Past and Future Trends

Computers in the Past (pre 1970)

- large
  - size of large rooms/cupboards/cabinets
- expensive
  - $1/2M onwards
- applied to scientific computations
  - ballistic computations
  - war-time cryptography
- technology
  - electro-mechanical relays
  - vacuum tube

Vacuum tubes

1948 On June 21, the Manchester Mark I, or "baby" machine, becomes the first operational stored-program digital computer. It used vacuum tube, or valve, circuits.

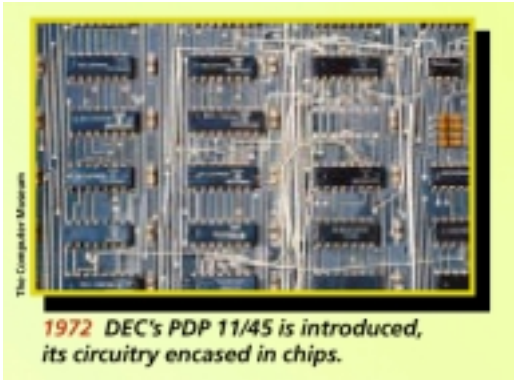
Transistors

1954 Texas Instruments introduces the silicon transistor, pointing the way to lower manufacturing costs.

1965 DEC debuts the first minicomputer, the PDP-8, which used transistor circuitry modules.

Integrated Circuits

1971 The team of Ted Hoff, S. Mazor, and F. Fagin develops the Intel 4004 microprocessor—a "computer on a chip."



1972 DEC's PDP 11/45 is introduced, its circuitry encased in chips.

Present Computers (1970-present)

- visible
  - boxes and note-pads
- cheaper
  - $6K to $500K in 1980
  - $1K to $50K in 2000
- applied to data-processing office/homes
  - payroll/billing, commercial applications
  - word-processing and personal computing
- technology
  - VLSI single-board circuits

Early Microcomputers

1976 Steve Jobs and Steve Wozniak design and build the Apple I, which consists mostly of a circuit board.

1980 The Osborne 1 "portable" computer weighs 24 pounds and is the size of a small suitcase.

Very Large Scale Integration

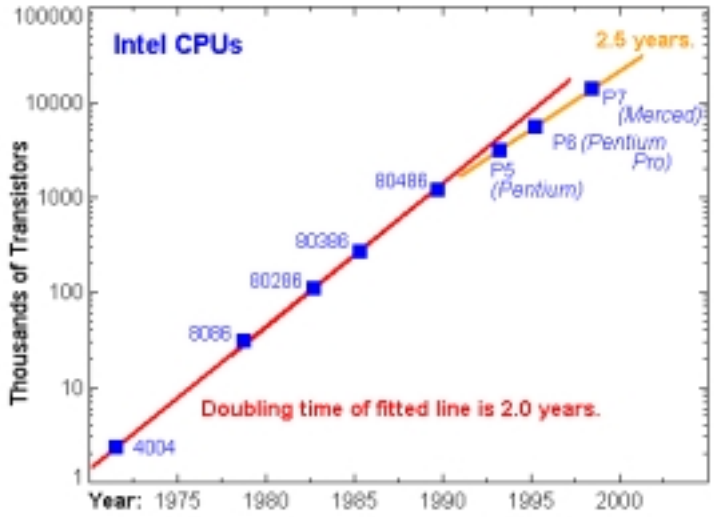
1984 Motorola introduces the MC68020 with 250,000 transistors.

1993 Intel's Pentium is introduced in March.

Moore's Law

- Gordon Moore in 1965, then research director of electronics pioneer Fairchild Semiconductor, predicted that devices in chips would double each year (revised to 2 years in 1975)
  - 1965: world's most complex chip had 64 transistors
  - 1999: PIII has 28M

Moore's Law



Moore's Law

Date	Intel CPU	Transistors (x1000)	Technology
1971.50	4004	2.3	
1978.75	8086	31	2.0 micron
1982.75	80286	110	HMOS
1985.25	80386	280	0.8 micron CMOS
1989.75	80486	1200	
1993.25	Pentium (P5)	3100	0.8 micron biCMOS
1995.25	Pentium Pro (P6)	5500	0.6 micron -- 0.25?
1998.5?	Merced (P7)	14000	0.18 micron?

Computing Power

- 1983
  CPU 8088
  4 MHz
  64 KB RAM
  5MB hard disk
  640x400 pixel
  Mono screen
  $8000

- 2000
  CPU PIII
  700 MHz
  128 MB RAM
  18 GB hard disk
  1400x1050
  colour panel
  $3800

What drives Moore's Law?

- transistor
  - fast electronic switch
  - made of 3 slabs of silicon
- integrated circuits
  - interconnection of transistors
  - circuits printed on silicon slice
  - light with shorter wavelengths can create finer patterns to produce more complex chips

Limits to Moore's Law?

- Challenges to hardware engineers
  - dopants (impurities in silicon to hold electric charge)
  - tunneling effect of electrons
    chip gates smaller than 2nm do not block electrons

Alternative Technologies?

- Optical computing
  - micro lasers sources
  - on/off filters on silicon
- Quantum transistors
  - transistors the size of single electron
- DNA computing
  - DNA chains like TM tapes
  - operations are slow chemical reactions, though massively parallel

Future – Ubiquitous Computing

- invisible, integrated and embedded into appliances and environment
- high degree of connectivity
  - wireless
- cheap and miniturized
  - even disposible
  - As cheap as scrap paper
- applied to everything
  - scans and sensor
  - wearable computing

Possibilities at home

- control and surveillance systems
- e-kitchen
- e-medical
- network connectivity

Possibilities while driving

- GPS map
- head-up technology
- distance sensors with auto-braking
- alcohol sensor
- sleep sensor

Will we have a better lifestyle?

- what other technologies have brought vast impact?
  - electricity
  - paper