Inside the Dream Machine

COMPUTERS: THE IMAGE

COMPUTERS: THE REALITY

UNIVAC correctly predicts outcome of US Presidential Election (1952)
Computers: The Image (Cont’d)

*Desk Set* (1957)
Computers: The Image (Cont’d)

Voyage to the Bottom of the Sea (TV) (1964)
Computers: The Image (Cont’d)

HAL 9000 (console)
2001: A Space Odyssey (1968)
Computers: The Image (Cont’d)

HAL 9000 (internals)

2001: A Space Odyssey (1968)
Intelligent Universal Operating System: All computers in the movies use the same amazingly powerful operating system that accepts plain English commands. A character simply types OPEN PRIMARY FILE or ACCESS SECURITY SYSTEM. The computer immediately responds. Such computers are always connected to a massive global network, and can access any private file anywhere in the world.

In addition, the operating system uses a gigantic, blocky font that is usually bright green on a black background, apparently for the benefit of visually impaired users.

- Jim Collier (in Ebert (1994))
Computers: The Reality

A computer is a machine that

(1) stores a very, very large number of numbers and
(2) performs very, very long specified sequences of very simple operations on these numbers
(3) very, very fast.
von Neumann stored-program architecture (1945)
Computers: The Reality (Cont’d)
Computer Memory

- A **bit** is a 0/1 memory element; a **word** is a set of bits.
- Store numbers compactly in words using binary encoding.
Computer memory consists of a set of words, each with its own unique numerical address.
Computers: The Reality (Cont’d)
Computer Memory (Cont’d)

• Word-sizes standardized in terms of 8-bit chunks (bytes).
• Memory size stated in terms of number of bytes:

  Kilobyte (KB) = 10^3 (thousand) bytes
  Megabyte (MB) = 10^6 (million) bytes
  Gigabyte (GB) = 10^9 (billion) bytes
  Terabyte (TB) = 10^{12} (trillion) bytes
  Petabyte (PB) = 10^{15} (quadrillion) bytes
  Exabyte (EB) = 10^{18} (quintillion) bytes

• What can you do with large amounts of digital memory?
What does

0100000101011000110001111

mean?
Computers: The Reality (Cont’d)
Computer Memory (Cont’d)

Things that digital memory does well:

- Numbers
- Text
  - 01000/00101/01100/01100/01111
- Sounds
  - "HELLO"
- Pictures
  - 8, 5, 12, 12, 15
  - "HELLO"
Computers: The Reality (Cont’d)
Computer Memory (Cont’d)

Things that digital memory doesn’t do so well:

**Floating-point Numbers**

<table>
<thead>
<tr>
<th>1/3</th>
<th>→</th>
<th>0.33</th>
</tr>
</thead>
</table>

| 1/3  | → | 0.33 |

1/3 + 1/3 = 0.33

1 ≠ 0.99

**Detailed Pictures**

Earth

↓

???
Computers: The Reality (Cont’d)
Computer Memory (Cont’d)

Paper card / tape (1940s)
Magnetic tape (1951)
Magnetic disk (1956)
Computers: The Reality (Cont’d)
Computer Processor

Claude Shannon (1916-2001)  Boolean logic gates (Shannon MSc (1937))
Computers: The Reality (Cont’d)
Computer Processor (Cont’d)

Transistor (1947)

Transistor Board
Integrated Circuit (IC) (1959)  IC Internals ("Chip")

Moore’s Law (1965): 2x transistor density every 18 months
Computers: The Reality (Cont’d)
Computer I/O Interface

- Punch card / tape (1940s)
- Teletype (1940s)
- CRT Display (1940s)

Early I/O devices known as terminals.
Several types of computers based on increasingly smaller processor, memory, and I/O devices:

1. **mainframe**, e.g., UNIVAC I (building / room size) (1945+)
2. **minicomputer**, e.g., DEC PDP-I (refrigerator size) (1960+)
3. **microcomputer**, e.g., Apple II (double-arm size) (1975+)
4. **handheld**, e.g., tablet or smartphone (hand size) (2000+)

Modern large computer installations are often not mainframes but networked collections of powerful minicomputers, e.g., server farms, data centers.
A program is a sequence of computer instructions.

Three main types of programs:

- **Application**: Performs a task, e.g., calculating taxes.
- **Compiler**: Translates a program written in one language into a behaviorally equivalent program in another language, e.g., Python $\Rightarrow$ assembler, assembler $\Rightarrow$ microcode.
- **Operating System** (e.g., Android, Linux, MS Windows): Co-ordinates all communications between memory, processors, other devices, and human beings.

Writing software that correctly performs complex tasks is very difficult to do, i.e., “No Silver Bullet” (Brooks (1995)).

- Development started in 1976; after rejection by other studios, picked up by Disney in 1980.
- Disney at the Crossroads.
- First major use of Computer Generated Imagery (CGI).
- Though only 15-20 minutes of CGI in movie, took years to produce.
- Was box office failure on release; is now a cult movie.
Computers at the Movies: *Tron* (1982) (Cont’d)

...FYI, *this* is a logic probe ...