

History

Catalysts for Change

Information Age

- Definition
 - Unprecedented access to information
- Examples
 - Cell phones
 - Email
 - World Wide Web
- Catalysts
 - Low-cost computers
 - High-speed communication networks

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Technology and Values

- Dynamic between people, technology
 - People adopt technology
 - Technology changes society
- Effects of technology use
 - Positive examples
 - Negative examples
- Ultimately, people in control
 - Decide whether to adopt technology
 - Influence rate of technological progress

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Milestones in Computing

- Mechanical machines (1600s–1800s)
- Boolean algebra (1850s)
- Electronic switching circuits (1930s)
- Early computers (1940s)
- Commercial computers (1950s –)
- Transistor (~1950)
- Integrated circuit (~1960)
- Microprocessor (~1970)

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Harvard Mark I

- Howard Aiken (1900-1973)
- IBM sponsored project
- Computer built from IBM products
 - Punched card readers/writers
 - Electronic typewriters
 - 73 IBM Automatic Accounting Machines
- Programs stored externally on paper tape

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Colossus

- Code-breaking machine
- Created at England's Bletchley Park during World War II
- Team included Alan Turing (1912-1954)
- Special-purpose electronic computer
- Secrecy: little impact on future machines

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Atanasoff-Berry Computer

- Built at Iowa State College (1939-1941)
 - Professor John Atanasoff (1903-1995)
 - Grad student Clifford Berry (1918-1963)
- Solved systems of linear equations
- Built with vacuum tubes
- Used rotating drum for random-access memory
- Stimulated work of Eckert and Mauchley

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ENIAC

- Built at University of Pennsylvania during World War II, completed 1946
 - Prof. John Mauchley (1907-1980)
 - J. Presper Eckert (1919-1995)
- General-purpose programmable computer
- Completely electronic internals
- Program “wired in” from outside — not stored in memory

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Commercial Computers

- Ferranti Mark 1
 - Introduced February 1951
 - Based on U. Manchester computer
- Remington Rand UNIVAC
 - Delivered March 1951
 - Based on ENIAC
 - Predicted outcome of 1952 Presidential election

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Transistor

- Replacement for vacuum tube
- Invented at Bell Labs (1948)
- Semiconductor
 - Faster
 - Cheaper
 - More reliable
 - More energy-efficient

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Integrated Circuit

- Semiconductor containing transistors, capacitors, and resistors
- Invented at Fairchild Semiconductor and Texas Instruments
- Advantages over parts they replaced
 - Smaller
 - Faster
 - More reliable
 - Less expensive

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IBM System/360

- Before System/360
 - IBM dominated mainframe market in 1960s
 - IBM computers were incompatible
 - Switch computers → rewrite programs
- System/360
 - Series of 19 computers with varying levels of power
 - All computers could run same programs
 - Upgrade without rewriting programs

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Microprocessor

- Computer inside a single semiconductor chip
- Invented in 1970 at Intel
- Made personal computers practical

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Personal Computers

- Hobby computers
 - Mark-8 (1974)
 - Altair 8800 (1975)
- Commercial PCs (personal computers)
 - Tandy (TRS-80)
 - Apple (Apple I, II)
- Business PCs
 - Spreadsheet program (VisiCalc, 1979)
 - IBM PC (1981)

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Milestones in Networking (1/2)

- Electromagnetism (early 1800s)
- Telegraph (1844)
- Telephone (1876)
- Typewriter and teletype (1873, 1908)
- Radio (1895)
- Television (1927)

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Milestones in Networking (1/2)

- Remote computing (1940)
- ARPANET (1969)
- Email (1972)
- Internet (1983)
- NSFNET
- Broadband

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Telegraph (1844)

- U.S. government funded first line
 - 40 miles from Washington, D.C. to Baltimore
 - Built by Samuel Morse in 1843-1844
- Private networks flourished
 - 12,000 miles of lines in 1850
 - Transcontinental line in 1861
 - 200,000 miles of lines by 1877
- Technology proved versatile
 - Fire alarm boxes
 - Police call boxes

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Telephone (1876)

- Alexander Graham Bell (1847-1922)
 - Constructed harmonic telegraph
 - Leveraged concept into first telephone
- Social impact of telephone
 - Blurred public life / private life boundary
 - Eroded traditional social hierarchies
 - Reduced privacy
 - Enabled first “online” communities

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Radio (1895)

- Pioneers
 - Hertz creates electromagnetic waves
 - Marconi invents radio
- First used in business
 - Wireless telegraph
 - Transmit voices
- Entertainment uses
 - Suggested by Sarnoff
 - Important entertainment medium by 1930s

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Television (1927)

- Became popular in 1950s
 - Price fell dramatically
 - Number of stations increased
- Social effects
 - Worldwide audiences
 - Networks strive to be first to deliver news
 - Impact of incorrect information; e.g., 2000 presidential election

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Email (1972)

- Creation
 - Tomlinson at BBN writes software to send, receive email messages
 - Roberts creates email utility
- Current status
 - One of world's most important communication technologies
 - Billions of messages sent in U.S. every day

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Internet (1983)

- Kahn conceives of open architecture networking
- Cerf and Kahn design TCP/IP protocol
- Internet: network of networks communicating using TCP/IP

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Broadband

- Broadband
 - High-speed Internet connection
 - At least 10x faster than dial-up connection
- South Korea
 - World leader in broadband networking
 - Three-quarters of homes have broadband connections

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Gutenberg's Printing Press

- Based on movable metal type
- Church principal customer of early publishers
- Powerful mass communication tool
- Printing press's impact on Reformation
 - More than 300,000 copies of Luther's publications
 - Protestants out-published Catholics by 10-to-1 in the middle 16th century

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Newspapers

- Newspapers: Stimulated free expression
- Governments responded
 - Licensing
 - Censorship
- Impact on American Revolution
 - Newspapers helped unify colonies
 - Swayed public opinion toward independence

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Hypertext

- Vannevar Bush envisions Memex (1945)
- Ted Nelson
 - Coined word hypertext
 - Proposed creation of Xanadu (1967)
- Douglas Engelbart
 - Directed construction of NLS (oNLine System)
 - Demonstrated windows, email, mouse, videoconferencing (1968)

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Personal Computers

- Xerox PARC (Palo Alto Research Center)
 - Alan Kay's Alto had CRT monitor, keyboard, and mouse
 - Ethernet
- Apple Computer
 - Steve Jobs and Steve Wozniak
 - Macintosh (1984)
- Microsoft Windows (1990) quickly became dominant graphical user interface

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World Wide Web

- First browser built at CERN in Switzerland
 - Tim Berners-Lee: WorldWideWeb (1990)
 - Berners-Lee created Web protocols
 - Protocols based on TCP/IP → general
- Later browsers
 - Mosaic
 - Netscape Navigator
 - Netscape Mozilla
 - Microsoft Internet Explorer (most popular)

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Information Technology

- Definition: Devices used in creation, storage, manipulation, dissemination of data, sound, and/ or images
- Examples: Computers, telephones, video cameras
- People making greater use of IT
 - Costs keep falling
 - Capabilities keep rising

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IT Issues (1/3)

- Email
 - Easy way to keep in touch
 - Spam has become a real problem
- Web
 - Free access to huge amounts of information
 - Harmful consequences of some sites
- CDs, MP3s
 - Free or cheap copies readily available
 - May be unfair to musicians

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IT Issues (2/3)

- Credit cards
 - Convenience over cash and checks
 - Increases possibility of identity theft
 - Who owns information about transactions?
- Telecommuting
 - Saves time, allows more flexible work hours
 - Can lead to longer work hours
 - May result in fewer chances for promotion

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IT Issues (3/3)

- Improved global communication network
 - Allow companies to sell to entire world
 - Allow companies to move jobs out of U.S.
- World Wide Web
 - A conduit for democratic ideas?
 - Another tool for totalitarian governments?

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Conclusions

- Revolutionary discoveries are rare
- Information technology has long history
- Rate of technological change accelerating
- Wrong question: "What will the computer do to us?"
- Right question: "What will we make of the computer?"

(quoting Seymour Papert)

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