Computers and The Internet

History of Information, August 9, 2010

What Is a Computer?

What Is a Computer?

- It depends at least partly upon the era

Human "Computers"

- Up to WWII era
- OED: "one who computes; a calculator, reckoner; specifically a person employed to make calculations in an observatory, in surveying, etc."

What Is a Computer For?

- Tracking
- Tabulating
- Calculating
- Controlling
- Predicting
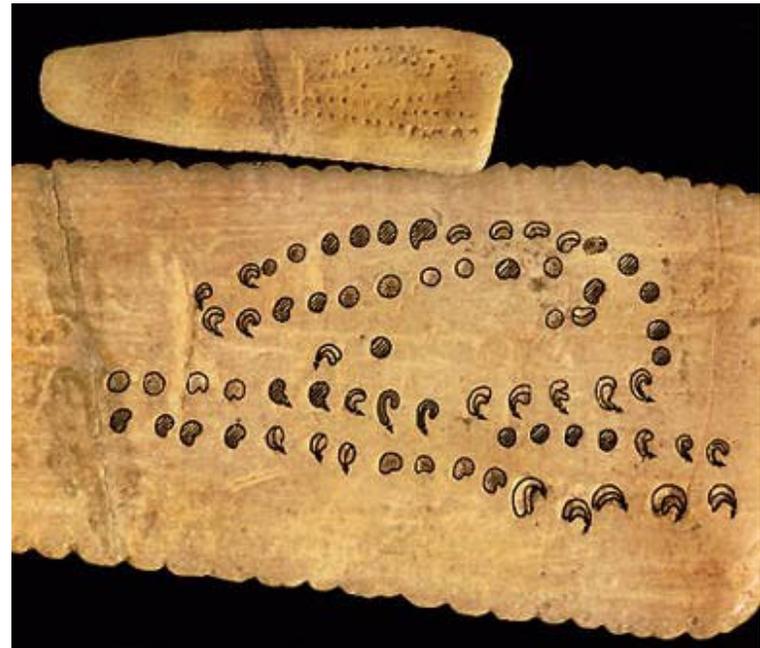
Historical Timekeeping and "Calculators"

- Stonehenge ca. 3100-2600 BC
- Sundial 2500-2000 BC (obelisks)
- Abacus 2700 BC

Tables

▸ Logarithmic

▸ Trigonometric

▸ By Late 18th C.:

　▸ Navigational – Mariners

　▸ Star – Astronomers

　▸ Life Insurance – Actuaries

　▸ Civil Engineering – Architects

　▸ Interest – Accountants, Financiers

Charles Babbage: *Table of Logarithms from 1 to 108000 1827*
**"I wish to God these calculations had been executed by steam."** *(1821)*

▸ "When Nevil Maskelyne died in 1811-Hitchins had died two years previously-the Nautical Almanac "fell on evil days for about 20 years, and even became notorious for its errors.""

　- Campbell and Aspray, *Computer*

▷

Babbage's Engines

- Difference Engine
  - Mechanical Calculator
  - Specialized – tabulates polynomials
  - Programmable
- Analytical Engine
  - general purpose machine
    - Programmable
    - Storing
    - Looping
    - Branching
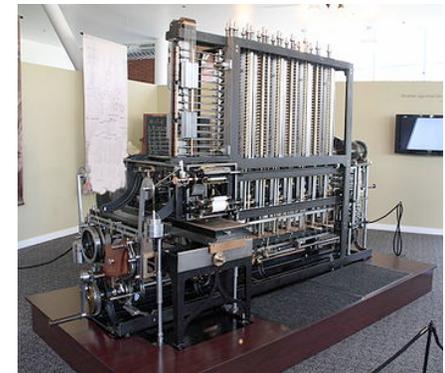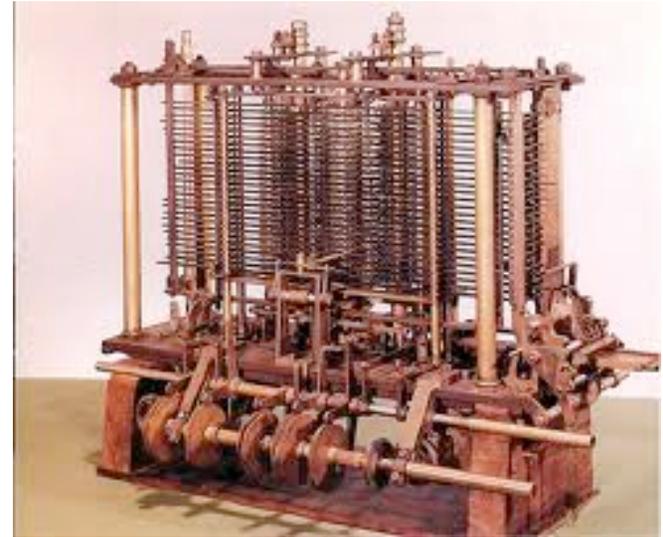
Ada

- Augusta Byron, Countess of Lovelace (1815-1852)
  - "a machine that not only would have foresight, but could act on that foresight"
  - "I want to put in something about Bernoulli's Number, in one of my notes, as an example of how an explicit function, may be worked out by the engine, without having been worked out by human head and hands first"
    - Lovelace to Babbage, 1843
  - "Analytical Engine *weaves algebraical patterns just as the Jacquard loom weaves flowers and leaves'*
    - Lovelace, *Notes*

Computation "Consumers"

▸ Who were interested in these capabilities?

▸ What did they want?

Bureaucracy

▸ "…we cannot say whether the society of the computer will give us the latter-day capitalist or the commissar, but it seems beyond question that it will give us the technician and the bureaucrat."

- Heilbroner

Government Info

- registration
- bills of mortality
- births & marriages
- parish members
- population

Business Info

- Financial Clearing Houses
  - "It is difficult to form a satisfactory estimate of the sums which daily pass through this operation: they fluctuate from two millions to above six. About two millions and a half may possibly be considered as something like an average, requiring for its adjustment perhaps 200,000 [pounds] in bank-notes… By an agreement between the different bankers, all checks which have the name of any firm written across them must pass through the clearinghouse…"
   - Babbage, *An analysis of the statistics of the clearing house during the year 1839*

International Business Machines

▸ **Herman Hollerith**

  ▸ 1890: mechanical tabulator used punchcards to tabulate census info in 1 year

  ▸ His company later becomes IBM (under Thomas J. Watson)
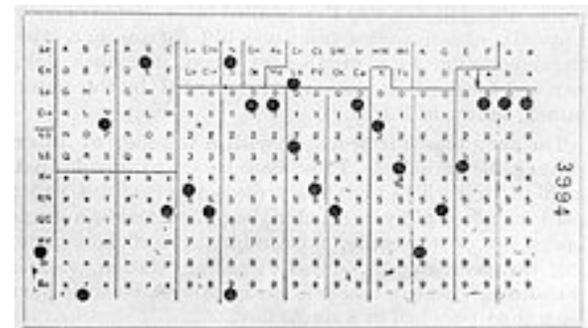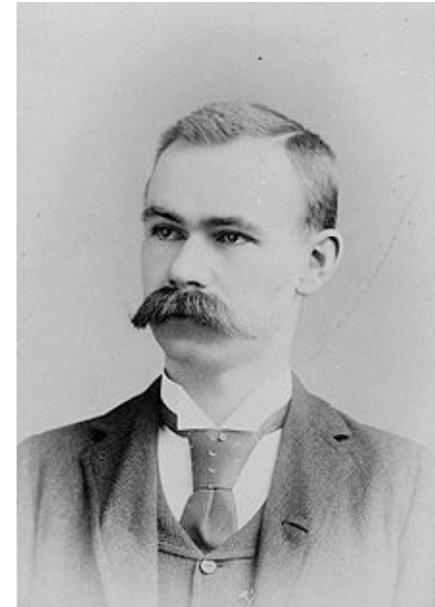
Information Workers

- clerks (UK)
  - 1871: 262,100
  - 1891: 534,622
  - 1911: 918,186
    - female clerks
      - 1891: 17,859
      - 1911: 117,057
      - 1921, women **46%** of all clerks
    - "typewriter girls"
      - 1931
        - 212,296 female typists
        - 5,155 male typists

What Does The Modern Electronic Computer Do?

▸ In fact, although the modern computer can work with numbers, its main use is for storing and manipulating information, that is, for doing the kinds of jobs performed by a clerk-defined in the Oxford English Dictionary as "one employed in a subordinate position in a public or private office, shop, warehouse, etc., to make written entries, keep accounts, make fair copies of documents, do the mechanical work of correspondence and similar 'clerkly' work." The electronic computer can be said to combine the roles of the human computer and the human clerk.

   - Campbell and Aspray, *Computer*

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Social Security

▸ FDR's 1935 New Deal created "largest bookkeeping job in the world"

IT and the Authoritarian Regime

- IBM Dahomag D-11 aided "Nazi census"
  - Census, 1933,1939
  - Labor Book, 1935
  - Health Pedigree book, 1936
  - Registry of the Populace, 1939
  - Blood (high, average, acceptable inferior), 1940
  - Personal Identification Number, 1944

Wartime Computing

- Decoding encrypted messages
  - Encoding: Navajo code talkers
- Ballistics "firing tables"
  - Human computers
  - Vannevar Bush's 1935 Differential Analyzer
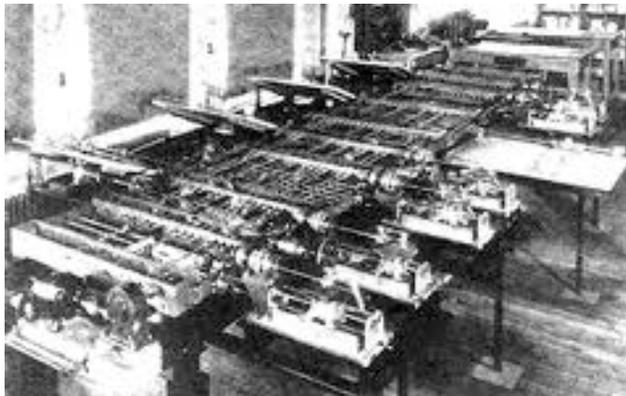
(Mostly) Postwar Computing

▸ 1944: Harvard Mark I (IBM)
▸ 1945: ENIAC (Stored-Program)
  ▸ (Electronic Numerical Integrator Computer) 18,00 vacuum tubes, 70,000 resistors, 10,000 capacitors, 6,000 switches, 1,500 relays
▸ 1947: transistor (Bell Labs)
▸ 1958: integrated circuit
  ▸ Team including Gordon Moore (Moore's Law)
▸ 1969: Xerox PARC "the architecture of information"
▸ 1969: UNIX (Bell Labs)
▸ 1976: Apple 1
▸ 1980: Ada programming language created
▸ 1981: IBM PC
▸ 1984: Macintosh
▸ 1991: Linux kernel
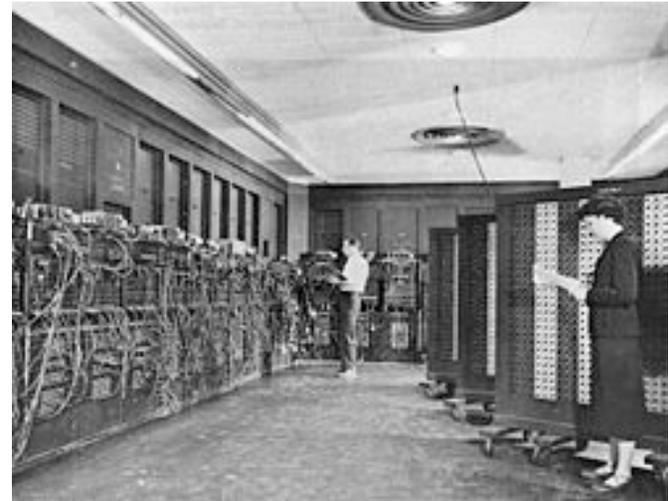
The "First Bug"

▸ 1946 – Mark I
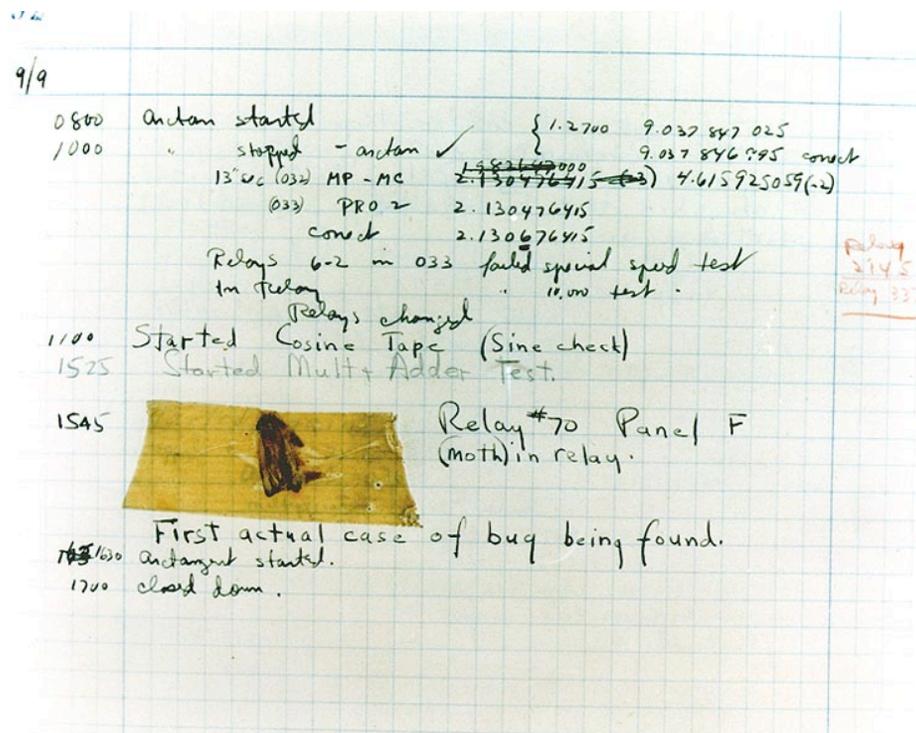
▸ "...an analyzing process must equally have been performed in order to furnish the Analytical Engine with the necessary operative data; and that herein may also lie a possible source of error. Granted that the actual mechanism is unerring in its processes, the cards may give it wrong orders."

— Ada Lovelace

Vertical Disintegration 1970-1990

Software	IBM	DEC	3rd Party	3rd Party	3rd Party
OS	IBM	DEC	Apple	AT&T Unix	Microsoft
CPU	IBM	DEC	Apple	Sun	Intel, etc.
Hardware	IBM	DEC	Apple	Sun	IBM/OEM

Computational Research: Data about Data

- ▸ **"brute force" analyses can provide answers to problems**
  - ▸ Application of computer science concepts to disparate fields: pattern matching, data mining, visualization, etc.
    - ▸ Bioinformatics
    - ▸ Stanford Digital Humanities Research – applying text analysis to the 19th C. Novel
      - ☐ Among other discoveries, the team has found that American usage of proper nouns nearly triples in frequency over the course of the century, while British usage remains relatively stable. "This trend is significant, says Blevins, "and may speak to the increasing desire and need of a young, expanding nation to assign new names to its places and people."
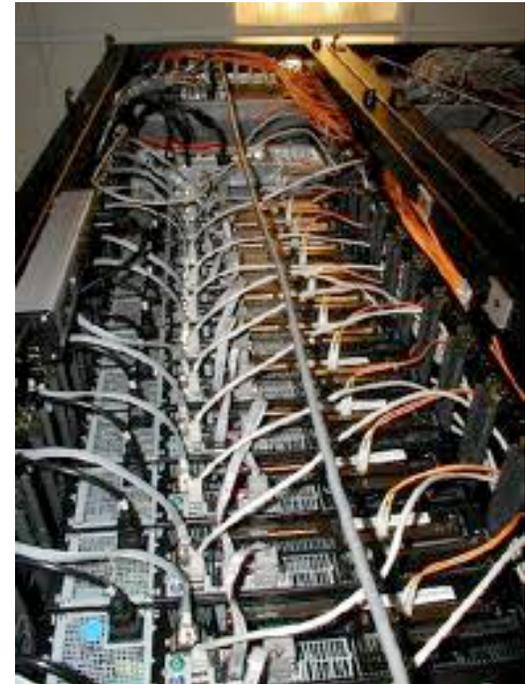
The Network is the Computer

- What is a computer for?
  - Tracking
  - Tabulating
  - Calculating
  - Controlling
  - Predicting

  - **And Communicating**

THE WHOLE INTERNET
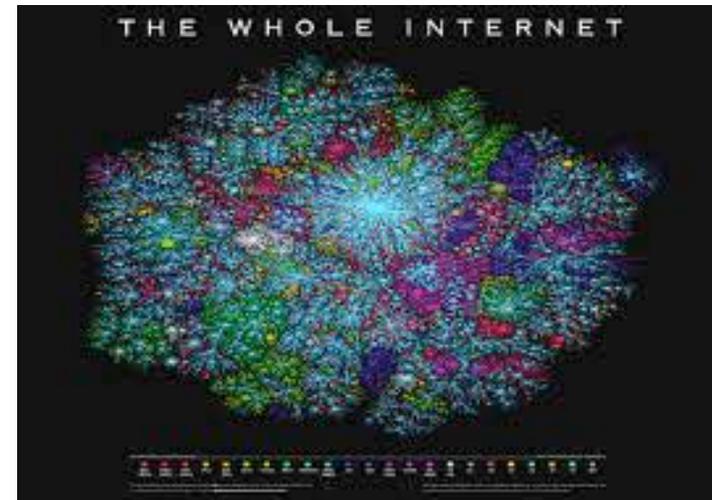
"Internet" Design Goals

▶ Fundamental

   ▶ Efficient **shared utilization** of existing **interconnected** networks

▶ Secondary

   ▶ **Survivability** paramount (among other goals)

"The protocols are widely used in the commercial and military environment, and have spawned a number of similar architectures. At the same time, its success has made clear that in certain situations, the priorities of the designers do not match the needs of the actual users." David D. Clark. *The design philosophy of the DARPA Internet protocols. In Proceedings of ACM SIGCOMM, Stanford CA, August 1988.*

▶

ARPANET

- ~1958: Advanced Research Projects Agency (ARPA)
- 1969: Computers connected using packet-switching and phone lines
  - UCLA->SRI->UCSB->University of Utah
- 1971: first email

ARPANET GEOGRAPHIC MAP, OCTOBER 1980
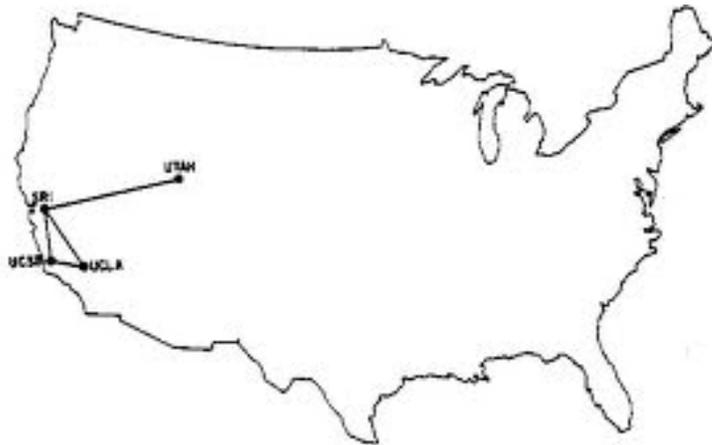
ARPAnet to Internet

- 1969: ARPAnet
- 1971: File Transfer Protocol (FTP)
- 1974: TCP
- 1974: Ethernet
- 1978: TCP/IP
- 1980s: NSF funds national backbone
- 1980s: Commercial networks begin to emerge
- 1983: Domain Name System (DNS)
- Late 1980s: First Internet Service Providers emerge
- 1989: Australia, UK, Germany, Italy, etc. join Internet
- 1990: ARPANET shuts down
- 1991: NSF removes all restrictions on commercial use of Internet
- 1991: Perl 4 released
- 1995: NSF discontinues support of infrastructure
- 1995: Apache
- 1996: SSL
- 1998: Internet Corporation for Assigned Names and Numbers (ICANN)

HTTP

▸ "The essential property of the World Wide Web is its universality…Web-like systems generate a lot of excitement at every level, from major corporation to individual user, and provide benefits that are hard or impossible to predict in advance. **Decentralization requires compromises**: the Web had to throw away the ideal of total consistency of all of its interconnections, ushering in the infamous message "Error 404: Not Found" but allowing unchecked exponential growth. "

   - Tim Berners-Lee

▸

Some of the Web's Antecedents

- "The Victorian Internet" and Ham Radio
- 1945: Vannevar Bush's (speculative) Memex
- 1968: Englebart's NLS
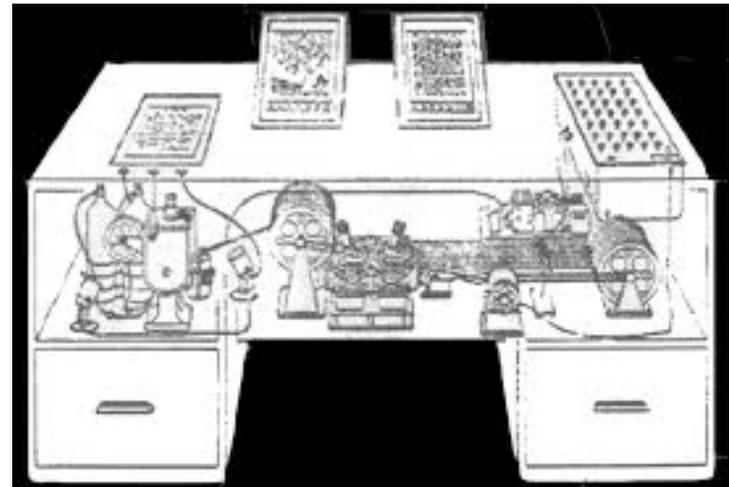
WWW

- 1990: HTTP (Sir Tim)
- 1993: NCSA Mosaic Mark Andreessen
  - CERN releases WWW technology
- 1994: 200+ HTTP servers; traffic up x1,000
- 1994: Netscape
- 1995: Internet Explorer
- 2004-8: Facebook, Twitter, other social media
- 2009: Google Chrome

Before "Googling"

- 1988: WAIS
- 1990: Archie
- 1992: Veronica (Gopher)
- 1994: Lycos, Infoseek
- 1995: Alta Vista, Yahoo
- 1996: Inktomi
- 1997: Ask Jeeves

- 2008-9: Cuil, Powerset, Bing…

Collective Goods/Action

▸ In some cases, information's non-rivalrous nature helps collective goods emerge without problem of free-riding

  ▸ F/OSS (Apache, Mozilla)

  ▸ Wikipedia

▸ Would an open-source model have worked for a project like Babbage's?

▸

Web 2.0 Utopianism

▸ Rather than Paris, Moscow, or Berkeley, the grand utopian movement of our contemporary age is headquartered in Silicon Valley, whose great seduction is actually a fusion of two historical movements: the counter-cultural utopianism of the '60s and the techno-economic utopianism of the '90s. Here in Silicon Valley, this seduction has announced itself to the world as the "Web 2.0" movement…It is technology that enables anyone with a computer to become an author, a film director, or a musician. This Web 2.0 dream is Socrates's nightmare: technology that arms every citizen with the means to be an opinionated artist or writer…"This is historic," my friend promised me. "We are enabling Internet users to author their own content. Think of it as empowering citizen media. We can help smash the elitism of the Hollywood studios and the big record labels. Our technology platform will radically democratize culture, build authentic community, create citizen media." Welcome to Web 2.0.

   - Andrew Keen, Weekly Standard, 2/15/06

Utopia or Dystopia?

- "Digital Divide"

- Privacy/Anonymity

- Net Neutrality

- "Google Makes Us Stupid"

- Inherent Bias In PageRank?

- Authoritarian States' Use of Technology
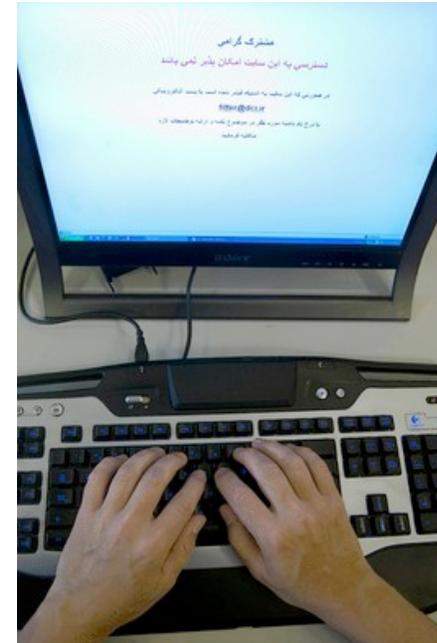
The Bright "Future"

▶ "The Semantic Web will bring structure to the meaningful content of Web pages, creating an environment where software agents roaming from page to page can readily carry out sophisticated tasks for users. Such an agent coming to the clinic's Web page will know not just that the page has keywords such as "treatment, medicine, physical, therapy" (as might be encoded today) but also that Dr. Hartman *works* at this *clinic* on *Mondays*, *Wednesdays* and *Fridays* and that the script takes a *date range* in *yyyy-mm-dd format* and returns *appointment times*. And it will "know" all this without needing artificial intelligence on the scale of 2001's Hal or Star Wars's C-3PO. Instead these semantics were encoded into the Web page when the clinic's office manager (who never took Comp Sci 101) massaged it into shape using off-the-shelf software for writing Semantic Web pages along with resources listed on the Physical Therapy Association's site. The Semantic Web is not a separate Web but an extension of the current one, in which information is given well-defined meaning, better enabling computers and people to work in cooperation. The first steps in weaving the Semantic Web into the structure of the existing Web are already under way. In the near future, these developments will usher in significant new functionality as machines become much better able to process and "understand" the data that they merely display at present."

   - Tim Berners-Lee, The Semantic Web, 2001

▷

The Gray Present?

▸ The new Pandora's boxes of genetics, nanotechnology, and robotics are almost open, yet we seem hardly to have noticed. Ideas can't be put back in a box; unlike uranium or plutonium, they don't need to be mined and refined, and they can be freely copied. Once they are out, they are out. Churchill remarked, in a famous left-handed compliment, that the American people and their leaders "invariably do the right thing, after they have examined every other alternative." In this case, however, we must act more presciently, as to do the right thing only at last may be to lose the chance to do it at all…As Thoreau said, "We do not ride on the railroad; it rides upon us"; and this is what we must fight, in our time. The question is, indeed, Which is to be master? Will we survive our technologies?

   - Bill Joy, Why The Future Doesn't Need Us, 2004