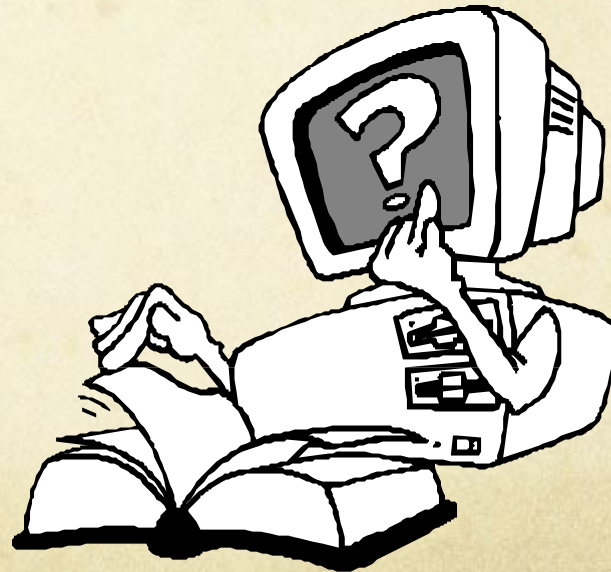# Today we will learn about:
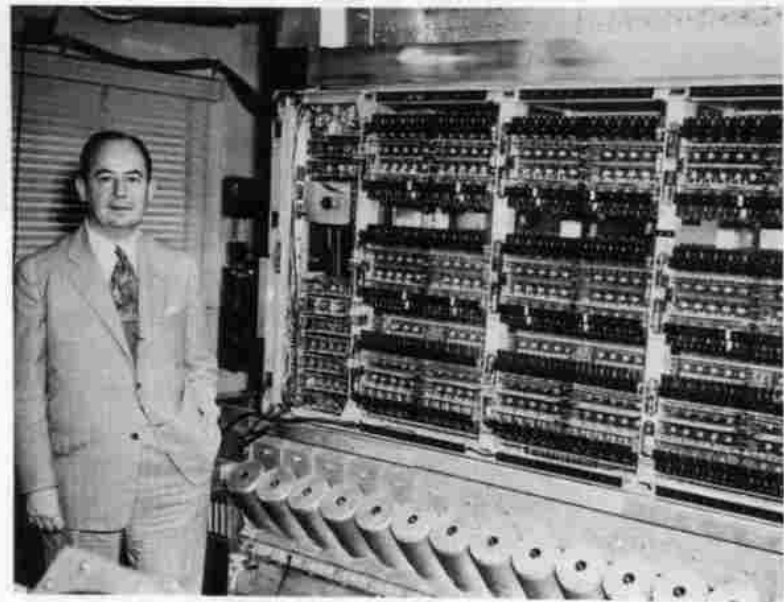
- The stored program concept
- Memory addresses
- RAM
- ROM
- Flash memory
- Cache
- CMOS

The Stored Program Concept

John Von Neuman solved the problem of limited programmability by giving the computer instructions as well as data for input.

He reasoned that the computer could be fed instructions as binary numbers and stored in memory.

Dr. John von Neumann stands next to his MANIAC (*M*athematical *A*nalyzer, *N*umerical *I*ntegrator *and* *C*omputer) at Princeton, New Jersey.

*Von Neumann proposed the concept of a stored program in a report written for the ENIAC project in 1945. Many people in the computer field feel that Mauchly and Eckert should share the honors for this invention.

What is Memory?

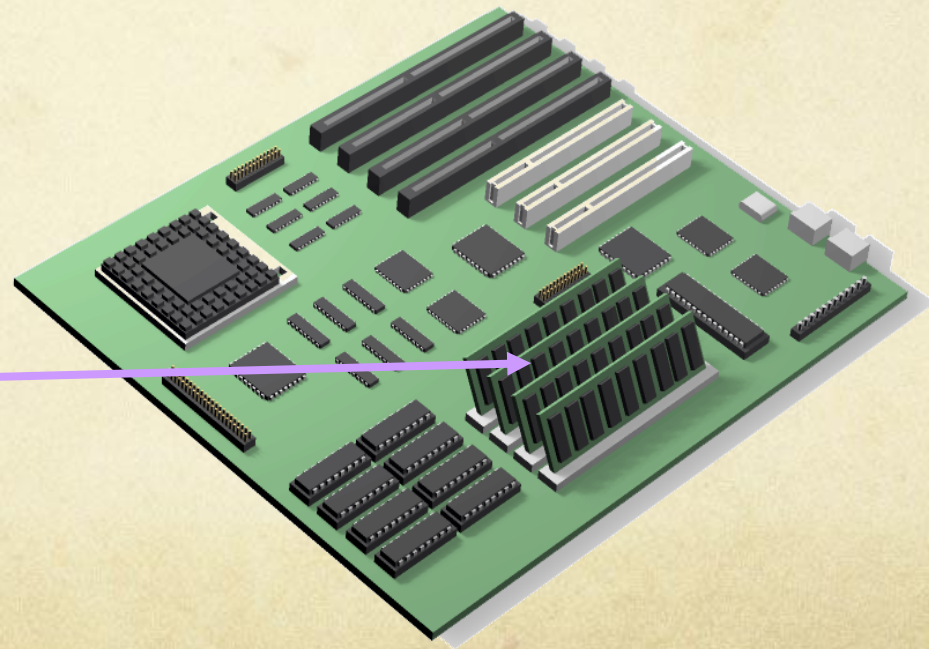Memory temporarily stores instructions to be executed and data to be used with those instructions.

Used to store:

- Operating System and other system software

- Application programs

- Data being processed by the application programs

Memory

- Consists of one or more chips on motherboard
- Each byte is stored in unique address

memory chips on a memory module

Terminology

The term "memory" typically refers to RAM, also known as main memory.

DRAM, SRAM, MRAM, SIMM, DIMM are terms used to describe different types of RAM.

Memory addresses

- A byte (8 bits) can represent one character or symbol.

- Bytes are the basic storage units in memory.

- A memory address is a unique number that identifies the location of a byte in memory.

0	0100 0001 *"A"*
1	0100 0010 *"B"*
2	0100 0011 *"C"*
3	0100 0100 *"D"*

MEMORY AND STORAGE SIZES

Term	Abbreviation	Approximate Number of Bytes	Exact Amount of Bytes	Approximate Number of Pages of Text
Kilobyte	KB or K	1 thousand	1,024	1/2
Megabyte	MB	1 million	1,048,576	500
Gigabyte	GB	1 billion	1,073,741,824	500,000
Terabyte	TB	1 trillion	1,099,511,627,776	500,000,000

The amount of memory you need depends upon what programs you intend to run on your computer.

Multi-tasking, loading more than one program at a time into RAM, also depends upon how much room there is in memory.

Volatile / Non-volatile

- **Volatile** – lost when power is off, anything stored in volatile memory must be saved before you shut down the computer.

- **Non-volatile** – remains even when memory is turned off

More special types of memory

○ **Cache Memory –**

Holds most frequently used data and instructions.

Speeds up processing.

○ **Virtual Memory –**

Using a hard-drive as part of memory, enables use of large programs without installation of extra RAM.

Slows down performance.

ROM

- **ROM** is permanent, cannot be erased or written over. It is hardwired into a chip on the motherboard. (Non-volatile)

- **PROM** – Programmable Read Only Memory (Non-volatile) are blank ROM chips that can be written to (programmed) only once.

- **EEPROM** – Electrically Erasable Programmable Read-Only Memory

Flash Memory

- Non-volatile chips that can be erased and re-written, for example, to allow the BIOS to be upgraded.

- Also used on mobile devices like PDAs, phones, cameras, MP3s...

- Flash memory cards (used in handheld devices) store flash memory on a removable card.

BIOS

ROM stores the Basic Input/Output System (**BIOS**) that controls the start-up (boot) and communications with devices.

1. CPU resets

2. BIOS runs a POST (power-on self-test)

3. computer loads the kernel of the OS

4. OS loads the system configuration

5. User interface is loaded

6. You're ready to go!

CMOS

used to store information about the

computer, such as:

- types of peripheral devices

- date and time

- start-up info

Memory Access Time

ACCESS TIME TERMINOLOGY

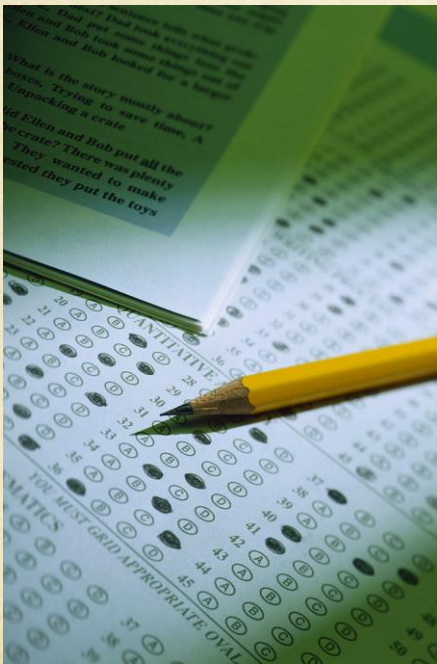| Term	Abbreviation	Speed
Millisecond	ms	One-thousandth of a second
Microsecond	μs	One-millionth of a second
Nanosecond	ns	One-billionth of a second
Picosecond	ps	One-trillionth of a second

Storage versus Memory

○ Memory holds data, programs and instructions.

○ Storage devices hold data, programs and instructions – so how are they different from memory???

○ Memory is used by the computer while the program or data is in use.

○ Storage saves programs/data for later use.

What you need to know

○ Describe the purpose of memory in a computer

○ Explain how memory differs from storage

○ Understand the terms that describe memory sizes
(kilo, mega, giga, etc.)

○ Explain the purpose of cache memory

○ Explain the purpose of virtual memory

○ Explain the purpose of ROM and flash memory

○ Explain what the BIOS does

○ Explain what the POST does

○ Explain what the CMOS does

○ Describe which types of memory are volatile/non-volatile?

○ Understand the terms that describe memory access time (milli, micro, nano, etc.)

Homework/Labs

- Read pages 38 – 40 on expansion cards and ports

- Take Quiz #5.