

# What is a Computer?

- Kind of obvious, but a computer is something that does computation.
- A device that performs (high-speed) mathematical and/or logical operations or that assembles, stores, correlates, or otherwise processes information.



# What is a Computer?

- What were the first computers?

# What is a Computer?

The first *computers* were people who performed difficult calculations *by hand*, for things like ballistic tables.



# What is a Computer?

- Where was the first digital computer built?

# What is a Computer?

The first modern digital *computer* was invented where?

<https://www.computerhope.com/issues/ch000984.htm>



# Modern Computer Systems



- Consist of two components:
  - Hardware: physical devices required to execute algorithms
  - Software:
    - The instructions that tells the computer what to do
    - Represented as **programs** in particular **programming languages**

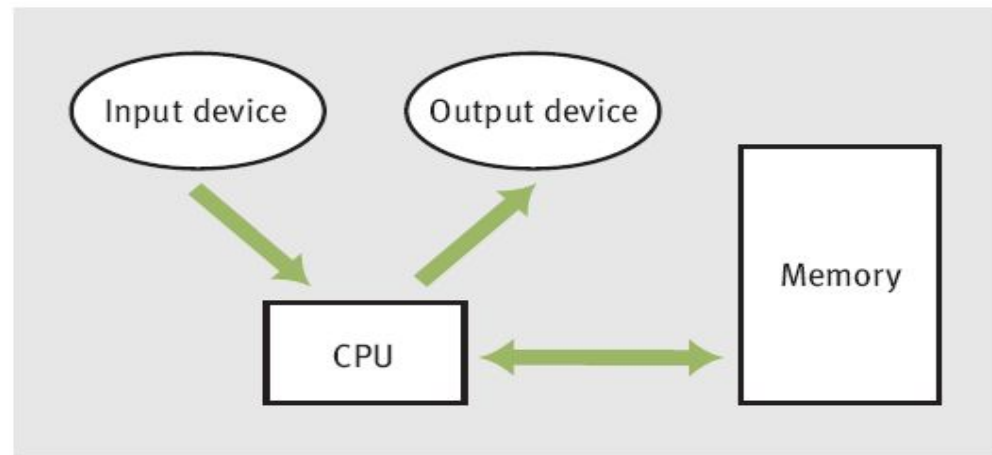
# Modern Computer Systems



- Those parts of the system that you can hit with a hammer are called hardware; those program instructions that you can only curse at are called software.  
- *Anonymous*

# Hardware

- Most computers consist of:
  - ❑ central processing unit (CPU)
  - ❑ storage/memory
  - ❑ input/output (I/O) devices



**[FIGURE 1.1]** Hardware components of a modern computer system



# CPU – Brain of the Computer



- Coordinates all computer operations
- Control Unit
  - Reads instructions from memory and decodes and executes them using the ALU
- Arithmetic/Logic Unit (ALU)
  - Does math and logic calculations on numbers in registers

345

263

Add register A  
to register B

608

Store the value  
in register C into  
memory location  
320843202

# Storage/Memory

- “Comes with 4 GB of RAM”



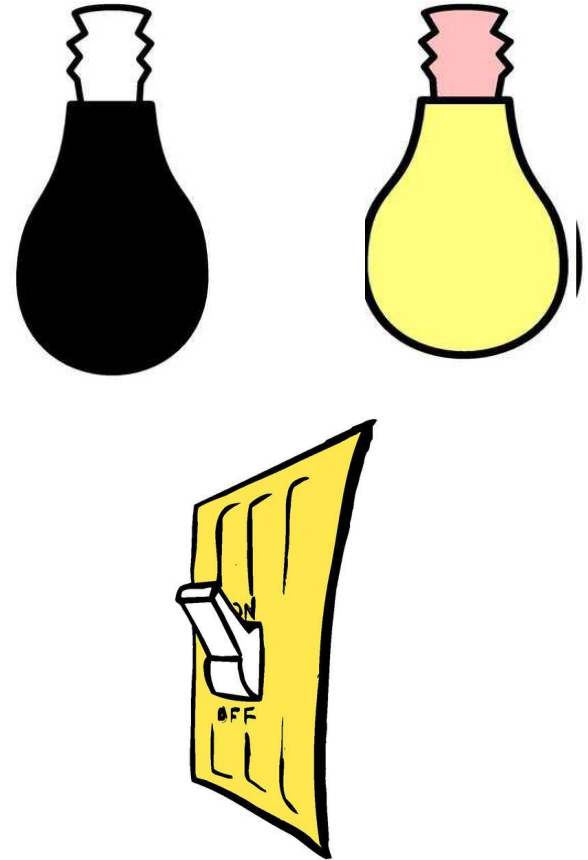
# Visualizing Memory

999	X
998	75.62
...	...
7	STO 005
6	ADD 003
5	RTV 001
4	H
3	-26
2	0.005
1	354
0	-27.2

- Memory is an ordered sequence of storage locations (memory cells)
- Each memory cell has a unique address
- Millions of these cells
- Every memory cell has some contents although the contents may not be meaningful.

# Storage/Memory

- The smallest unit of memory is a bit (**B**inary **d**ig**I**T)
- A bit can be off (no voltage) or on (has voltage) which we interpret to be 0 or 1
- Memory is organized into 8 bit contiguous groups called bytes. A megabyte is 1 million bytes. A gigabyte is 1 billion bytes.

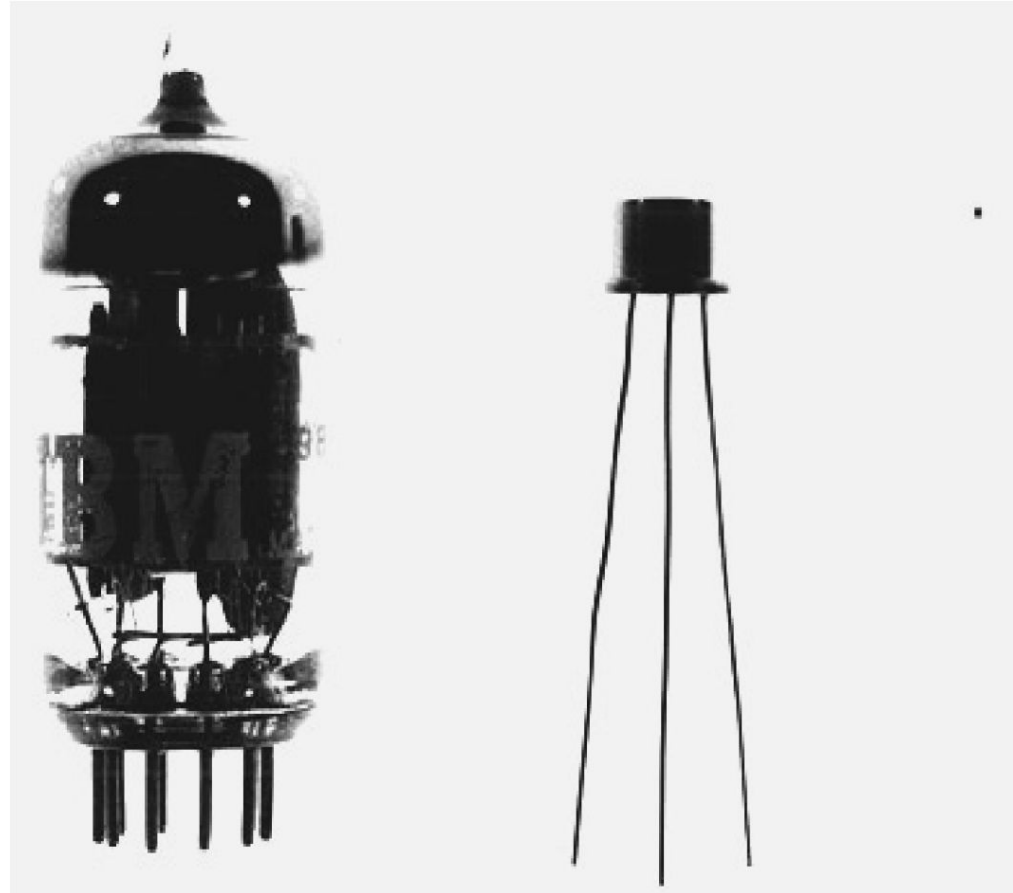


# It's All About the Switch

- The basic component of most digital circuitry is nothing more complicated than a simple switch.
- A switch's function is pretty obvious, said in a number of different ways
  - ❑ On or Off
  - ❑ True or False
  - ❑ 1 or 0

# Electronic Switch

- Early computers used vacuum tubes as switches
- Later, transistors were used as substitutes



# Visualizing Memory

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- Thus, while we might visualize the computer with all sorts of data in the memory slots...

# Visualizing Memory

- ... It really consists of an arrangement of 1s and 0s

Cell 7	1	1	0	1	1	1	1	0	1	1	1	1	1	0	1
Cell 6	1	0	1	1	0	1	1	1	1	1	0	1	1	1	1
Cell 5	1	1	1	1	1	1	1	0	1	1	1	1	0	1	1
Cell 4	1	0	1	1	1	0	1	1	1	1	1	0	1	1	1
Cell 3	1	1	1	0	1	1	1	1	0	1	1	1	1	1	1
Cell 2	0	0	1	1	1	1	0	1	1	1	0	1	1	0	1
Cell 1	1	1	1	0	1	1	1	1	1	1	1	1	0	1	1
Cell 0	1	1	1	0	1	1	0	1	1	1	1	1	1	1	0

**[FIGURE 1.2]** A model of computer memory



# Why are there so many types of memory?

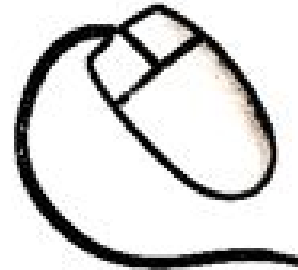
- The faster memory is the more it costs
  - So we reduce the cost by using small amounts of expensive memory (registers, cache, and RAM) and large amounts of cheaper memory (disks)
- Why do we need cache?
  - Processors are very fast and need quick access to lots of data
  - Cache provides quick access to data from RAM

# Types of Memory

- Registers
  - ❑ Very high speed temporary storage areas for use in the CPU
  - ❑ Used for calculations and comparisons
- Cache
  - ❑ High speed temporary storage for use with the CPU
- Main Memory – Random-access Memory (RAM)
  - ❑ High speed temporary storage
  - ❑ Contains programs and data currently being used
  - ❑ Often described in low numbers of Gigabytes (GB)
- Secondary Memory - Disks
  - ❑ Contains programs and data not currently being used
  - ❑ Often described in Gigabytes (GB) or even Terabytes (TB)

# Input/Output Devices

- Allow for human/computer interaction
- Input devices include keyboard and mouse



- Output devices include monitor and printer

