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History of Science 189v: Introduction to the History of Software and Networks

Fall 2007, Harvard Department of History of Science

Room: History of Science (Science Center) 469

Instructor: Christopher Kelty

Description: 20th century history of the differentiation of hardware and software and the rise of networked, distributed forms of computing. Topics may include: mathematical precursors to programming languages, language and automata theory, history of computer science; development of key ideas and technologies in operating systems, networking, personal computing; geneaologies of the office, the library, the global brain, hypertext, and interactivity; history of telecommunications industries in US and Europe; the development of data networking, videotex, private networks, Bulletin Board Systems, Arpanet, CSNET, Internet and current debates about network structure and design. Theories of information society and network society. The role of intellectual property, regulation and forms of organization and coordination in the development of information technologies.

Prerequisites: None

Requirements: Three Writing assignments, participation in discussion.

Books Available at the Bookstore:

- Abbate, J. (2000). *Inventing the internet* (inside technology). The MIT Press.

- Campbell-Kelly, M., & Aspray, W. (2004). *Computer: a history of the information machine* (the sloan technology series). Westview Press.
- Campbell-Kelly, M. (2003). *From airline reservations to sonic the hedgehog: a history of the software industry* (history of computing). The MIT Press.
- Dibbell, J. (2006). *Play money: or, how i quit my day job and made millions trading virtual loot*. new York: Basic Books.
- Gerovitch, S. (2004). *From newspeak to cyberspeak: a history of soviet cybernetics*. The MIT Press.
- Gitelman, L. (2006). *Always already new: media, history, and the data of culture*. The MIT Press.
- Mackenzie, D. (2004). *Mechanizing proof: computing, risk, and trust* (inside technology). The MIT Press.
- Salus, P. H. (1994). *A quarter century of unix* (addison-wesley unix and open systems series). Addison-Wesley Professional.
- Smith, B. C. (1998). *On the origin of objects* (bradford books). The MIT Press.
- Turner, F. (2006). *From counterculture to cyberculture: stewart brand, the whole earth network, and the rise of digital utopianism*. University Of Chicago Press.
- Ullman, E. (2003) *Bug: a novel*. Nan Talese.
- Waldrop, M. M. (2002). *The dream machine : j.c.r. licklider and the revolution that made computing personal*. Penguin.
- Weber, S. (2005). *The success of open source*. Harvard University Press.

Schedule

(Subject to Capricious and Sudden changes based on mood, check the website before reading).

Login: What is the interface?

For most people, the only aspect of software and networks they ever see will be the interface–the series of actions and responses that are perceivable by human senses. In many ways, the way an interface is understood reflects deep assumptions about the way human beings think and act. As interfaces have evolved, so have definitions of what humans can do.

concepts: interaction, event, response time, real-time/batch-processing, editors, human-computer symbiosis

Week 1

Mon Sept. 17: Introduction, Orientation of class

General Overview Works (useful for both the uninitiated and the learned):

1. Campbell-Kelly, M., & Aspray, W. (2004). *Computer: a history of the information machine* (the sloan technology series). Westview Press.
2. Waldrop, M. M. (2002). *The dream machine : j.c.r. licklider and the revolution that made computing personal*. Penguin.

Wed Sept. 19: interface

Reading:

1. JCR Licklider, "Man-Computer Symbiosis," *IRE Transactions on Human Factors in Electronics*,volume HFE-1, pages 4-11, March 1960 Comment-able version for class. Other versions at DEC Archives and MIT AI Lab HTML version.
2. AIM-519A "EMACS: The Extensible, Customizable, Self-Documenting Display Editor" by Richard M. Stallman, March 1981. CSAIL Historical Archives and GNU Website.
3. Matthew Fuller, "It Looks Like you are Writing a Letter" in *Beyond the Blip* Autonomedia, 2003. Originally published online at Heise.de
4. Charles Eames and Ray Eames: The Computer Perspective, IBM, Cambridge Ma: Harvard University Press, 1973. **On Reserve**
5. Maurice V. Wilkes, David J. Wheeler, and Stanley Gill *The preparation of programs for an electronic digital computer, with special reference to the EDSAC and the use of a library of subroutines* Cambridge, Mass., Addison-Wesley Press, 1951. **On Reserve**
6. Lydia H. Liu, "iSpace: Printed English after Joyce, Shannon, and Derrida" *Critical Inquiry* 32(3) Harvard Library E-Journals

Fri Sept. 21: Discussion

other topics and readings of note:

- van Dam, A. and Rice, D. E. 1971. "On-line Text Editing: A Survey." *ACM Comput. Surv*. 3, 3 (Sep. 1971), 93-114. ACM Portal
- Dodge, Martin, *Atlas of cyberspace* by Martin Dodge and Rob Kitchin. Harlow, England: Addison-Wesley, 2001. **On Reserve**
- Thierry Bardini *Bootstrapping : Douglas Engelbart, coevolution, and the origins of personal computing* Stanford, Calif. : Stanford University Press, c2000. **On Reserve**
- Andrew Hertzfeld, *Revolution in the valley* Sebastopol, CA : O'Reilly, c2005. **On Reserve**
  - Apple's Current Human Interface Design Guidelines
- Gitelman, L. (2006). *Always already new: media, history, and the data of culture*. The MIT Press.
- Olia Lialina, "A Vernacular Web" 2005 html "Vernacular Web 2" html
- Guidebook, a graphical user interface Gallery

Love/Danger: What is a userid?

Beyond the dyadic approach to the interface is the question of world-making using the computer. The obvious candidates include games and online worlds, social networking software and sites, and online love and sex. But the vagaries of world-making stretch beyond the simple question of "virtuality" to economics, politics, warfare and security. Across media, but beginning especially with the time-shared multi-user computer, new modes of being in the world emerge.

Concepts: identity, avatars, sociality, users, accounts, passwords, security, privacy, authorship

Week 2

Mon Sept. 24: Games to Worlds

Readings:

1. Dibbell, J. (2006). *Play money: or, how i quit my day job and made millions trading virtual loot* New York: Basic Books.
2. Tom Boellstorff, "A Ludicrous Discipline? Ethnography and Game Studies" *Games and Culture* 1(1) pdf from the author's website
3. Chapter on History of Video Games *Handbook of Computer Game Studies* by Joost Raessens (Editor), Jeffrey Goldstein (Editor) (pdf version)(access instructions distributed in class)
4. Two other brief stories to make the point ("Bow Nigger" and "Real Life: The Full Review")

Optional:

- Steven L. Kent, *The ultimate history of video games : from Pong to Pokémon and beyond : the story behind the craze that touched our lives and changed the world* New York : Three Rivers Press, c2001.
- Edward Castronova *Synthetic Worlds: The Business and Culture of Online Games*Chicago : University of Chicago Press, 2005. **On Reserve**
- T.L. Taylor *Play Between Worlds: Exploring Online Game Culture* Cambridge, Mass. : MIT Press, c2006. **On reserve**
- Jack Balkin and Simone Noveck, eds. *The state of play : law, games, and virtual worlds* New York:New York University Press, c2006. **On Reserve**

Wed Sept. 26: "Social" software

1. Second Life, or, whichever online world you inhabit
2. Facebook, or, wherever you make your social world go round.
3. Nelson Goodman, *Ways of Worldmaking* Indianapolis: Hackett Publising, 1978 (distributed in class, and On Reserve).

Other related texts:

- Dibbell, Julian, *My tiny life : crime and passion in a virtual world* London : Fourth Estate, 1999. **On reserve**
- Heidegger, Martin, *The fundamental concepts of metaphysics : world, finitude, solitude* translated by William McNeill and Nicholas Walker. Bloomington : Indiana University Press, c1995. **On reserve**
- Winograd, Terry and Fernando Flores, *Understanding computers and cognition : a new foundation for design* Reading, Mass. : Addison-Wesley, c1987. **On reserve**
- Dreyfus, Hubert L., *What computers still can't do : a critique of artificial reason / Hubert L. Dreyfus* Cambridge, Mass. : MIT Press, c1992. **On reserve**

Week 3

Mon Oct. 1: Culture, Counterculture, History

Reading:

1. Turner, F. (2006). *From counterculture to cyberculture: stewart brand, the whole earth network, and the rise of digital utopianism.* University Of Chicago Press.
2. Abbate, J. (1999). *Inventing the Internet* Cambridge, MA: MIT Press.

Other:

- Standage, Tom, *The Victorian Internet : the remarkable story of the telegraph and the nineteenth century's on-line pioneers* New York : Walker and Co., c1998, 1999.**On Reserve**
- Fischer, Claude S., *America calling : a social history of the telephone to 1940* Berkeley : University of California Press, 1992.**On Reserve**

Wed Oct. 3: Privacy, Security, Etiquette

Reading:

1. RAND Corporaion, "Toward an Ethics and Etiquette for Electronic Mail" Norman Shapiro, Robert H. Anderson From RAND
2. Jerome Saltzer and Michael Schroeder, "The Protection of Information in Computer Systems" Proceedings of the IEEE 63(9), Sept. 1975 IEEE Xplor version or Version on Saltzer's MIT site or David Evans' UVa Version

Other:

- Bruce Sterling, *The Hacker Crackdown: Law and Disorder on the Electronic Frontier* Many Books versions or MIT online Version
- Thomas, Douglas. *Hacker Culture*. Minneapolis: University of Minneapolis Press, 2002. **On reserve**
- Levy, Steven. *Hackers: Heroes of the Computer Revolution*. New York: Bantam Press, 1984. **On reserve**
- Ludlow, Peter, *High noon on the electronic frontier : conceptual issues in cyberspace* Cambridge, Mass. : MIT Press, c1996. **On reserve**
- Ludlow, Peter, Ed. *Crypto anarchy, cyberstates, and pirate utopias* Cambridge, Mass. ; London : MIT, c2001. **On reserve**
- David Brin, *The Transparent Society: Will Technology Force Us to Choose between Freedom and Privacy?* Reading, Mass. : Perseus Books, 1998. Chapters 1-4 Online at Brin's site

Fri Oct. 5:

- Visit from Casey O'Donnell, RPI Ph.D student working on the culture of the video game industry.

Week 4: Movie week

Mon Oct. 8: No Class Columbus Day

Wed Oct. 10: Movie: *Hackers* 1984, dir. Fabrice Florin 26 Minutes; *BBS: The Documentary* 2004 dir. Jason Scott (Disc 1: c. 45 min; Discs 2+3 on reserve)

Money: What is an application?

The history of the "application" has yet to be told. More than software, but less than a computer, the application is the motivating force, economically, practically and socially behind the computer revolution– but what is an application? From the "application" of computers to warfare to the emergence of "libraries" to the beginning of an independent market in software to the personal computer to the current generation of web services.

Concepts: databases, files, file structure, formats, unbundling, business logic, wysiwyg, windows, key-commands, path dependency (QWERTY), killer apps, the software crisis, software engineering, structured programming, extreme programming.

Week 5

Mon Oct. 15: Origins/Ends of Software

Readings

1. Campbell-Kelly, M. (2003). *From airline reservations to sonic the hedgehog: a history of the software industry* (history of computing). The MIT Press.
2. Mahoney, Michael, "Finding a History for Software Engineering", Annals of the History of Computing 26,1(2004), 8-19 From Michael Mahoney's Website

Other

- Gerald Brock, *The Second Information Revolution* Cambridge, MA: Harvard University Press 2003. **On Reserve**
- The NATO Conferences on Software Engineering and the Software Crisis; Both are available on Brian Randell's site
  - P. Naur and B. Randell, (Eds.). *Software Engineering: Report of a conference sponsored by the NATO Science Committee*, Garmisch, Germany, 7-11 Oct. 1968, Brussels, Scientific Affairs Division, NATO (1969) 231pp.
  - B. Randell and J.N. Buxton, (Eds.). *Software Engineering Techniques: Report of a conference sponsored by the NATO Science Committee*, Rome, Italy, 27-31 Oct. 1969, Brussels, Scientific Affairs Division, NATO (1970) 164pp.

- Nathan Ensmenger, *From Software Crisis to Black Art* Dissertation U Penn 2001. Proquest Dissertation Abstracts
- Downey, Greg *Uncovering Labour in Information Revolutions* Special issue of the International Review of Social History Cambridge Journals Online

Wed Oct. 17: Personal Computers and beyond

Readings:

1. Ivan Sutherland, "Sketchpad: a man-machine graphical communication system" Ph.D Dissertation MIT, 1963. From Cambridge University pdf
2. "Doing With Images Makes Symbols" Alan Kay Video from the Internet Archive Part 1 Part 2
3. Original Demo Videos from Engelbart's famous 1968 demonstration of the oNLine System

On Englebart:

1. Thierry Bardini *Bootstrapping : Douglas Engelbart, coevolution, and the origins of personal computing* Stanford, Calif. : Stanford University Press, c2000. **On Reserve**

Week 6

Mon Oct. 22: Digital vs. Analog applications, analysis vs. computation.

Readings:

1. Tympas, Aristotle "Perpetually Laborious: Computing Electric Power Transmission Before The Electronic Computer," International Review of Social History 2003, 48: 73-95. Cambridge Online
2. Tympas, Aristotle, "From Digital to Analog and Back: The Ideology of Intelligent Machines in the History of the Electrical Analyzer, 1870s-1960s" *IEEE Annals of the History of Computers* (Winter 1996 (Vol. 18, No. 4) pp. 42-48 IEEE Xplore
3. Yates, Joanne, *Structuring the Information Age: Life Insurance and Technology in the 20th Century* Baltimore: Johns Hopkins University Press, 2005. Selections TBD

Wed Oct. 24: Researching the history of applications

A list to start from: dbase (databases), lotus 123 (groupware), visicalc (spreadsheets), word processing programs, drawing programs (sketchpad, macdraw, illustrator), hypertext (applecard), photo manipulation programs (photoshop), statistics (SPSS), Engineering (MatLab), architecture and design (AutoCad), mapping (GIS, ESRI) Mathematics (Mathematica), Artificial Intelligence (DENDRAL), email, web, blog, wiki, youtube, napster, bittorrent.

A few places to start:

- The Computer History Museum's collection of interviews and resources in the Software Industry
- Bibliography of resources on Software at the Charles Babbage Institute
- James W. Cortada, *A bibliographic guide to the history of computer applications, 1950-1990* Westport, Conn. : Greenwood Press, 1996. **On Reserve**

Liberty: What is an operating System?

Do hardware and software enslave, or do they set you free? The history of the operating system is also the history of the political economy of information technology and more recently, the Free Software movement. Decisions about organization, privacy, security, accountability and engineering elegance are combined in the evolution of the time-shared operating system and its transformations over the last 30 years, in combination with networks and applications. This section focuses primarily on the example of Free Software as a site for understanding the transformations of liberty by hardware and software.

Concepts: time sharing, batch processing, memory management, super-users, kernel, process management, modular, micro and monolithic, drivers and user space.

Week 7

Mon Oct. 29: Movie: Revolution OS. dir. J.T.S. Moore, 2003. **On Reserve**

Readings:

1. Christopher Kelty, *Two Bits: The Cultural Significance of Free Software* Duke University Press, forthcoming. Intro and chapter 3.

Optional background:

- Gerald Brock, *The Second Information Revolution* Harvard University Press, 2003. **On Reserve**
- Glyn Moody *Rebel code: Linux and the open source revolution* London: Penguin, c2002.
- Chris DiBona, Sam Ockman & Mark Stone eds. *Open sources : voices from the open source revolution* Cambridge, [Mass.] : O'Reilly, c1999. O'Reilly Online
- The writings of Richard Stallman. Some important pieces: "What is Free Software?" "What is copyleft?" and "The GNU Manifesto"
- The ravings of Eric Raymond. Especially "The Cathedral and the Bazaar".

Wed Oct. 31: Background to FOSS

Readings:

1. The Multics website Multicians.org
2. Readings from the *Annals of the History of Computing* From IEEE Xplore

1. "Claims to the term `time-sharing'" by Lee, J.A.N. *Annals of the History of Computing* 14(1) Jan 1992 p. 16-17
2. "The beginnings at MIT" by Lee, J.A.N.; McCarthy, J.; Licklider, J.C.R. pps. 18-30 *Annals of the History of Computing* 14(1) Jan 1992
3. "CTSS-the compatible time-sharing system" Corbato, F.J.; Merwin-Daggett, M.; Daley, R.C. pps: 31-32 *Annals of the History of Computing* 14(1) Jan 1992
4. "Project MAC [time-sharing computing project]" by Lee, J.A.N.; Fano, R.M.; Scherr, A.L.; Corbato, F.J.; Vyssotsky, V.A. *Annals of the History of Computing* 14(2) April 1992 pps. 9-13
5. "The social impact [Project MAC]" by Lee, J.A.N.; David, E.E., Jr.; Fano, R.M. *Annals of the History of Computing* 14(2) April 1992 pps. 36-41

Optional Background:

1. Hafner, Katie and matthew Lyon, *Where wizards stay up late : the origins of the Internet* New York : Simon & Schuster, c1996. **On Reserve**
2. Levy, Steven, *Hackers: Heroes of the Computer Revolution* New York: Penguin, 1984.

Week 8

Mon Nov. 5: UNIX

Readings:

1. Kelty, *Two Bits* Chapters 4,5 (pdf1 | pdf2).

Primary Sources and Background:

1. Peter Salus, *A Quarter Century of UNIX* Addison Wesley, 1994 (Especially Chapters 1-3.
2. Lions, John *Lions' Commentary on UNIX 6th edition with source code* with forewords by Dennis M. Ritchie and Ken Thompson, prefatory notes by Peter H. Salus and Michael Tilson, a historical note by Peter H. Salus, and appreciations by Greg Rose San Jose, Calif. : Peer-to-Peer Communications, c1996. **On reserve**
3. Malamud, Carl *Exploring the Internet : a technical travelogue* Englewood Cliffs, N.J. : PTR Prentice Hall, c1993. **On Reserve**

Wed Nov. 7: Analyzing FOSS

Readings:

1. Weber, S. (2005). *The success of open source*. Harvard University Press. CHAPTERS 1,3,5 and 6
2. Gabriella Coleman Coleman, E. Gabriella, "Three Ethical Moments in Debian" (September 15, 2005). SSRN

Also look at:

1. Benkler, Yochai, *The wealth of networks : how social production transforms markets and freedom* New Haven : Yale University Press, c2006. Online Version on Benkler's site.

Memory: What is a programming language?

Why Programming *Languages*? Who created the science of software and why? The story of the transition from the engineering of machines to the programming of computers comes in myriad forms. The "proleptic" version, in which the the future of the computer is imagined by multiple disciplines from economics and engineering to biophysics and neurology; the "bootstrap" version, in which the successive innovations are understood as progressive liberations of a pure software from an increasingly generalized hardware; the simple linear story of progress of logical theory to computer science and so on. The question of "memory" and its twin "composition" guide the story here: memory both as an engineering problem and as that which drives the structure and increasing complexity of programming languages and levels of abstraction that create the possibility for new kinds of composition.

In this section readings focus on the weird period of 1950-1980 in which the discipline of computer science was created, and the computer went from being a specialized scientific device for calculating to a ubiquitous feature of family living rooms.

concepts: compiler, parser, debugger; procedural and object oriented, programming, scripting, macros, bookmarks. history of automation, automata and formal languages, computational complexity, formal semantics, languages: LISP, Algol, Fortran, Pascal, BASIC, C, Java.

Week 9

Mon Nov. 12: No Class (Veterans Day)

Wed Nov. 14: Memory/Composition as Programming

1. Carruthers, Mary. *The craft of thought : meditation, rhetoric, and the making of images, 400-1200* New York: Cambridge University Press, 1998. Chapter 1, pages 7-46 (the rest is optional) (PDF)
2. Hagen, Wolfgang, "The Style of Sources: Remarks on the Theory and history of Programming Languages" in Wendy Hui-Kyong Chun ed. *New Media, Old Media: A History and Theory Reader* (New York: Routledge, 2005), with Thomas Keenan Author's Website

Other

- Brian W. Kernighan, P. J. Plauger, *Elements of Programming Style* New York : McGraw-Hill, c1978. **On Reserve**
- Richard L. Wexelblat, ed. *History of programming languages* New York : Academic Press, 1981. **On Reserve**

- Thomas J. Bergin, Jr. and Richard G. Gibson, Jr. eds. *History of programming languages II* New York: ACM Press ; Reading, Mass. : Addison-Wesley Pub. Co., c1996. **On Reserve**
- Friederich Kittler, "There is no Software" online version at CTheory

- Bowker, Geoffrey, *Memory Practices in the Sciences* MIT Press 2006. **On Reserve**

Week 10

Mon Nov. 19: Programming Languages and Style

- Mahoney, Michael, "Software as Science, Science as Software" in *History of Computing: Software Issues* ed. Ulf Hashagen, Reinhard Keil-Slawik, and Arthur Norberg, 2003. On the author's website

1. Mahoney, Michael, "Computer Science: The Search for a Mathematical Theory", in John Krige and Dominique Pestre (eds.), *Science in the 20th Century* (Amsterdam: Harwood Academic Publishers, 1997), Chap. 31. On the author's website

Stop by the library and take a look at these two books:

- C.E. Shannon and J. McCarthy, eds *Automata studies* Princeton, Princeton University Press, 1956. **On Reserve**
- National Physical Laboratory (Great Britain) *Mechanisation of thought processes* London, H. M. Stationery Off. 1959. **On Reserve**

Optional primary and background:

- Clark, David J, *Enclosing the Field From 'Mechanisation of Thought Processes' to 'Computer Science.'* Enclosing the Field. PhD Thesis University College, London, 2002. Author's website.

Wed Nov. 21: Discussion.

Justice: What are data structures and algorithms?

The promise and the danger of the computer both concern their ability to transform society, sovereignty and security– but exactly how is never quite obvious. From the first stirrings of the giant brains of the 1950s, to current obsessions with identity theft, every aspect of life and governance has been subjected to the logics and practices of software, and at heart to the power and flexibility of data structures and algorithms. From the perspective of issues of control, management and decision making, the history of the computer can be re-imagined as a problem of governance, a problem of the management of organizations, territories, institutions and individuals.

concepts: data structures, trees, lists, sorting, searching, algorithms. Decision analysis, operations research, risk, trust, verification.

Week 11

Mon Nov. 26: The Cold War I, Russia

1. Gerovitch, S. (2004). *From newspeak to cyberspeak: a history of soviet cybernetics*. The MIT Press. At least chapters 1,3,4 and 6.

Wed Nov. 28: The Cold War II, The US

1. S.M. Amadae, *Rationalizing capitalist democracy : the Cold War origins of rational choice liberalism* Chicago: University of Chicago Press, 2003. Selections. Intro and Chapter 1

Background:

1. Miroski, Philip *Machine dreams : economics becomes a cyborg science* Cambridge; New York: Cambridge University Press, 2002. Selections **On Reserve**

Week 12

Mon Dec. 3: Trust, Risk and Proof, cont't

1. Mackenzie, D. (2004). *Mechanizing proof: computing, risk, and trust* (inside technology). The MIT Press. At least: Ch 1,5,7 and 9
2. "Open Source Warfare," *IEEE Spectrum* online November 2007 by Robert Charette

Wed Dec. 5: From Algorithm to "Design Priniciple"

1. Gillespie, Tarleton. "Engineering a Principle: 'End-to-End' in the Design of the Internet." *Social Studies of Science* 36(3), June 2006, pps. 427-457. Cornell Eprint server.

Background;

1. Saltzer, Jerome, David Reed & David Clark (1984) 'End-to-End Arguments in System Design', ACM Transactions on Computer Systems 2/4: 277-88. Available online at Reed?
2. Kruse, H., Yurcik, W., and Lessig, L. 2001. "The interNAT: policy implications of the internet architecture debate." In *Communications Policy in Transition: the internet and Beyond* Mit Press Telecommunications Policy Research Conference Series. MIT Press, Cambridge, MA, 141-157. Available at CiteSeer
3. Clark, D. 1988. The design philosophy of the DARPA internet protocols. SIGCOMM Comput. Commun. Rev. 18, 4 (Aug. 1988), 106-114. DOI= At ACM Portal

Other works

* Agar, Jon, *The government machine : a revolutionary history of the computer* Cambridge, Mass. : MIT Press, 2003. **On reserve**
* Light, Jen, *From warfare to welfare : defense intellectuals and urban problems in Cold War America* Baltimore : Johns Hopkins University Press, 2003.
* Knuth, Donald, *The Art of Computer Programming, 3 vols.* Reading, Mass. : Addison-Wesley, c1997-c1998.

Life: What is a process?

Program, process and context. Computational objects simultaneously exist in three forms: as the source code or program that describes what the computer should do, as the process running on a computer, and as the context of actions that are expected from other humans or non-humans interacting. Such a strange ontology is both new and old: it is new because the machines and programs and devices and algorithms are new; but it is old because it invokes a very old metaphysical conundrum about the impossible and infinitely receding temporality of living. Two books address this: BC Smith's is a book of metaphysics that seeks to be appropriate to the novelty of computational objects; E. Ullman's novel is about that one event that brings everyone directly into confrontation with the frustrating inaccessibility of a process as it runs: the bug.

Week 13

Mon Dec. 10: The mysteries of the organism

1. Smith, B. C. (1998). *On the origin of objects* (bradford books). The MIT Press. Chapters 1, 11 and 12.
2. Ullman, Ellen, *Bug: a novel* Nan Talese, 2003

Wed Dec. 12: Ullman and Smith cont'd

Logout: what was your grade?

Week 14

Mon Dec. 17: Conclusion

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