A Historical View of Computing

CS 391
Why look at history?

To understand how we got to where we are it is important to not just understand where we’ve been, but also understand why we took the path we did:

- Understand past challenges and constraints
- Avoid repeating same mistakes
- Revisit and challenge assumptions, ideas, technologies
- See where we are heading next

Appreciate the deep impact that IT has had on our lives, and how we can use technology to shape our future:

- We don’t have to be passive passengers, we can be in the drivers’ seat
Technology shapes society, society shapes technology

• Dynamic relationship between people & technology
  – People adopt and shape technology selectively
    – Technology changes society

• Different ways people are affected by technology
  – Physical changes (e.g., cars)
  – Psychological changes (e.g., cell phones)

We can control whether to adopt new technology
  – Nuclear power moratorium in United States
  – Nuclear power advances in rest of world

• People can influence rate at which technologies are developed
  – Intellectual property laws
  – Tax/fee structure
Discussion...

When should or shouldn’t we adopt new technological advances?

– Amish, “Does it bring us together or draw us apart?”
Milestones in Computing

- Aids to manual calculating
- Mechanical calculators
- Cash register
- Punched card tabulation
- Precursors of commercial computers
  - Specialized computers
  - One-offs
- First commercial computers
  - Programming languages and time-sharing
  - Transistor and integrated circuit
- Mainframes
- Microprocessor
- Personal computer
How Social Change Creates Market for Computation

- Gilded Age (late 19th century America)
  - Rapid industrialization
  - Economic expansion
  - Concentration of corporate power

- New, large corporations
  - Multiple layers of management
  - Multiple locations
  - Needed up-to-date, comprehensive, reliable, and affordable information

- Growth of finance, engineering & war required vast tables of data

- “De-skilling” of bookkeeping
  - Technology could make people of average ability quite productive (6× faster)
  - Wages dropped, women replaced men
Pre-electronic Computing

- Blaise Pascal – Pascaline calculator (1642)
- Charles Babbage – Difference Engine (1849)
Pre-electronic Computing

- Ada Lovelace – Programming Language & Algorithms

Bernoulli number 'algorithm' 1843
Pre-electronic Computing

• Herman Hollerith – Electrical Tabulation (1884) -> IBM
What are the defining events of the 20th century?
GEN 0 – How Computing Changes the World
Gen 0 – How Computing Changes the World

- Ballistic trajectories
  \[ d = \frac{v \cos \theta}{q} \left( v \sin \theta + \sqrt{(v \sin \theta)^2 + 2gy_0} \right) \]
- Code Breaking
- Modeling
A general view of the ENIAC, the world's first all electronic numerical integrator and computer.
HARVARD MARK I (1944)

From Harvard University Cruft Photo Laboratory.

The Mark I paper tape readers.
Programming/Debugging

Grace Hopper 1945

(9/9)

0800  Analog started
1000  zonder stopped  solder
13:05  03/02  MP-NW
030  PRO 2  2.130476415
conk
Relays 6-2 in 033 failed speed test
In testing
Relay changed
Relays 6-2 in 033 failed speed test
In testing
Relay changed
Start Cosine Tape (Sine check)
11:10  Started Multiplier Test
13:45  Relay #70 Panel F
moth in relay
First actual case of bug being found
19:00  panel closed down.

(Photocourtesy of the United States Naval Historical Center)
History of computer adoption

- Batch
- Command Line
- WIMP (Windows)
- Home users
- Mobile Tactile
- Everyone Everywhere

1940s – 1950s
1960s – 1970s
1980s – 2000’s
2010’s

Experts
Professionals
Everyone Everywhere

User Adoption

Now Prog. Lang.
Gen 1 — Batch Processing

- Computer performed one task at a time
- No “interaction” once computation started
- Switches, wires, punch cards and tapes for I/O
- Very limited, highly trained group of operators

A close-up of the Stretch control panel.

From IBM Archives.
Programming Languages

Machine language - 1+0:
- Assembly language
  - Symbolic representations of machine instructions
  - Programs just as long as machine language programs
- FORTRAN
  - First higher-level language (shorter programs)
  - Designed for scientific applications
- COBOL
  - U.S. Department of Defence standard
  - Designed for business applications
- BASIC
  - Developed at Dartmouth College
  - Simple, easy-to-learn programming language
  - Popular language for teaching programming
Gen 2 — Command Line (Mid 1960s)

- Computers and “big business”
  - More varied tasks; text processing, editing, email etc
  - Need for interactivity
  - Used by secretaries, salesmen, accountants, CS students etc
  - Reduced training
The Ubiquitous Glass Teletype

- 24 x 80 characters
- Up to 19,200 bps (Wow - was big deal!)

Source: http://www.columbia.edu/acis/history/vt100.html
Pushing beyond Computing in Business

- Need to do more with less

- Need to rethink usability
  - Little or no training for users
  - More diverse populations
  - More diverse uses
“As We May Think”
Vannevar Bush

Atlantic Monthly, July 1945

- At a time of patch-panels and paper tape, Bush envisions the computer of the future as tools to augment human intelligence in everyday tasks.

- Envisioned hyperlinks, voice input, pen input, etc.

The Problem (early ‘50s)

“...The world is getting more complex, and problems are getting more urgent. These must be dealt with collectively. However, human abilities to deal collectively with complex / urgent problems are not increasing as fast as these problems.

If you could do something to improve human capability to deal with these problems, then you'd really contribute something basic.”

...Doug Engelbart
Ivan Sutherland

- **SketchPad** - 1963 PhD thesis at MIT
  - Hierarchy - pictures & subpictures
  - Master picture with instances (ie, OOP)
  - Constraints
  - Icons
  - Copying
  - Light pen input device
  - Recursive operations
6 October 1986 • Typing is easy enough on this computer, and I can store hundreds of files on the diskettes. Once I figure out how to turn on the color, I’ll be in business.

8 October 1986 • Just called the salesman. There’s no color? How did I get tricked into spending two thousand dollars on a black and white computer?

The guy even told me to buy some of this Apple Computer stock. I told him, “well, I may look stupid, but I wasn’t born yesterday, mister!” Honestly.

Well, time to play some Solitaire.

9 October 1986 • No Solitaire.
WIMP - Windows, Icons, Menus, Pointers
GUI - Graphical User Interface

WIMP interface emulates existing work practices
Direct manipulation
Desktop metaphor

Why was this such an innovation?

What were the innovations making this possible?
The First Mouse
(1964)
Xerox Star - 1981

- First commercial PC designed for “business professionals”
  - desktop metaphor, pointing, WYSIWYG, high degree of consistency and simplicity

- First system engineered for usability
  - Paper prototyping and analysis
  - Usability testing and iterative refinement
Evolution from Xerox Star?

1981
Evolution from Xerox Star?

1981

1985

Mac OS 1.0

Windows 1.0
Evolution from Xerox Star?

Mac OS 1.0
Mac OS 5.0
Mac OS 7
Windows 1.0
Windows 3.0
Windows 5.0
Perspective — Why PC’s?

Okay, now down there, the flashy thing... that’s the cursor. Press down the keys— no, not like that, you don’t have to hit them! Just gently. Yes, there you go. Now type “RT 90”. That tells the turtle to turn right, ninety degrees.

The turtle is the triangle.

What? Why should you learn this? Okay. Listen. One day, all of the computers are going to be linked together, and you’ll be able to type messages to people all over the world.

Penpals? No, it’ll be nothing like... well, okay, it’ll be a little like penpals.
A different retelling
The dawn of the personal computer

• Homebrew Computer Club
  – Meeting of hobbyists interested in building personal computers
  – Many had access to computers in universities
  – Launch of Altair 8800
    • Jan 1975 ~$400
      • Basic available, written by Bill Gates & Paul Allen => Microsoft
      • Pirated at launch meeting
From homebrew to everyday?

• Why would normal people buy PCs?
• The search for the killer app
  – Spreadsheets
  – Word processing
  – Games
  – Internet
    • Email
    • Gopher/BBS
    • WWW
    • Social media
Milestones in Networking

- Telegraph (1844)
- Telephone (1876)
- Typewriter and teletype (1873, 1908)
- Radio (1895)
- Television (1927)
- Remote computing (1940)
- ARPANET (1969)
- Email (1972)
- Internet (1983)
- NSFNET (1986-1995)
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 put Pony Express out of business
- 200,000 miles of lines by 1877
- Technology proved versatile
  - Fire alarm boxes
  - Police call boxes
**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
- Remote computing 1940
ARPANET (1969)

- DoD creates ARPAnet in late 1950s
- Decentralized design to improve survivability
- Packet-switching replaces circuit switching
- Email – 1972
  - Revolutionized communication
When did you first use email?
Why did you need it over pen and paper?
Do you write letters anymore?
How many do you think we send a day?

emails
200 billion
INTERNET (1983)

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

• Vannevar Bush envisions Memex (1945)
• Ted Nelson
  – Coined word hypertext (1967)
• Douglas Engelbart
  – Directed construction of NLS (oNLine System) (1968)
• Peter Brown at University of Kent
• Apple Computer
  – HyperCard (1987) - System based on “stacks” of “cards”, links represented by buttons
World Wide Web

- First browser built at CERN in Switzerland
  - Berners-Lee created Web protocols
  - Protocols based on TCP/IP → general

- Later browsers
  - Mosaic (1993)
  - Netscape Navigator (1994)
  - Microsoft Internet Explorer (1995)
  - Netscape Mozilla (1999)
Search Engines

• Human-assisted engines (Yahoo)
  – Humans build Web page database
  – Limited pages in database

• Crawler-based engines (AltaVista, Google)
  – Programs called spiders follow hyperlinks and visit millions of Web pages
  – System automatically constructs Web page database

• Hybrid systems (MSN Search)
The Rise of U.S. Broadband
Total number of U.S. broadband subscribers in millions
AVERAGE BROADBAND SPEED IN MBPS

JAPAN 61mbps
KOREA 46mbps
FINLAND 22mbps
SWEDEN 18.2mbps
FRANCE 17.6mbps
U.S.A. 4.8mbps

BROADBAND PENETRATION PERCENTAGE

SOURCE: Internet World Stats Broadband Penetration
The adoption of computers and productivity
Discussion...

• Now, most email is spam. Is that destroying the value of email?

• Should you be allowed to post what is legal in one place on the internet where people from somewhere where it is illegal can do or purchase?

• If I use a credit card, who has right to that information?

• Is the IT age dumbing down people?
Future...

• Read Chap. 2
• Assignment #1 is posted...