A brief history of computer hardware
How have things changed over time?

1998

If you have come looking for specific information, I hope you find it.
If you have come to learn something about the nature of the University and its activities or have just come to visit, I hope we convey Princeton's commitment to both teaching and research, and to its informal motto of "Princeton in the Nation's Service and in the Service of all Nations."

Since we are constantly expanding and improving our website, I hope you will return whenever you think we ought to be helpful.

And if you live outside Princeton but somebody has occasion to visit in person, I hope you will explore the campus, perhaps take a tour, and take full advantage of the many activities, exhibitions, and events available to the public.

Again, welcome!

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2017

Welcome
Who We Are
Speeches & Writings
News
Conversations with the President/Office Hours
Princeton Pre-Read

Welcome to Princeton University. We are a community that values learning. Our modest but heartfelt goal is to be a world-class research university with a distinctive commitment to teaching at both the undergraduate and graduate levels. We regard these two pursuits as mutually reinforcing, a belief that is exemplified by our defining commitments. For example, we expect all of our undergraduate students to complete a major independent research project, and we insist that all of our faculty members—from newly minted assistant professors to internationally renowned Nobel Laureates—engage fully with our teaching mission.

The resulting University is a special and varied place. Princeton is home to world-class research laboratories, wondrous libraries, inspiring art, graceful architecture and charming landscapes. But at Princeton's core are the devoted and talented students, alumni, faculty, staff and friends who care about this University like no other. They form an inclusive community centered on this campus but extending throughout the nation and around the globe, where its members strive to live up to the University's informal motto: to be "in the nation's service and the service of humanity."

I hope that this website will help you to understand the spirit that animates this University, and I hope that you will find answers to at least some of the questions that brought you here. But I hope most of all that— if you are not already on our campus—you will soon have occasion to visit us here at the place we call "Old Nassau," whether to renew old acquaintances or to create new ones.

With best wishes,
Christopher L. Eisgruber '83
Babbage – Analytical Engine (1837)

Could store 1000 40 digit decimal numbers (16.7kB)

Was programmable

Was never built

Ada Lovelace (nee Byron)
the first programmer
Differential analyzer (Bush and Hazen 1931)

Mechanical analog computer worked by using wheel-and-disc mechanisms
One of the first advanced computing devices to be used operationally
Computation via circuits

• Boolean logic
  • Invented by George Boole in 1854

• An algebra where the only values are TRUE or FALSE

• Basic operations to combine values
  • similar to + - x

• Claude Shannon 1936
  • While writing his thesis under Vannevar Bush’s direction

  • Showed that Boolean logic could be used as the basis of computations

  • Designed of the first 4 bit adder
Mathematical models for computation

Alan Turing *38
An abstract model of a computing device

Alonzo Church *37
Church’s thesis -- The computing device can compute everything that is computable
Colossus 1943

• Built to break codes

• Was the first programmable (though by plugs and switches) electronic digital computer
Bombe

• Designed by Alan Turing starting in 1939
• Electromechanical switching
• Built to emulate the German enigma machine (code breaking)
IBM Automatic Sequence Controlled Calculator (ASCC) (Harvard) 1944-1959

Howard Aiken
Grace Murray Hopper and the first bug
Electronic Numerical Integrator and Computer
Size 3’x8’x100’; weight 30 tons; clock speed 5kHz;
could store ~ 30 10 digit numbers
built at Penn by Eckert and Mauchley
John von Neumann and the Johnniac (1953)

Johnniac had 1024 words (40 bits each) of memory. Was used 1953—66.

Von Neumann architecture was first used on the IAS machine (1951).
Transistor 1947

John Bardeen, William Shockley and Walter Brattain in 1948
The integrated circuit (Intel) 1968

Gordon Moore (right) and Robert Noyce (center) founded Intel in 1968 when they left Fairchild Semiconductor. Andy Grove (left) joined the company the day it was incorporated.
Lee Felsenstein was moderator of the club meetings.
Presenting the first personal computers
Apple- 1
• Debuted by Steve Wozniak at the Homebrew Computer Club in 1976.
• For $666.66, buyers received
  • single-board computer w 4K of RAM
  • cassette-based BASIC interpreter
• users had to add a power supply, keyboard, storage system, and display

Altair 8800 (1975)
• Sold for $439 as a kit, $621 assembled
• 4K RAM; 2 MHz clock rate
• Programmed by toggling switched to positions (in binary) corresponding to microprocessor instructions; then hit enter and repeated until all instructions had been entered
• When first shipped, all you could do was make the lights blink
Apple II 1977

Steve Jobs

Steve Wozniak
Xerox PARC Alto 1973

- Mouse
- Bitmap display (606x808)
- Software (text editor, picture editor)
- Local storage
- Local area network
- Connected to laser printer

Steve Jobs visit to Xerox 1979
in exchange for Xerox being able to buy stock options in Apple
Macintosh 1984
First personal computer for sale

Altair 8800
(1975)

Sold for $439 as a kit, $621 assembled
4K RAM; 2 MHz clock rate
First major piece of software for Altair

- BASIC programming language
Paul Allen and Bill Gates pose for the camera on October 19, 1981, in a sea of PCs after signing a pivotal contract with IBM.
Where are they now?

charitable endeavors
Support for AI research
Investigations of the brain

Gates foundation – world’s wealthiest transparent foundation
Two paths to personal computers

• Homebrew ComputerClub ➞ Apple 1; + Xerox ➞ Apple Macintosh
• Altair ➞ Microsoft Basic + IBM PC ➞ Windows

Larry Tesler was Steve Jobs’ tour guide at Xerox
Chuck Simonyi brought the idea of a WYSIWYG editor From Xerox to Microsoft
Back to integrated circuits

• Moore’s Law formulated in 1965
  • computing power (roughly, number of transistors on a chip)
    • doubles about every 18 months
    • and has done so since ~1961

• consequences
  • cheaper, faster, smaller, less power consumption per unit
  • ubiquitous computers and computing

• limits to growth
  • fabrication plants now cost $4-5B; many are outside US
  • line widths are nearing fundamental limits
  • complexity is increasing
Transistor counts and Moore's Law
A linear plot of Moore’s Law

A computer in 2014 is around 130 000 times more powerful than in 1988
Evolution of Computer Power/Cost

MIPS per $1000 (1997 Dollars)

From http://www.dai.ed.ac.uk/homes/cam/Rbots_Wont_Rule.shtml
1. The accelerating pace of change...

Agricultural Revolution 6,000 years
Industrial Revolution 120 years
Light-bulb 80 years
Moon landing 22 years
World Wide Web 19 years
Human genome sequenced

2. ...and exponential growth in computing power...

Computer technology, shown here climbing dramatically by powers of 10, is now progressing more each hour than it did in its entire first 90 years.

UNIVAC I
The first commercially marketed computer, used to tabulate the U.S. Census, occupied 943 cu. ft.

Colossus
The electronic computer, with 1,500 vacuum tubes, helped the British crack German codes during WW II.

COMPUTER RANKINGS

By calculations per second per $1,000

3. ...will lead to the Singularity

Apple II
At a price of $1,298, the compact machine was one of the first mass-market personal computers.

Power Mac G4
The first personal computer to deliver more than 1 billion floating-point operations per second.

2045
Surpasses brainpower equivalent to that of all human brains combined

Supposes brainpower of human in 2023

Supposes brainpower of mouse in 2013
How Lara Croft's changing face illustrates Moore's law

From http://www.vox.com/2015/2/1/7955921/lara-croft-moores-law
Pentium II

1997

7.5M transistors
Pentium III 1999 24M transistors
Intel Core i7 2008 731M transistors
This is likely to be in your PC/Mac
Keeping out the specs of dirt
Macintosh PowerBook 100 -- 1991

9 inch display (600x400 resolution)
20-40 MB disk
2MB RAM
16 MHz processor
2.5—3 hour battery
WorldWideWeb (Tim Berners-Lee 1993)

Welcome to the GNU Project web server, www.gnu.org. The GNU Project was launched in 1983 to develop a complete GNU-style operating system which is free software. The GNU system (GNU) is a recursive acronym for GNU's Not Unix. It is a pronounced déja-vu (or deja-vu) variant of the GNU operating system, which uses the standard Unix, but is not really a standard Unix, though these systems are often referred to as standard Unix, but they are more accurately called GNU/Unix systems.

This is also the web site of the Free Software Foundation (FSF). FSF is the principal organizational sponsor of the GNU Project. FSF receives very little funding from corporations or grant-making foundations. We rely on support from individuals like you who support FSF’s vision to preserve, protect and promote the freedom to use, study, copy, modify, and redistribute computer software, and to defend the rights of Free Software.

This is a new version of the NextStep WorldWideWeb application with the 1.2.3.5.4 library. Bug reports to lwn@lwn.net, or by posting to the newsgroup alt.binaries.linux.programs-web. If you have additional issues, then using “Help” under the File menu will tell you what to do about this application. If you don’t have an internet connection — get one :-)
Mosaic Browser from NCSA 1993
The world of 1996
A few of my favorite places

Internet Live
Have I been pwned
Wayback machine
Kitten Wars
Puppy Wars
Student government version
EPIC 2015
Project Alexandria
The nicest place on the internet
speed test
mental floss
surveillance cameras
how unique are you?
search on google for "do a barrel roll"
google pacman
tilt google
all my faves
lots of options
useless websites
Bacon Numbers
Here is today
What's in the air