# the information age

**HSTM 20282 • UCOL 20282** (10 credits)

**HSTM 20782 • UCOL 20282** (20 credits)

Semester 2, 2015-2016

Course lecturer: **Dr James Sumner**

Classes: Thursdays 16.00–18:00, Roscoe Building 3.2



| Date | 16.00–17.00 | 17.00–18.00 |
|---|---|---|
| 4 Feb | **01.** Introduction | |
| 11 Feb | **02.** Information then: nineteenth-century industry and arithmetic engines | |
| 18 Feb | **03.** Information now: identity, privacy and power in the smartphone age | |
| 25 Feb | **04.** The changing computer: trends and complications in the development of information technology | |
| 3 Mar | **05.** Catastrophic failures? Information, infrastructure and engineering | |
| 10 Mar | **06.** An information icon: Alan Turing and the power of legends | |
| 17 Mar | **07.** Machines that think: hopes, dreams, failures and nightmares | |
| *Easter break: no classes 21 Mar – 8 Apr* | | |
| 14 Apr | **08.** Computers for the people! Home micros and techno-evangelists | |
| 21 Apr | **09.** Hacker histories | |
| 28 Apr | **10.** Geek mythology: skills and identities, women and men | |
| 5 May | **11.** Internet connections | |
| 12 May | **12A.** Exam skills | **12B.** Conclusion: memory expansion |

# Introduction

How did information-processing equipment come to dominate, by the beginning of the twenty-first century, so many areas of human life? Who are the winners and losers in a computerised, automated, data-driven world? Is "information technology" applied computer science, or applied bureaucracy? And what about those who use it? Even now that computerised technology is a familiar household convenience, there are still identifiable kinds of 'computer people'. They are sometimes viewed as wizards, sometimes as dullards — but rarely as just 'ordinary.' Why is this? Have the 'boffins,' 'nerds' or 'code junkies' always been a breed apart?

To answer these questions, this course traces the histories of a range of technological developments, from the mechanical calculating machines of the nineteenth century to the global networked systems of today. Equally importantly, it focuses on the hopes and fears attached to information. In popular culture, information technologies have appeared as secret weapons that win wars, infernal machines that destroy jobs, vehicles for journeys of personal discovery, badges of industrial success, and irritants that don't work properly and need to be kicked. Their users, meanwhile, have been pictured as Victorian capitalists, wartime boffins, 1970s techno-radicals, 1980s whizzkids, hackers, crackers, geeks, cybernauts and perfectly ordinary wage-slaves who drink too much coffee. Factual or fictional, these images also have the power to change the world.

The course is equally suitable for computer science students and those who have never studied the field, but are interested in learning more about the background of one of the dominant technologies of our time.

# Aims

This course uses historical case studies to show how and why digital information-processing occupies a crucial role in present-day human life. Combining strands from technical, social, cultural and economic history, it will describe the development of mass-produced computer technology and mass public access to information systems, and their consequences for society. It will also show the role of hopes, fears and other visions in informing public ideas, using examples ranging from employment forecasting to science-fiction dreams.

# Intended learning outcomes

By the end of this unit, it is expected that all students will

- have a good working knowledge of major developments in the history of information technology, particularly from the Second World War onwards
- have developed skills in critical reasoning and analysis, understanding the different motivations of historical characters in the history of information technology, and the differences in the ways they interpret and describe events

- be able to appreciate, and display the ability to analyse and discuss, the different factors — social, technical, sometimes accidental — which shape the history of computing, and the definition of the computer and its users

In addition, a student taking the 20-credit version will

- have defined (in consultation with the lecturer) a research project in the history of computing
- be able to find, and assess critically, relevant primary and secondary sources
- have produced, with full scholarly apparatus, a report (or alternative piece of work, subject to the lecturer's approval) based on this research.

# Teaching

This course unit will be taught in a single weekly two-hour slot. Each class will consist of a mixture of lecture and group discussion, with occasional short video screenings and other activities. **You may ask questions at any time** in a lecture or discussion. Feel free to (politely) interrupt if there's anything you need to clarify, or if you think I have made a mistake.

**Attendance at classes is expected.** Anyone who is repeatedly absent without a good explanation may receive penalties up to and including **exclusion from the course.** Study on this kind of course is based on a combination of lecture content, seminar discussion, and reading around the subject. The classes are partly there to help to direct and structure your reading, but will also include important information about course content and assessment. You should **take notes** during the lectures to guide future work.

Each class has one or more **required readings**. You need to read these in advance of the class. There will also be something specific to prepare in writing, listed under the heading "Exercise for this class": this will usually be a response to one of the readings, based on questions supplied.

There are also **background readings,** which are usually the sources I used in writing the lecture content. You should read as much background material as you have time for, in the parts of the course which interest you most. This will be useful for exam preparation, and essential for essays.

# Blackboard

Blackboard is the learning environment used for online learning (eLearning). Your main route of access to your eLearning resources is via the student portal at www.portal.manchester.ac.uk:

- Log into your portal
- Click on the "My Studies" tab
- Locate the Blackboard box on the left hand side

- Click on the "My Blackboard Homepage" link
- You will automatically be signed into Blackboard 9. Now you can select your course.

If you cannot access your eLearning through this method, you must submit an eLearning enquiry form immediately.

You should **check Blackboard regularly** for new course materials, updates, and suggested reading for research. Any **corrections** to the course outline (this document) will also be announced on the Blackboard site.

If you have any questions about **course content,** please **don't** report them through Blackboard. Email the course lecturer directly.

If you want to report **technical problems** with the Blackboard site, please contact eLearning support using the link provided.

# Libraries

The most useful library for this course is the University of Manchester Library (Main Building), number 55 on the campus map: see www.manchester.ac.uk/discover/maps/interactive-map/?id=53. You may also find some readings in the other libraries on campus to which you have access (see www.library.manchester.ac.uk/locations-and-opening-hours/) and should be able to borrow books.

A useful additional library resource is Manchester Central Library on St Peter's Square: www.manchester.gov.uk/centrallibrary.

# Assessment

Assessment is by examination, and by essay (or alternative kinds of project work if agreed beforehand with the lecturer). A range of permitted essay titles will be distributed early in the course.

Students taking the **10-credit version, HSTM 20282 or UCOL 20282**, will normally be assessed on

- **one essay** of about 1500 words (1350-1650 words acceptable, including all notes and references), to be submitted by **15.00, Thursday 23 April,** counting for 50% of the total
- **one examination** of two hours' duration, in the Semester 2 exam period (date to be announced), counting for 50% of the total

Students taking the **20-credit version, HSTM 20782 or UCOL 20782**, will be assessed on

- **one essay** as above, counting for 25% of the total
- **one examination** as above, counting for 25% of the total

- **one project** or extended critical essay, to be submitted by 15.00, **Thursday 14 May** and counting for 50% of the total

All work should be submitted in accordance with the **essay guidelines** supplied for this unit. Arrangements for handing in will be announced during the course. **Late essays** will be penalised according to Faculty of Life Sciences guidelines.

# Project (20-credit version only)

The project on the 20-credit version of the course is intended to introduce you to specialist literature on a topic that you want to study in more depth. The project may take the form of an extended research piece (3000-3500 words), and could address one of the themes from the essay list just given, or a theme of your own. You should take care that your essay and project themes are not too similar, and **must consult the lecturer to get your title approved.** Some suggestions will be circulated early in the course.

You need to allow considerable time for reading around the subject. Start looking for the readings you will need as soon as possible in the library, and if they are already on loan, put in reservations.

You might also like to consider other formats for a project. Possibilities include oral history interview work; a short dramatisation or documentary presentation; or work on documents or artefacts held by the National Archive for the History of Computing or Museum of Science and Industry (if you know of, or can find, staff who are willing to help you out.) If you are thinking of one of these alternative formats, you should discuss it as early as possible with the lecturer to make sure your work will meet the requirements of the course. Further documentation will be circulated during the course.

# Contacting us

This course is organised by the **Centre for the History of Science, Technology and Medicine (CHSTM)** — **not** by Computer Science or SALC. CHSTM is part of the Faculty of Life Sciences and is based in the Simon Building on Brunswick Street. See [www.manchester.ac.uk/chstm] for full details.

The unit co-ordinator, and sole lecturer on this course, is **Dr James Sumner.** I can most easily be contacted by **email,** at [james.sumner@manchester.ac.uk].

You can phone me or leave voicemail on 0161 275 5845: however, I'm often away from my desk, so email usually finds me more quickly. My office is 2.34 Simon Building.

I do not have a regular tutorial hour this semester, but I encourage you to meet me if you have any problems or need advice. Just email me for an appointment, suggesting times when you're available.

# Course communications

**You need to check your University e-mail account regularly.** I will routinely use email (not Blackboard) for course announcements, and it's your responsibility to make sure you're up to date with them. If you prefer to use a private address, you should arrange to forward e-mails from your University address to it.

# A note about plagiarism

Plagiarism is a very serious offence, comparable to cheating in exams. It consists of passing off others' work as though it were your own (eg lifting passages – either word-for-word or closely paraphrased – from books, articles, online sources, etc.). Even 'recycling' parts of your **own** work, which has previously been submitted for assessment at this University or elsewhere, is defined as plagiarism under the University's guidelines.

It is not difficult for staff, who are all professional academic writers, to recognise instances of plagiarism. Likewise, software for detecting material lifted from internet sources is regularly employed in this regard.

**Ignorance of the rules on plagiarism will not be accepted as a defence.** It is your responsibility to familiarise yourself with the University's policy on plagiarism before you prepare and submit any coursework so that you do not inadvertently commit this offence. All students should read, and make sure they understand, the University's regulations on plagiarism:

[documents.manchester.ac.uk/display.aspx?DocID=2870]

Since academic writing typically draws on the work and specific language of other writers, it is vital that you understand the (often subtle) distinctions between ethical use of others' texts and unethical appropriations of the work of others. The penalties for plagiarism range from being required to resubmit the piece of work in question (possibly for a mark of zero), for minor instances, to **expulsion from the University** in serious ones.

# Disability support

The University of Manchester is committed to providing all students access to learning in the way most beneficial to them. It is important to tell us about any additional support that you need. If you have a disability, a learning difficulty or any condition that **you feel** may affect your work then you might want to tell us about it. Please feel free to approach me to discuss any additional needs that you have. You may wish to email me or we can arrange a meeting. Any discussion we have will be confidential. If you wish, you can also inform the Disability Advisory and Support Service. It is based on the second floor of University Place. You can drop in, but for appointments/enquiries telephone 0161 275 7512, or email [dass@manchester.ac.uk]. For further information, see [www.dso.manchester.ac.uk/].

# What to do each week

- Attend the lecture and seminar and **make notes**.
- In advance of the next class, read the "Required reading" listed for it and **make notes on this too.** Think how it relates to the lecture and to the rest of the course so far. Look at the exam past papers provided for this course: which questions are relevant to the reading? How would you use the reading to help you answer it?
- At the same time, do the task listed under "Exercise for this class", which is usually (but not always) tied to part of the reading.
- For most weeks there are plenty of "Background readings". The annotations will help you to choose which ones are most likely to be useful to you. Use them to learn more about the parts of the course you are most interested in, when you are planning an essay, and when you need more coverage for exam preparation.

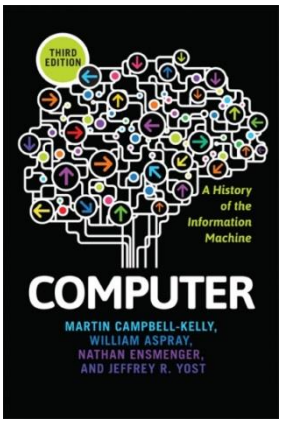
# General course readings

## Overview and survey texts

Wide reading is useful on this course. There are many texts which are not set as required reading, but will help you to understand the weekly class content and the background to the development of information technology.

The most useful single-volume survey of the history of computing for this course is:

- Campbell-Kelly, Martin, William Aspray, Nathan Ensmenger and Jeffrey R Yost, *Computer: a history of the information machine*, 3rd edition. Boulder: Westview 2014.




This book is referred to in this outline as **Campbell-Kelly et al** ("et al", meaning "and others", is a standard abbreviation used when a text has a lot of co-authors). Most of the chapters in it are useful background reading for one or more weeks.

It's worth considering buying a copy to read as we go through the course, although there is full electronic access via the University of Manchester Library, and two paper copies available for short loan in the High Demand Collection.

Copies of the first (1997) and second (2004) editions can sometimes be picked up for a few pounds second-hand (try, for instance, abebooks or Amazon New & Used). The third edition is obviously the most up-to-date (particularly for internet technologies) and has more coverage of skills and professionalization, and a better bibliography. However, the earlier editions are still reliable and usable. Chapters 1 to 8 are very similar in all three editions.

**If you have trouble getting access to the book – or any books on this course – please contact the course lecturer AS SOON AS POSSIBLE.** We often hear of problems only at the end of the course, when it's too late to do anything about them.

Some other useful general texts are:

- Ceruzzi, Paul E, *A History of Modern Computing*, 2nd edition. Cambridge, Mass: MIT Press 2003.

  The main alternative to Campbell-Kelly et al. Covers a narrower time period (roughly 1945-1990) in more detail. Where Campbell-Kelly et al write business history, focusing on commercial applications and software, Ceruzzi writes technical history, focusing on hardware producers and information technology concepts.

- Swedin, Eric, and David L Ferro, *Computers: the life story of a technology*. Westport, Conn: Greenwood 2005.

  The whole history of computing in 150 pages. Try this first if you want a quick and readable overview, to get things into perspective before tackling more complex studies. Not detailed enough to substitute for Campbell-Kelly et al. Mostly covers traditional 'standard' stories you will find in other texts, but Chapter 7 is a fresh attempt to address convergent tech, open-source and security.

- Ceruzzi, Paul E, *Computing: a concise history*. Cambridge, Mass.: MIT Press 2012.

  Ceruzzi's newer book is also short, but not so simple. Try this if you prefer a quick overview with more technical and analytical depth to it. The book is partly an experiment in putting together a more 'future-proof' history of computing, so it moves away from traditional stories to focus on analytical concepts such as the stored-program principle.

- Williams, Michael R, *A History of Computing Technology*, 2nd edition. London: Wiley 1997.

  Broad history from the ancient world to the 1960s. Very good on mathematical and technical perspectives, very little on users.

- Baym, Nancy K. *Personal Connections in the Digital Age*, second edition. Cambridge: Polity, 2015.

  Probably the best general survey introduction to themes of online identity and society. Already looking a bit out of date. A second edition is expected soon.

There are many general histories of computing aimed at a more popular audience. While not always good essay sources, these can be useful in helping you to pick up the historical background. Some of the most interesting are:

- Palfreman, John, and Doron Swade, *The Dream Machine*. London: BBC Books 1993.

  Accompanies the TV documentary series used in this course.

- Blyth, Tilly, ed. *Information Age: Six Networks That Changed Our World*. London: Scala, 2014.

  Accompanying the major permanent exhibition "Information Age" at the Science Museum in London, this volume takes a less traditional approach, melding computer and communications history, and structuring its chapters around a range of different connection principles – the web, the exchange, etc – rather than particular technologies.

- Hally, Mike, *Electronic Brains: stories from the dawn of the computer age*. London: Granta 2005.

  Another readable popular survey. More attention to British cases than the others.

- Lohr, Steve, *Go To: the story of the math majors, bridge players, engineers, chess wizards, maverick scientists and iconoclasts*. London: Profile 2002.

  Anecdotal long-range overview of the development of computer languages, 1950s-90s. Based on many interviews with influential coders.

## More specialised texts dealing with broad themes

The most appropriate background readings are listed for individual lectures and seminars in this handbook. You will often find these useful in essay preparation, or as background for exam revision. The following is a list of useful texts which, though specialised, are relevant to

more than one week's material, or give a different perspective which may be useful for writing essays or (especially) projects.

- Abbate, Janet, *Inventing the Internet*. Cambridge, Mass.: MIT Press 1999.
  The first serious book-length Internet history, mainly covering the ARPAnet years.
- Abbate, Janet, *Recoding Gender: women's changing participation in computing*. Cambridge, Mass.: MIT Press 2012.
  Best recent introduction to gender themes, running quite quickly and readably through the literature on quite a wide range of situations and problems, backed up with new research based on interviews with women computing professionals. Focuses on the UK and USA.
- Agar, Jon, *The Government Machine: a revolutionary history of the computer*. Cambridge, Mass: MIT Press 2003.
  Detailed British-focused survey which sees the rise of computing technology as a part of the general growth of the large information organisation, as typified by the Civil Service "machine."
- Aspray, William, ed, *Computing Before Computers*. Ames: Iowa State University Press 1990.
  Multi-author survey of early computing machinery, including an account of analogue computing.
- Brock, Gerald W, *The Second Information Revolution*. Cambridge, Mass: Harvard University Press 2003.
  Computers in the context of the postwar explosion in communications technology.
- Campbell-Kelly, Martin, *From Airline Reservations to Sonic the Hedgehog: a history of the software industry*. Cambridge, Mass: MIT Press 2003.
  First book-length treatment of the software industry. Focuses mainly on US cases and on the commercial dimension.
- Cortada, James, *The Digital Hand: how computers changed the work of American manufacturing, transportation, and retail industries*. Oxford: Oxford University Press, 2003.
  Volume 1 of an enormous industry-by-industry survey (mainly US-focused) of the difference computers made. See also Volume 2 (2005) on finance, telecomms, entertainment and the media; and Volume 3 (2007) on education and government.
- Croarken, Mary, *Early Scientific Computing in Britain*, Oxford: Clarendon Press, 1990.
  The development of automated calculation in scientific research facilities. Covers the mechanical and early electronic periods, including some material on analogue computers.
- Edwards, Paul, *The Closed World: computers and the politics of discourse in Cold War America*. Cambridge, Mass: MIT Press 1996.
  Engages the politics so often lacking from accounts of computer history, and introduces ideas from cultural theory, to address how military and civil policymakers' ideas about control, surveillance and territory changed in the Cold War, and the role played by cybernetics, computers and AI.
- Ensmenger, Nathan, *The Computer Boys Take Over*. Cambridge, Mass: MIT Press 2010.
  How industry hired and managed – or mismanaged – software specialists from the 1950s to the 1990s. Themes include professional identity, mistrust of subcultures, and reasons why the "computer boys" remain mostly "boys".
- Hendry, John, *Innovating for Failure: government policy and the early British computer industry*. Cambridge, Mass: MIT Press 1989.
  The shift from consensus to competition and its effect on a nation's technological profile.
- Ifrah, Georges, *The Universal History of Computing: from the abacus to the quantum computer*. London: Wiley 2002.
  Very wide-ranging general-interest text on techniques of computation, translated from a French source: its arrangement and interpretations are often interestingly different from comparable English-language studies.

- Kidder, Tracy. *The Soul of a New Machine*. Boston: Little, Brown, 1981.
  Classic journalistic study of one company's project to develop a minicomputer and "make a lot of money."
- Lavington, Simon, *Early British Computers*. Manchester: Manchester University Press 1980. Online transcript at [ed-thelen.org/comp-hist/EarlyBritish.html].
  Overview focusing on the development of the technologies involved.
- Norberg, Arthur, and Judy O'Neill, *Transforming Computer Technology: Information Processing for the Pentagon, 1962-1986*. Baltimore: Johns Hopkins, 1996.
  The role of the US Advanced Research Projects Agency in sponsoring computer science research for (possible) military application, much of which eventually became part of 'everyday' computing. Includes AI work and ARPAnet.
- Rochlin, Gene, *Trapped in the Net: the unanticipated consequences of computerization*. Princeton University Press 1997.
  Not (necessarily) the Internet, but the 'net' of commitments and dependencies we sign up for when we transfer tasks to automated digital information structures. From supermarket checkouts to banking to airline safety, Rochlin considers the risks of trusting the technology.
- Turkle, Sherry, *The Second Self: computers and the human spirit*. New York: Simon and Schuster 1984.
  Classic study, one of the first seriously to address the involvement of computers in the social and psychological lives of experts and non-experts. Includes studies of the first generation of children growing up with digital equipment as 'everyday' familiar objects.
- Wardrip-Fruin, Noah, and Nick Montfort, *The New Media Reader*. Cambridge, Mass: MIT Press 2003.
  Valuable collection of primary sources written to promote or describe new methods of information distribution, often involving computers. Includes work by Alan Turing, Norbert Wiener, Ted Nelson, Richard Stallman and the originators of the World Wide Web.
- Yates, JoAnne, *Control through Communication: the rise of system in American management*. Baltimore: Johns Hopkins University Press 1989.
  Includes coverage of early information processing.
- Yates, JoAnne, *Structuring the Information Age: life insurance and technology in the twentieth century*. Baltimore: Johns Hopkins University Press 2005.
  Case study of the consequences of data-processing, mechanical and electronic, in the insurance industry.

If there's a book which you find helpful but which isn't on this list, let me know!

## Where can I look for more history of computing?

If you want to look further, an excellent annotated bibliography is

- Thomas Haigh, "History Resources" at [www.sigcis.org/resources]
  Maintained for the Society for the History of Technology Special Interest Group on Computers, Information and Society (SHOT SIGCIS). Lists books and articles, museums and archives, oral history resources, recommended texts for beginners, texts *about* the history of computing, and more.

And see also my contribution:

- James Sumner, "History of computing in the UK: a resource guide" at [www.sigcis.org/britain]
  More detailed guide focusing on Britain, mainly covering published books and articles.

You may also find relevant scholarly articles by journal searching. There is one journal devoted to the field, *IEEE Annals of History of Computing*. Journals which regularly publish history of computing content include *Technology and Culture*, *Information and Culture*, *History and Technology* and *Business History Review*.

# Where to find the readings and other texts

## Required readings

All the required readings will be available electronically, either in electronic full text or as PDF images of scanned photocopies. Links will be provided **on Blackboard for the relevant week.** If there are any exceptions to this, you'll be notified.

In this course, you will also be expected to undertake **independent reading** for essay and exam preparation (and, for 20-credit students, the project). Various background readings are recommended for each week of this course. You should also read as widely in and beyond these as time allows.

An increasing volume of the material you might need to look at is available **online,** either on the open web, or through services subscribed to by the University of Manchester Library (UML). This is particularly true for journal articles. Bear in mind, however, that **many of the most important sources are still only available on paper** — particularly books. You **will** need to visit libraries to access paper sources.

## Finding paper materials in the University Library

The University Library search catalogue at [www.library.manchester.ac.uk/searchresources/librarysearch/] is not always helpful. When searching for books, you may need to select the **Library catalogue only** tab to stop your results being clogged with irrelevant journal articles and reviews. The default approach is a roughly Google-like phrase search: if you go to **Advanced search** instead you can search specifically by author and title. Unfortunately there is no date search.

There should be at least one copy of every print book recommended on this course at the **UML Main Building** (Building 55 on the campus map: see [www.manchester.ac.uk/discover/maps/interactive-map/?id=53]. Books will be either in the main collection or in the **High Demand Collection** on the ground floor. You may find extra copies in the **Joule Library** in the Sackville Street building, or the **Precinct Library** next to the shopping precinct on Oxford Road. See [www.library.manchester.ac.uk/locations-and-opening-hours/] for details of all UML locations.

If you find that a text you need to use has been borrowed by another reader, you can **reserve it** through the online catalogue. This means that anyone who has taken out a popular book will usually find it is recalled quickly.

**Don't hog books.** Beside the other students on this course, there are many other readers in the University who may be waiting to access books. You should therefore return all materials to the Library as soon as you have finished with them. You may wish to make your own copies of anything you need to use regularly.

## Material outside the University

The main non-University library in Manchester is the **Central Library** on St Peter's Square. This holds many local collections and archives (potentially useful if you are writing an essay on a Manchester topic.) More information is available at [www.manchester.gov.uk/centrallibrary].

**COPAC**, accessed at [www.copac.ac.uk], is a union catalogue allowing you to search the collections of the British Library and over 20 major university research libraries at the same time. If you find useful material via COPAC, you may be able to borrow it through **Inter-Library Loans and Document Supply** at Manchester: see [www.library.manchester.ac.uk/ourservices/servicesweprovide/documentsupply/].

**WorldCat**, accessed at [www.worldcat.org], is another powerful union catalogue: as the name suggests, it's international. You probably won't be able to borrow material from abroad, but WorldCat sometimes finds things in the UK which COPAC misses. (The reverse is also true.)

# 01. Introduction

Attempts to automate calculation and other kinds of information-processing can be found as far back as human history can be recorded. The history of this endeavour is not only long but complex and controversial. This lecture sets out the aims, scope and themes of the course.

Also, in this week's session, we will be looking at excerpts of some of the **video material** recommended to view during the course. Since the idea of electronic information processing first reached general audiences in the late 1940s, computers and computer operators have been represented in various ways on film and television. In the 1970s and 80s, television was also used to encourage mass audiences to get involved in computer use themselves. Today, shows about IT are much rarer. Is this simply because audiences now are so much more familiar with the concepts? Or do we live in a less IT-aware society than the earlier programme-makers expected?

There is no required reading for this class, but you may wish to take a look at some of the following to prepare, or after the lecture.

## Background reading

- Campbell-Kelly, Martin, et al, *Computer: a history of the information machine*, 3rd edition. Boulder: Westview 2014. Chapters 1 and 2.

  Good overview of the origins of automatic information-processing if you want to be ready for next week's class. Like the whole book, it's quite focused on business and commercial history.

- Ceruzzi, Paul E, *Computing: a concise history*. Cambridge, Mass.: MIT Press 2012, chapter 1.

  More technical, but probably the best one-chapter introduction to the origins of computing.

- Williams, Michael R, *A History of Computing Technology*, 2nd edition. London: Wiley 1997, pp 191-198.

  Brief background on the astrolabe and Antikythera device (discussed in the lecture).

- Jones, Alexander, "The Antikythera mechanism and the public face of Greek science", *Proceedings of Science*, 2012, online at [pos.sissa.it/archive/conferences/170/038/Antikythera%20&%20SKA_038.pdf].

  Survey of studies of the Antikythera device including more recent research.

- Baym, Nancy K. *Personal Connections in the Digital Age*. Cambridge: Polity, 2010, chapter 1.

  Background concepts for understanding the rise of mass online digital connection.

- Blyth, Tilly, ed. *Information Age: Six Networks That Changed Our World*. London: Scala, 2014.

  Easy reading. Includes material on developing-world telephony.

- Sjoerd Sijsma and Mirjam de Bruijn, "Connecting dreams: life histories, crossing borders and new communication technologies in Africa", 2013. Online at [www.youtube.com/watch?v=xeSOlCnEXXA].

  Interviews showing how the mobile phone has changed everyday life in Cameroon.

# 02. Information then: nineteenth-century industry and the Babbage engines

New information technology obviously make a lot of activities faster, cheaper and easier. People sometimes claim it's "impossible to imagine" anything like the modern world without digital data storage or microprocessors. But it's important not to get carried away. Centuries ago, people were building transport networks, financial systems and military empires that spanned the world, using handwriting, ledger-books, and large numbers of unskilled, poorly paid human workers.

One person who *did* believe information needed machines was the mathematician and manufacturing theorist Charles Babbage (1791-1871), who developed grand plans for cog-driven, programmable brass calculating devices. We will look at Babbage's achievements, dreams and disappointments in the context of their time.

We will also look at the controversy over Babbage's influence and importance: while some see him as the "father of the modern computer", others emphasise that his plans had little or no influence on twentieth-century developments. Alongside this, we will examine the role of Ada, Countess of Lovelace (1815-1852), whose popular account of Babbage's work has led her to be described as the "first programmer" – again, not without considerable controversy.

## Required reading (to be done in advance)

- Campbell-Kelly, Martin, "Data processing and technological change: the Post Office Savings Bank, 1861-1930", *Technology and Culture* 39:1 (1998), 1-32
- Campbell-Kelly, Martin, et al, *Computer: a history of the information machine*, 3rd edition. Boulder: Westview 2014. Chapter 1: "When computers were people", 3-19.

## Exercise for this class

**Make notes** on the "Data processing" reading – about two sides of A4 – and **bring them to the class** to discuss. Use these questions to guide your reading, and be prepared to answer them:

- How do you process data cheaply if you haven't got a machine to do it?
- What challenges did the Post Office Savings Bank depend on? What pre-existing systems did it rely on to overcome them?
- What decides whether an information-processing industry will mechanise?
- Does this help to explain why Charles Babbage's engines weren't more successful?
- What do you make of the "lesson in exactness" for "Mary Ann" discussed on page 11? (If you don't understand the relevance of the name "Polly", try looking up the origins of this name online…) Is it reasonable to treat this as a case of a user making a mistake? Can you see connections to the way modern-day systems deal with users?

## Recommended video (see "Videos" page)

- The Dream Machine, part 1: "Giant Brains" (1991)

  *The Dream Machine* (BBC/WGBH Boston co-production) was a five-part documentary on the history and projected future of the computer, including useful interviews with significant people (many of them no longer alive). This first instalment covers the work of Charles Babbage and the development of electronic computing in the 1940s and 50s.

## Recommended museum exhibit

- Babbage's Difference Engine Number 2 (1991; 2000), The Science Museum, London. Details at [www.sciencemuseum.org.uk/objects/computing_and_data_processing/1992-556.aspx]

  The vast mechanism specified in Babbage's second (and in some ways *simplified*) plan for the Difference Engine was eventually completed to the original designs, in full working order, for his 1991 bicentenary. The printing apparatus was completed nine years later. The Science Museum also has on public display a small trial component of the unbuilt Analytical Engine.

## Background reading on information processing before computers

- Campbell-Kelly, Martin, "The Railway Clearing House and Victorian Data Processing" in Lisa Bud-Frierman, ed, *Information Acumen*, London: Routledge 1994, 51-74.

  A useful companion-piece by the same author, looking at another classic nineteenth-century activity which needed heavy and centralised information processing.

- Perry, Charles, *The Victorian Post Office*, Woodbridge: Royal Historical Society, 1992.

  Background on the institution which made the Savings Bank system possible.

- Marsden, Ben, and Crosbie Smith, *Engineering Empires: a cultural history of technology in nineteenth-century Britain*, Basingstoke: Palgrave Macmillan 2005, chapter 5: "The most gigantic electrical experiment", 178-225.

  Global communication technologies in the nineteenth century.

- Cortada, James, *Before the Computer: IBM, Burroughs and Remington Rand and the Industry they Created, 1865-1956*, Princeton: Princeton University Press, 1993.

  Broader study of the general area of data-processing automation technologies Campbell-Kelly discusses towards the end of the paper.

- Yates, JoAnne, *Control through Communication: the rise of system in American management*. Baltimore: Johns Hopkins University Press 1989.

  More on data-processing systems, showing particularly how they related to US white-collar work. See particularly Chapter 2 on the main pre-digital technologies: letterpress, ledgers, vertical filing etc.

- Agar, Jon, *The Government Machine*, Cambridge, Mass.: MIT Press, 2003.

  Moving into the twentieth century, argues that information technology is shaped by the existing needs of systematic activities, using the case of the British Civil Service.

## Background reading on Babbage and Lovelace

- Babbage, Charles, *Passages from the Life of a Philosopher*. London: Longman, 1864, online at [archive.org/details/passagesfromlif01babbgoog]; or reprint, London: Pickering, 1994.

  Babbage's autobiography. Very readable, and the best possible way of getting an insight into this eccentric and sometimes tragic character.

- Menabrea, Luigi, translated with additional notes by Ada Lovelace, "Sketch of the Analytical Engine invented by Charles Babbage." Originally published in the *Bibliothèque*

*Universelle de Genève*, 1842; translation and notes published in Richard Taylor, ed, *Scientific Memoirs*, 1843. Online transcript at [www.fourmilab.ch/babbage/sketch.html].

The single most influential account of the unbuilt Engine's nature and possibilities. Read the "Notes by the Translator" and assess Lovelace's contribution for yourself.

- Williams, Michael R, *A History of Computing Technology*, 2nd edition. London: Wiley 1997. Chapter 4.

  Accessible account of how the Babbage and Scheutz machines worked.

- Hyman, Anthony, *Charles Babbage: pioneer of the computer*. Princeton University Press 1982.

  Best book-length biography of Babbage.

- Swade, Doron, "The Shocking Truth about Babbage and his Calculating Engines." *Resurrection*, New Year 2004, 18-27; online at [www.cs.man.ac.uk/CCS/res/res32.htm#d]

  More recent research on the role of the nineteenth-century science writer and populariser, Dionysius Lardner.

- Swade, Doron, *The Cogwheel Brain: Charles Babbage and the quest to build the first computer.* London: Abacus 2000.

  Mostly a light general survey of Babbage and his machines, with some original research. More important is the final third of the book: a first-hand account of efforts to construct a working Difference Engine Number 2 for the Science Museum, to original plans, in time for the 1991 bicentenary of Babbage's birth.

- Schaffer, Simon, "Babbage's Intelligence: calculating engines and the factory system." *Critical Inquiry* 21 (1994) 203-227.

  The importance of social and geographical place, setting Babbage in the wider context of Victorian industrialism.

- Swade, Doron, "'It will not slice a pineapple': Babbage, miracles and machines", in Francis Spufford and Jenny Uglow, eds, *Cultural Babbage: technology, time and invention*. London: Faber and Faber 1996.

  Babbage's historical reputation, and the role of miracles in his demonstrations with the model Difference Engine.

- Misa, Thomas, "Charles Babbage, Ada Lovelace, and the Bernoulli numbers" in Robin Hammerman and Andrew Russell, eds, *Ada's Legacy: cultures of computing from the Victorian to the digital age*. New York: ACM, 2016.

  Best introduction to the complicated debate over Lovelace's mathematical abilities, the extent of her contribution to the Analytical Engine project, and her role in the history of computing. Great source for finding further reading.

- Fuegi, John, and Jo Francis, "Lovelace and Babbage and the creation of the 1843 'Notes'", *IEEE Annals of History of Computing* 25 (2003), 16-26.

  Based on examination of the Lovelace-Babbage correspondence, and an influence on later presentations of Lovelace as both a more realistic operator and a more articulate computing visionary than Babbage.

- Stein, Dorothy, *Ada: a life and a legacy.* Cambridge, Mass: MIT Press 1985.

  Often overlooked early biography which aimed to de-mythologise Lovelace. Has been criticised – fairly – by Lovelace enthusiasts for overstating her lack of mathematical skill, and by historians for applying twentieth-century psychology to the very different world of the nineteenth century. On the other hand, Stein usefully corrects the cardboard heroism of simplistic pro-Lovelace writing, and is realistic about the consequences of women's limited opportunities and the strangeness of Lovelace's position as a mathematically inclined female aristocrat.

- Toole, Betty A, *Ada: the enchantress of numbers*. Mill Valley, Calif: Strawberry Press 1992.

  Toole is an opponent of those (including Stein) who downplay Lovelace's abilities. This volume consists mostly of excerpts from Lovelace's letters to Babbage and others.

- Padua, Sydney, *The Thrilling Adventures of Lovelace and Babbage: the (mostly) true story of the first computer*. London: Particular, 2015.

  Highly speculative cartoon strip treatment, with the pair as mathematically enabled crime-fighting superheroes who never quite get around to fighting any crime. Surprisingly heavily based on historical research, and worth reading as an indication of just how far the Lovelace/Babbage cultural phenomenon has spread. Also funnier than anything else on this reading list.

# 03. Information now: identity, privacy and power in the smartphone age

The rise of mass public internet use, one of the major social changes of the 1990s, was accompanied by a wave of optimistic claims predicting the end of censorship, the levelling out of inequalities in education and opportunity, and the rise of a public-spirited global community. Today, however, the picture is not so rosy. Indeed, many commentators – including not only traditional "technophobes", but IT professionals, legal experts and informed activists – fear that we may be heading in the opposite direction: towards unprecedented government surveillance and control, growing erosion of personal privacy by corporate social media platforms, or new technological barriers that exclude certain kinds of people from positions of power. This class examines the fears, as well as the hopes, of the information age we live in.

## Required reading

- boyd, danah, "Privacy: why do youth share so publicly?", Chapter 2 in *It's Complicated: the Social Lives of Networked Teens*, New Haven: Yale University Press 2014, 54-76, full text online at [www.danah.org/books/ItsComplicated.pdf]
- Baym, Nancy K, "Digital media in everyday relationships", Chapter 6 in *Personal Connections in the Digital Age*, second edition, Cambridge: Polity, 2015, 142-173.

## Exercise for this week

boyd's book uses a standard plaint of older generations – "What is wrong with kids these days? Why can't they be more sensible?" – to frame a series of issues which don't only apply to young people: the effects of global connection on privacy, the differing and fuzzy definitions of "public" and "private", the differences between technological and social fixes to problems.

Think about the cases and questions boyd presents: do you recognise them from your own life online? Make notes, and come to the class prepared to discuss.

## Background reading

- Further chapters in Baym's *Personal Connections* and boyd's *It's Complicated*
- Goldsmith, Jack, and Tim Wu, *Who Controls the Internet? Illusions of a borderless world*. Oxford: Oxford University Press, 2006.

  When the internet first became public, it was widely hyped as a kind of libertarian utopia where traditional boundaries, censorship and government could not function. This book, by two law professors, surveys the technical and political details of internet control in practice to reach a very different conclusion.

- Turkle, Sherry, *Life on the Screen: identity in the age of the internet*. London: Phoenix 1997.

  The most influential study so far on how people project identity online. As is true for most of Turkle's work, the details of the particular subcultures studied have very quickly fallen out of date, but the general points should be obviously relevant to today's internet. See in particular Chapter 8, "TinySex and Gender Trouble", on the familiar phenomenon of online gender-swapping.

- Turkle, Sherry, *Alone Together: why we expect more from technology and less from each other*. New York: Basic 2011.

  Compare and contrast. Whereas *Life On The Screen* drew many positive conclusions about living online, fourteen years later *Alone Together* was far more guarded. Assessing the effects of more recent technologies from robot pets and care assistants, to text messages and instant-messenger services, to Second Life, Myspace, Facebook and ChatRoulette, Turkle finds evidence of a new and unsettling form of loneliness, to which young "digital natives", who have never known a world without these technologies, are as vulnerable as anyone.

- Wajcman, Judy, *TechnoFeminism*. Oxford: Polity 2004.

  Chapter 3 is a relatively accessible introduction to the wider issues in gender theory which inform discussion of 'online' or 'virtual' identities.

- Nakamura, Lisa, *Cybertypes: race, ethnicity, and identity on the internet*. New York: Routledge 2002.

  The groundswell of 1990s literature on online identity focused heavily on gender issues; Nakamura raises comparable questions of racial identity. Deals with general principles more than particular technologies, so hasn't dated as badly as some other literature from this period.

- Nakamura, Lisa, and Peter Chow-White, eds, *Race After the Internet*, New York: Routledge, 2011.

  Studies by a range of authors looking at how digital media technologies, including Facebook-era social media platforms, influence and are influenced by racial identities and assumptions.

- Morozov, Evgeny. *The Net Delusion: How Not to Liberate the World*. London: Penguin, 2012.

  Challenges the assumption that new online media must, or indeed can provide freedom, pointing out the many ways they in fact help to support established centres of power and repression. Some grandstanding public intellectualism, but useful in correcting various popular misconceptions.

- Joyce, Mary, ed. *Digital Activism Decoded: The New Mechanics of Change*. New York: International Debate Education Association, 2010.

  More perspectives on the potential uses of online technology in changing the world, with various authors analysing activism online. See, for instance, Katharine Brodock's chapter on digital divides with regard to access and therefore scope for activism.

- Pariser, Eli. *The Filter Bubble: What the Internet Is Hiding from You*. London: Viking, 2011.

  Journalistic, provocative account dealing with a more technical, but important side of the rise of online media: the way corporations use algorithms to tailor and filter what information is delivered to people based on their past behaviour and various other, less than transparent factors, giving you "What you want, whether you want it or not."

- Michael Bittman, Judith E Brown and Judy Wajcman, "The mobile phone, perpetual contact and time pressure". *Work, Employment and Society* 23 (2009), 673-691.

  So, does the "constant touch" of mobile telephony destroy the work-life balance of its users? This study reaches some complex and perhaps surprising answers.

- Plus your own experience of blogs, social networking sites, user-generated videos, product reviews…

# 04. The changing computer: trends and complications in the development of information technology

During the forty years or so following their invention, electronic computers became more and more familiar to general audiences: but the story of their representation and reputations is not a simple one. In the 1940s, many journalists wrote of them as "electronic brains", mysterious new inventions offering revolutionary possibilities. The 1950s saw the first mass-produced computer models, many of which were put to use on relatively humdrum business tasks – but the machines remained large, fabulously expensive devices operated by experts. The 1960s saw smaller machines and greater public knowledge about the role of computerisation in everyday life, but it was not until the late 1970s that "ordinary people" could begin to buy simple computers of their own for home use.

This class surveys the broad changes which got us from the pre-electronic information world to the mass digital connectivity of today. We'll consider the computer industry's peculiar innovation culture, with its emphasis on ever faster, smaller and cheaper hardware; but also at the shift in attention from hardware to software as mass computing took hold. We will look in particular at International Business Machines (IBM), a corporation which dominated information processing in the USA (and many other places) in the years before the coming of the computer, and swiftly learned to do the same in the digital computing age; and at how making digital equipment caught up not only people and companies, but whole geographical areas in its operation.

## Required video (see "Videos" page)

- *The Dream Machine*, part 2: "Inventing the Future" (1991)

  Covers a lot of important themes: the growth of the US and British hardware industries, the first programming languages, popular representations of the computer, miniaturisation and the early stirrings of a desire for personal computers.

## Exercise for this week

As preparation for this session, you will investigate primary sources — direct evidence from throughout the historical period we are studying — to consider how ideas about computing machines, and how they fit into the lives of everyday people, have changed over the years. Instructions will be given out in advance (see Blackboard).

## Background reading

- Campbell-Kelly, Martin, et al, *Computer: a history of the information machine*, 3rd edition. Boulder: Westview 2014. Chapters 3, 4, 5, and 6.

  Probably the best introduction to the spread of computers for most readers. Focuses on business computing and particularly IBM.

- Swedin, Eric, and David L Ferro, *Computers: the life story of a technology*. Westport, Conn: Greenwood 2005. Chapters 2, 3, 4 and 5.

  A shorter, more general overview, good for skimming to get a sense of the general picture to build on with more detailed sources. Not as focused on IBM etc as Campbell-Kelly et al, but gives a relatively traditional, US-focused story.

- Ceruzzi, Paul E, *A History of Modern Computing*, 2nd edition. Cambridge, Mass: MIT Press 2003. Chapters 1 and 4.

  Still a general introduction, but a bit more technical in tone, with more detail on particular hardware developments.

- Watson, Thomas J, and Peter Petre, *Father, Son & Co.: my life at IBM and beyond*. London: Bantam 1990.

  Autobiography of the younger Watson, looking back at his father's life, the growth of IBM, and the move into digital computing.

- DeLamarter, Richard, *Big Blue: IBM's use and abuse of power*. London: Macmillan 1986.

  Readable anti-IBM account by an economist involved in the antitrust initiative. Contrasts interestingly with official histories.

- Lécuyer, Christophe, *Making Silicon Valley: innovation and the growth of high tech*, 1930-1970. Cambridge, Mass: MIT Press 2006.

  How a small collection of firms making radio and radar parts in the far American West grew into a defining feature of the information-technology world.

- Christine Finn, *Artifacts: an archaeologist's year in Silicon Valley*. Cambridge, Mass: MIT Press 2001.

  See in particular the "Photo Essay" (pp xviii-xlix). Finn's aim is to investigate, not so much the Valley's built environment, as its overall culture.

# 05. Catastrophic failures? Information, infrastructure and engineering

In the 1950s, as computer use took off in science and business, the common complaint was that there were not enough software developers to keep up with the hardware installations. As this problem was solved, others became clear: managers found that the habits and expectations of "good programmers" didn't necessarily fit in with the industrial workplace, and struggled to get projects completed however many developers were assigned. Ongoing talk of a "software crisis" in the 1960s led to new ideas about professional identity which, it was hoped, would solve the problem. And yet, decades later, claims of crisis are still very much alive.

Some commentators have also argued that making software, as a professional activity, has lost its way – that its core values and assumptions ignore the needs of users and other people, and that it is dangerously prone to sudden, catastrophic collapse, in ways that would not be tolerated in other industries or activities.

In this class, we'll be looking at computing culture's shift in focus from hardware to software, and how the software business has tried and sometimes failed to meet the challenges of its ever-growing role in keeping the world as we know it running smoothly.

## Required reading

- Bogost, Ian, "Programmers: stop calling yourselves engineers", *The Atlantic*, 5 November 2015. Online at http://www.theatlantic.com/technology/archive/2015/11/programmers-should-not-call-themselves-engineers/414271/?utm_source=SFFB
- Ensmenger, Nathan, "Conclusion: visible technicians", chapter 9 in *The Computer Boys Take Over*. Cambridge, Mass: MIT Press 2010, 223-243.

## Exercise for this week

Read both sources carefully and answer the following questions:

- What does Bogost mean when he says that "software development has become institutionally hermetic"? List some examples of the problem he's referring to, from his account or from your own knowledge.
- According to Bogost, what are the successful approaches that "real" engineering has but software engineering doesn't?
- Why is Ensmenger so keen to emphasise that we need to focus on the *maintenance* of software (and other technological systems)?
- Why is gender analysis important to Ensmenger's argument?
- What's your own experience of catastrophic software failures? Can you relate to the points being made here?

## Background reading

- Further chapters in Ensmenger, *The Computer Boys Take Over*.

  The story of how early desperation to find good programmers gave way later on to bafflement as to what to do with them.
- Campbell-Kelly, Martin, et al, *Computer: a history of the information machine*, 3rd edition. Boulder: Westview 2014. Chapters 8 and 9: "Software" and "New modes of computing".
- Thomas Haigh, "'Crisis, What Crisis?' Reconsidering the Software Crisis of the 1960s and the origins of software engineering". Unpublished draft, 2010; online at [tomandmaria.com/Tom/Writing/SoftwareCrisis_SofiaDRAFT.pdf].

  A challenge to the established view: Haigh argues that the idea of a particular "crisis" in the late 1960s, though important to some in the field, has little to do with the actual development of programming culture.
- Randell, Brian, "The NATO software engineering conferences", 1968/1969/2001. Online at [homepages.cs.ncl.ac.uk/brian.randell/NATO/]

  One of the central contributors to the original "software engineering" proposals maintains this archive, including full text of the reports from the 1968 Garmisch meeting and the follow-up conference in Rome, plus recollections.
- Brooks, Frederick P, *The Mythical Man-Month: essays on software engineering.* London: Addison-Wesley 1975.

  The most influential primary source on the particular problems of managing software. Brooks's Law – "Adding manpower to a late software project makes it later" – summed up the central problem and inspired numerous very different attempts to change coding culture.

- Brooks, Frederick P, "No silver bullet: essence and accidents of software engineering", first published in *Proceedings of the IFIP Tenth World Computing Conference* (1986); many reprints.

  Important follow-up: Brooks here assesses responses so far, and argues that *no* solution will make software costs drop as fast as hardware costs.

- Ceruzzi, Paul E, *A History of Modern Computing*, 2nd edition. Cambridge, Mass: MIT Press 2003. Chapter 3.
- Campbell-Kelly, Martin, *From Airline Reservations to Sonic the Hedgehog: a history of the software industry*. Cambridge, Mass: MIT Press 2003.

  Full-length history of software, mainly from a US perspective and focusing on business history. An earlier version of Chapter 8 — which usefully points out a recent tendency to exaggerate the role of Microsoft in recent software history — is available electronically:

- Campbell-Kelly, Martin, "Not Only Microsoft: the maturing of the personal computer software industry, 1982-1985," *Business History Review* 75 (2001) 103-145.
- Rochlin, Gene, *Trapped in the Net: the unanticipated consequences of computerization*. Princeton: Princeton University Press.

  See in particular Chapter 4, "Taylorism redux". "Taylorism", or "Scientific Management", was a theory applied to traditional industry in the early twentieth century: based on precise measurement, hierarchy and standardisation, its results were invariably a deskilled workforce and a powerful management. How far can the same approach be applied with information technology, and what are the dangers?

- David Noble, *Forces of Production: a social history of industrial automation*, Oxford: Oxford University Press, 1986.

  Classic critical account. Noble argues that managers use automation as a tool to remove the power that comes with shop-floor workers' skills and knowledge. (What, then, happens when it's time to automate management…?)

- Thomas Haigh, "The chromium-plated tabulator: institutionalizing an electronic revolution, 1954-1958", *IEEE Annals of the History of Computing* 23:4 (2001), 75-104.

  Addresses the shift from punched-card information processing to electronics. Did computers simply automate existing processes? Or did they create something entirely new, in terms of labour roles and management structure?

- Taylor, Phil, and Peter Bain, "'An assembly line in the head': work and employee relations in the call centre", *Industrial Relations Journal* 30:2 (1999), 101-117.

  Written not long after the call centre emerged as a major social phenomenon, and focuses on questions of routinisation, de-skilling and power relations.

- David Noble, "Technology and the commodification of higher education", *Monthly Review* 53:10 (2002). Online at [www.monthlyreview.org/0302noble.htm].

  Noble's expansion of his argument into a field in which you're directly involved: university-level teaching. Published at the height of the "distance learning" boom in the US.

# 06. An information icon: Alan Turing and the power of legends

The media circus around the 2014 feature film *The Imitation Game*, starring Benedict Cumberbatch, completed the rise to global public prominence of the name and achievements of Alan Turing (1912-1954) – a rise which had already been heavily boosted by the 2012 celebrations of Turing's centenary, but which had been building gradually for

several decades. The career of Turing's reputation in the decades since his early death, from near obscurity to an increasingly central role in studies of twentieth-century science and sexuality, is as extraordinary as was his life.

Alan Turing's story is also partly a local story. Turing came to the University of Manchester at the end of 1948, following a series of achievements in computability theory, wartime cryptanalysis and computer design at Cambridge, Bletchley Park and the National Physical Laboratory. Ahead of him lay equally significant work on the nature of machine intelligence, investigations into the theory of biological form, and disgrace – which many hold responsible for his untimely death – at the hands of a society fundamentally out of line with his identity and beliefs.

This class will look at Turing's life, work and legacy together to consider why the apparently cold and rational world of computing and information science seems to need highly personal heroes. The creation of computing as we know it was, surely, a decades-long process featuring very different contributions from very many people: why, then, is the question "Who invented the computer?" so popular, and why has Turing become popular as an answer in the twenty-first century?

## Required video (see "Videos" page)

- *Horizon:* "The Strange Life and Death of Dr Turing" (BBC2, 1992)

  Still the best documentary on Turing, giving a brief history of Turing's ideas, and outlining the controversy surrounding his death. Closing comment about lack of any permanent memorial to Turing is now out of date.

## Required reading

- Turing, Alan, "Computing Machinery and Intelligence," *Mind* 59 (1950) 433-460. Reprinted in various publications (see bibliography on Andrew Hodges' Turing site – link below – for details) and online in several places including [cogprints.org/499/1/turing.html].

## Exercise for this week

The discussion this week will focus on Turing's later work, which moved from the creation of automatic computing to its possible consequences. Turing's 1950 paper is a classic attempt to lay down rules as to when a machine should be accepted as demonstrating true intelligence, of the kind we recognise instantly in humans but find very difficult to define precisely. Make careful notes on the paper, and come to the class prepared to discuss the following questions:

- Look at Turing's description of the Turing Test. Do you agree with Turing that a machine that passes the test *must* be accepted as thinking, to the same degree that a human thinks?
- If not, what do you make of Turing's responses to possible objections?
- The Turing Test is an *operational* definition of intelligence: not a list of properties to look for, but a sequence of steps to take. Why did Turing think it was important to create an operational definition?
- What impression do you get of Turing as a communicator of scientific ideas?

## Background reading

- Hodges, Andrew, *Alan Turing: the Enigma.* Originally published 1983; paperback editions 1992 (London: Vintage), 2012 (centenary edition, Princeton: Princeton University Press), 2014 (*Imitation Game*, Princeton, with different pagination)

  Definitive Turing biography. Too long and detailed for casual reading, but essential background for a Turing-based essay or project. Available cheaply in paperback. Useful sections to read, covering sex, intelligence, morphogenesis and Manchester, are pp372-455 in the editions before 2014. The "Author's note" at the end is the inspiration for some of the discussion of Turing's reputation in this class. All editions have the same main content, but the 2012 and later editions have a new preface addressing more recent developments.

- Hodges, Andrew, Alan Turing Website at [www.turing.org.uk].

  Online companion-piece to the biography, with useful additional material.

- Haigh, Thomas, "Actually, Turing did not invent the computer," *Communications of the ACM* 57:1 (2014), online at [www.tomandmaria.com/tom/Writing/CACMActuallyTuringDidNotInventTheComputer.pdf]

  The idea that one person invented a fully-formed practical computer from nowhere is, of course, very silly, but many popular sources make this claim about Turing (among others). More plausible are the claims by Turing's admirers, including Andrew Hodges (see in particular [www.turing.org.uk/turing/scrapbook/computer.html]) and Jack Copeland (see below), that Turing's 1936 specification of the stored-program concept is a crucial origin point for computing as we know it. Haigh's piece surveys the evidence and takes a different view.

- Edgar Daylight, "Towards a historical notion of 'Turing—the Father of Computer Science'. *History And Philosophy Of Logic* 36 (2015): 205-228.

  Approaching the question from a similar position to Haigh's, seeks reasons for Turing's posthumous fame in the specialist computer science community, finding them in the priorities of particular researchers active in the Association of Computing Machinery in the 1950s and 60s.

- Agar, Jon, *Turing and the Universal Machine: the making of the modern computer*. Cambridge: Icon 2001.

  Effective, fairly simple brief survey of major issues surrounding Turing, computability and universality, aimed at a general audience. Best introduction to computability theory for non-mathematicians.

- Copeland, B Jack, ed, *The Essential Turing*. Oxford: Clarendon 2004.

  An extensive collection of Turing's own writings, together with some material from various of his colleagues. Spans 1936-54, and so covers computability, the Bletchley Park years, automatic computing, artificial intelligence, morphogenesis and more. The editor adds a useful introduction to each source text, together with several analytical overview pieces.

- Teuscher, Christof, ed, *Alan Turing: life and legacy of a great thinker*. London: Springer 2004.

  Multi-author collection on, and inspired by, the full range of Turing's work in computer science, cryptanalysis, morphogenesis biology and the philosophy of mind.

- Hinsley, F H, and Alan Stripp, eds, *Codebreakers: the inside story of Bletchley Park*. Oxford: Oxford University Press 1994.

  Multi-author volume consisting entirely of first-hand recollections by those who worked on Britain's wartime cryptanalysis programme. Gives a good sense of the sheer scale and variety of the operations surrounding the information-processing endeavour.

- Copeland, B Jack, ed., *Colossus: the secrets of Bletchley Park's codebreaking computers*. Oxford: Oxford University Press 2006.

  A mixture of first-hand recollections and journalistic overview pieces. Draws on material still classified at the time of Hinsley and Stripp's book.

### Recommended video

- *Breaking The Code* (BBC, 1996). Online at [www.youtube.com/watch?v=S23yie-779k].
  TV-movie adaptation of Hugh Whitemore's 1986 stage play of the same name, which draws on Andrew Hodges' biography. Widely acclaimed for drawing together elements of Turing's personal life and cryptographic work for a general audience, and for the central performance by Derek Jacobi.

# 07. Machines that think: hopes, dreams, failures and nightmares

Early computers were designed to replace human mental effort, and the term 'giant brain' or 'electronic brain' was often applied, especially in the popular press — although many experts insisted that their machines' operations were very different from, and more limited than, those of the human brain.

In the 1950s, debates over the nature of 'brainlike' behaviour spawned 'Artificial Intelligence' as a vibrant area of academic activity, sitting somewhere between computer science, cognitive psychology and philosophy. Many researchers were, and still are, confident that sufficiently complex computer systems will ultimately learn to take on roles currently filled by thinking humans. The past forty years, however, have seen a limited success record and a trenchant strain of criticism, leading some to believe that AI, as initially defined, will never achieve its goals.

There is also another line of attack: that if AI *were* ever really successful, it would alter human society in unpredictable and perhaps very dangerous ways. This position draws on a powerful set of ideas which appear again and again in speculative and fictional accounts, reaching back long before electronic computers were ever imagined.

### Required reading

- Čapek, Karel, RUR (Rossum's Universal Robots), English-language translation by David Wyllie, "Introductory Scene" online at [ebooks.adelaide.edu.au/c/capek/karel/rur/act0.html].
- Crevier, Daniel, *AI: the tumultuous history of the search for artificial intelligence*. New York: Basic Books 1993, chapter 5: "Clouds on the AI horizon".

### Exercise for this week

*RUR* is the 1921 Czech play which introduced the term 'robot' – though not the concept of a mechanical worker – into the English language. In the class discussion, we'll be using it to look at different concepts of the robot (some practical, some not-so-practical) and their relationship to automation and computerisation in general. Study the introductory scene carefully and come to the class prepared to discuss the following questions:

- How do Čapek's robots differ from robots as we know them?
- And how are they similar?
- What point is Čapek making with the concept of the robot?

- It's clear almost from the outset that the story of the RUR factory is not going to end happily. Why?

## Background reading on artificial intelligence

- Further chapters in Crevier, *AI* (above)
- McCorduck, Pamela, *Machines Who Think*, 2nd edn, Natick, Mass.: Peters, 2004.

  Classic popular survey of the development of AI, first published 1979. Based on interviews with AI founders and tends to reflect their views (particularly those of Herbert Simon), including strong dismissal of Dreyfus's challenges.
- Pratt, Vernon, *Thinking Machines: the evolution of artificial intelligence*. Oxford: Blackwell 1987.

  Discusses the work of both Babbage and Turing, and the earlier ideas of the famed philosopher Gottfried Leibniz, in AI context.
- Minsky, Marvin, *The Society of Mind*. New York: Simon and Schuster 1986.

  Philosophical account by one of the most high-profile researchers who see AI as a probable future prospect.
- Weizenbaum, Joseph, *Computer Power and Human Reason: from judgment to calculation*. San Francisco: Freeman 1976.

  Influential statement of the position that while advanced artificial intelligence may be possible, it is likely to be so different from intelligence based on human values as to pose a major danger to society.
- Dreyfus, Hubert, *What Computers Can't Do: the limits of artificial intelligence*, revised edition. London: Harper Colophon 1979.

  The most influential attack on the possibility that machines can ever be meaningfully "intelligent" at all.
- Martin, C Dianne, "The myth of the awesome thinking machine", *Communications of the ACM* 36 (1993), 121-133.

  Surveys popular ideas of early digital computers (discussed in earlier weeks) as 'brains' or 'robots'.
- Bloomfield, Brian, ed, *The Question of Artificial Intelligence*. London: Croom Helm 1987.

  Fairly advanced philosophical and sociological accounts by various authors. Includes Bloomfield's own piece on the culture of the AI community, and Harry Collins on "expert systems" and the possibility of mechanising skill and expertise.
- Roland, Alex, with Philip Shiman, *Strategic Computing: DARPA and the quest for machine intelligence*. Cambridge, Mass: MIT Press 2002.

  The US Department of Defense Advance Research Projects Agency spent a billion dollars trying to make AI happen in the 1980s. This book considers why they didn't manage it, and what they got instead.

## Background reading on robots

- The rest of RUR: see index page at [ebooks.adelaide.edu.au/c/capek/karel/rur/contents.html].

  This is a recent translation. You can also see the somewhat different script used for the first English-language production, of 1923, collected in *RUR and The Insect Play*, Oxford University Press 1961 (paper copy in UML).
- Nocks, Lisa. *The Robot: the life story of a technology*. Westport, Conn: Greenwood 2007.

  Broad overview covering early automata, mechanical automation, the link to AI, and recent scientific prototypes.
- Hankins, Thomas, and Robert Silverman, *Instruments and the Imagination.* Chichester: Princeton University Press 1996.

  The long historical view of automated devices, including fascinating examples shrouded in mystery and magic.

- Schaffer, Simon, "Babbage's dancer and the impresarios of mechanism", in Francis Spufford and Jenny Uglow, eds, *Cultural Babbage: technology, time and invention*. London: Faber and Faber 1996.
  Charles Babbage's early interest in automata; and the mysterious Mechanical Turk.
- Evans, Christopher, *The Mighty Micro*. London: Gollancz 1979, 139-151.
  This chapter on "Work and robots" should give you an indication of how automation and its relationship to the employment question were being presented to the public around 1980.

# 08. Computers for the people! Home micros and techno-evangelists

In the era of big mainframes, computers existed in corporate space: a computer in the home would have seemed as out of place and impractical as a jumbo jet in the garage. The arrival of cheap microprocessors, however, coincided with a movement to 'democratise' computing power, and a new generation of mostly amateur enthusiasts began to seek computers of their very own. Part of this change was the growth of the 'home micro', or 'personal computer', firmly encouraged by various established and new electronics manufacturers who saw profits to be made from a whole new category of consumer goods.

Some users, however, were not happy to be consumers. They saw computers as an opportunity to gain new skills, to change lives, and in some cases to create an alternative to the whole established social and political order. This class looks at the complicated tangle of dreams and realities which brought people and computers together.

A key part of this story is the idea of using a computer to play games. Gaming actually has a longstanding relationship with research at the forefront of computer science, sponsored by some exceedingly 'serious' clients — most notably the US military. Gamers and Cold Warriors alike were attracted to the latest in graphics, response processing, and AI simulation; but their hopes and dreams were often very different. Looking at the history of one of the first-ever videogames, we will see how long-haired countercultural hackers first got hooked on making war.

## Required reading

- Haddon, Leslie, "The Home Computer: the making of a consumer electronic." *Science as Culture* 2 (1988) 7-51.
- Brand, Stewart, "Spacewar: Fanatic Life and Symbolic Death among the Computer Bums" Originally published in *Rolling Stone*, December 1972; online at [www.wheels.org/spacewar/stone/rolling_stone.html].

## Exercise for this week

Once you have read Brand's 1972 article about Spacewar, try to play the game itself. There is a faithful re-creation, running on a Java emulation of the PDP-1 minicomputer, at [spacewar.oversigma.com].

Now answer the following questions and bring your answers to the class:

- Why *Spacewar*? Why were these early gamers attracted to life-or-death battle in a science-fiction environment?
- How have computer games changed?
- What were the aims of the "Counter-computer" movement? How much of their influence can you see in computer use today?
- "Spacewar serves Earthpeace." Do you agree?

## Background reading on home computers and popular computing

- Campbell-Kelly, Martin, et al, *Computer: a history of the information machine*, 3rd edition. Boulder: Westview 2014. Chapter 10: "The Shaping of the Personal Computer."
- Ceruzzi, Paul E, *A History of Modern Computing*, 2nd edition. Cambridge, Mass: MIT Press 2003. Chapters 7 and 8.
- Turner, Fred, *From Counterculture to Cyberculture: Stewart Brand, the Whole Earth Network, and the rise of digital utopianism*. Cambridge, Mass: MIT Press 2006, chapter 4.

  Excellent survey of how US West Coast counter-culturalists and human-focused computer interface designers came together to "bring computers to the people".
- Campbell-Kelly, Martin, *From Airline Reservations to Sonic the Hedgehog: a history of the software industry*. Cambridge, Mass: MIT Press 2003. Chapters 8 and 9.
- Evans, Christopher, *The Mighty Micro*. London: Gollancz 1979.

  The book which alerted British public and policy-makers to the 'challenge of the chip.'
- Spufford, Francis, "Chapter 3: The Universe in a Bottle" in *Backroom Boys*. London: Faber 2003.

  Off-beat but fascinating story of the seminal space-trader game Elite, originated on the BBC Micro platform. Well worth reading to get an idea of the conditions in which early-80s programmers operated.
- Alberts, Gerard, and Ruth Oldenziel, eds, *Hacking Europe: From Computer Cultures to Demoscenes*. London: Springer 2014.

  Interesting survey of mostly 1980s home computer use in national cases including the Netherlands, UK, Greece, Yugoslavia, Poland and West Germany.
- Hiltzik, Michael, *Dealers of Lightning: Xerox PARC and the Dawn of the Computer Age*. London: Orion 2000.

  The story of the institution whose staff created so many features of the modern graphical user interface.
- Lindsay, Christina, "From the Shadows: Users as Designers, Producers, Marketers, Distributors and Technical Support", in Nelly Oudshoorn and Trevor Pinch, eds, *How Users Matter*. Cambridge, Mass: MIT Press, 2003, 29-50.

  The survival of an early personal-computing community (TRS-80), and the role of users in the development and representation of technologies
- Sumner, James, "Standards and Compatibility: the rise of the PC computing platform", in James Sumner and Graeme Gooday, eds., "By Whose Standards?: Standardization, stability and uniformity in the history of information and electrical technologies" (*History of Technology* vol. 28). London: Continuum, 2008, 101-128; online at [www.jbsumner.com/writing/2008-history-of-technology-pc.pdf].

  Covers the fading of the 1980s "home" microcomputer formats as the PC became dominant.
- Raessens, Joost, and Jeffrey Goldstein, eds, *Handbook of Computer Game Studies*. Cambridge, Mass.: MIT Press, 2005.

  A bit old now, but still a useful introduction to the field, including some historical orientation.

- Cassell, Justine, and Henry Jenkins, eds, *From Barbie to Mortal Kombat: Gender and Computer Games*. Cambridge, Mass: MIT Press 1998.

  Early milestone in analytical game studies: includes numerous interviews with designers, coders and gamers. Useful for links to the class on gender and skills.

- Montfort, Nick, *Twisty Little Passages: an approach to interactive fiction*. Cambridge, Mass: MIT Press 2003.

  Discusses interactive fiction and 'text adventure' games, a huge commercial phenomenon in the 1980s.

- Švelch, Jaroslav, "Say it with a computer game: hobby computer culture and the non-entertainment uses of homebrew games in the 1980s Czechoslovakia." *Game Studies* 13 (2013), online at [http://gamestudies.org/1302/articles/svelch].

  Interesting study of a less well known national case, which discusses three uses of games (other than game-playing): demonstrating coding skills, carrying messages within a community, and promoting political statements.

### Recommended video

- *The Dream Machine*, part 3: "The Paperback Computer" (1991)

  Covers the foundations of 'user-friendliness' and 'usability', the difference made by disposable integrated circuits, and several well-remembered individuals (Clive Sinclair, Steve Jobs) and machines (Altair 8800, Xerox Alto, the original Apple Mac…)

- *Horizon*: "Now the Chips are Down" (BBC2, 31 March 1978).

  The documentary which introduced many viewers to the microprocessor for the first time. Was also viewed, privately, by many policymakers. The presentation is in many ways negative, focusing on possible unemployment and the destruction of traditional industries — in sharp contrast to what came later.

- *Commercial Breaks:* "The Battle for Santa's Software" (BBC2, 13 December 1984).

  Business documentary. The film-makers set out to tell the story of the highly-successful Liverpool games company, Imagine, famous for tabloid headlines involving teenage "whiz-kid" programmers, fast cars and fortunes. The reality turned out to be very different…

# 09. Hacker histories

We have looked at many aspects of the computer's development and place in the wider world: but what about those who operate computers? Even now that the computer is a familiar household object, there are still identifiable kinds of 'computer people,' who enjoy a mixed reputation in society. They are sometimes viewed as wizards, sometimes as dullards — but rarely as just 'ordinary.' Why is this? Have the 'boffins,' 'nerds' or 'code junkies' always been a breed apart?

In this lecture we begin to address this question by looking at the shifting meanings of the term 'hacking'. From college pranks, to obsessive or particularly ingenious interaction with the computer, to unauthorised remote access, hacks and hackers have been presented as socially useful, criminally destructive or plain weird — but always as subversive. If 'computer people' are fascinated by rules, they are also fascinated by how to break them.

### Required reading

- Levy, Steven, Hackers: heroes of the computer revolution, updated edition. London: Penguin 2001, Chapter 2: "The Hacker Ethic".

  *Hackers* is a well-known and colourful account of hacker activity (first published 1984), among the first to put hacking on the popular cultural map. Levy defines three waves of hackers: early minicomputer users at specialist (mostly university) facilities; the builders of the first user-owned microcomputers; and games software developers in the early

1980s. This chapter is Levy's take on the philosophy laid down by members of MIT's Tech Model Railway Club after they were introduced to the TX-0 minicomputer.

## Exercise for this week

In preparation for this week's class, spend 20 minutes or so looking at **recent** news and current affairs coverage dealing with "hackers". You can conveniently do this using a keyword search: try [www.google.co.uk/search?q=hackers#q=hackers&tbm=nws]. (At the time of writing, this provides such gems as "Hackers Remotely Kill a Jeep on the Highway" and "Hackers could use this cute Fisher Price teddy bear to steal from your kids" – but also "Hacker: the maddeningly imprecise term that is loaded with menace.")

Come prepared to answer the following questions:

- What are the usual features of descriptions of "hackers" and "hacking" in recent news accounts?
- How do they differ from "hacker" behaviour as described in Levy's chapter?
- Can you also see some similarities to what Levy discusses?

## Background reading

- Further chapters in Levy, *Hackers*
- Peterson, T F, *Nightwork: a history of hacks and pranks at MIT*. Cambridge, Mass: MIT Press 2003.

  Why hacking is called hacking: the term's origins in elegant (non-computing) campus trickery.
- Cringely, Robert X, *Accidental Empires: how the boys of Silicon Valley make their millions, battle foreign competition, and still can't get a date*. London: Penguin 1996.

  Informal, gossipy, very readable account of the US personal computer and software industry. Don't rely on it as an authoritative historical account; concentrate on how it portrays the people described — and how they themselves like to be portrayed.
- Turkle, Sherry, *The Second Self: computers and the human spirit*. New York: Simon and Schuster 1984, chapter 6: "Hackers: loving the machine for itself."

  Influential attempt to characterise the psychology and social relations of the serious hacker, with case studies from MIT.
- Raymond, Eric, "The Jargon File". Online at [www.catb.org/jargon].

  Guide to hacker language, with appendices charting some hacker folklore and (supposedly) typical hacker traits.
- Ensmenger, Nathan, "From whiz kids to cybercriminals: emerging narratives of risk in computer security", draft version on Blackboard for this unit.

  Useful survey of myths and realities showing how the "computer crime" trope – which originally grew up around the idea of employees committing fraud – gravitated towards hackerish stories of mysterious online access.
- Cornwall, Hugo [pseudonym, = Peter Sommer], *The Hacker's Handbook*, London: Century Communications 1985. Full text online at [www.textfiles.com/etext/MODERN/hhbk].

  Hugely controversial in its day, the how-to manual which in Britain popularised the idea of the 'hacker' as a dangerous whizkid obsessed with breaking into computer systems.
- Gates, Bill, "An open letter to hobbyists", 3 February 1976. Online at [commons.wikimedia.org/wiki/File:Bill_Gates_Letter_to_Hobbyists.jpg]

  Later to become famous in the light of Gates's growing fame, this letter was typical of the traditional commercial approach to software as it confronted the newcomers.

- Himanen, Pekka, *The Hacker Ethic: a radical approach to the philosophy of business*. New York: Random House 2001.

  Social theory of hacker values, contrasted with the traditional ('Protestant') work ethic. Prologue by Linus Torvalds.

- Stallman, Richard, *The GNU Manifesto*, 1985, online with notes at [https://www.gnu.org/gnu/manifesto.html]

  Earliest and most important practical definition of the goals of Free Software.

- Kelty, Christopher, *Two Bits: the cultural significance of Free Software.* Durham, NC: Duke University Press 2008. Free online (as you might expect!) at [twobits.net/read/]

  The Free Software movement in the context of wider political commitments to communal ownership of intellectual property.

# 10. Geek mythology: women, men and machines

Computers have long been seen as 'boys' toys'; the stereotypical 'computer nerd' is a young man; the information technology professions are by anybody's standards male-dominated. Most people, seeing the ongoing efforts to attract more women to work with computers, vaguely suppose that the field must have started out as all-male, with the gender balance gradually improving ever since. In reality, there was a significant number of women among the first generation of computer professionals, especially on the software side. The field has actually become *more* male-dominated since then.

The reasons for this complicated history have a lot to do with judgments and assumptions about the skills involved in working with computers. In particular, programming and documentation were routinely assigned to women during the Second World War: as unfamiliar new activities, they were sometimes assumed to be low-grade clerical tasks (and sometimes not really thought about at all). As it became clear that coding was a highly skilled and crucial task, it was increasingly reclassified as the kind of highly paid professional work which tended to go to men – but not before some women had found footholds in the industry, and begun developing new ways forward.

The class will also connect up points raised earlier in the course by considering how some opponents of women's under-representation have used history as a resource, drawing attention to the achievements and abilities of women in computing and mathematics over more than a century. The most popular such figure is the abovementioned Ada Lovelace – who died in 1852, never knew of electronics, and never experienced a computing machine powerful enough for practical use. Is it useful to promote Lovelace as a symbolic foundational figure, or is the "first programmer" legend a glamorous distraction from more important stories?

## Required reading

- Abbate, Janet, "Breaking codes and finding trajectories: women at the dawn of the digital age", Chapter 1 in Janet Abbate, *Recoding Gender: women's changing participation in computing*. Cambridge, Mass.: MIT Press 2012.
- "Chapter 4: Geek Mythology" in Margolis, Jane, and Allan Fisher, *Unlocking the Clubhouse: women in computing*. Cambridge, Mass: MIT Press 2003.

  In 1995, the percentage of women undergraduates entering the School of Computer Science at Carnegie Mellon University (one of the three famed centres of computer science innovation, alongside Stanford and MIT) was just 7%. In 2000, it was 42%, an international record. The reforms which caused this change were largely based on a collaboration between Allan Fisher, a member of the Computer Science faculty, and Jane Margolis, a social scientist who conducted hundreds of hours of interviews on the positive and negative experience of female students.

## Exercise for this week

Margolis and Fisher's book, though now beginning to show its age, provides an unusually direct and practical introduction to the problems and responses involved. Does the lack of women in most CS departments result from 'lack of interest' or pre-existing 'male dominance'? Or is there a more complicated explanation to be found in the obsessive behaviour of the 'typical' computer geek? Read the required chapter from the book – and skim the rest if possible: it's available electronically – and answer these questions:

- A question for the Computer Science students: what's familiar to you in the picture Margolis and Fisher paint of life in Computer Science at CMU? What's different?
- What is the "geek mythology paradox" (pp 67-68)?
- If Margolis and Fisher's explanation of the problem is correct, what changes need to be made to the way computer science is promoted and taught?
- Do you agree with their position?

## Background reading

- Abbate, Janet, *Recoding Gender: women's changing participation in computing*. Cambridge, Mass.: MIT Press 2012.

  Best recent introduction to gender themes, running quite quickly and readably through the literature on quite a wide range of situations and problems. The oral history interviews listed as required reading above were conducted as part of the project which produced this book.
- Misa, Thomas, ed, *Gender Codes: why women are leaving computing*. Hoboken: Wiley, 2010.

  The proportion of women in the computing professions has fallen since the 1980s. It is falling *now*. This book asks why, focusing on cases from the beginnings of the field to the present, and finding answers in the public image of computing and the history of professionalisation. See in particular Marie Hicks, on the status of computer operators/coders in the British civil service, also available at [mariehicks.net/writing/GenderCodesIllus.pdf]. See also Tom Misa's concluding chapter; and Caroline Clarke Hayes on the practicalities of solving the problem.
- Further chapters in Margolis and Fisher 2003, especially Chapter 2 (on school-age computer users).
- Hammerman, Robin, and Andrew Russell, eds, *Ada's Legacy: cultures of computing from the Victorian to the digital age*. New York: ACM, 2016.

  This edited collection explores the rise of Lovelace's fame from various angles, giving space both to Lovelace enthusiasts and to more analytical historians. Includes the chapter by Tom Misa recommended for the Lovelace/Babbage class earlier in the course.

- Cohoon, J McGrath, and William Aspray, eds, *Women and Information Technology: research on underrepresentation*. Cambridge, Mass.: MIT Press, 2006.

  Social-science research on what deters women and girls from IT education and professions, mostly concentrating on American cases.

- Abbate, Janet, ed, special issue on "Women and Gender in the History of Computing." *IEEE Annals of the History of Computing* 25:4 (2003).

  A range of approaches to diverse cases in the nineteenth and twentieth centuries, including some first-hand memoirs of women computer users.

- Light, Jennifer, "When computers were women," *Technology and Culture* 40 (1999) 455-483.

  Why did women engineers and programmers disappear from the historical record of the ENIAC?

- Beyer, Kurt W, *Grace Hopper and the Invention of the Internet Age*. Cambridge, Mass.: MIT Press, 2009.

  Biography of the most influential of early female coders. Hopper was able to command serious respect across a long career, but, unlike her male colleagues, had to sacrifice the opportunities of a typical family life to do so.

- Ensmenger, Nathan, *The Computer Boys Take Over*. Cambridge, Mass: MIT Press 2010.

  How industry hired and managed – or mismanaged – software specialists from the 1950s to the 1990s. Themes include professional identity, mistrust of subcultures, and reasons why the "computer boys" remain mostly "boys".

# 11. Internet connections

The communication systems which make up the internet, in particular the World Wide Web and the social applications that run on it, have been the hottest, most widely debated feature of computing culture in recent years — a fact few would have predicted even a couple of years before the Web was launched. This class ties together the military origins of distributed communication networks, the idealism of early hypertext enthusiasts, and big-business responses to the promise of worldwide, instantaneous and (partly) anonymous transactions, to explain how the public internet evolved.

## Required reading

- Bush, Vannevar, "As we may think", *The Atlantic*, July 1945; reproduced online at [www.theatlantic.com/magazine/archive/1945/07/as-we-may-think/303881/].

  Please focus on Section 6 onwards, dealing with the 'Memex'.

- de Lacy, Justine, "The sexy computer", *The Atlantic*, July 1987, 18-26.
- Haigh, Thomas, "Protocols for profit: web and e-mail technologies as product and infrastructure" in William Aspray and Paul Ceruzzi, eds, *The Internet and American Business*. Cambridge, Mass: MIT Press 2008, 105-158.

## Exercise for this week

Please come to the class ready to answer the following questions:

- Bush's piece was written at a time when the whole principle of electronic computing was still in its infancy. Are there, however, recognisable features in his proposals for a data storage system? Do you think the 'Memex' was an influence on later developments?

- The 1980s world of the French Minitel, as described by de Lacy, obviously has much more in common with present-day online culture. Again, what are the likely influences – and what are the major differences?
- What does de Lacy's account focus on, in particular? Are there similarities to the way journalists cover stories about online life today?
- How does the history of the internet's evolution define its nature and constrain what can happen online today? In what ways is this a problem?

## Background reading on the history of online technologies

- Further chapters in Aspray and Ceruzzi, *Internet and American Business*.

  This is the only good broad survey so far of the commercial use, rather than the initial production of Internet technology: it's part history, part policy study. See in particular Haigh's second chapter, on search engines and portals; Campbell-Kelly and Garcia-Swartz on computer utility/software-as-service; and Aspray on filesharing and the music industry.

- Campbell-Kelly, Martin, et al, *Computer: a history of the information machine*, 3rd edition. Boulder: Westview 2014. Chapter 12

  For this chapter, in particular, make sure you do use the third edition of the book (available online).

- Weber, Marc, "Self-fulfilling history: how narrative shapes preservation of the online world". *Information and Culture* 51 (2016), 54-80.

  pp63-68 provide a particularly good brief overview of the problem with "traditional" histories which mistake a small part of the technical history of ARPANET for the whole "history of the Internet".

- Campbell-Kelly, Martin, and Daniel D Garcia-Swartz, "The History of the Internet: The Missing Narratives", *Journal of Information Technology* 28 (2013), 18-33.

  Good survey of how various parallel developments (computer utility, bulletin boards, videotex etc) fit in alongside the traditional ARPANET-to-Internet narrative. Only provides a brief overview of each topic, but more detailed than the equivalent treatments in the Campbell-Kelly et al book.

- Ceruzzi, Paul E, *A History of Modern Computing*, 2nd edition. Cambridge, Mass: MIT Press 2003, chapter 10.
- Abbate, Janet, *Inventing the Internet*. Cambridge, Mass: MIT Press 1999.

  Thorough history of ARPANET, from the early Cold War context which created it to the emergence of the commercial internet and the birth of the Web.

- Russell, Andrew L, "'Rough Consensus and Running Code' and the Internet-OSI Standards War", *IEEE Annals of History of Computing* 28:3 (2006), 48-61.

  The battle between 'bottom-up' and 'top-down' visions of network planning.

- Turner, Fred, *From Counterculture to Cyberculture: Stewart Brand, the Whole Earth Network, and the rise of digital utopianism*. Cambridge, Mass: MIT Press 2006, chapter 5.

  "Virtuality and community on the WELL" looks at the Whole Earth 'Lectronic Link, an online (but pre-mass public internet) data resource inspired by the countercultural trends discussed in previous lectures.

- Nelson, Ted, "Xanalogical Structure, Needed Now More than Ever" (1999) Online at [www.xanadu.com.au/ted/XUsurvey/xuDation.html]

  The pioneer of hypertext wrote this revised specification after the arrival of the Web, and his views set the WWW model in interesting context… See also the 2008 demo of Xanadu Space at [www.youtube.com/watch?v=En_2T7KH6RA]

- Katie Hafner, "The epic saga of the WELL", *Wired* 5:5 (1997), 98-142, online at [www.wired.com/wired/archive/5.05/ff_well_pr.html]

  Journalistic account of the Whole Earth 'Lectronic Link (WELL), an influential 1980s/90s online system rooted in the countercultural ideas of Stewart Brand. Focuses on the nature of online community.

- Frana, Philip L, "Before the Web there was Gopher," *IEEE Annals of History of Computing* 26:1 (2004) 20-41.

  Useful not only as a description of the vanished Gopher system (flourished 1991-4), but for its depiction of a time when the World Wide Web was neither the only, nor the most obvious, model of internet use.

- Brunton, Finn. *Spam: a Shadow History of the Internet*. Cambridge, Mass.: MIT Press, 2013.

  First full-length academic study of the spam phenomenon. A bit theoretically ponderous, but worth a look.

### Recommended video

- *The Net* (BBC2, 1994).

  Since around 1990, 'educational' TV documentary programming on computers has been rare: to most audiences, computer technology is ordinary and familiar now. An exception was the mid-90s bubble of interest around the as-yet unfamiliar internet and World-Wide Web. The BBC's final (to date) computer magazine show covered IT issues more broadly, but — as the title suggests — took internet culture as a defining theme.

# 12A. Exam skills

This session will provide advice on how to tackle the exam.

There is no required reading for this class.

### Recommended exam skills guidance

Beside the materials discussed in class, you might find the following useful:

- "Exams and revision", Faculty of Humanities study skills website, online at [http://www.humanities.manchester.ac.uk/studyskills/assessment_evaluation/assessment/exams_revision.html].

  The advice here is tailored to essay-based exams similar to the one you'll be doing, which call for a very different approach from science/engineering exams.

- Chapel Hill "Essay Exams" handout, online at [writingcenter.unc.edu/handouts/essay-exams/].
- Dixon, Thomas, *How To Get A First.* London: Routledge 2004, chapter 11: "Revision and exams"
- Palmer, Stephen, and Angela Puri, *Coping with Stress at University: a survival guide*. London: Sage 2006, chapter 14: "Preparing for exams"

# 12B. Conclusion: memory expansion

This class looks back over the history of data from the nineteenth to the twenty-first century. We will chart the relationship between the ever-growing size, speed and affordability of digital data processing and the wider themes of commercialisation, popular culture, labour relations and personal identity.

There is no required reading for this class.

## Background reading

- Mahoney, Michael S, "The history of computing in the history of technology", *Annals of the History of Technology* 10 (1988), 113-125.

  Mahoney was the first serious commentator on what "the history of computing" as an academic branch of study ought to be. In this paper he aimed to give direction to the field by taking lessons from the broader field of history of technology.

- Haigh, Thomas, "The history of computing: an introduction for the computer scientist" in Atsushi Akera and William Aspray, eds, *Using History to Teach Computer Science*. Computing Research Association, 2004, 5-26; online at [www.tomandmaria.com/Tom/Writing/HistoryOfComputingIntro.pdf].

  Convenient summary – not of the history of computing itself, but of efforts to write and record the history of computing, including the roles of various archives and museums, professional groups, and academic disciplines.

- Winner, Langdon, "Mythinformation" in *The Whale and the Reactor: a search for limits in an age of high technology*, Chicago: University of Chicago Press, 1986, 98-117.

  The definitive takedown of how we *shouldn't* write the history of computing: as a "revolution" which came from nowhere to radically change society and everything in its path. Objections like Winner's mean that the "revolutionary change" account is now largely unacceptable in academic history, but it still survives in popular accounts. Why?

- Edwards, Paul N, "Virtual machines, virtual infrastructures: the new historiography of information technology", *Isis* 89 (1998), 93-99.

- Edwards, Paul N, "Making history: new directions in computing historiography", *IEEE Annals of History of Computing* 23 (2001), 87-85.

  Another manifesto for future directions, making connections which (more than a decade on) the field is still coming to terms with.

- Burrell, Jenna. *Invisible Users: Youth in the Internet Cafés of Urban Ghana.* Cambridge, Mass.: MIT Press, 2012.

  What do current histories of computing typically miss? "Global user perspectives" is one obvious answer. Burrell's book is one of several recent volumes which are beginning to challenge the omission, and helps to reveal some of the unconscious assumptions on which standard histories – and predictions for the future – perhaps unduly rely.

- Rankin, Joy, "Toward a history of social computing: children, classrooms, campuses, and communities", *IEEE Annals of History of Computing* 36 (2014), 88-87.

  Noting how histories often focus on "the lone programmer or hacker, the personal computer, and the user", Rankin urges more attention to how *groups* of people interact with IT, and communicate with each other about it, using a case study of schools education.

# Undergraduate options in the Centre for the History of Science, Technology and Medicine

CHSTM teaches option courses for undergraduates on degree programmes across the University. We cover the history of the physical and life sciences, mathematics, computing and medicine, the role of science and technology in everyday life, medical ethics, and representations of science in the news and in fiction. Most courses are available in **both 10 and 20-credit versions.**

It is often possible to take a unit from outside your level of study (for instance, a Level 1 unit in your second year). Please check with your programme director or undergraduate administrator. CHSTM accepts most students without prerequisites. Which courses are open to you depends on your degree programme's options policy and timetabling. Please ask your course director or local undergraduate administrator if you are unsure.

## Option courses for 2015-2016

| Semester One | Semester Two |
|---|---|
| **Level 1** | |
| **Science and the modern world**<br>HSTM10221 · HSTM10721<br>UCOL10221 · UCOL10721<br>Monday 15.00-17.00 | **Bodies in history: an introduction to the history of medicine, 1500-2000**<br>HSTM10272 · HSTM10772<br>Thursday 14.00-16.00 |
| **A history of biology in 20 objects**<br>BIOL10381<br>Monday 11.00-12.00 and 13.00-14.00<br>Wednesday 11.00-12.00 | |
| **Level 2** | |
| **From cholera to AIDS: a global history of epidemics**<br>HSTM20031 · HSTM20081<br>UCOL20031 · UCOL20081<br>Monday 14.00-16.00 | **The crisis of nature: issues in environmental history**<br>HSTM20092 · HSTM20592<br>UCOL20092 · UCOL20592<br>Monday 11.00-13.00 |
| **Science, the media and the public**<br>HSTM20181 · HSTM20681<br>UCOL20181<br>Thursday 13.00-15.00 | **The information age**<br>HSTM20282 · HSTM20782<br>UCOL20282 · UCOL20782<br>Thursday 16.00-18.00 |
| **Level 3** | |
| **History of climate change**<br>HSTM33201 · HSTM33701<br>Monday 11.00-13.00 | **Madness and society**<br>HSTM30832 · HSTM40332<br>Tuesday 11.00-13.00 |
| **From Sherlock Holmes to *CSI*: a history of forensic medicine**<br>HSTM32011 · HSTM32511<br>UCOL32011 · UCOL32511<br>Wednesday 11.00-13.00 | **The nuclear age: Hiroshima to nuclear terrorism**<br>HSTM31211 · HSTM31711<br>Wednesday 11.00-13.00 |
| **Dissertation project**<br>HSTM40100 · HSTM40200 · HSTM40400<br>*Research-only course available for 10, 20 or 40 credits* | **Dissertation project**<br>HSTM40100 · HSTM40200 · HSTM40400<br>*Research-only course available for 10, 20 or 40 credits* |

For up-to-date details of undergraduate teaching, please visit
**www.chstm.manchester.ac.uk/undergraduate/courses/**

If you enjoy our undergraduate courses, you might be interested in further study. CHSTM runs a full range of postgraduate programmes at MSc (taught Masters), MPhil (research Masters) and PhD levels.

The Centre for the History of Science, Technology and Medicine (CHSTM) is a major international focus for research in the history of modern science, technology and medicine. The department is supportive and friendly, with a lively postgraduate community, and strong formal and informal seminar programmes.

## Taught Master's (MSc)

Our taught Master's programmes last one year (full-time) or two years (part-time). They are suitable for students with undergraduate backgrounds in both the humanities and the sciences. The following awards are available:

**MSc History of Science, Technology and Medicine.** Our long-standing flagship course, spanning the histories of the physical and life sciences, engineering, infrastructure, information, medicine, and healthcare.

**MSc Science Communication.** Addresses the theory and practice of communicating scientific ideas in the news media, film, literature, museums, and public life, with a focus on engagement between specialists and non-specialists.

**MSc Medical Humanities.** An innovative interdisciplinary course, taught in association with the Manchester Medical School and with colleagues across the Faculty of Humanities. It is provided as an intercalated course for medical students, but can also be taken as a stand-alone MSc.

All versions feature a comprehensive introductory survey course; skills training in research and writing; specialist option courses taught by staff involved in current research; and a research dissertation (which may be substituted by a portfolio of creative work on Medical Humanities).

## Research degrees: PhD and MPhil

CHSTM is also home to a thriving community of research students, working in a range of HSTM and related fields. We expect PhD applicants to have a strong background in HSTM (e.g. a good MSc in the subject). We offer two research degrees: PhD (3 years full-time, 6 years part-time) and MPhil (1 year full-time, 2 years part-time). The MPhil can serve as a preparatory degree for the PhD, or as a free-standing research qualification.

Full details of all CHSTM's activities, plus contact details, can be found at

**www.manchester.ac.uk/chstm**