COS 583: Great Moments in Computing (Spring 2013)
Last updated: April 24, 2013

Instructors:
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Where to find stuff:
Course materials available on blackboard.princeton.edu

When:
Tuesdays and Thursdays: 1:30-2:50 PM. CS Room 302.

Course Description:
This course will cover pivotal developments in computing, including hardware, software, and theory. Material will be covered by reading seminal papers, patents and descriptions of highly-influential architectures. Emphasis will be on developing deep understandings of the discoveries and inventions that brought computer systems to where they are today. Discussion-oriented class will focus on in-depth analysis of readings. Final project or paper required.

Note: The papers you will read are seminal but are not always simple or approachable. You should expect to have difficulty understanding some, or even many, of them. You therefore will not be expected to master these readings, but rather to make your best effort. The in-class discussion is intended to help you to better understand the parts that may be difficult.

Course Grading Overview:
Participation in class discussions: 50%
Written responses to per-paper questions: 25%
Paper/project: 25%

A Few Disclaimers:
1) There have been more than great moments in computing than we can fit in one semester, so nobody is claiming completeness.
2) Careful examination of the list would no doubt reveal subtle, shameless biases towards topics closest to the instructors' areas of expertise and interest.
3) Strong feelings that some favorite seminal papers have been left out may be addressed in one's final project. Weak feelings too.

Class participation and response papers
This course uses a discussion, not lecture, format. Each class will cover particular subjects from the assigned reading; particular issues for discussion will be posed in a handout available at least a week in advance (usually via the course homepage).

Students will be expected to have carefully read the relevant assigned readings and to have prepared responses to, and analyses of, any assigned questions or topics. Some of these will require a brief written response; your written responses (1 or 2 pages) are due no later than the *beginning* of the class to which they pertain. Twenty-five percent of the course grade will come from response papers, but I will discard the worst two. (Late written responses won't be accepted.)

The quality and quantity of student participation in class discussions is worth 50% of the course grade. Participation grades will reflect the ***quality*** of the student's preparation and analysis as well as the student's contribution to the process of discussion: making connections with other students' remarks, raising overlooked issues, asking good questions, making good summaries. Be aware: effective participation requires a great deal more ***listening*** than speaking, and in particular requires careful listening *to other students*, and not just to the instructors. The goal is to have a truly dynamic discussion, not a student-instructor ping-pong match.

Course Project Description:
In past years, the course project was always simply written. This year, I will offer two choices.

Choice 1: Written: Your final project here is be a cogent, well-supported two-part essay regarding great moments to be added or deleted from this course. In particular, Part 1 is to pick one paper from *before you were born* and argue why it should be included in next year's version of the course. (Part of your case should be a claim that some paper included this year didn't really deserve to be.) In Part 2, you will select a published work from *after you started college (undergrad)* and argue why it will become influential enough in the future to warrant inclusion when *your children are taking this class*. Use citation counts, commercialization, and other rich/diverse aspects of "greatness" to defend your choice.

Choice 2: Programming: Some folks like to build real systems more than they like to write essays. So, here's another option. Select a programming project of your choosing, related to one of the papers we discuss. This could be: An emulator of an early computer system, a GUI representation of the Turing test (e.g. to use as teaching tool in an undergraduate course), etc etc. Please check with me about what you're planning.

Project Phases (Tentative dates)

- Topic proposal, due before Spring Break.
- First draft or outline (to be returned with instructor's feedback) due around April 22
- Final paper due (pdf) May 14 (Dean's Date)

Great Moments: Approximate Syllabus and Reading Assignments

Week	Dates	Tuesday	Thursday
1	Feb 5, 7	Class Overview	Foundations of Digital Logic [Boole, 1854] [Shannon, 1938]
2	Feb 12, 14	Artificial Intelligence [Turing, 1950] [Searle, 1980]	Early Architectures [Wilkes, 1951] [Burks et al. 1946]
3	Feb 19, 21	Ethernet [Metcalfe and Boggs, 1976]	Architecture vs. Implementation [Amdahl, 1964] [Tomasulo, 1967]
4	Feb 26, 28	Human-Computer Interaction [Sutherland, 1963]	Caches and Virtual Memory [Wilkes, 1965] [Kilburn, 1962]
5	Mar 5, 7	Computability [Turing, 1936]	Dawn of Transistors [Bardeen, 1956] [Bardeen & Brattain, 1948, 1950]
6	Mar 12, 14	RAID [Patterson et al.,1988]	Dawn of Parallelism: Cray-1 and Illiac IV [Russell, 1978]
Mar 19, 21		No Class: Spring break	

7	Mar 26, 28	Machine Learning [Rumelhart, 1986] [Valiant, 1984]	Integrated Circuits and the first Microprocessor [Kilby 1964, 2000] [Faggin et al., 1996]
8	Apr 2, 4	Compilers [Hopper, 1952] [Backus et al. 1957]	UNIX [Ritchie & Thompson, 1974]
9	Apr 9,11	Network Protocols [Cerf & Kahn, 1974]	Video Games: Past and Present [Brand, 1972] [Graetz, 1981]
10	Apr 16, 18	Moore's Law and its Future [Moore, 1965] [Moore, 2003]	Crypto and Encryption [Diffie & Hellman, 1976] [Rivest et al., 1978]
11	Apr 23, 25	This year's Turing Award winner=More Crypto. Probabilistic Encryption [Goldwasser & Micali, 1984]	Invention of the Mouse [Engelbart, 1970]
12	Apr 30, May 2	Wildcard: Data Abstraction [Liskov et al. 1977] [Liskov, 1987]	Back to the Future [Bush, 1945]

Reading List

[Amdahl, et al. 1964] G. M. Amdahl, G. A. Blaauw, and F. P. Brooks, Jr. Architecture of the IBM System/360. *IBM Journal of R & D*, vol. 8, no. 2 (April 1964), pp. 87-101.

[Backus, 1957] J. W. Backus, R. J. Beeber, S. Best, R. Goldberg, L. M. Haibt, H. L. Herrick, R. A. Nelson, D. Sayre, P. B. Sheridan, H. Stern, I. Ziller, R. A. Hughes, and R. Nutt. 1957. The FORTRAN automatic coding system. In Papers presented at the February 26-28, 1957, western joint computer conference: Techniques for reliability (IRE-AIEE-ACM '57 (Western)). 188-198.

[Bardeen 1948] J. Bardeen and W. H. Brattain. The Transistor, A Semi-Conductor Triode. Phys. Rev. 74, 230 - 231 (1948)

[Bardeen, 1950] Bardeen, J. and Brattain, W. Three-Electrode Circuit Element Utilizing Semiconductive Materials. U.S. Patent #2,524,035, issued Oct. 1950.

[Bardeen, 1956] Bardeen, J. Semiconductor research leading to the point contact transistor. Nobel Lecture, Dec. 1956.

[Boole, 1854] George Boole, *An investigation into the Laws of Thought, on Which are founded the Mathematical Theories of Logic and Probabilities*. 1854. Chapters 2 and 3.

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[Burks et al. 1946] Arthur W. Burks, Herman H. Goldstine, and John von Neumann, "Preliminary discussion of the Logical Design of an Electronic Computing Instrument," report to U.S. Army Ordnance Dept, 1946.

[Bush, 1945] Vannevar Bush, "As We May Think," *Atlantic Monthly*, July 1945. http://www.theatlantic.com/unbound/flashbks/computer/bushf.htm

[Cerf & Kahn 1974] V.G. Cerf and R. E. Kahn, A Protocol for Packet Network Intercommunication. *IEEE Trans. Comms*. Vol. COM-22, No. 5, May 1974, pp. 637-648.

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[Diffie & Hellman 1976] W. Diffie and M.E. Hellman, New Directions in Cryptography, *IEEE Trans. on Information Theory*. Vol. IT-22, No. 6. Nov. 1976, pp. 644-654.

[Engelbart, 1970] Engelbart, D. X-Y Position Indicator for a Display System. US Patent #3,541,541, filed June 1967, issued Nov., 1970.

[Faggin et al., 1996] Faggin, F., Hoff, M.E., Mazor, S., and Shima, M. The history of the 4004. *IEEE Micro*, Vol 16, Issue 6, Dec. 1996, pp. 10-20.

[Graetz, 1981] J. Martin Graetz. The Origin of Spacewar. Creative Computing. 1981.

[Hopper, 1952] Grace Murray Hopper. 1952. The education of a computer. In Proceedings of the 1952 ACM national meeting (Pittsburgh) (ACM '52). ACM, New York, NY, USA, 243-249.

[Karp, 1972] Karp, R.M. Reducibility among combinatorial problems. R.E Miller and J.W. Thatcher, editors, *Complexity of Computer Computations*, 85-103, Plenum Press, NY, 1972.

[Kilby, 1964] Kilby, J. Miaturize Electronic Circuits. U.S. Patent #3,138,743, issued 1964.

[Kilby, 2000] Kilby, J. Turing potential into realities: the invention of the integrated circuit. Nobel Lecture, Dec. 2000.

[Liskov et al. 1977] B. Liskov, A. Snyder, R. Atkinson, C. Schaffert. Abstraction Mechanisms in CLU. Communications of the ACM. August, 1977. Volume 20, Number 8.

[Liskov, 1987] B. Liskov. Data Abstraction and Hierarchy. OOPSLA 1987 keynote.

[Metcalfe and Boggs, 1976] R.M. Metcalfe and D. R. Boggs, Ethernet: Distributed packet switching for local computer networks. *Comm. ACM*. Vol. 19, Issue 7 (July 1976). pp: 395 – 404.

[Moore, 1965] Gordon E. Moore. Cramming more components onto integrated circuits. Electronics, 38(8) pp. 114 - 117, April 1965.

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[Page et al., 1998] Page, L., Brin, S, Motwani, R., and Winograd, T. The PageRank Citation Ranking: Bringing Order to the Web, Unpublished draft (!), 1998.

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