Introduction to Computers

CMPT-2?0

(Electronic) Computer Systems

# What is a (electronic) computer system?

What is an electronic computer system?

- An electronic computer system is a collection of electronic and mechanical parts (the hardware)

- … that has been given a set of instructions (the software), that lets you store and manipulate information.

Do other than electronic computers exist today or existed in the past ?

➢ "Abacus", Roman times

➢   In the ancient world a mechanical computer

     (Antikythera Machine/Computer)

➢   Napier's Bones

➢   The Pascaline

➢ …

Abacus

The abacus is an ancient calculating tool (2.300-2.700 B.C.) capable of performing the four basic arithmetic operations.
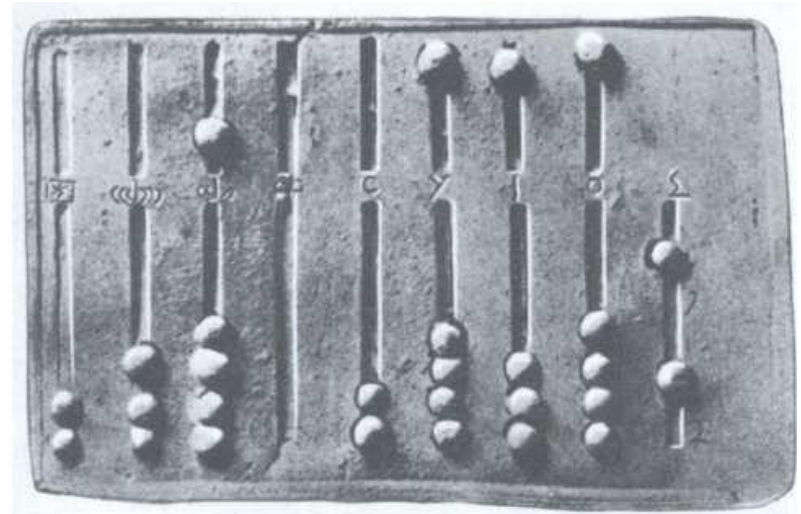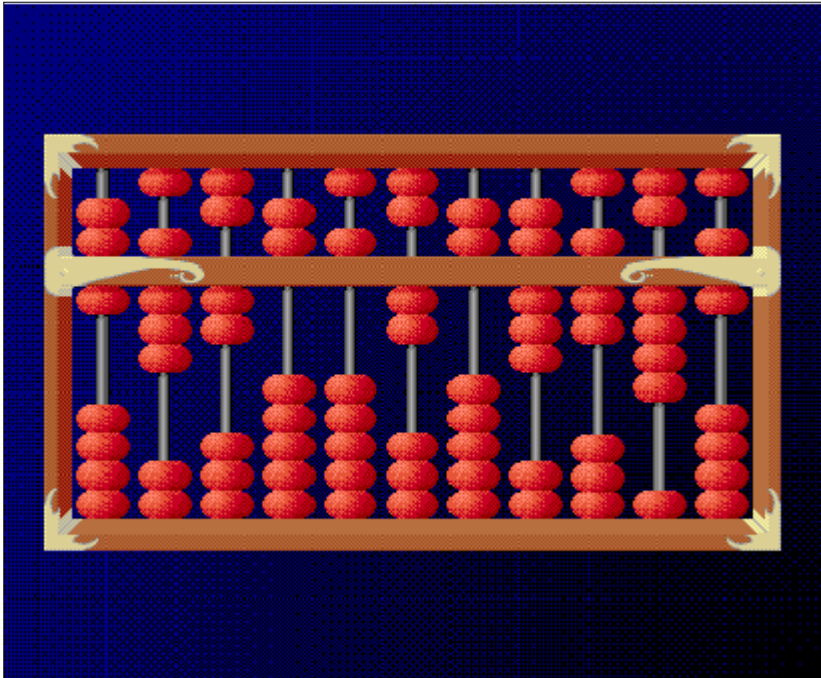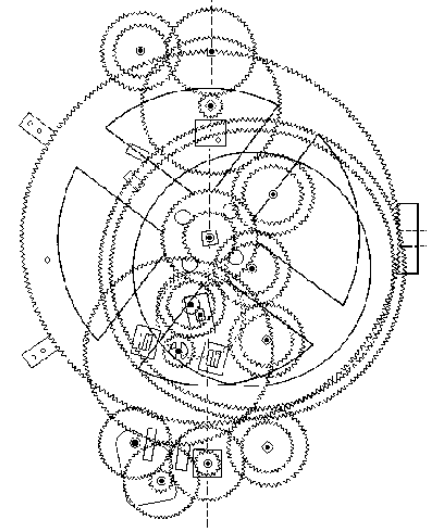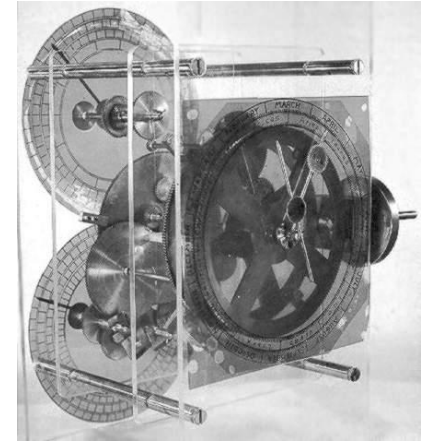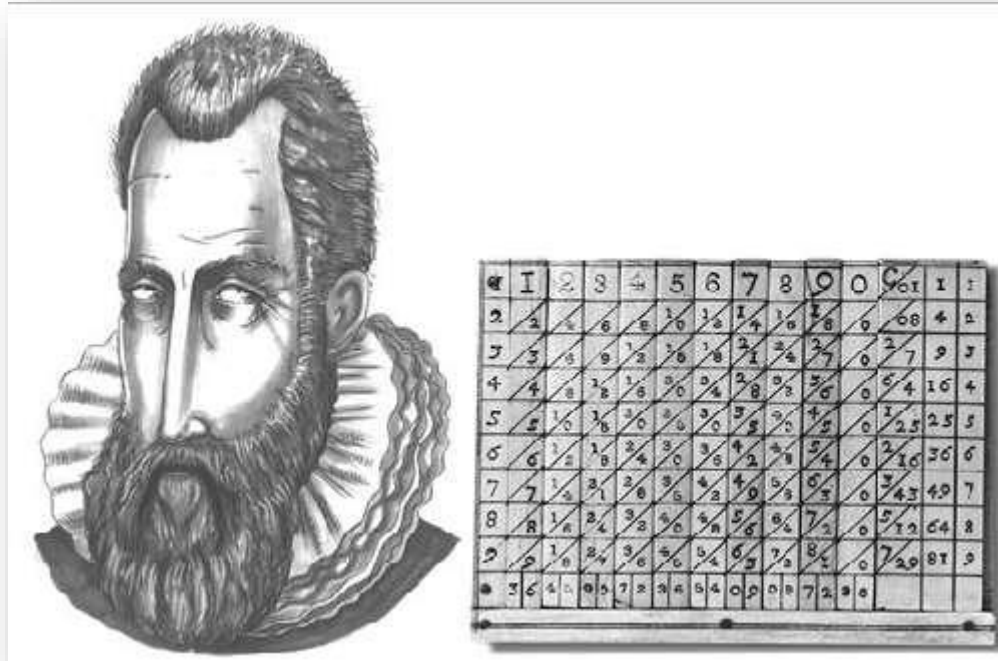
Abacus

Today … Beijing, China

Antikythera Computer (140 B.C)

Was build in ancient Greece the year 140 B.C. The Antikythera Mechanism was able to align the number of lunar months with years and display where the sun and the moon were in the zodiac. {CNN.com}
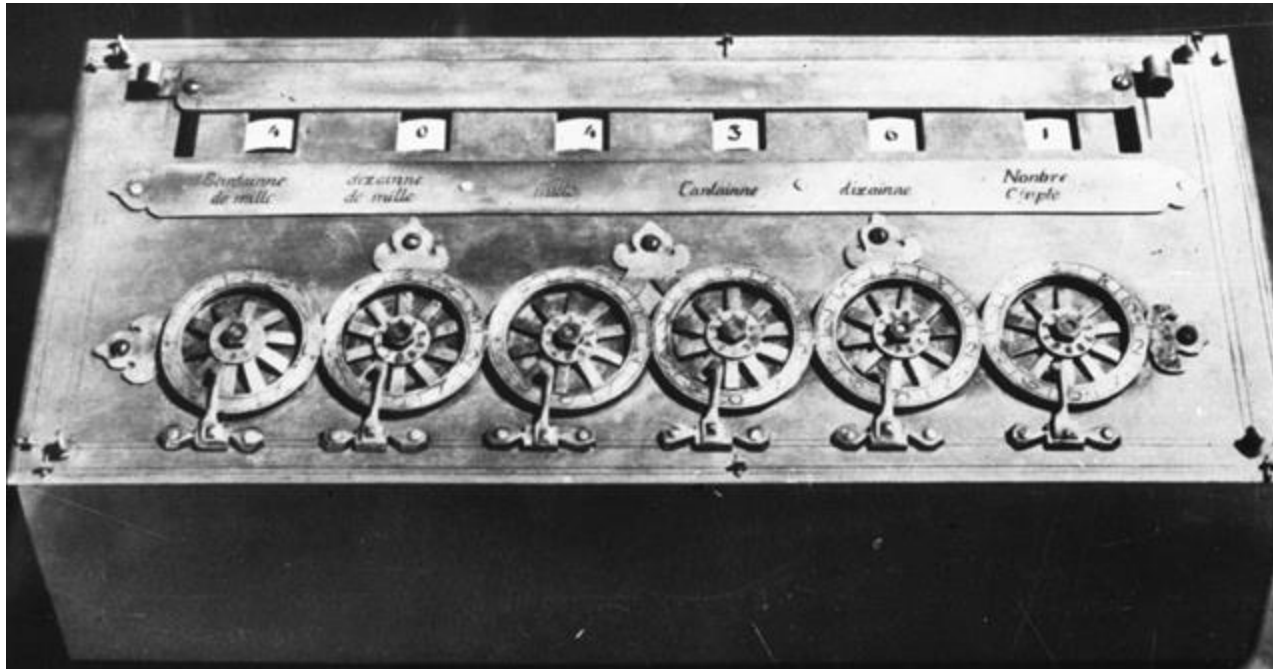
Napier's Bones (1610)

Napier's bones is an abacus created by John Napier (1550 – 1617) for calculation of products and quotients of numbers.
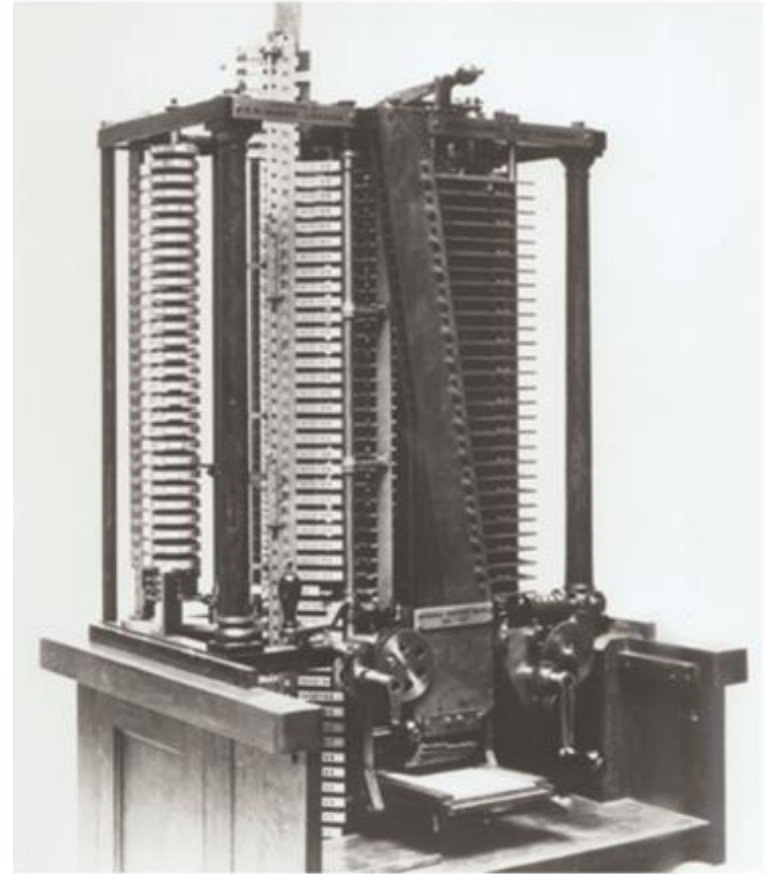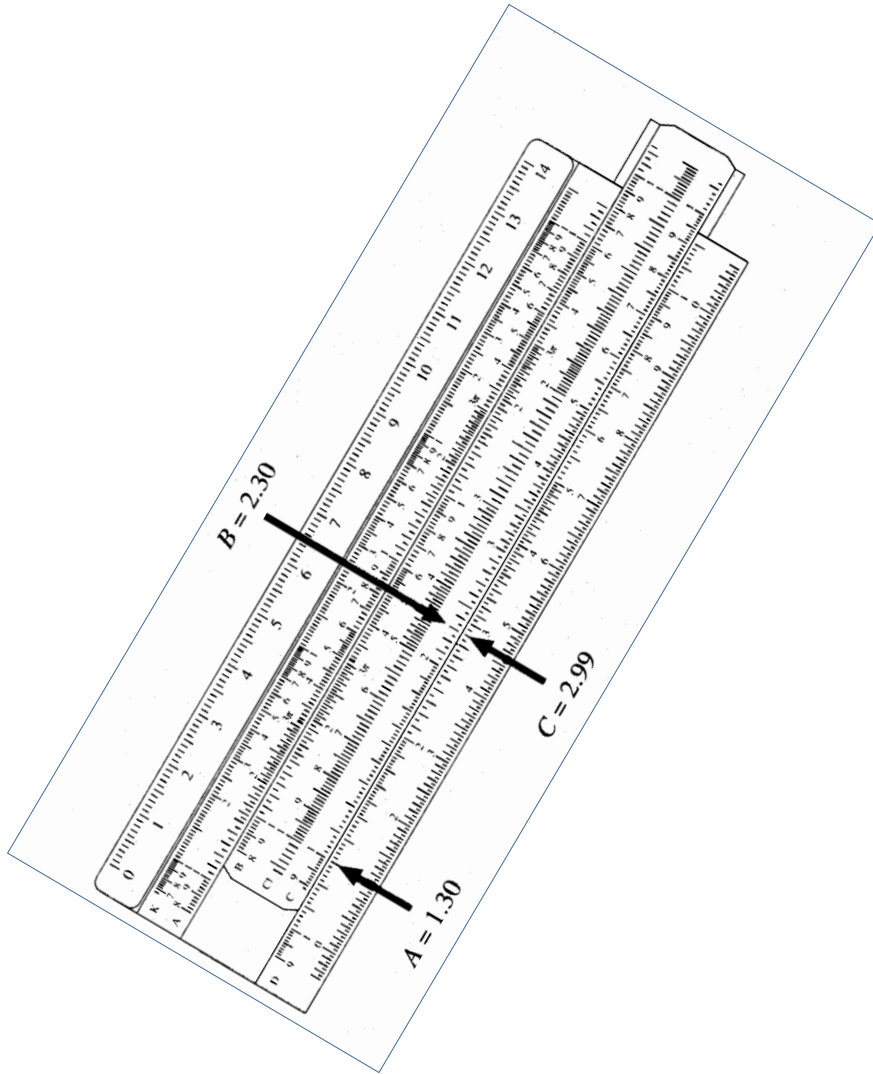
The Pascaline (1642)

Pascal invented and build the "Pascaline" to help his father, a tax collector.

Analytical Engine-1822, (Charles Babbage)

An Engine (mechanical computer) to compute mathematical tables, such as logarithmic and trigonometric functions.

Slide rule

B = 2.30

C = 2.99

A = 1.30

A plugger doesn't worry about his computer getting infected with an Internet virus.
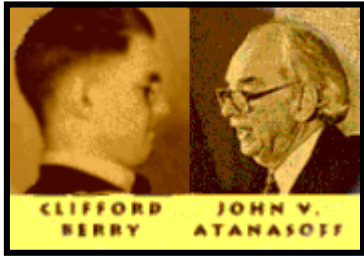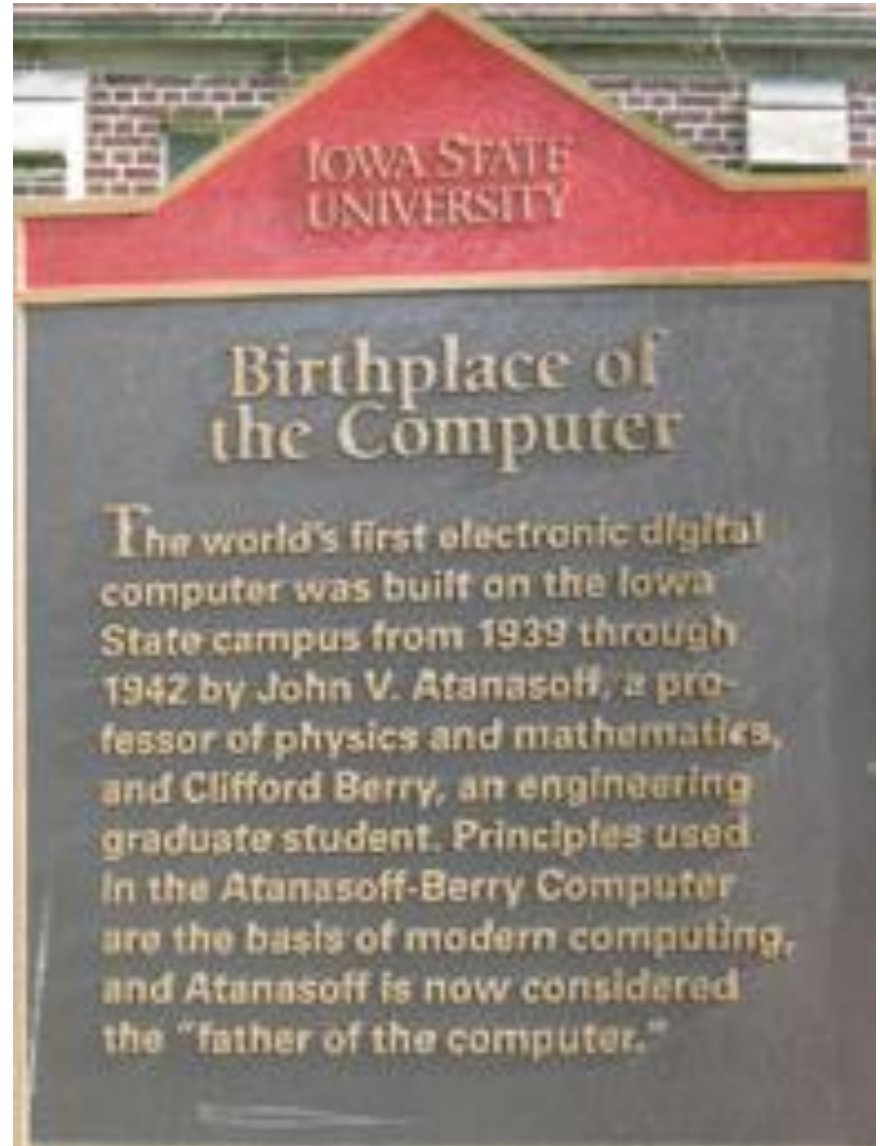
Z1- Computer (1938)

The First Freely Programmable Mechanical Computer invented by Konrad Zuse, 1910-1995 (Germany)

Prof. Atanasoff-Berry (graduate student) Electronic Computer (1939-1942)

CLIFFORD BERRY   JOHN V. ATANASOFF

IOWA STATE UNIVERSITY

Birthplace of the Computer

The world's first electronic digital computer was built on the Iowa State campus from 1939 through 1942 by John V. Atanasoff, a professor of physics and mathematics, and Clifford Berry, an engineering graduate student. Principles used in the Atanasoff-Berry Computer are the basis of modern computing, and Atanasoff is now considered the "father of the computer."

The world's first electronic-digital computer at Iowa State University. The Computer State used a binary system of arithmetic, parallel processing, separation of memory and computing functions.
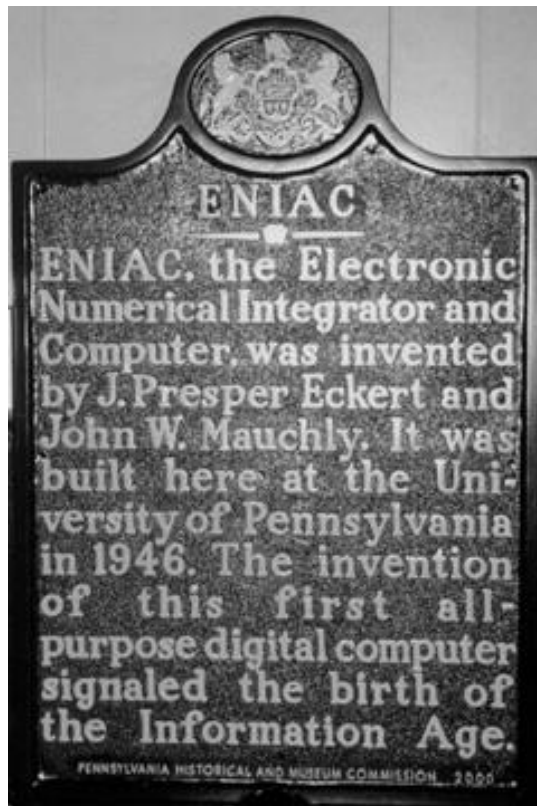
The Harvard MARK-I Computer -
Howard Aiken and Grace Hopper (1944)

Grace Hopper   Howard Aiken

ENIAC (Electronic Numerical Integrator and Computer) 1944-46

- Developed by Army Ordnance to compute World War II ballistic firing tables.

|	ENIAC	Intel Core Duo chip
Debut	1946	2006
Performance	5,000 addition problems/sec	21.6 billion ops/sec
Power use	170,000 watts	31 watts max
Weight	28 tons	negligible
Size	80' w x 8' h	90.3 sq. mm.
What's inside	17,840 vacuum tubes	151.6 M transistors
Cost	$487,000	$637

- **(Moore School of Electrical Engineering, University of Pennsylvania)**

ENIAC: Electronic Computer
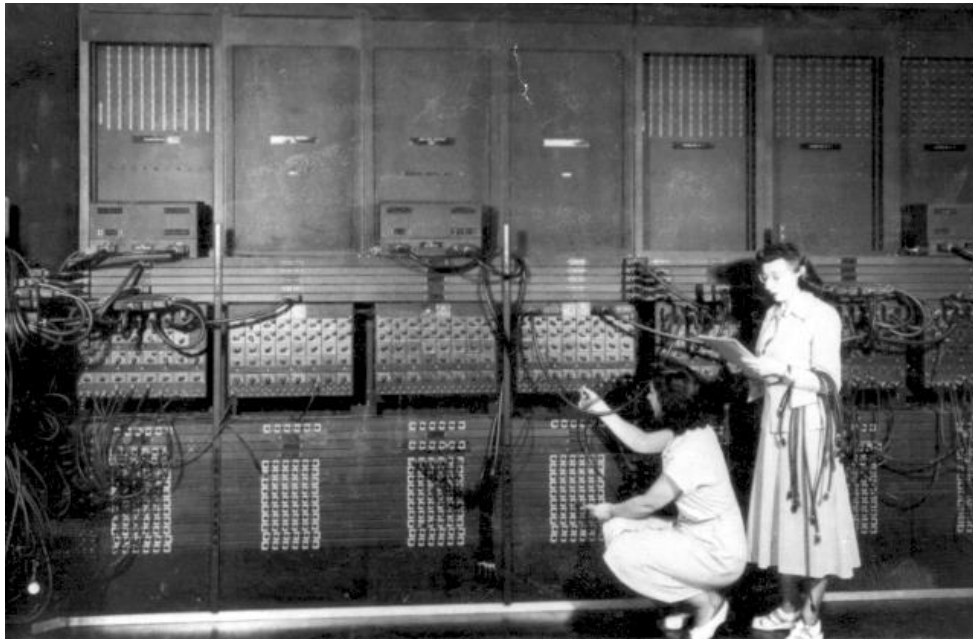
DYSEAC: First portable computer (1954)

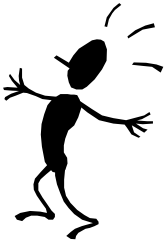DYSEAC = Second Standards Electronic Automatic Computer

- 900 vacuum tubes
- 512-4096 words of memory. word =b 45 bits
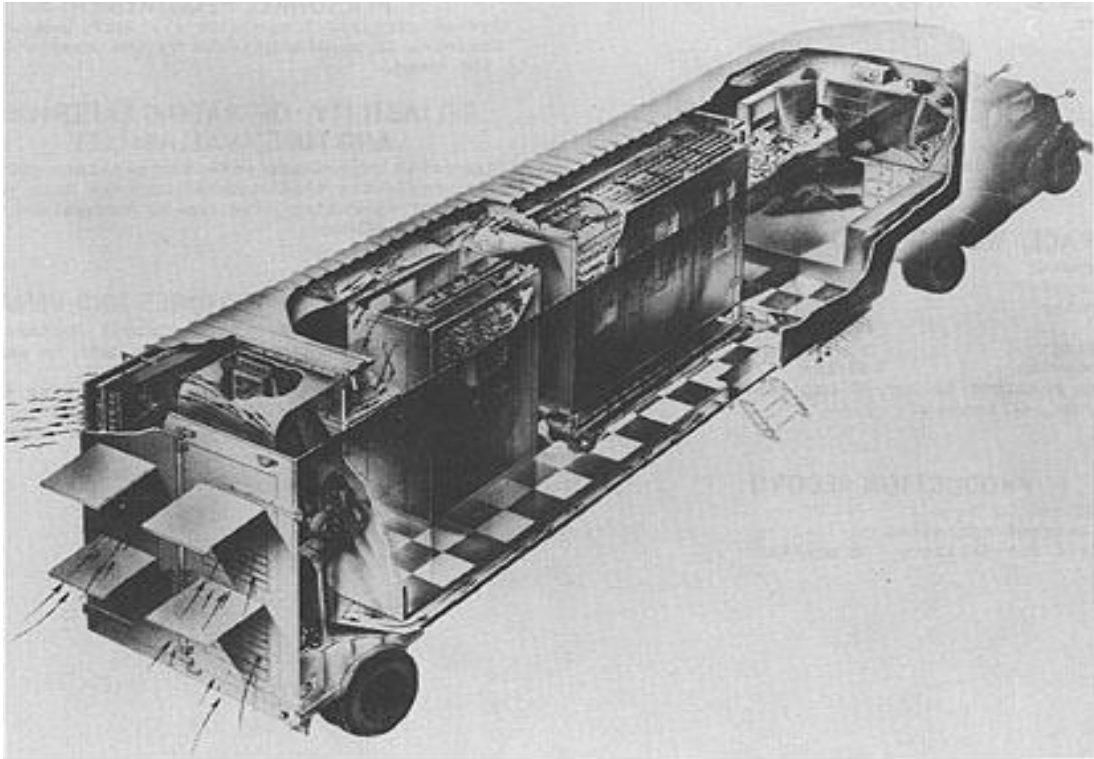
- Carried in two tractor trailers, 12 tons + 8 tons
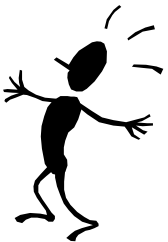- Built for US Army Signal Corps

What can a computer do?

- Predict weather

- Run a factory

- Transportation and travel

- Money (Banks/ATM machines)

- Communications (Mobile phone, email, …)

- Play games

- Robotics

- Medicine

What a computer can't do?

- Drink coffee

- Listen and solve your problems

- Design solutions to problems

Medicine … Robot (computer) surgery

Human computer

Input: *eye, nose, ear*

Process: brain

Output: *feet, voice*

Human made computer

Input: Keyboard, Bar code device, Monitor
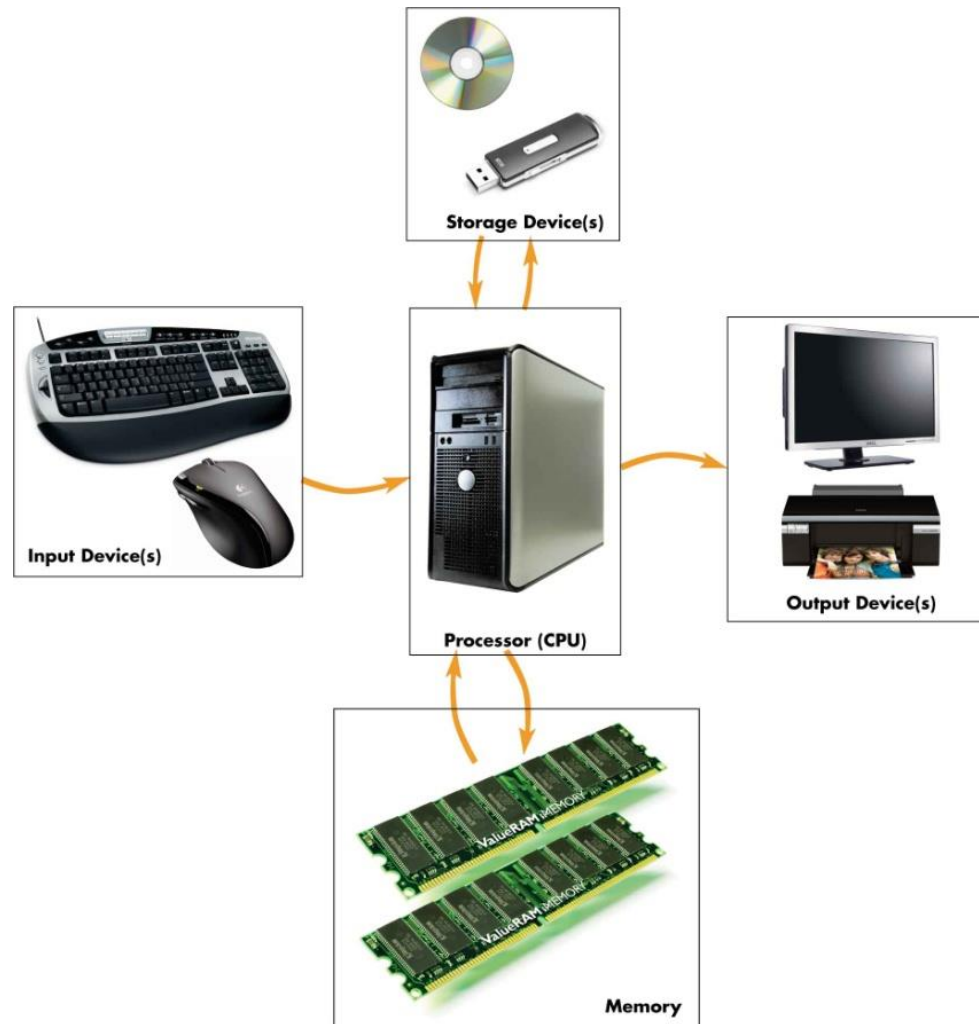
Process: CPU

Output: Monitor, Printer

and

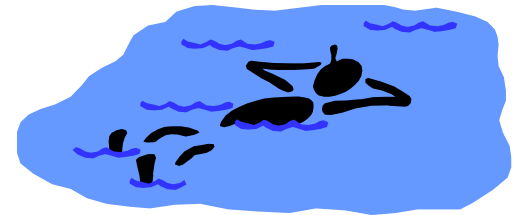Instructions to run the system

Human made computer

and

Instructions to run the system
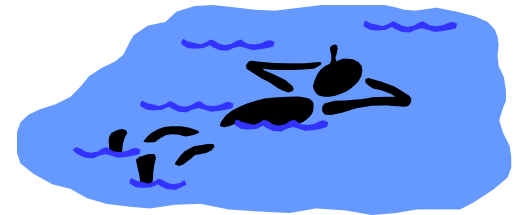
Human made "Computers" …

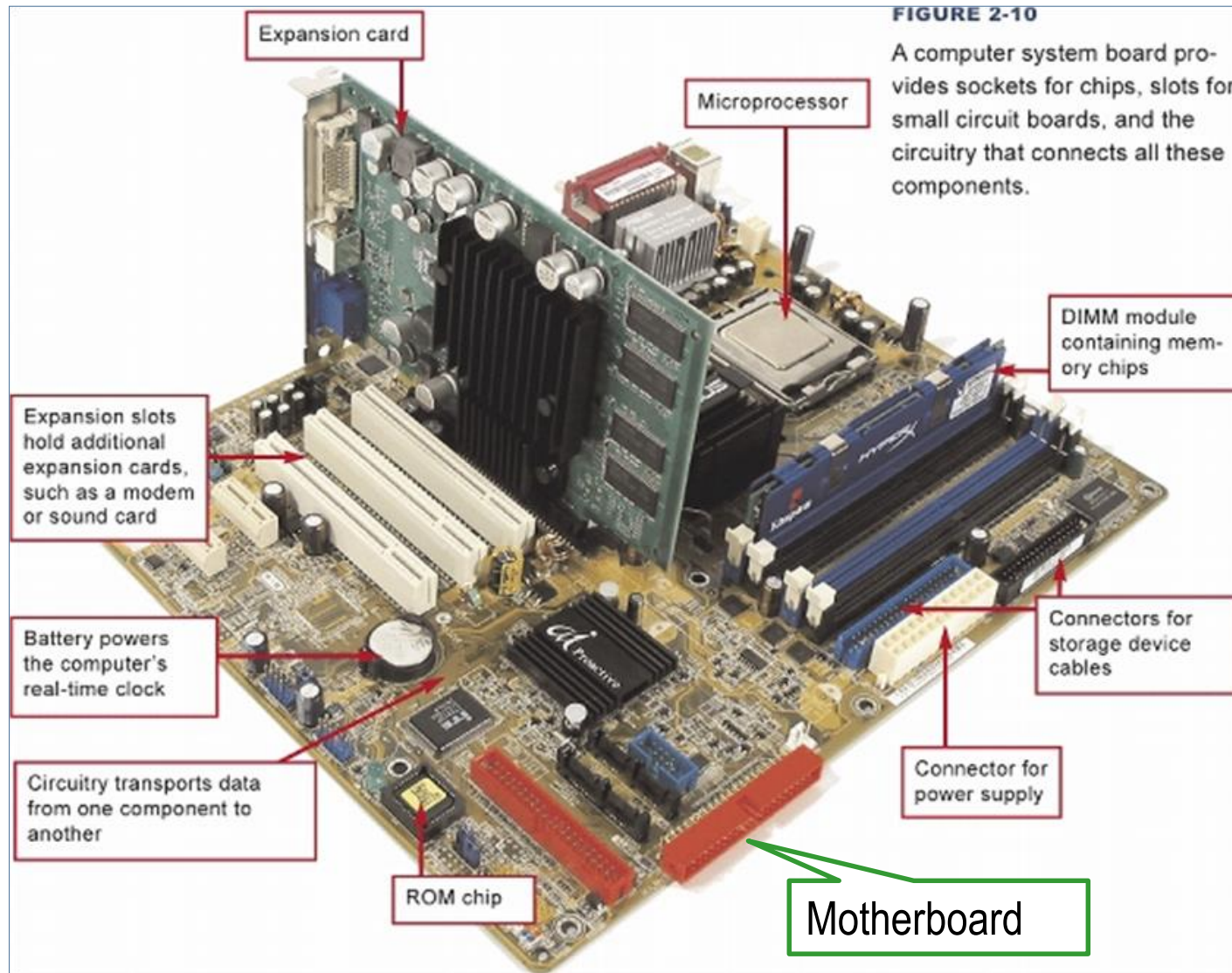# A computer system has two main parts

- Hardware

- Software

A computer system has two main parts

- Hardware; Physical equipment

- Software; Instructions that run the hardware

Hardware

FIGURE 2-10

A computer system board provides sockets for chips, slots for small circuit boards, and the circuitry that connects all these components.

Expansion card

Microprocessor

DIMM module containing memory chips

Expansion slots hold additional expansion cards, such as a modem or sound card

Battery powers the computer's real-time clock

Connectors for storage device cables

Circuitry transports data from one component to another

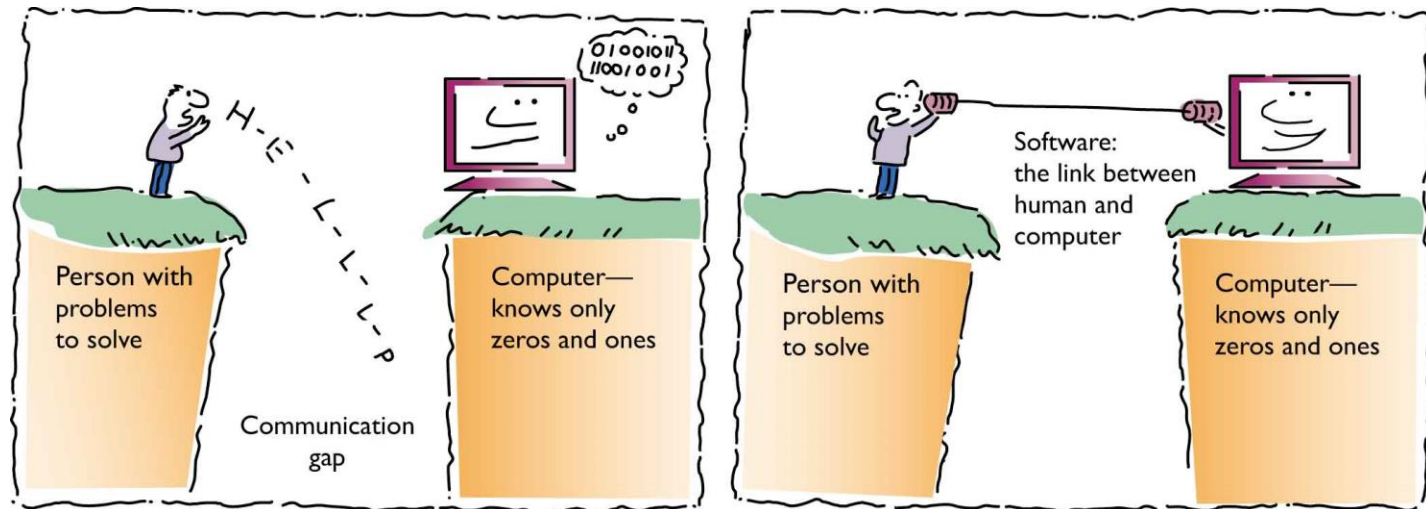Connector for power supply

ROM chip
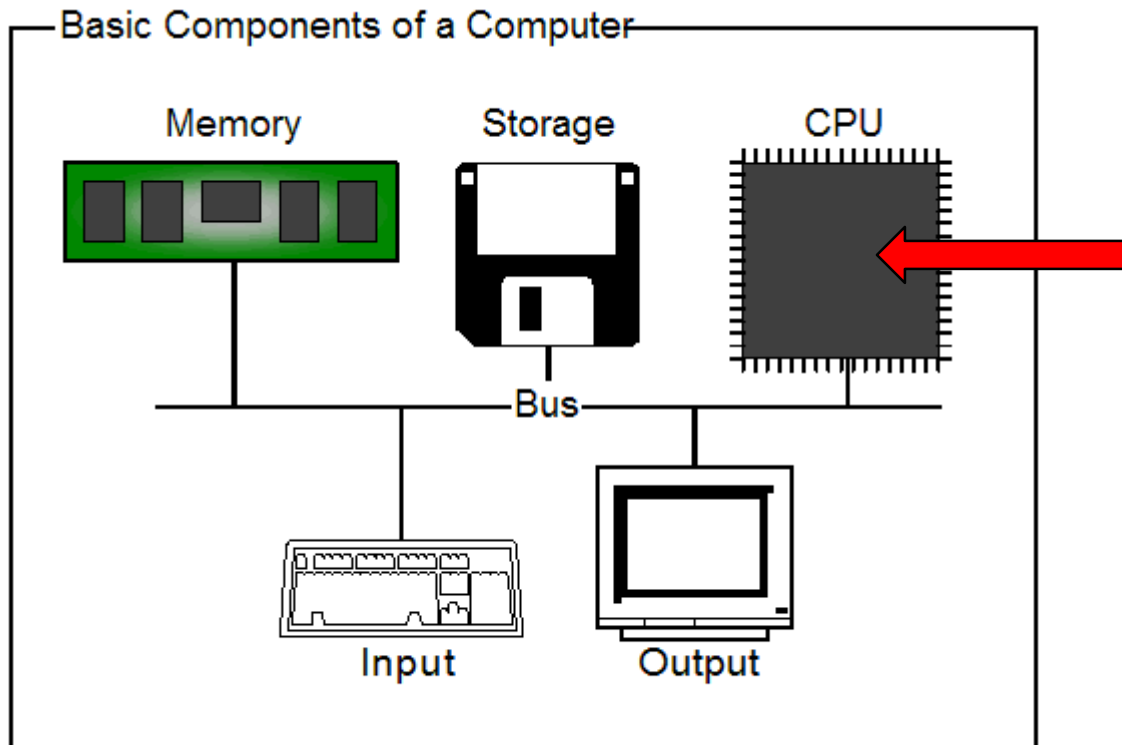
Motherboard

A computer system has two main parts

- Hardware = Physical equipment

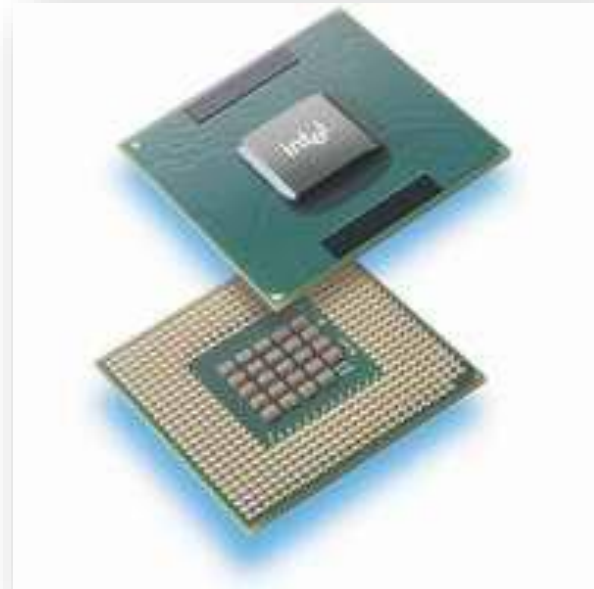- Software = Instructions that run the hardware (programs @ applications)

Such as…
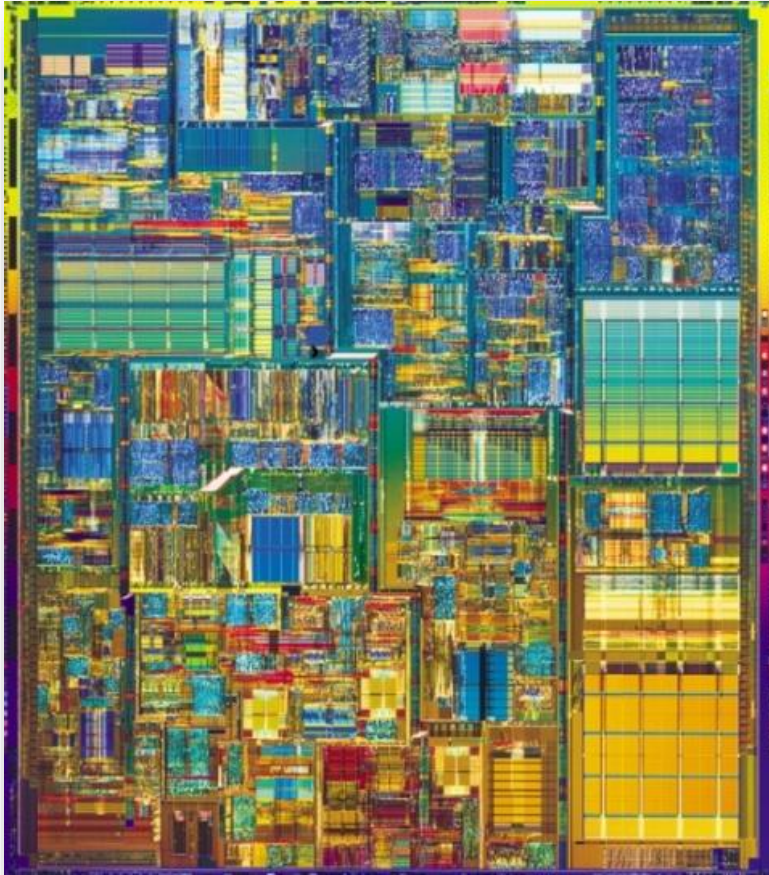
- Operating System (Win7, OSX, Unix, etc)

- Office 2010

- Web browsers

- iTunes

- Games

- etc…

Computer hardware …basic componets

CPU's … single core

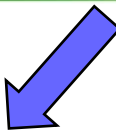# Different types of CPU's ?

- Yes …

- SingleCore

- MultiCore

CPU

- The most popular are manufactured by INTEL corporation.

Intel …. Up to today

Name	Date		MHz
8086	**1978**		**5-10**

- **8086**   **1978**   **5-10**
  - First 16-bit Intel processor. Basis for IBM PC & DOS

- **386**   **1985**   **16-33**
  - **First 32-bit Intel processor**

- **Pentium 4F**   **2004**   **2800-3800**
  - First 64-bit Intel processor, referred to as x86-64

- **Core 2**   **2006**   **1060-3500**
  - First multi-core Intel processor, **64-bit word size**

- **Core i7**   **2008**   **1700-3900**
  - Four cores, **64-bit word size**

Speed of CPU's … Hertz (Hz)

- Hertz (Hz) is a measure of the frequency (cycles per second)

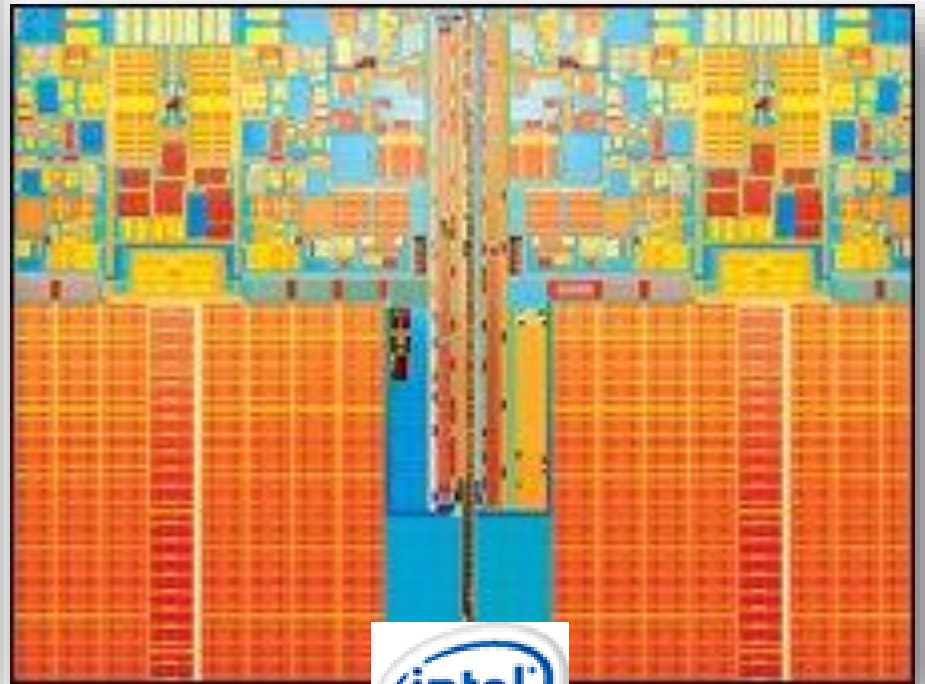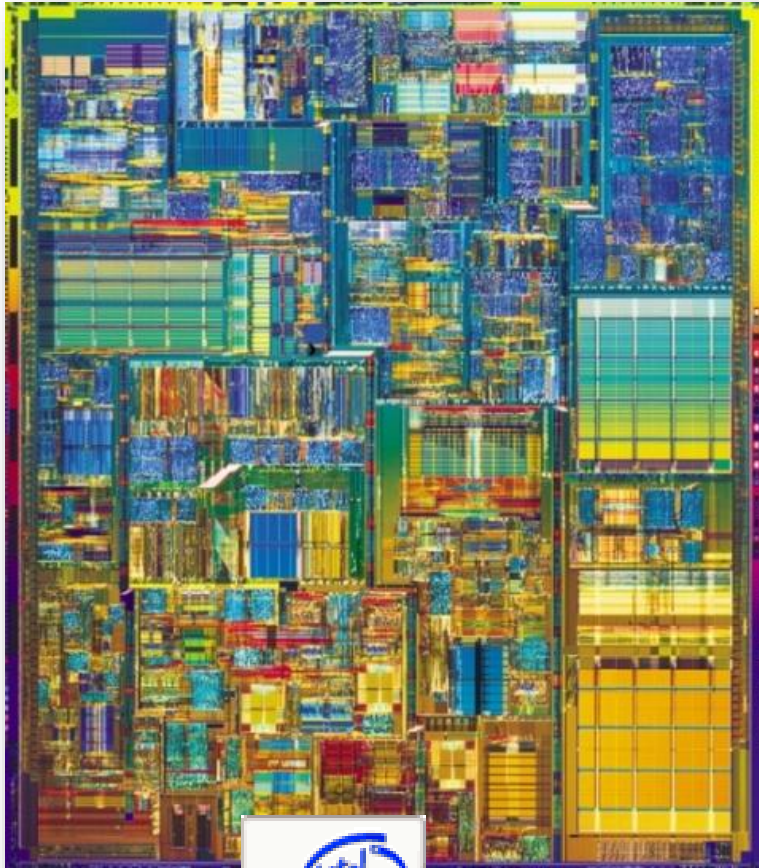- Today … typical CPU values 2-4 GHz

Note:

1 GHz = 1,000,000,000 Hz
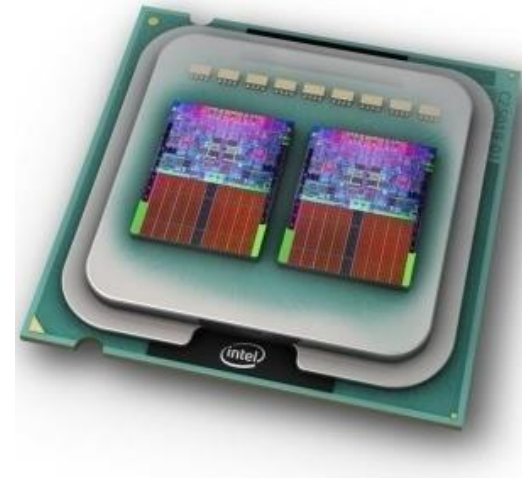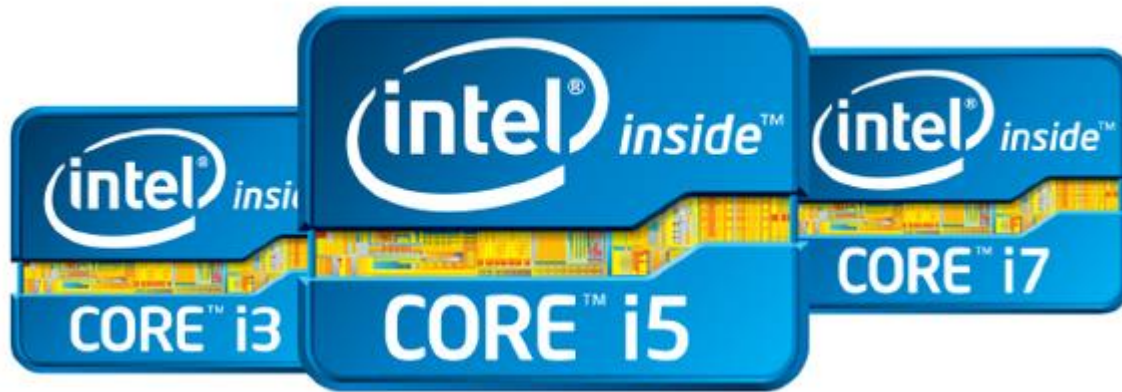
1 MHz = 1,000,000 Hz

1 KHz = 1,000 Hz

SingleCore and MultiCore CPU's

Multicore CPU's

Today… from "INTEL" … i7, i5

Processor type	Frequency (GHz)	Cores	Cache memory (MB)
i3	1.4 - 2.6	2	3
i5	2.3 - 3.4	2-4	3-6
i7	2.5 - 3.6	2-6	4-15

… from "AMD" … Opteron (12 cores)
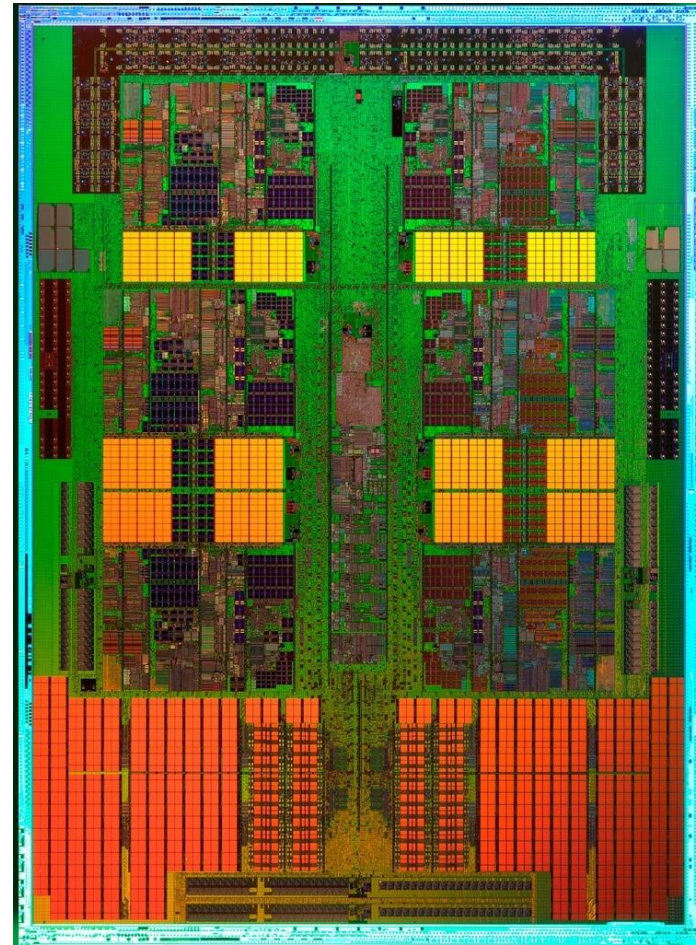
ARM CPU for mobile devices ....

ARM (Cortex-9)…next generation devices

Mobile Handsets
Connected Mobile Computers

Networking / Home Gateways

Consumer and Auto-infotainment

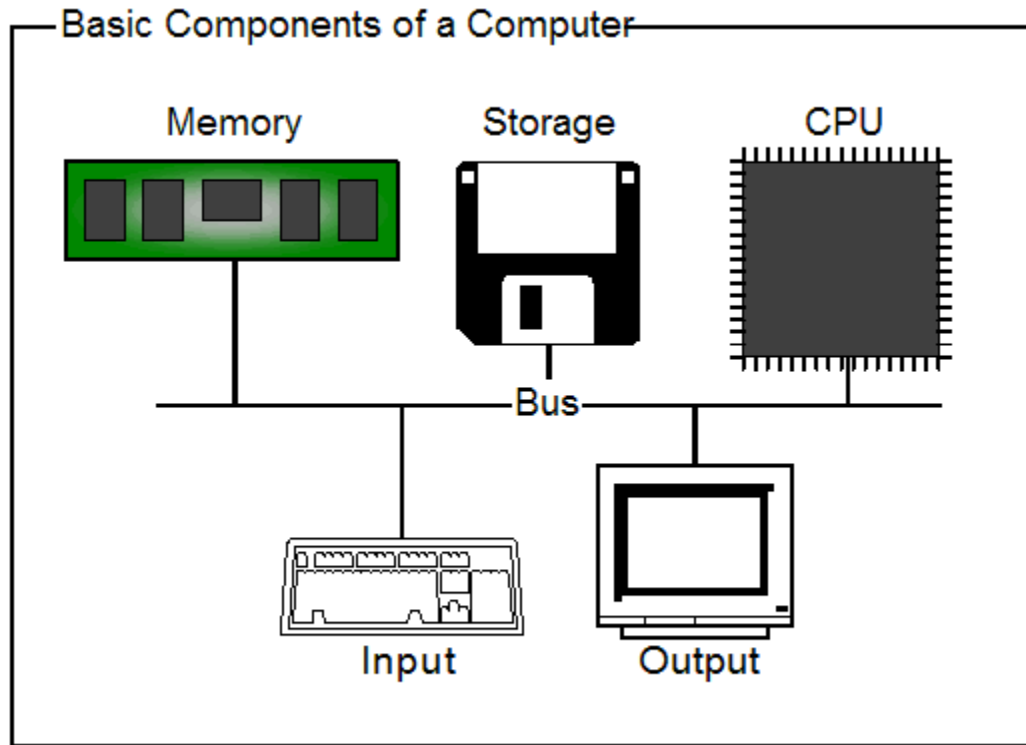Embedded

CPU's

CPU's are also called MicroProcessors

Next … Computer memory

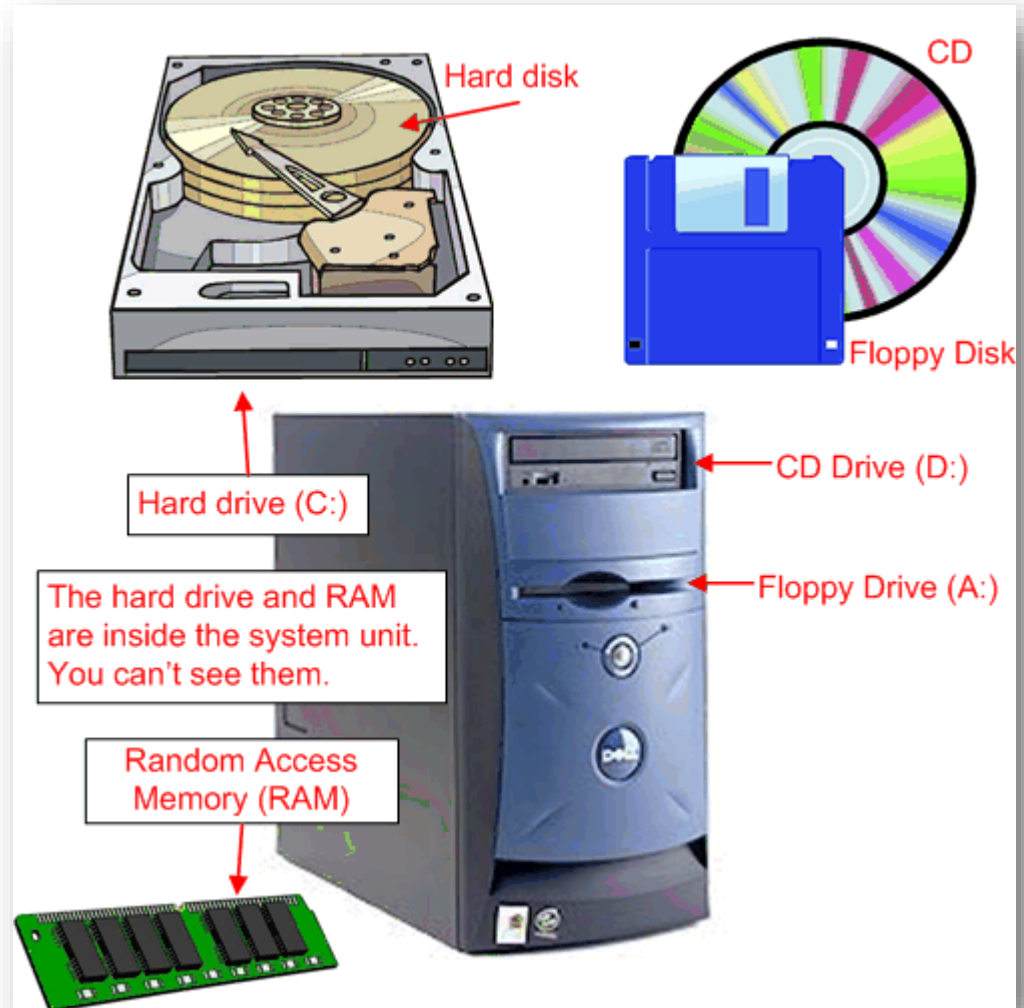Basic Components of a Computer — Memory, Storage, CPU, Bus, Input, Output

Computer Memory

Computer Memory

- ➢ Primary

- ➢ Secondary

Computer Memory

❖ **Primary**
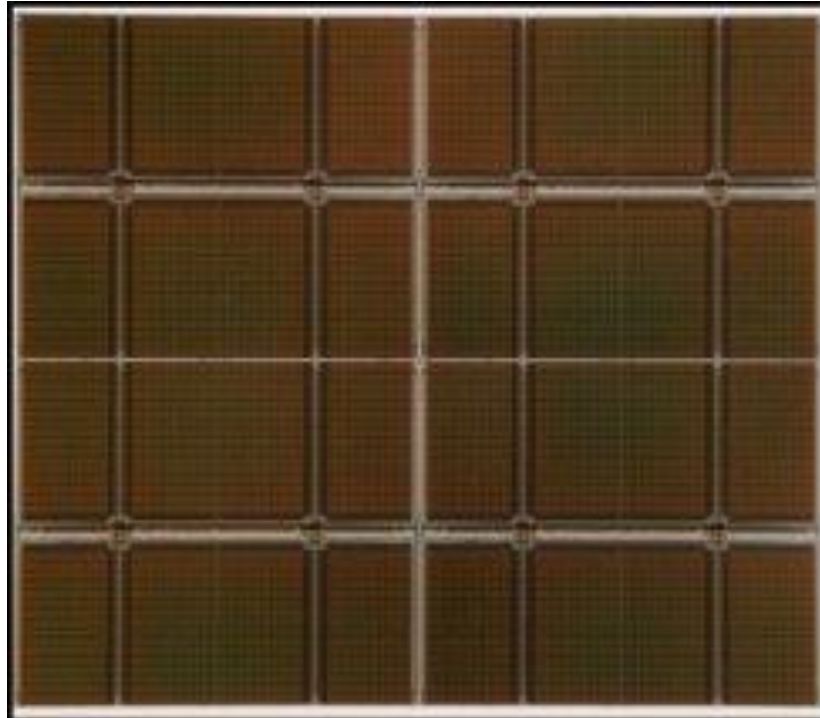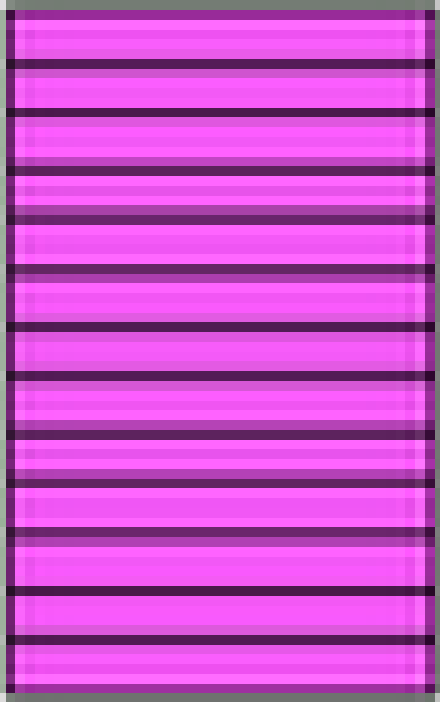
- RAM

❖ **Secondary**

- Hard Disk

- Diskettes, CD, DVD, Tapes, Flash, …

RAM

Rows and columns with 0's and 1's

RAM or System Memory

- ## RAM (Random Access Memory)

  - ➢ Fast

  - ➢ Volatile (not permanent)

  - ➢ Limited

  - ➢ Relatively expensive

RAM
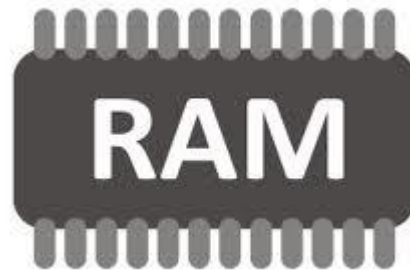
- Random Access Memory (Read And Write Memory)

- When the power goes off, any information stored in the RAM is erased.

Booting - RAM

- The process of loading the operating system program into the memory (**RAM**) … is called initializing or booting-up.

Boot program tells hard disk to load the OS

ROM

Hard disk

Operating system kernel loaded into RAM

RAM

Operating system is available as needed

Processor
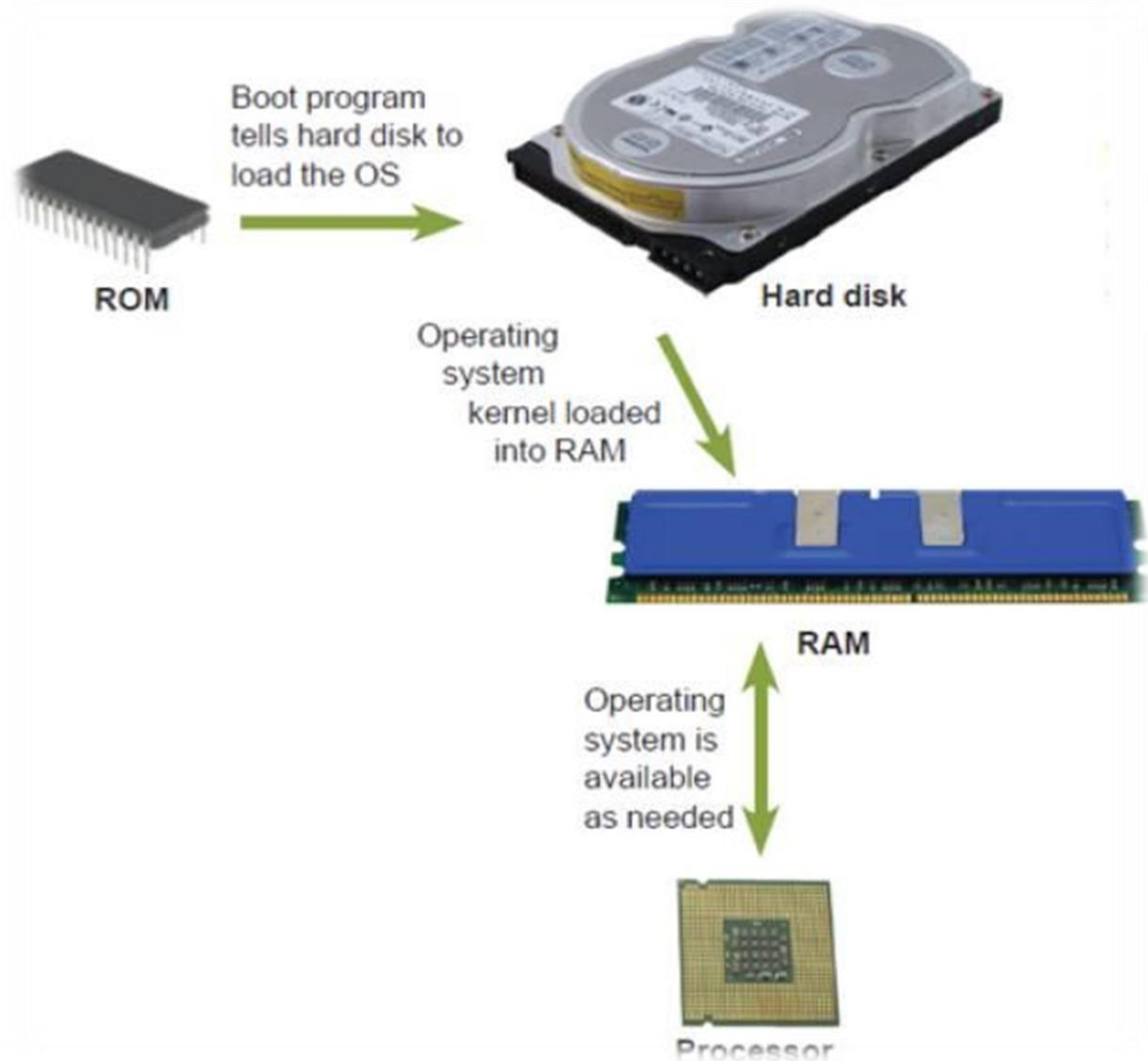
Operating system

- Main program that controls how a computer system functions.

- All computer systems have an operating system

- Examples?

  Windows ….

RAM

Memory chips

Memory module

RAM (main memory)
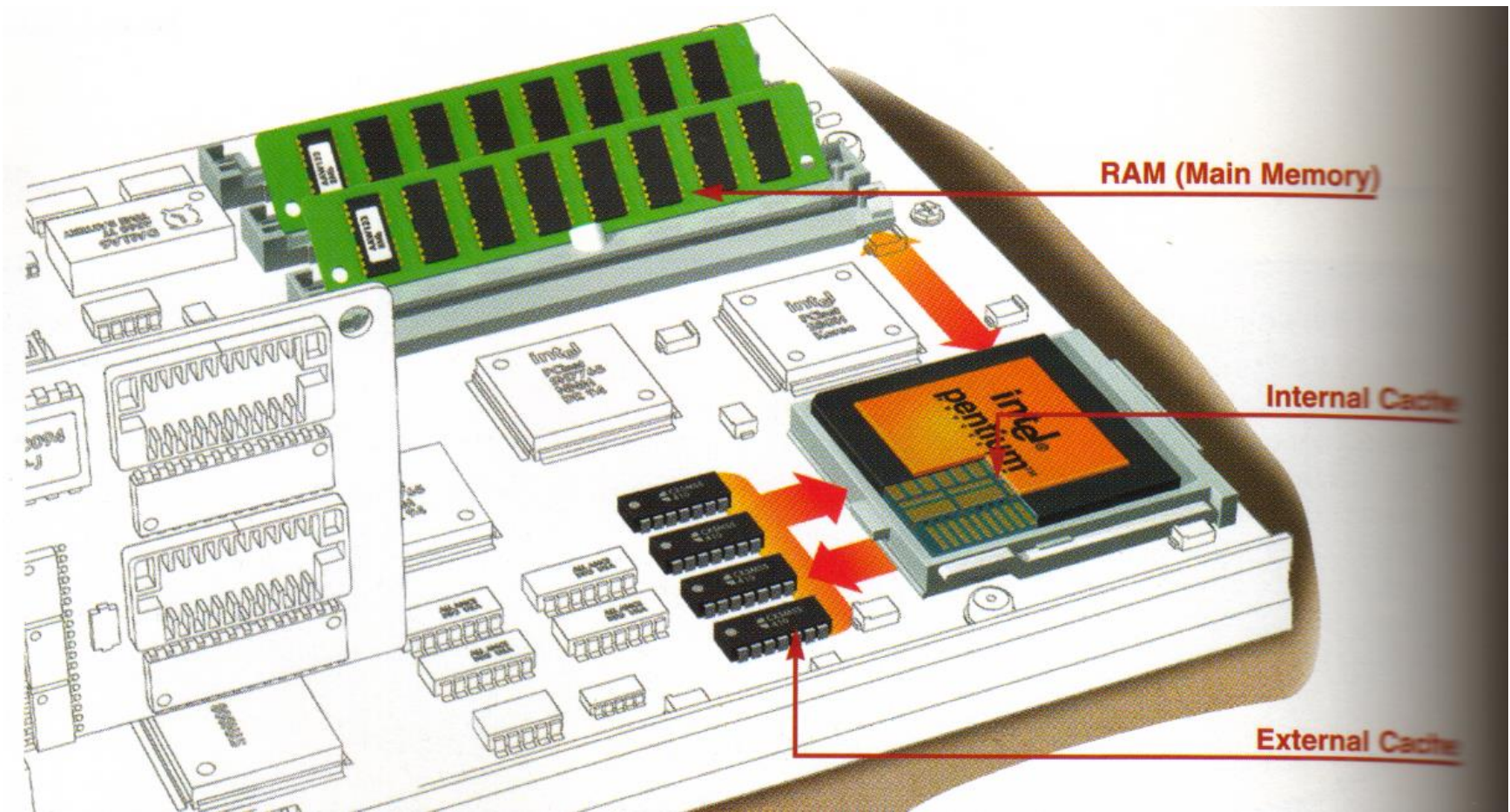
How to add RAM memory
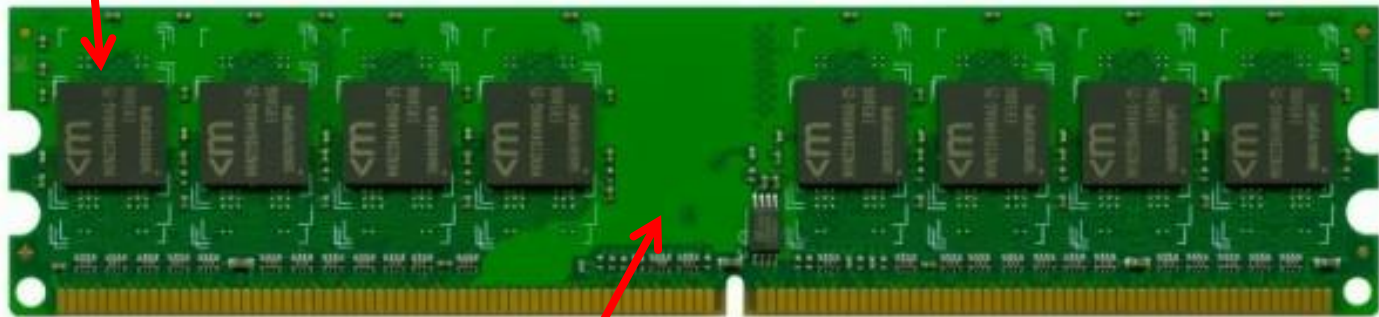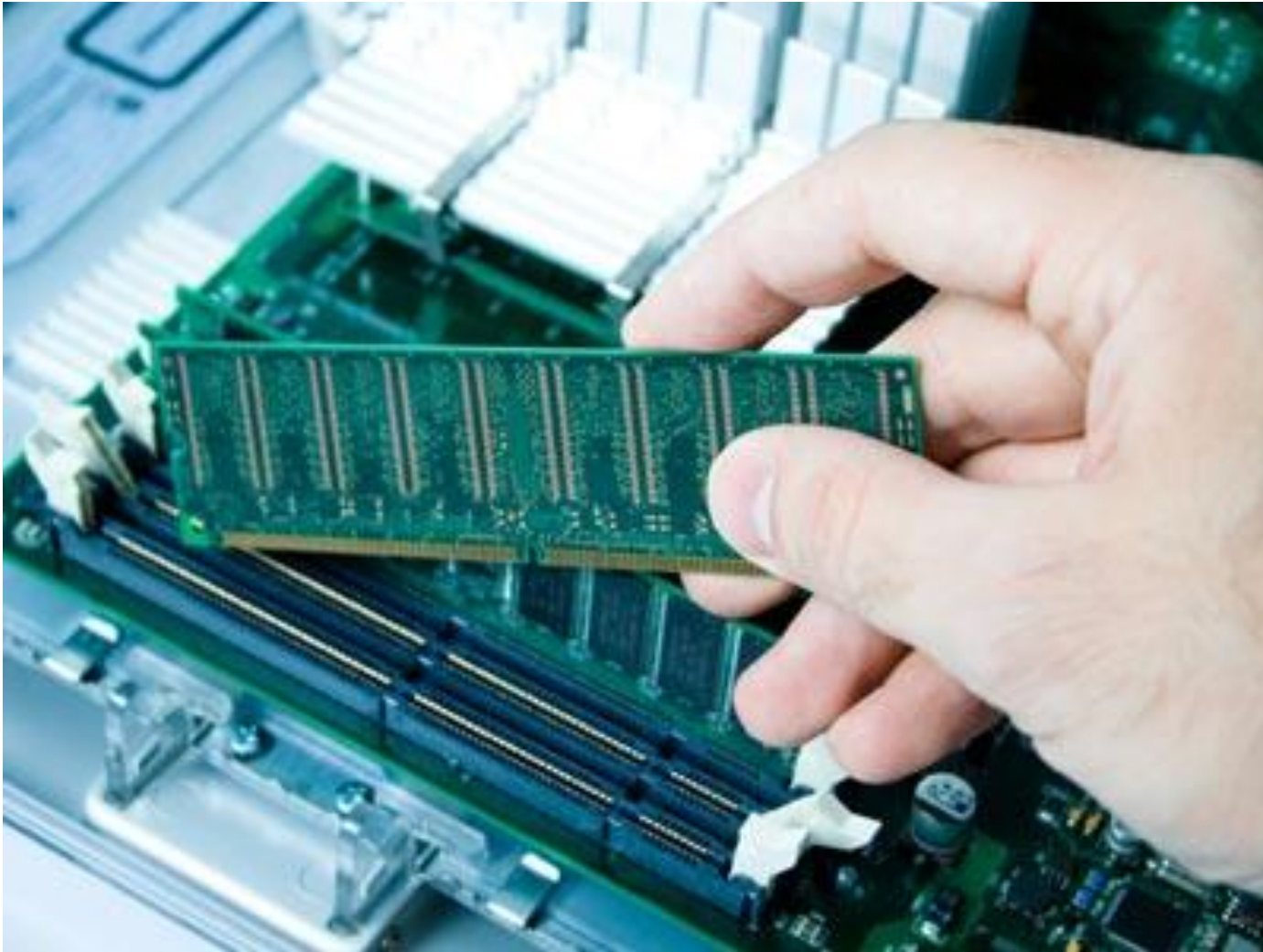
Two types … RAM

➢ DRAM (Dynamic RAM); Main memory

➢ SRAM (Static RAM); Faster and more expensive than DRAM

➢ SRAM = Cache memory

DRAM & SRAM chips

DRAM
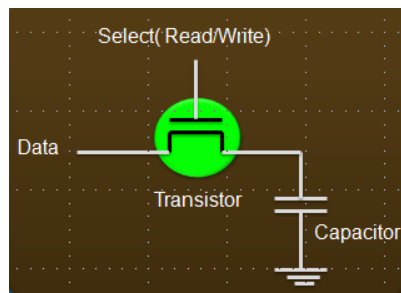
SRAM
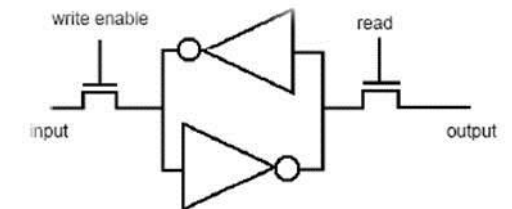
RAM modules (types)

- The memory chips are packaged in memory modules that plug into expansion slots on the main system board (motherboard).

✓ SIMMs

✓ DIMMs

SIMM's   & DIMM's

❑SIMM = Single Inline Memory Module

    ❑(32-bit bus)

❑ DIMM = Dual Inline Memory Module

    ❑(64-bit bus >> more data).

Actual DIMM's
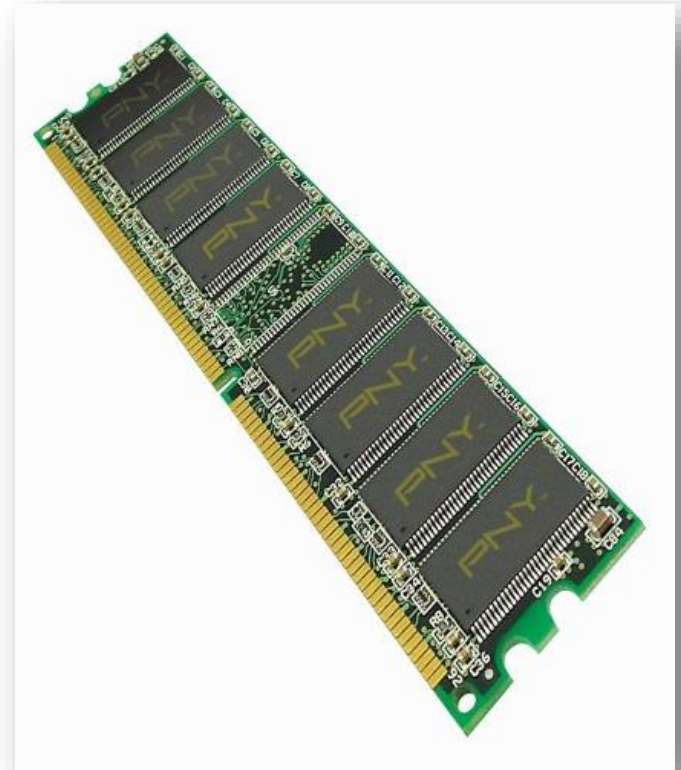
RAM capacities

- System memory (DRAM)

  4-32 GB

- Cache memory (SRAM)

  2-64 MB

What is MB (MegaByte), GB (GigaByte) … ?

What is Byte?

Byte - Bit

1 Byte = 8 Bits

1 Bit   =   0 - 1

bit
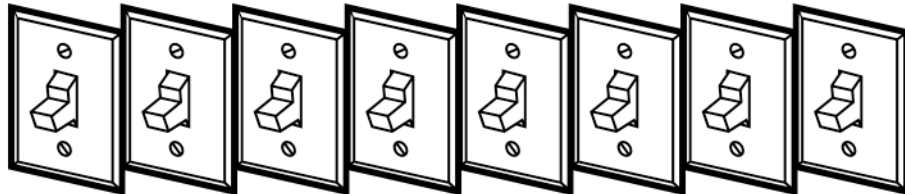
byte

PC/CPU Word

- A PC/CPU-Word is the fixed number of bits that are processed by the CPU' as an instruction-set.
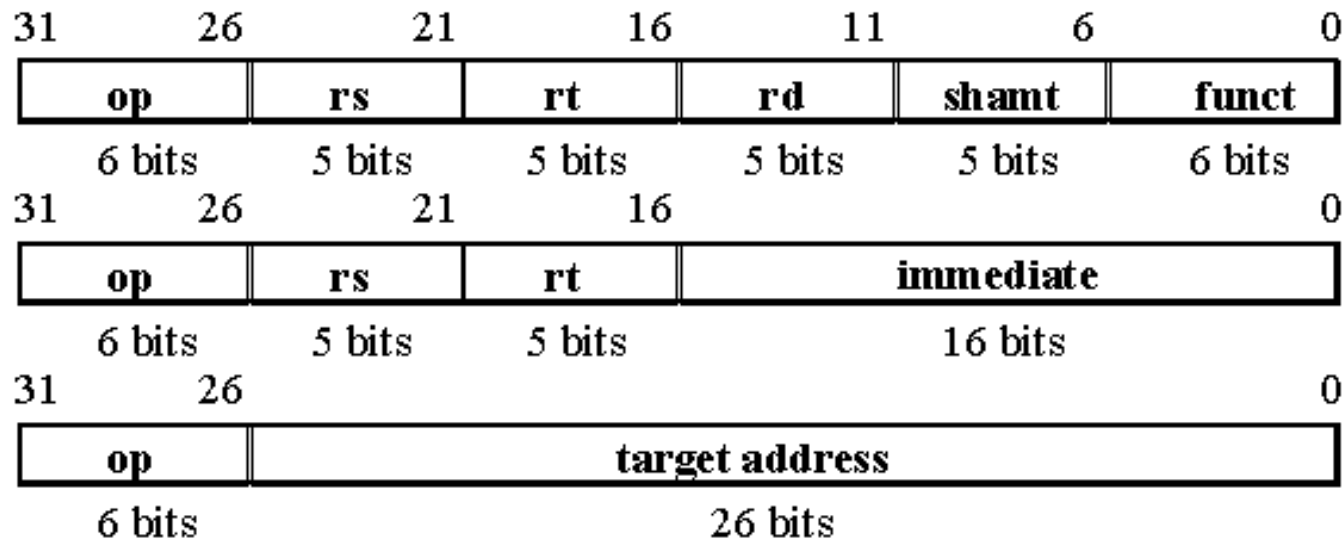
Example…

File.txt

0123456789
0123456789

- The file is 10 Bytes

- Each Byte is 8-Bits (ASCII)

- Therefore Total Bits: 10 X 8 = 80 Bits

- 1 character in our keyboard = 1 Byte

ASCII Code

- Each character (letter-number) corresponds to single ASCII character

- ASCII = American Standard Code for Information Interchange

ASCII codes for some of the keys on a keyboard.

```
SPACE   =   00100000
A   =   01000001      a   =   01100001
B   =   01000010      b   =   01100010
C   =   01000011      c   =   01100011
D   =   01000100      d   =   01100100
E   =   01000101      e   =   01100101
F   =   01000110      f   =   01100111

etc ...               etc ...

RETURN (end of a line)  =   00001010
```
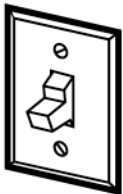
ASCII = American Standard Code for Information Interchange
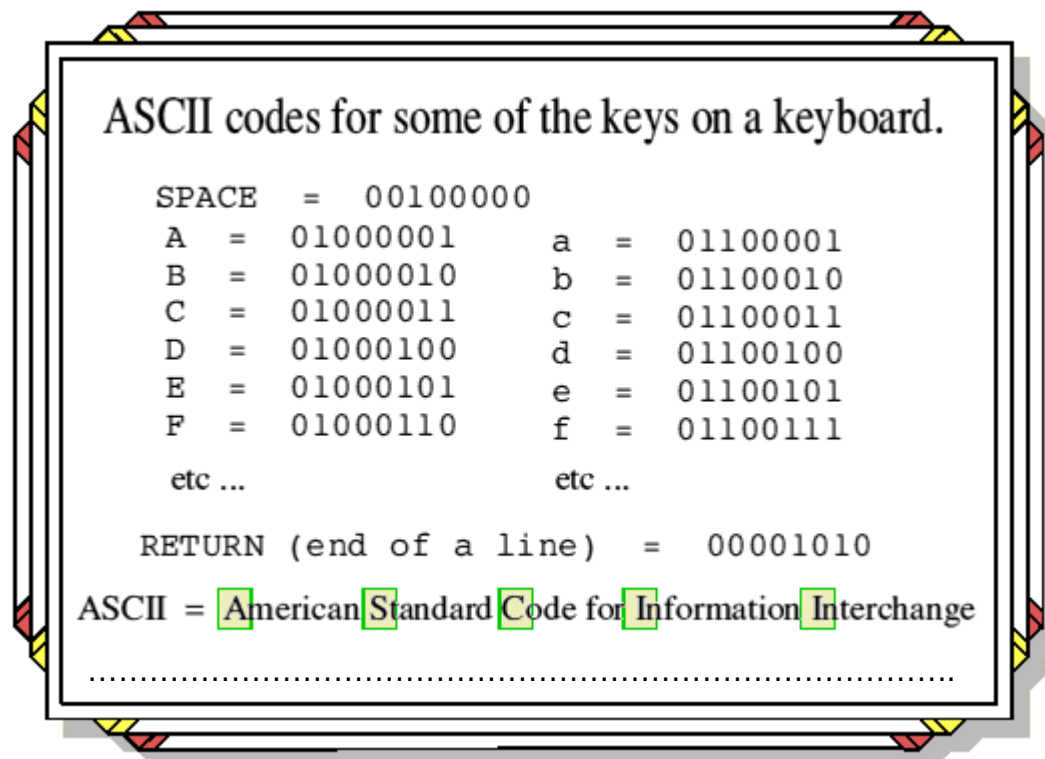
Units used for computer storage

Kilo, Mega, Giga, Tera [SI units]

➢ 1 K (Kilo)   = 1,000

➢ 1 M (Mega) = 1,000,000

➢ 1 G (Giga)   = 1,000,000,000

➢ 1 T (Tera)   = 1,000,000,000,000

• SI = International System of Units

[Kb, Mb, Gb, Tb] … in computer science

- ➢ 1 Kibi (Kilobinary)   = 2^{10} = 1,024   bits
- ➢ 1 Mebi (Megabi)   = 2^{20} = 1,048,576   bits
- ➢ 1 Gibi (Gigabi)   = 2^{30} bits
- ➢ 1 Tebi (Terabi)   = 2^{40} bits

- bi = binary

Size << Songs- Video

Size	Song Capacity	Video content
1 GB	250	
2 GB	500	4-7 hours
8 GB	2,000	30 hours
30 GB	7, 000	100 hours

- What is the memory size … 1 song ?

1 song … about 4 MBytes

Size	Song Capacity	Video content
1 GB	250	
2 GB	500	4-7 hours
8 GB	2,000	30 hours
30 GB	7, 000	100 hours

- 1,000,000,000/250 = 4,000,000 Bytes

- $\qquad\qquad\qquad$ = 4 MBytes

How much RAM do you have in your Computer?

- ➢ Start

- ➢ Settings

- ➢ Control Panel

- ➢ System

How much RAM do you have in your Computer?
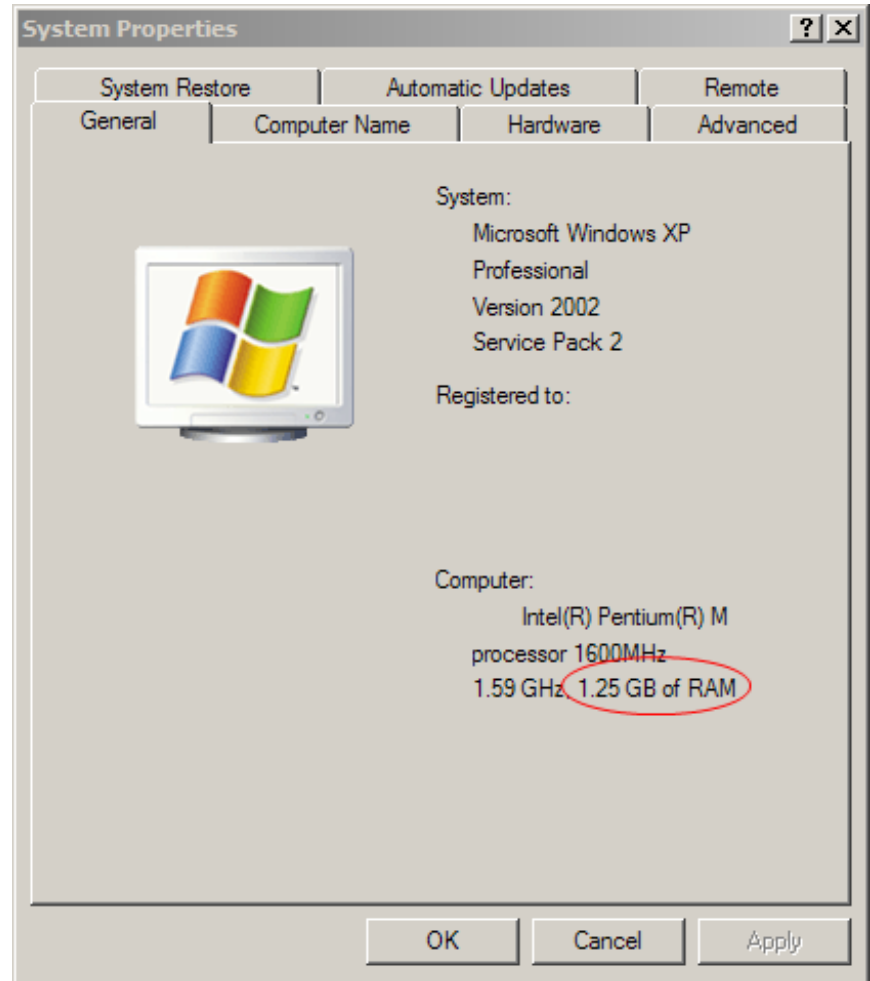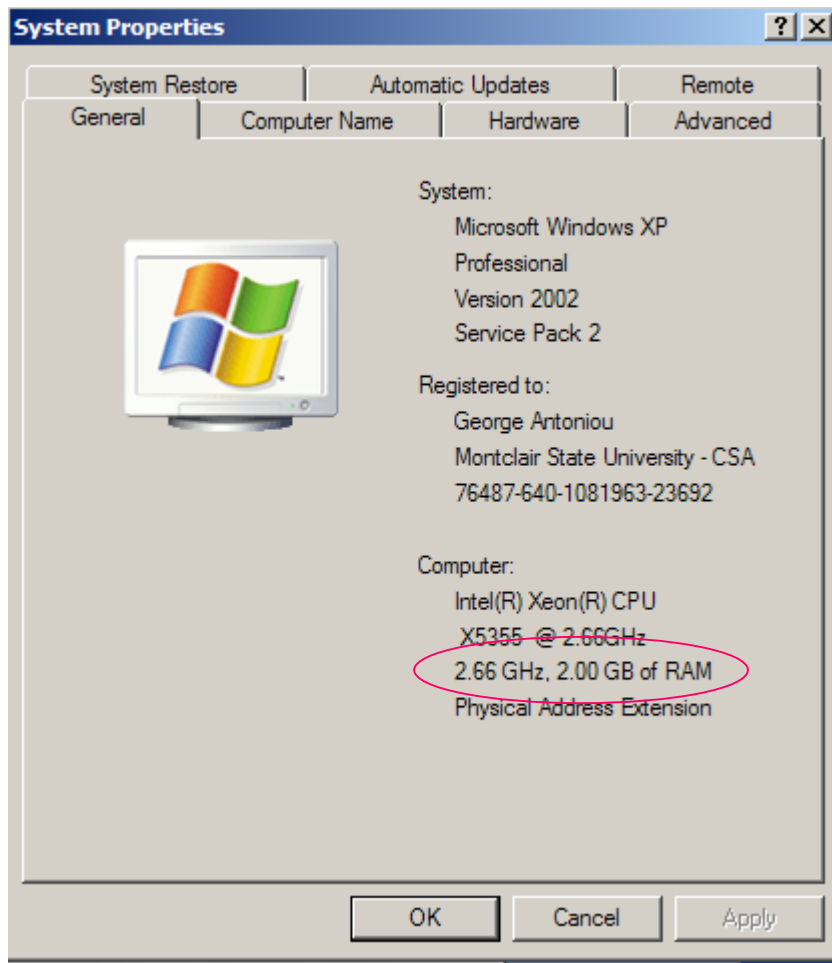
How much RAM do we need?

- Need RAM to run the Windows 7

- Need RAM to run the Microsoft office

- Need RAM to run the Media Player

- …

- Need RAM to run a Graphics Program

- …

Find-out how much memory we need for each program above to run …   **then we add**

We need…

- RAM for Windows 7   =   128 MB

- RAM for Microsoft office   =   128 MB

- RAM for Media Player   =   64 MB

For this Example we need: ??? MB

We need 320 MB of memory …

- RAM for Windows 7   =   128 MB

- RAM for Microsoft office   =   128 MB

- RAM for Media Player   =   64 MB

For this Example we need: 320 MB

If we have only 256MB System Memory, then what happens?

Another "invisible" Memory;

➢ Non-Physical memory … invisible to us …

➢ Computers have limited memory (DRAM)

➢ In order to run more than one applications ... we need MORE memory (DRAM)…

➢ The computer (Windows OS) borrows some memory (virtual) from the hard disk (very slow) ... in order for all applications to run ...

➢ Using Virtual-Memory … we slow down the computer

➢ If you need to run many applications at the same time … get more physical memory (DRAM).

Hard disk and RAM

Virtual Memory; Logical address space
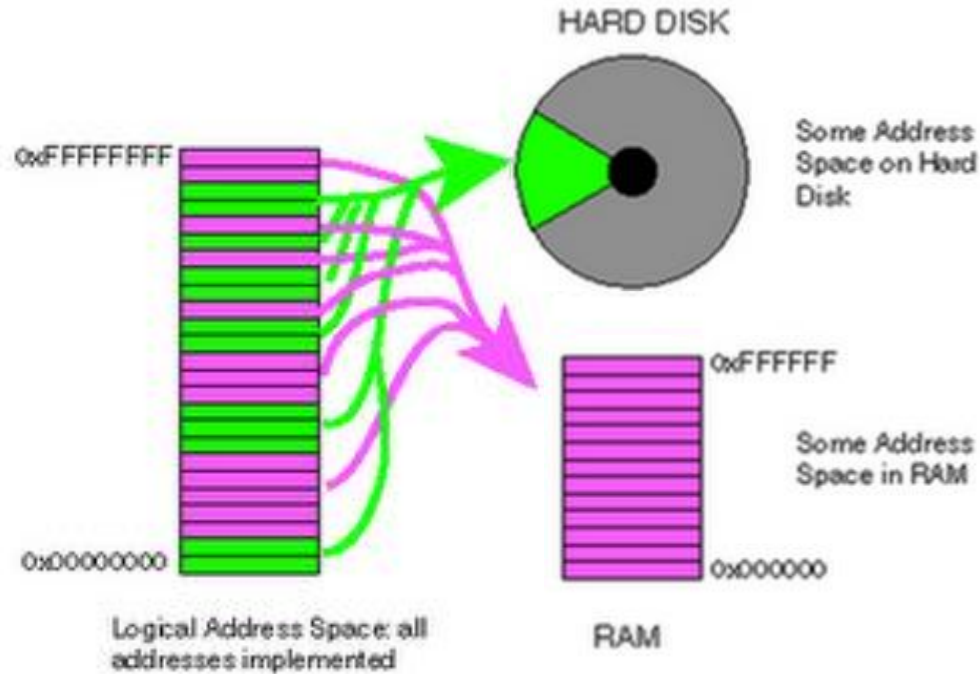
Continue about Computers

- CPU (Central Processing Unit)   ← last lecture

- Memory (RAM)   ← last lecture

- More about Memories   ← Next Lecture

- I/O (Input/Output) units = peripheral devices

- Computer Systems …

Basic Components of a Computer