing and intellectual property