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U.S. Department of Health, Education, and Welfare, *The Seeds of Artificial Intelligence: SUMEX-AIM* (Washington: Government Printing Office, 1980), p. 6. (Image courtesy of the U.S. Department of Health, Education, and Welfare.)

Highlights of this Course

This course features a complete set of downloadable [assignments](#), [sample student work](#) for all weekly reading response papers and [sample final papers](#).

Course Description

This course focuses on one particular aspect of the history of computing: the use of the computer as a scientific instrument. The electronic digital computer was invented to do science, and its applications range from physics to mathematics to biology to the humanities. What has been the impact of computing on the practice of science? Is the computer different from other scientific instruments? Is computer simulation a valid form of scientific experiment? Can computer models be viewed as surrogate theories? How does the computer change the way scientists approach the notions of proof, expertise, and discovery? No comprehensive history of scientific computing has yet been written. This seminar examines scientific articles, participants' memoirs, and works by historians, sociologists, and anthropologists of science to provide multiple perspectives on the use of computers in diverse fields of physical, biological, and social sciences and the humanities. We explore how the computer transformed scientific practice, and how the culture of computing was influenced, in turn, by scientific applications.

Staff

Instructor:
Prof. Slava Gerovitch

Course Meeting Times

Lectures:
One session / week
3 hours / session

Level

Undergraduate

Additional Features

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Syllabus

Description

This course will focus on one particular aspect of the history of computing: the use of the computer as a scientific instrument. The electronic digital computer was invented to do science, and its applications range from physics to mathematics to biology to the humanities. What has been the impact of computing on the practice of science? Is the computer different from other scientific instruments? Is computer simulation a valid form of scientific experiment? Can computer models be viewed as surrogate theories? How does the computer change the way scientists approach the notions of proof, expertise, and discovery? No comprehensive history of scientific computing has yet been written. This seminar will examine scientific articles, participants' memoirs, and works by historians, sociologists, and anthropologists of science to provide multiple perspectives on the use of computers in diverse fields of physical, biological, and social sciences and the humanities. We will explore how the computer transformed scientific practice, and how the culture of computing was influenced, in turn, by scientific applications.

Requirements

Students are expected to participate in class discussions by reading the assigned materials before class, thinking about the issues and historical patterns suggested in the readings, and relating these issues to their own personal experience. Students will submit a short (one page) reading response paper in the morning before each class. The papers are intended to provoke discussion, rather than give definitive answers. The instructor will provide tentative questions for response papers, but students are encouraged to raise their own questions. The response papers will serve as a basis for subsequent discussion in class.

Assignments for this course also include a final paper (10-15 pages; typed, double-spaced, with 1.25" margins). The final paper is due in class on Session 14. On that day, students will give brief presentations (5-10 min.) of their final papers. A proposal for the final paper (1-2 pages) is due in class on Session 9. It will receive the instructor's feedback the following week. The proposal should include:

1. the central question the final paper will address;
2. the historical significance of this question and how it relates to discussions in class;
3. a brief outline; and
4. a tentative bibliography, including both primary and secondary sources.

Grading

The seminar meets only once a week. This means that attendance is particularly important. If you do need to miss class, you must obtain permission from the instructor in advance. Final grades will be determined as follows:

ACTIVITIES	PERCENTAGES
Class Participation	30
Reading Response Papers	40
Final Paper	30



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Calendar

SES #	TOPICS	KEY DATES
1	Introduction Course Overview	
2	Issues in the History of Computing	Reading response assignment due
3	Computers in Nuclear Physics: ENIAC and the Hydrogen Bomb	Reading response assignment due
4	Computers in Meteorology: Simulating the World	Reading response assignment due
5	Computers in Mathematics: The Logic Theorist and the Automation of Proof	Reading response assignment due
6	Computers in Cognitive Psychology: GPS and Psychological Theory	Reading response assignment due
7	Computers in Biochemistry: DENDRAL and Knowledge Engineering	Reading response assignment due
8	Computers in Aerospace: The Apollo Guidance Computer	Reading response assignment due
9	Computers in the Laboratory: The LINC Between the Designer and the User	Proposal for final paper due
10	Computers in Medicine: MYCIN and the Formalization of Expertise	Reading response assignment due
11	Supercomputing at Home: A Social Experiment in Distributed Computing	Reading response assignment due
12	Computers in Linguistics: Lost in Machine Translation	Reading response assignment due
13	Computers in the Humanities: Hype, Text, and Hypertext	Reading response assignment due

	Reservations	and	
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Readings

Film viewings are linked to Web sites for further information when available.

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1	Introduction Course Overview	<i>Viewing</i> "2001: A Space Odyssey" (1968). Directed and produced by Stanley Kubrick (excerpt).
2	Issues in the History of Computing	Edwards, Paul N. "From 'Impact' to Social Process: Computers in Society and Culture." Chapter 12 in <i>Handbook of Science and Technology Studies</i> . Edited by Sheila Jasanoff. Beverly Hills, CA: Sage Publications, 1994. ISBN: 0803940211. Mahoney, Michael S. "The History of Computing in the History of Technology." <i>IEEE Annals of the History of Computing</i> 10 (1988): 113-125. Kling, Rob. "Reading 'All About' Computerization: How Genre Conventions Shape Non-Fiction Social Analysis." <i>The Information Society</i> 10, no. 3 (1994): 147-172.
3	Computers in Nuclear Physics: ENIAC and the Hydrogen Bomb	Galison, Peter. "Monte Carlo Simulations: Artificial Reality." Chapter 8 in <i>Image and Logic: A Material Culture of Microphysics</i> . Chicago, and London: University of Chicago Press, 1997, pp. 689-780. ISBN: 0226279170. Kowarski, L. "The Impact of Computers on Nuclear Science." In <i>Computing As a Language of Physics</i> . Edited by International Center for Theoretical Physics. Vienna: International Atomic Energy Agency, 1972, pp. 27-37. LCCN: 73155630. <i>Viewing</i> "Giant Brains" (1992). Written, produced and directed by Fiona Holmes.
4	Computers in Meteorology: Simulating the World	Edwards, Paul N. "The World in a Machine: Origins and Impacts of Early Computerized Global Systems Models." In <i>Systems, Experts, and Computers</i> . Edited by Thomas P. Hughes, and Agatha C. Hughes. Cambridge, MA: MIT Press, 2000, pp. 221-254. ISBN: 0262082853. ———. "Global Climate Science, Uncertainty and Politics: Data-laden Models, Model-Filtered Data." <i>Science as Culture</i> 8, no. 4 (1999): 437-472. <i>Viewing</i> "Inventing the Future" (1992). Written, produced and directed by Nancy Linde.
5	Computers in Mathematics: The Logic Theorist and the Automation of Proof	MacKenzie, Donald. "The Automation of Proof: A Historical and Sociological Exploration." <i>IEEE Annals of the History of Computing</i> 17, no. 3 (Fall 1995): 7-29. ———. "Slaying the Kraken: The Sociohistory of a Mathematical Proof." <i>Social Studies of Science</i> 29, no. 1 (February 1990): 7-60. Simon, Herbert A. "Climbing the Mountain: Artificial Intelligence Achieved." Chapter 13 in <i>Models of My Life</i> . New York, NY: Basic Books, 1991, pp. 198-214. ISBN: 0456046401. <i>Viewing</i> "The Paperback Computer" (1992). Written, produced and directed by Jon Palfreman and Robert Hone.

6	Computers in Cognitive Psychology: GPS and Psychological Theory	<p>in the closed world. <i>Computers and the Politics of Discourse in Cold War America</i>. Cambridge, MA: MIT Press, 1996, pp. 239-273. ISBN: 026205051X.</p> <p>Newell, Allen, and Herbert A. Simon. "Computer Simulation of Human Thinking." <i>Science</i> 134, no. 3495 (22 December 1961): 2011-2017.</p> <p>Newell, Allen. "Remarks on the Relationship Between Artificial Intelligence and Cognitive Psychology." In <i>Theoretical Approaches to Non-numerical Problem Solving</i>. Edited by R. B. Banerji, and M. D. Mesarovic. Berlin, and New York: Springer-Verlag, 1970, pp. 363-378 (excerpt). LCCN: 79121996.</p> <p>Frijda, Nico H. "Problems of Computer Simulation." <i>Behavioral Science</i> 12 (1967): 59-67.</p> <p>Weizenbaum, Joseph. "Computer Models in Psychology." Chapter 6 in <i>Computer Power and Human Reason</i>. New York: Freeman, 1976, pp. 154-181. ISBN: 0140225358.</p> <p><i>Viewing</i></p> <p>"The Thinking Machine" (1992). Written, produced and directed by Jon Palfreman (Part I).</p>
7	Computers in Biochemistry: DENDRAL and Knowledge Engineering	<p>Lenoir, Timothy. "Shaping Biomedicine as an Information Science." In <i>Proceedings of the 1998 Conference on the History and Heritage of Science Information Systems</i>. Edited by Mary Ellen Bowden, Trudi Bellardo Hahn, and Robert V. Williams. Medford, NJ: Information Today, Inc., 1999, pp. 27-45. ISBN: 1573870803.</p> <p>Lederberg, Joshua. "How DENDRAL Was Conceived and Born." In <i>Proceedings of ACM Conference on the History of Medical Informatics</i>. New York, NY: ACM, 1987, pp. 5-19. ISBN: 0897912489.</p> <p>Lindsay, Robert K., Bruce G. Buchanan, and Edward A. Feigenbaum. "DENDRAL: A Case Study of the First Expert System for Scientific Hypothesis Formation." <i>Artificial Intelligence</i> 61 (1993): 209-261 (skim).</p> <p>Lederberg, Joshua. "Afterword: The Anti-Expert System — Thirteen Hypotheses an AI Program Should Have Seen Through." In <i>Artificial Intelligence and Molecular Biology</i>. Edited by Lawrence Hunter. Cambridge, MA: MIT Press, 1993, pp. 459-463. ISBN: 0262581159.</p> <p>Browse a collection of documents on DENDRAL.</p> <p><i>Viewing</i></p> <p>"The Thinking Machine" (Part II).</p>
8	Computers in Aerospace: The Apollo Guidance Computer	<p>Ceruzzi, Paul E. Chapter 6, "Minuteman, Apollo, and the Chip", chapter 8, "Advances in Simulation, Testing, and Control", chapter 9, "Software." In <i>Beyond the Limits: Flight Enters the Computer Age</i>. Cambridge, MA: MIT Press, 1989. ISBN: 0262530821.</p> <p>Hall, Eldon C. "From the Farm to Pioneering with Digital Control Computers: An Autobiography." <i>IEEE Annals of the History of Computing</i> 22 (April-June 2000): 22-31.</p> <p>Hoag, David G. "The History of Apollo On-Board Guidance, Navigation, and Control." The Charles Stark Draper Laboratory, P-357, September 1976, pp. 28.</p> <p>Browse a collection of documents on the Apollo Guidance Computer.</p>
9	Computers in the Laboratory: The LINC Between the Designer	<p>Rosenfeld, Samuel A. "Laboratory Instrument Computer (LINC): The Genesis of a Technological Revolution." Seminar in Celebration of the Twentieth Anniversary of the LINC Computer,</p>

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SES #	TOPICS	READINGS AND VIEWINGS			
	and the User	<p>November 30, 1983.</p> <p>Clark, Wesley. "The LINC was Early and Small." In <i>Proceedings of ACM Conference on the History of Medical Informatics</i>. New York, NY: ACM, 1987, pp. 51-73. ISBN: 0897912489.</p> <p>Cox, Jerome R. "Recollections on the Processing of Biomedical Signals." In <i>Proceedings of ACM Conference on the History of Medical Informatics</i>. New York, NY: ACM, 1987, pp. 95-103. ISBN: 0897912489.</p> <p><i>Special Events</i></p> <p>Guest lecture by Joseph A. November (Princeton University).</p> <p>Visit to the MIT Museum.</p>			
10	Computers in Medicine: MYCIN and the Formalization of Expertise	<p>Forsythe, Diana E. "Engineering Knowledge: The Construction of Knowledge in Artificial Intelligence." <i>Social Studies of Science</i> 23 (1993): 445-477.</p> <p>Forsythe, Diana E. "Blaming the User in Medical Informatics: The Cultural Nature of Scientific Practice." In <i>Studying Those Who Study Us: An Anthropologist in the World of Artificial Intelligence</i>. Stanford, CA: Stanford University Press, 2001, pp. 1-15. ISBN: 0804742030.</p> <p>Duda, Richard O., and Edward H. Shortliffe. "Expert Systems Research." <i>Science</i> 220, no. 4594 (April 15, 1983): 261-268.</p> <p>Browse a collection of documents on MYCIN.</p> <p><i>Viewing</i></p> <p>"The World at Your Fingertips" (1992). Written, produced and directed by Jon Palfreman and Robert Hone.</p>			
11	Supercomputing at Home: A Social Experiment in Distributed Computing	<p>Ross-Flanigan, Nancy. "The Virtues (and Vices) of Virtual Colleagues." <i>Technology Review</i> (March-April 1998): 52-59.</p> <p>Waldrop, M. Mitchell. "Grid Computing." <i>Technology Review</i> (May 2002): 31-37.</p> <p>Johnson, George. "Supercomputing '@Home' Is Paying Off." <i>The New York Times</i> (23 April 2003): F1.</p> <p><i>Web Sites</i></p> <p>Folding@home</p> <p>Genome@home</p> <p>SETI@home</p> <p><i>Viewing</i></p> <p>"Bill Gates" (1996). A&E's Biography.</p>			
12	Computers in Linguistics: Lost in Machine Translation	<p>Hutchins, W. John. Chapter 2, "Precursors and Pioneers"; chapter 8, "Expectations and Criticisms"; chapter 19, "Present Developments and Some Future Prospects." In <i>Machine Translation: Past, Present, Future</i>. Chichester, UK: Ellis Horwood, 1986. ISBN: 0853127883.</p> <p>Weizenbaum, Joseph. "The Computer and Natural Language." Chap. 7 in <i>Computer Power and Human Reason</i>. New York: Freeman, 1976, pp. 182-201. ISBN: 0140225358.</p> <p>Erard, Michael. "Translation in the Age of Terror." <i>Technology Review</i> (March 2004): 54-60.</p> <p><i>Web Sites</i></p> <p>Free online translation (compare different translation programs)</p> <p>ELIZA emulator</p>			

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SES #	TOPICS	READINGS AND VIEWINGS
		<p><i>Viewing</i></p> <p>"Hackers" (2001). Produced and directed by Neil Docherty.</p>
13	Computers in the Humanities: Hype, Text, and Hypertext	<p>van Dam, Andries. "Hypertext '87: Keynote Address." <i>Communications of the ACM</i> 31, no. 7 (July 1988): 887-895.</p> <p>Beeman, William O., et al. "Hypertext and Pluralism: From Lineal to Non-lineal Thinking." <i>Proceeding of the ACM Conference on Hypertext</i>. New York: ACM Press, 1989, pp. 67-88. ISBN: 089791340X.</p> <p>Raskin, Jef. "The Hype in Hypertext: A Critique." <i>Proceeding of the ACM Conference on Hypertext</i>. New York: ACM Press, 1989, pp. 325-330. ISBN: 089791340X.</p> <p>Ruhleder, Karen. "Reconstructing Artifacts, Reconstructing Work: From Textual Edition to On-Line Databank." <i>Science, Technology, and Human Values</i> 20, no. 1 (Winter 1995): 39-64.</p> <p>Crane, Gregory, et al. "The Symbiosis Between Content and Technology in the Perseus Digital Library." <i>Culture Interactive</i>, no. 2 (October 2000).</p> <p><i>Web Site</i></p> <p>Perseus Digital Library</p> <p><i>Viewing</i></p> <p>"Desk Set" (1957). Directed by Walter Lang (excerpt).</p>
14	Final Paper Presentations	

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Assignments

This section includes reading response paper assignments in the [unstructured](#) and [structured](#) formats and a [final paper assignment](#).

Weekly Questions

Reading Response Paper Assignment (Sessions 2-6: The Unstructured Format)

Write a 1-2 page reading response paper addressing the issues raised in the readings. You may choose from the provided list of tentative questions, but you are encouraged to raise your own questions. Your paper must touch upon all the readings assigned for the upcoming session.

Strategies for Writing a Good Reading Response Paper

- Define your personal stance towards the issues raised in the readings.
- Avoid generalities, be specific.
- Focus on the points where you disagree, or where you can push the argument further.
- Cite examples from your personal experience or from other literature.
- Ask provocative questions, even if you do not know the answers.

Your paper will be made accessible to other members of the class after the deadline. It will be part of discussion in class.

Papers must be submitted in the morning before each class. No late papers are accepted.

Be creative and imaginative! Good luck!

SES #	TOPICS	WEEKLY QUESTIONS	STUDENT SAMPLES
2	Issues in the History of Computing	(PDF)	Daniel Roy (PDF)
3	Computers in Nuclear Physics: ENIAC and the Hydrogen Bomb	(PDF)	Anthony Grue (PDF) Steven Stern (PDF) (Courtesy of Steven Stern. Used with permission.)
4	Computers in Meteorology: Simulating the World	(PDF)	Jason Ruchelsman (PDF) (Courtesy of Jason Ruchelsman. Used with permission.) Katherine A. Franco (PDF) (Courtesy of Katherine Franco. Used with permission.)
5	Computers in Mathematics: The Logic Theorist and the Automation of Proof	(PDF)	Joshua Tauber (PDF) Patrick Griffin (PDF) (Courtesy of Patrick Griffin. Used with permission.)
6	Computers in Cognitive Psychology: GPS and Psychological Theory	(PDF)	Aaron Bell (PDF) (Courtesy of Aaron Bell. Used with permission.) Steven Stern (PDF) (Courtesy of Steven Stern. Used with permission.)

Reading Response Paper Assignment (Sessions 7-13: The Structured Format)

Write a 1-2 page **structured paper** in response to your readings. The paper must focus on a single question; you may choose from the provided list, but you are encouraged to formulate your own question. Your paper must have the following format:

1. Title
2. Introduction: State your question; explain its significance; formulate your thesis.

5. Analysis: Give your own perspective and supporting argument.
6. Conclusion: What is the lesson here? What are further lines of inquiry, new questions to ask?
7. References: Use the format from the syllabus.

Devote no more than 1-2 paragraphs to each section. You may combine sections 2 and 3, if necessary. I realize that information in your readings may not be sufficient to fill all the sections; do the best you can. Your paper does not have to cite all the readings for the week, but you must read all of them. Spell-check and proof-read your paper before submission.

SES #	TOPICS	WEEKLY QUESTIONS	STUDENT SAMPLES
7	Computers in Biochemistry: DENDRAL and Knowledge Engineering	(PDF)	Aaron Bell (PDF) (Courtesy of Aaron Bell. Used with permission.) Jason Ruchelsman (PDF) (Courtesy of Jason Ruchelsman. Used with permission.)
8	Computers in Aerospace: The Apollo Guidance Computer	(PDF)	Anthony Grue (PDF) Patrick Griffin (PDF) (Courtesy of Patrick Griffin. Used with permission.)
10	Computers in Medicine: MYCIN and the Formalization of Expertise	(PDF)	Aaron Bell (PDF) (Courtesy of Aaron Bell. Used with permission.) Daniel Roy (PDF)
11	Supercomputing at Home: A Social Experiment in Distributed Computing	(PDF)	Antoinne Machal-Cajigas (PDF) Patrick Griffin (PDF) (Courtesy of Patrick Griffin. Used with permission.)
12	Computers in Linguistics: Lost in Machine Translation	(PDF)	Aaron Bell (PDF) (Courtesy of Aaron Bell. Used with permission.) Steven Stern (PDF) (Courtesy of Steven Stern. Used with permission.)
13	Computers in the Humanities: Hype, Text, and Hypertext	(PDF)	Aaron Bell (PDF) (Courtesy of Aaron Bell. Used with permission.) Patrick Griffin (PDF) (Courtesy of Patrick Griffin. Used with permission.)

Final Paper Assignment

Write a 10-15 page paper (double-spaced, 1.25" margins, 12 pt font). You may choose any topic that addresses the use of the computer as a scientific instrument. You may choose something close to your own area of expertise, or something completely different. You can focus on one specific computer system and analyze its uses from different perspectives (designers', users', scientists', humanists', etc.), or you can address a larger issue that involves a certain category of computer systems (for example, expert systems) and perhaps a range of scientific disciplines. You may choose one of the topics we discussed in class, but you must significantly broaden the range of your sources. Your final paper must analyze both primary sources (participants' accounts) and secondary sources (works by historians, sociologists, anthropologists, or other commentators). Choose an issue over which there has been (or should have been) some debate, and take a stand on that issue. Provide ample argumentation for your position and explain your objections to the alternative position(s). The final paper should follow the same structured format that is required for the Session 7-13 reading responses.


Final Paper Guide

Proposal for a Final Paper

Write a 1-2 page proposal for your final paper. The proposal should include: (1) the central question the final paper will address; (2) the historical significance of this question and how it relates to discussions in class; (3) a brief outline; and (4) a tentative bibliography, including both primary and secondary sources. Your proposal will receive the instructor's feedback the following week. The proposal is due in class on Session 9.

Final Paper Guidelines

Write a 10-15 page paper (double-spaced, 1.25" margins, 12 pt font). You may choose any topic that addresses the use of the computer as a scientific instrument. You may choose something close to your own area of expertise, or something completely different. You can focus on one specific computer system and analyze its uses from different perspectives (designers', users', scientists', humanists', etc.), or you can address a larger issue that involves a certain category of computer systems (for example, expert systems) and perhaps a range of scientific disciplines. You may choose one of the topics we discussed in class, but you must significantly broaden the range of your sources. Your final paper must analyze both primary sources (participants' accounts) and secondary sources

[Works by Historians, Sociologists, and Anthropologists](#)  or other commentators). Choose an issue over which there has been (or should have been) some debate, and take a stand on that issue. Provide ample argumentation for your position and explain your objections to the alternative position(s). The final paper should follow the same structured format that is required for the Session 7-13 reading responses. The final paper is due in class on Session 14.

Sample Final Paper

Anthony Ronald Grue ([PDF](#))

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