COS 583: Great Moments in Computing (Spring 2015)
Last updated: March 12, 2015

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Where to find stuff:
Course materials available on blackboard.princeton.edu
Q&A or other discussions on Piazza.

If you don't visit both often, then please set your notification preferences so that you will get announcements if needed.

When:
Mondays and Wednesdays: 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.

Note1: The papers you will read are seminal but are not always simple or approachable, and they span many different areas of CS. 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.

Note2**:** There have been more than great moments in computing than we can fit in one semester, so nobody is claiming completeness. I've left the later part of the semester schedule open, to accommodate some amount of class influence/suggestions, so please let me know your preferences.

Note3: If you are curious about **possible or likely** classes for after spring break, it's pretty easy to find the 2013 course syllabus online and see what was covered.

Course Grading Overview:
Participation in class discussions: 35%
Written responses to per-paper questions: 30%
Paper/project: 35%

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. 30% 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 35% 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:
There are two choices of course projects.
Choice 1: Citation Timeline Survey (Written): As you will see when we start reading and discussing papers, there are often some significant steps required between the original "Great Moment" paper and the subsequent uses of the idea that make its greatness clear. For example, Boole's book on logic (covered in lecture 2) needed considerable further steps before it came to be the Boolean logic we manipulate today.

So the purpose of this project is to pick one great moment paper that we cover in the class, and write up a paper (roughly 10 pages) covering some aspect of the "citation chain" either following from this paper to the present, or leading up to this paper beforehand. For example, you might show the citation chain from Boole's logic book towards Shannon's logic minimization work. Or you might show what has happened to any of the other class ideas from their original publication to the present. Or perhaps you could choose to follow time backwards from a great moment, in order to see what were the seminal building blocks that helped lead to it. In general, the idea is to show and discuss a direct citation-by-citation set of at least five steps. You can use scholar.google.com or other citation indices to track citations forwards and backwards. If you have ideas that are related to this, but don't precisely fit the 5-citation-link requirement, please do talk with me about them.

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 architecture, a GUI representation of the Turing test (e.g. to use as teaching tool in an undergraduate course), etc etc.

For example, there was recently a lot of news buzz about the Internet Archive recently adding a bunch of old but playable computer games to its collection. (https://archive.org) Also, Paul Allen's Living Computer Museum allows one to write and execute programs on very old hardware. (http://www.livingcomputermuseum.org) Please check with me about what you're planning.

Project Phases:

- Topic proposal, due March 25. Please email MRM one paragraph regarding your idea or plan.
- You are required to schedule one checkpoint meeting or demo session with MRM between April 1 and April 22. Please use WASS to sign up for a 15-minute slot:

  https://wass.princeton.edu/pages/viewcalendar.page.php?cal_id=1552&view=month&st_dt=2015-04-01&makeapp=1

- Final paper due (pdf) May 12 (Dean's Date). Programming projects may do a demo instead of a final writeup. To schedule your final demo, sign up for a 15-minute slot on WASS (above).

Great Moments: Syllabus and Reading Assignments

Week	Dates	Monday	Wednesday
1	Feb 2, 4	Class Overview	Foundations of Digital Logic [Boole, 1854] [Shannon, 1938]
2	Feb 9, 11 (MRM out of town on Feb 11. Prof. Feamster sub.)	Artificial Intelligence [Turing, 1950] [Searle, 1980]	Network Protocols [Cerf & Kahn, 1974]
3	Feb 16, 18	Ethernet [Metcalfe and Boggs, 1976]	Early Architectures [Burks et al. 1946] [Wilkes, 1965]
4	Feb 23, 25 (MRM out of town on Feb 23. Prof. Clark substitutes.)	Computability [Turing, 1936]	Virtual Memory [Kilburn, 1962] [Daley & Dennis 1968] [Anderson, 2014]
5	Mar 2, 4	Human-Computer Interaction [Sutherland, 1963]	UNIX [Ritchie & Thompson, 1974]
6	Mar 9, 11	RAID [Patterson et al.,1988]	Invention of the Mouse [Engelbart, 1970]
Mar 16, 18		No Class: Spring break	

Week	Dates	Monday	Wednesday
7	Mar 23, 25	Machine Learning [Rumelhart, 1986] [Valiant, 1984]	Compilers [Hopper, 1952] [Backus et al. 1957]
8	Mar 30, Apr 1	Moore's Law and its Future [Moore, 1965] [Moore, 2003]	Crypto and Encryption [Diffie & Hellman, 1976] [Rivest et al., 1978]
9	Apr 6, 8	Data Abstraction [Liskov et al. 1977] [Liskov, 1987]	Video Games: Past and Present [Brand, 1972] [Graetz, 1981]
10	Apr 13, 15	Pagerank & MapReduce [Page et al., 1998] [Dean & Ghemawat, 2004]	Event Ordering and Memory Consistency Models [Lamport, 1978] Lamport, 1979]
11	Apr 20, 22	Quantum Computing (Shor's Algorithm) [Shor, 1997]	Personal computing & Ubiquitous Computing [Kay 1972] [Weiser, 1993]
12	Apr 27, 29	Project Status: Lightning Round (2 minutes per person)	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.

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[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.

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

[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.

[Kay, 1972] Alan Kay. A Personal Computer for Children of All Ages. www.mprove.de/diplom/gui/kay72.html

[Kilburn 1962] T. Kilburn, D. B. G. Edwards, M. J. Lanigan, F. H. Sumner. 1962. One-Level Storage System. IRE Transactions on Electronic Computers. April, 1962.

[Kilburn 1961] T. Kilburn, R. B. Payne, and D. J. Howarth. 1961. The Atlas supervisor. In Proceedings of the December 12-14, 1961, eastern joint computer conference: computers - key to total systems control (AFIPS '61 (Eastern)). ACM, New York, NY, USA, 279-294. DOI=10.1145/1460764.1460786 http://doi.acm.org/10.1145/1460764.1460786

[Lamport 1978] Leslie Lamport. 1978. Time, clocks, and the ordering of events in a distributed system. Commun. ACM 21, 7 (July 1978), 558-565.

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