Introduction To Computers: Hardware and Software

James Tam

What Is Hardware?

The physical components of a computer system e.g., a monitor, keyboard, mouse and the computer itself.

Basic Units Of Measurement

Bit

- *bi*nary digi*t*
- smallest unit of measurement
- two possible values

Byte

- 8 bits

Word

- The number of adjacent bits that can be stored and manipulated as a unit
- 32, 64 for home computers, 128 for the most powerful

Large Units Of Measurement (Memory, Storage)

Note: use powers of two because computer memory and storage are based on the basic unit (bit).

Kilobyte (kB) – a thousand bytes ($1,024 = 2^{10}$)

Megabyte (MB) - a million ($1,048,576 = 2^{20}$)

Gigabyte (GB) – a billion ($1,073,741,824 = 2^{30}$)

Terabyte (TB) – a trillion ($1,099,511,627,776 = 2^{40}$)

~ 20 million four-drawer filing cabinets full of text

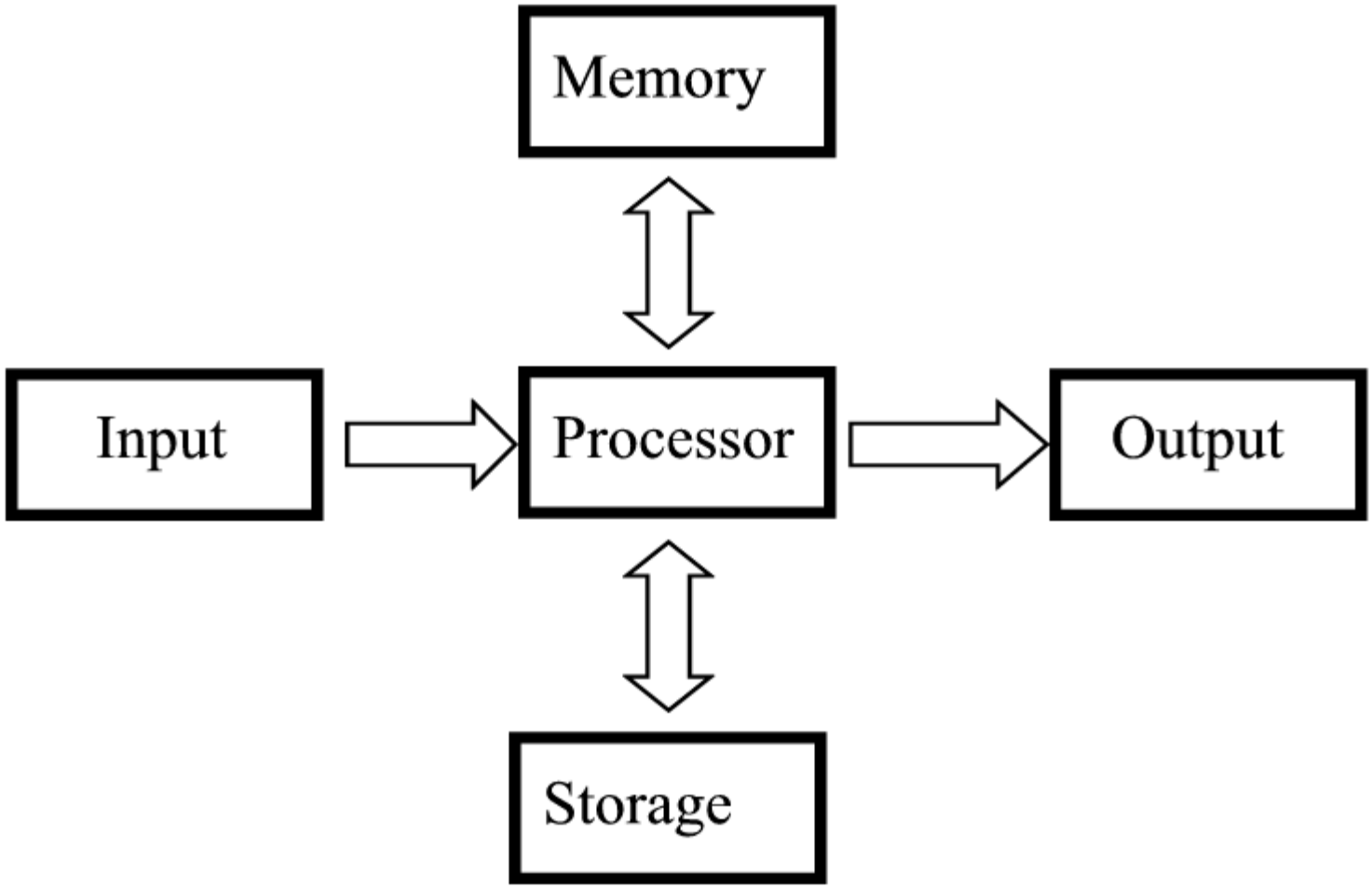
Small Units Of Measurement (Speed)

millisecond (ms) – a thousandth of a second ($1/1{,}000 = 10^{-3}$)

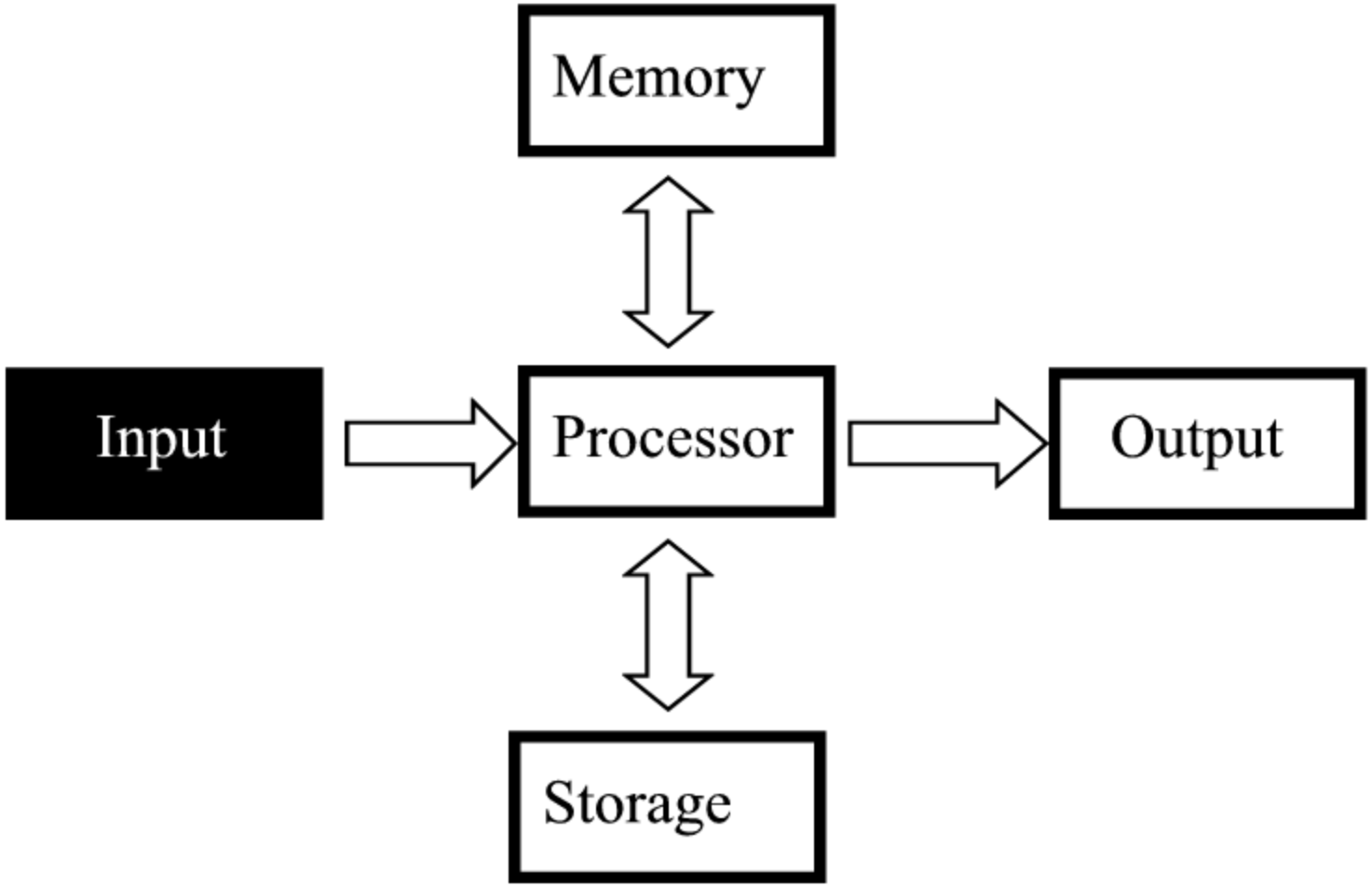
microsecond (μs) - a millionth of a second ($1/1{,}000{,}000 = 10^{-6}$)

nanosecond (ns) – a billionth of a second ($1/1{,}000{,}000{,}000 = 10^{-9}$)

High Level View Of A Computer



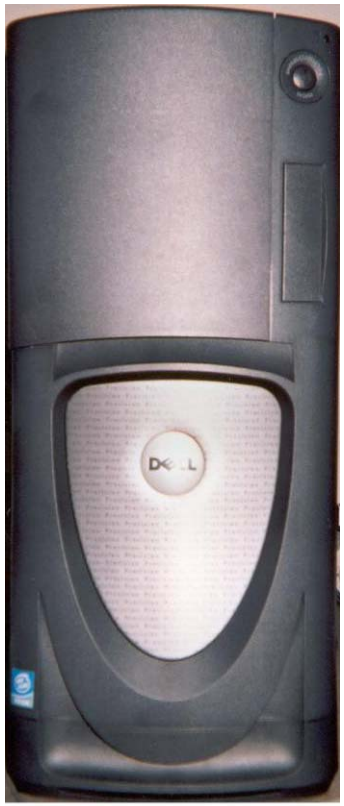
Input



Input Devices

Used by a person to communicate to a computer.

Person to computer



Example Input devices

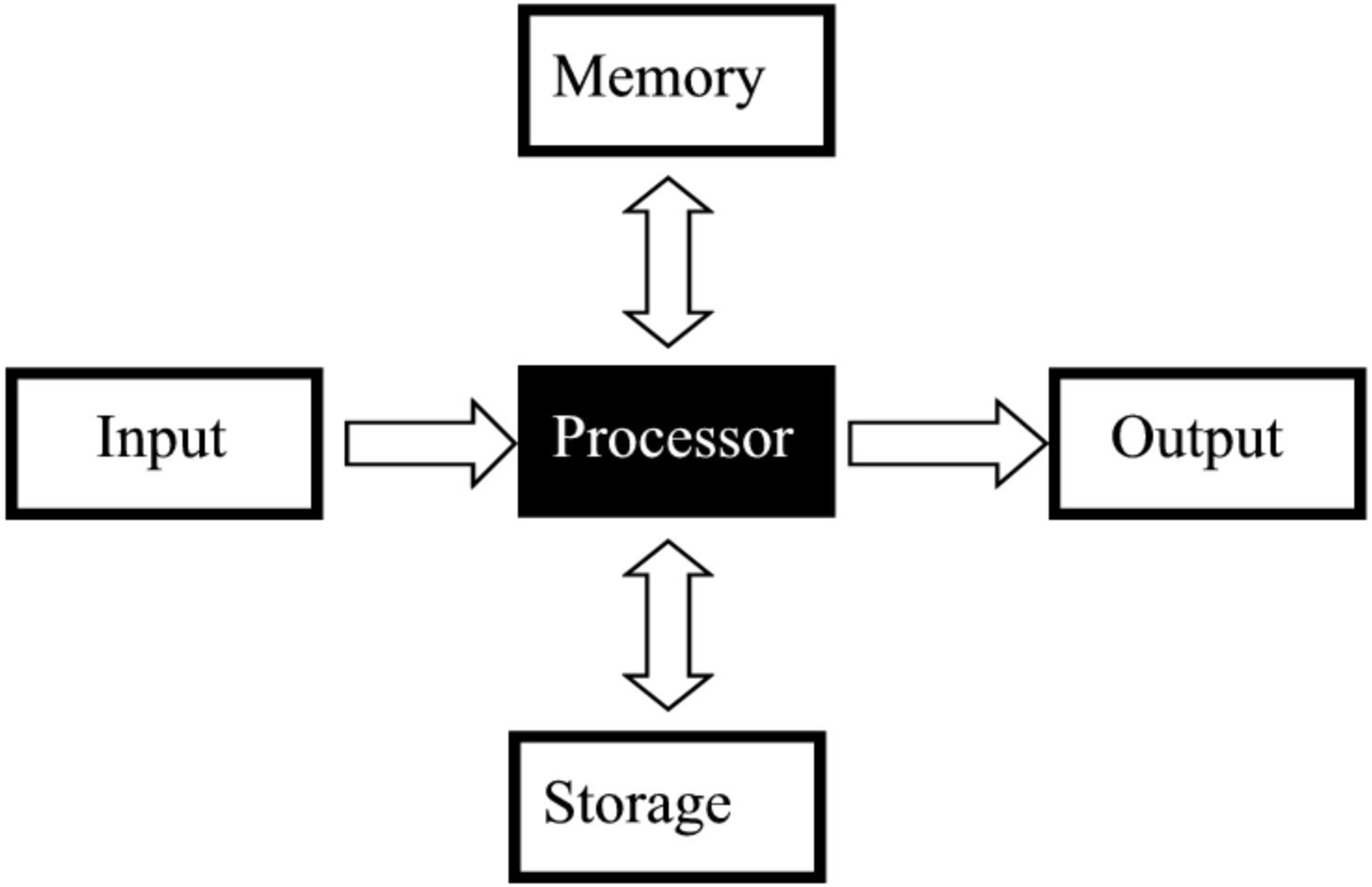
Keyboard

Mouse

Need not be mundane! (A Jouse)

From http://www.jouse.com/

Processor



Processor

The brains of a computer (maybe not…)

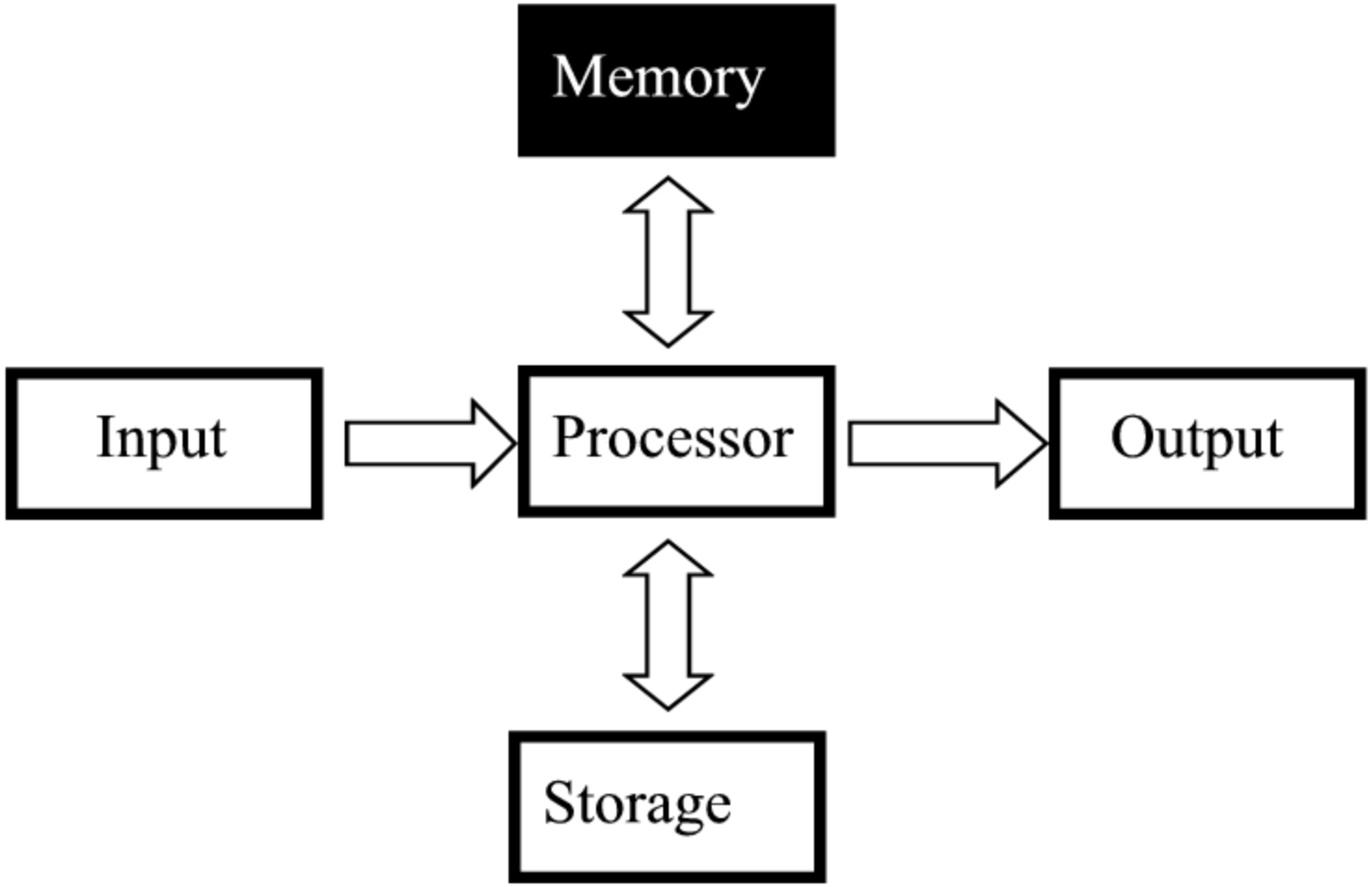
A real processor

Processor Speed

Determined by:

- Type of processor e.g., Pentium III, IV, AMD Duron, Athalon
- Clock speed
  - 1 Hz = 1 pulse is sent out each second (1 second passes between each pulse)
  - 10 Hz = 10 pulses are sent out each second (0.1 seconds passes between each pulse)
  - :
  - 25 MHz machine = 25 million pulses sent out each second (0.000 000 04 seconds between each pulse or 40 ns between pulses)

Memory



RAM

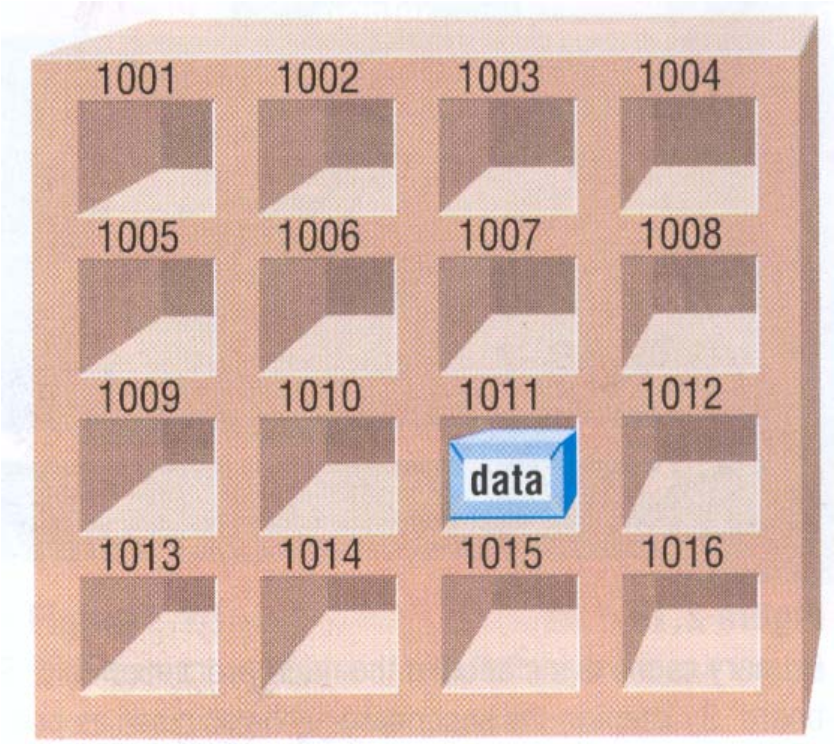
Volatile

Used for temporary storage

Typical ranges 256 MB ~1 GB

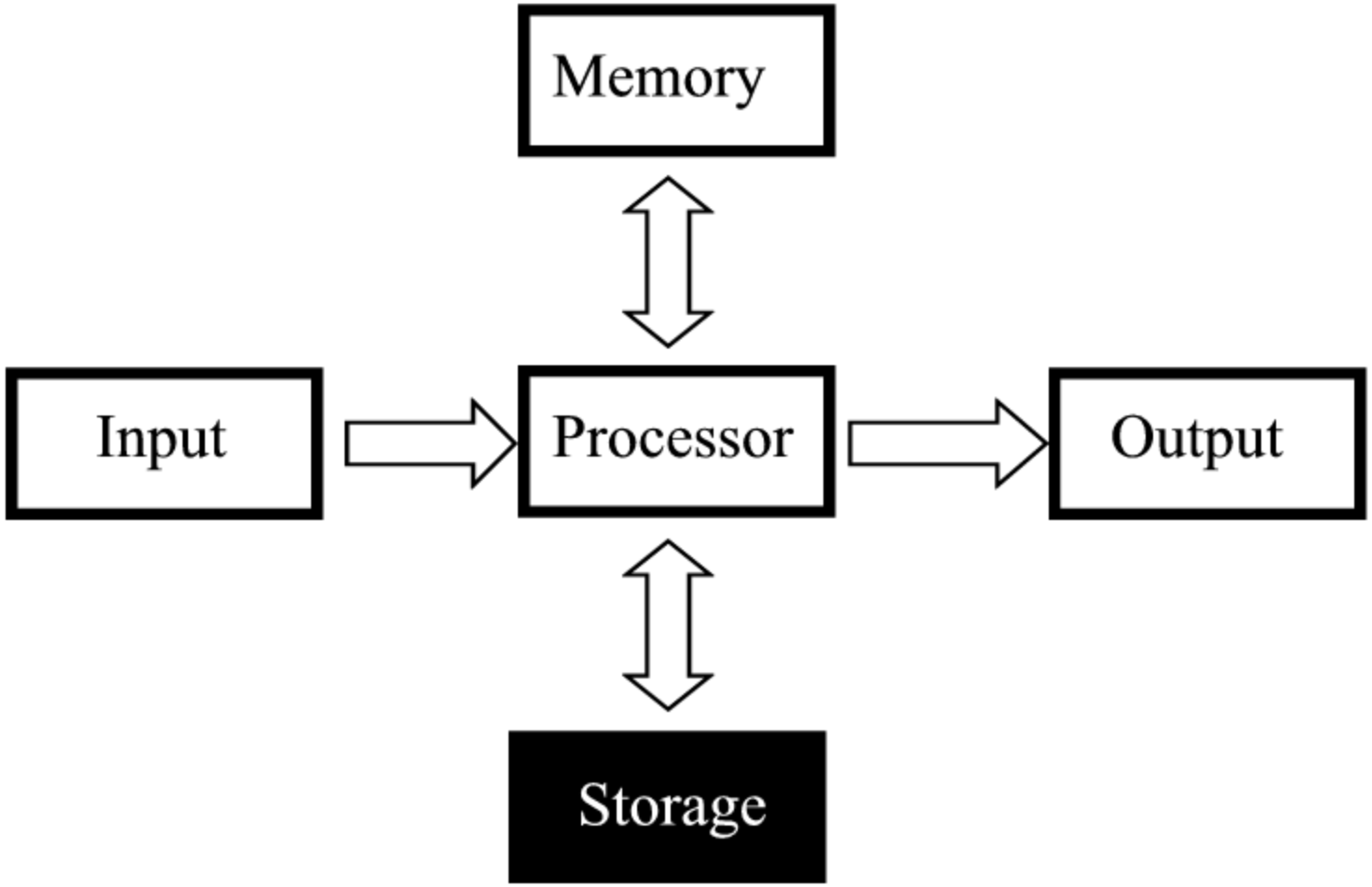
RAM

Means direct access to any part of memory



Picture from Computers in your future by Pfaffenberger B

Storage



Storage Vs. Memory?

Memory (e.g., RAM)

- **keep the information for a shorter period of time**
- **faster**
- **more expensive**
- **"scrap paper for the computer"**

Storage (e.g., Hard disk)

- **the information is retained longer**
- **slower**
- **cheaper**
- **"file cabinet for the computer"**

Categories Of Storage

1) Magnetic

- Floppy disks
- Zip disks
- Jazz drives
- Hard drives

2) Optical

- CD-ROM
- DVD

Magnetic Drives: A Hard Drive In Action

Magnetic Drives: Storage Capacities

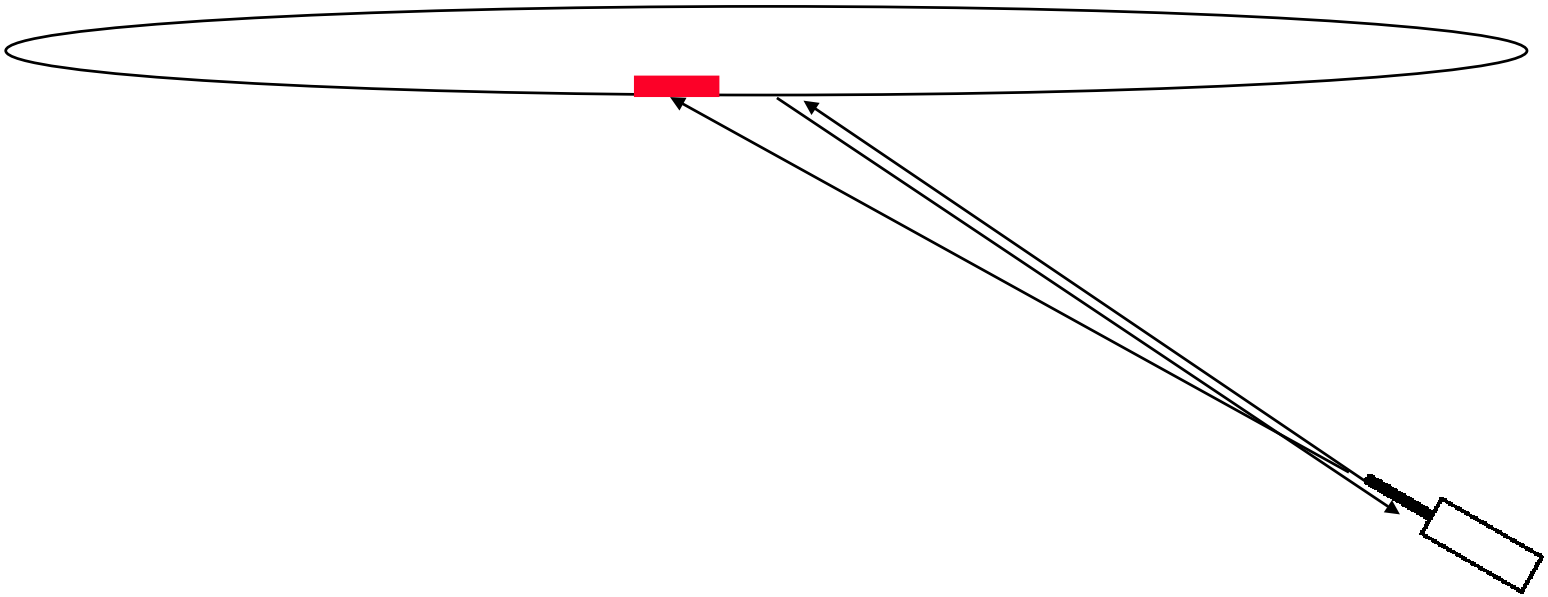
Floppy disks
- ~ 1 MB

Zip disks
- 100 or 250 MB

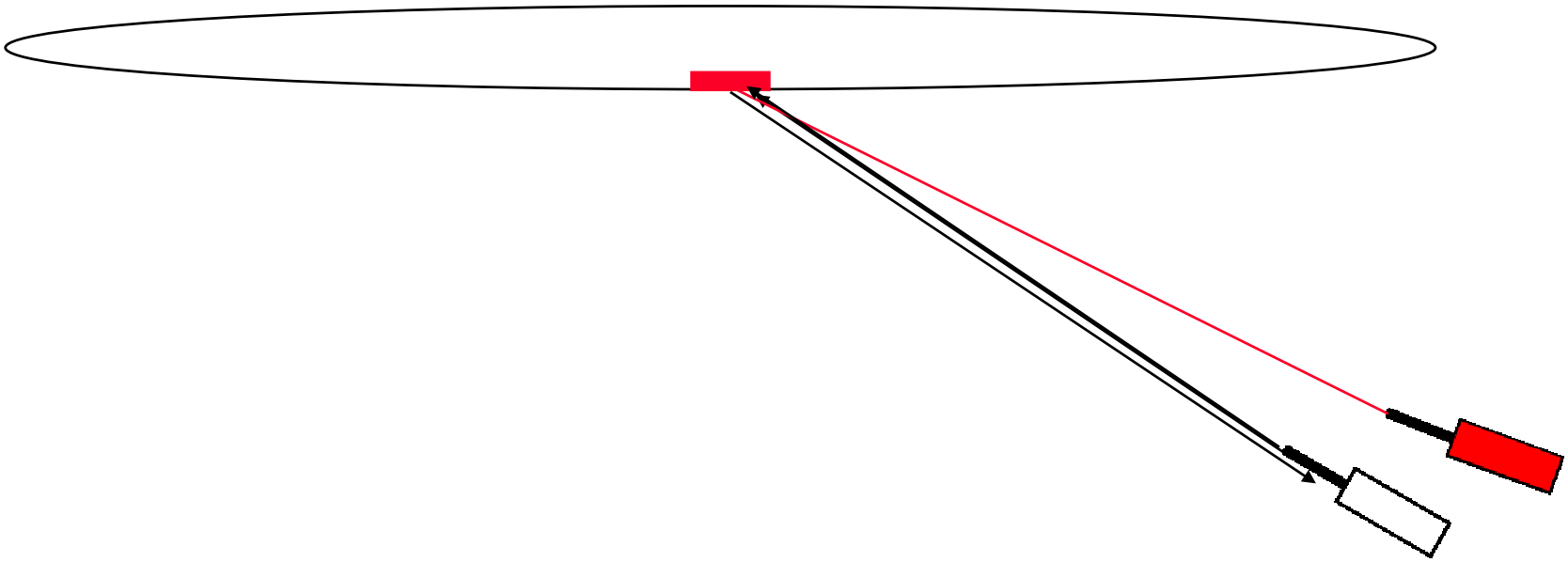
Jazz drives
- 1 – 2 GB

Hard drives
- ~20 – 120+ GB

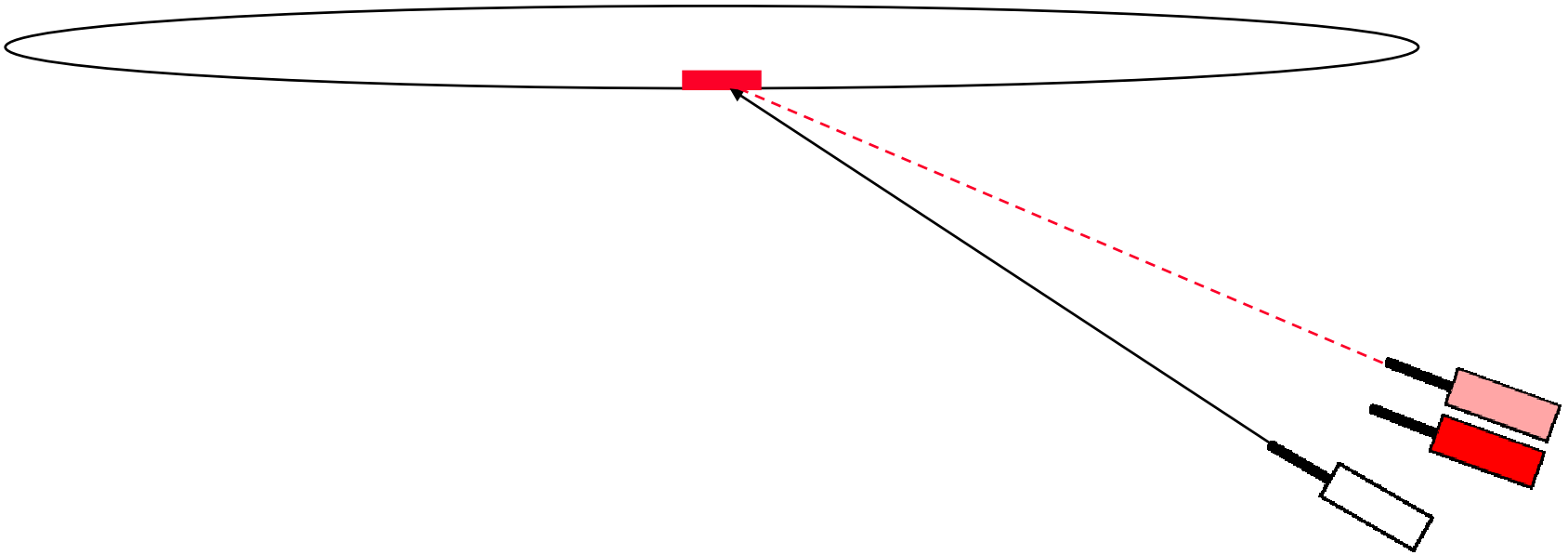
Optical Drives: Reading Information



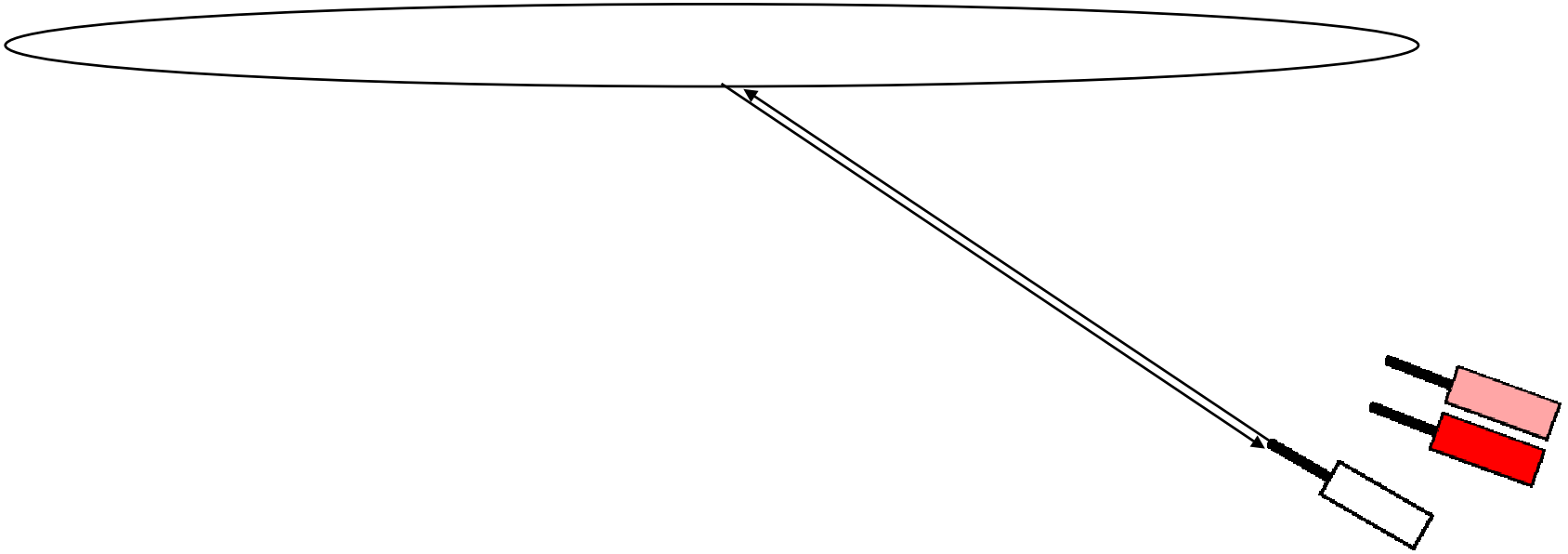
Optical Drives: Recording and Reading Information



Optical Drives: Re-writing



Optical Drives: Re-writing



Optical Drives

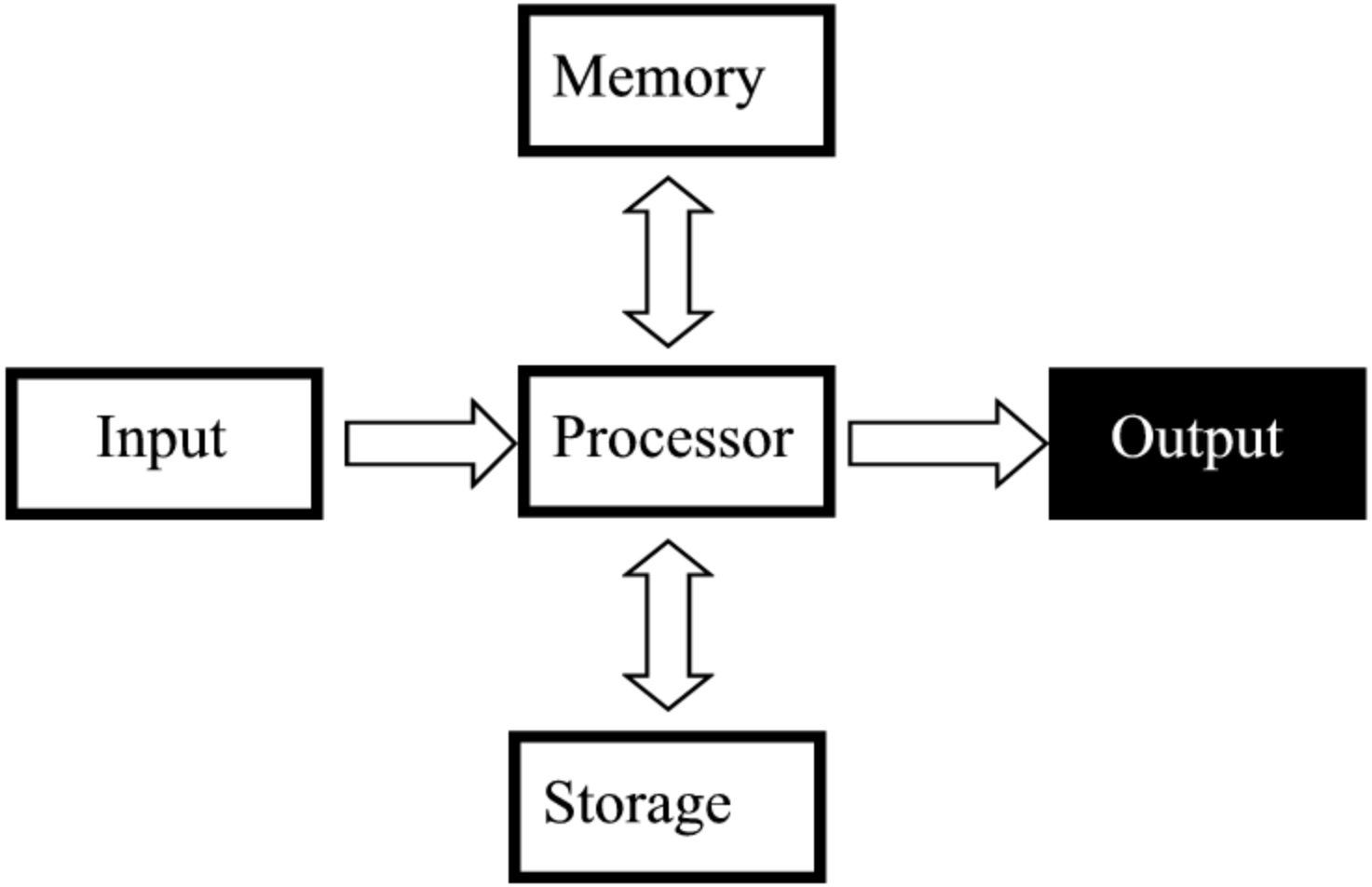
CD's

- ~ 700 MB storage
- CD-ROM (read only)
- CD-R: needs a CD-burner to create (*r*ecord) to a CD
- CD-RW: can write and erase CD to reuse it (*r*e-*w*ritable)

DVD-ROM

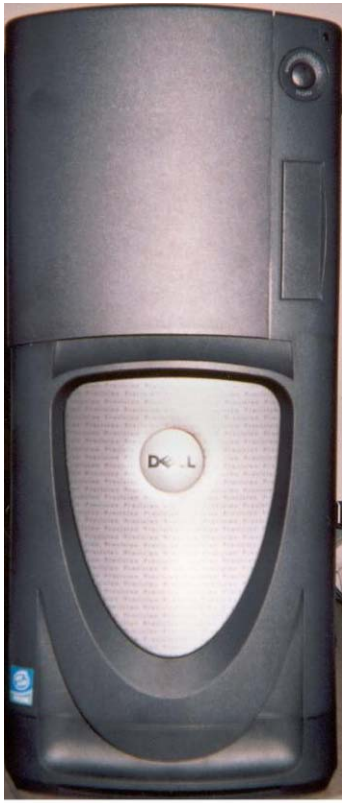
- ~ 3.8 – 17 GB storage
- DVD- ROM (read only)
- Many recordable formats (e.g., DVD/CD-RW, DVD-RAM, DVD-R, CD-RW etc)

Output



Output Devices

Displays information from the computer to the a person.



The Most Common Output Device: The Monitor

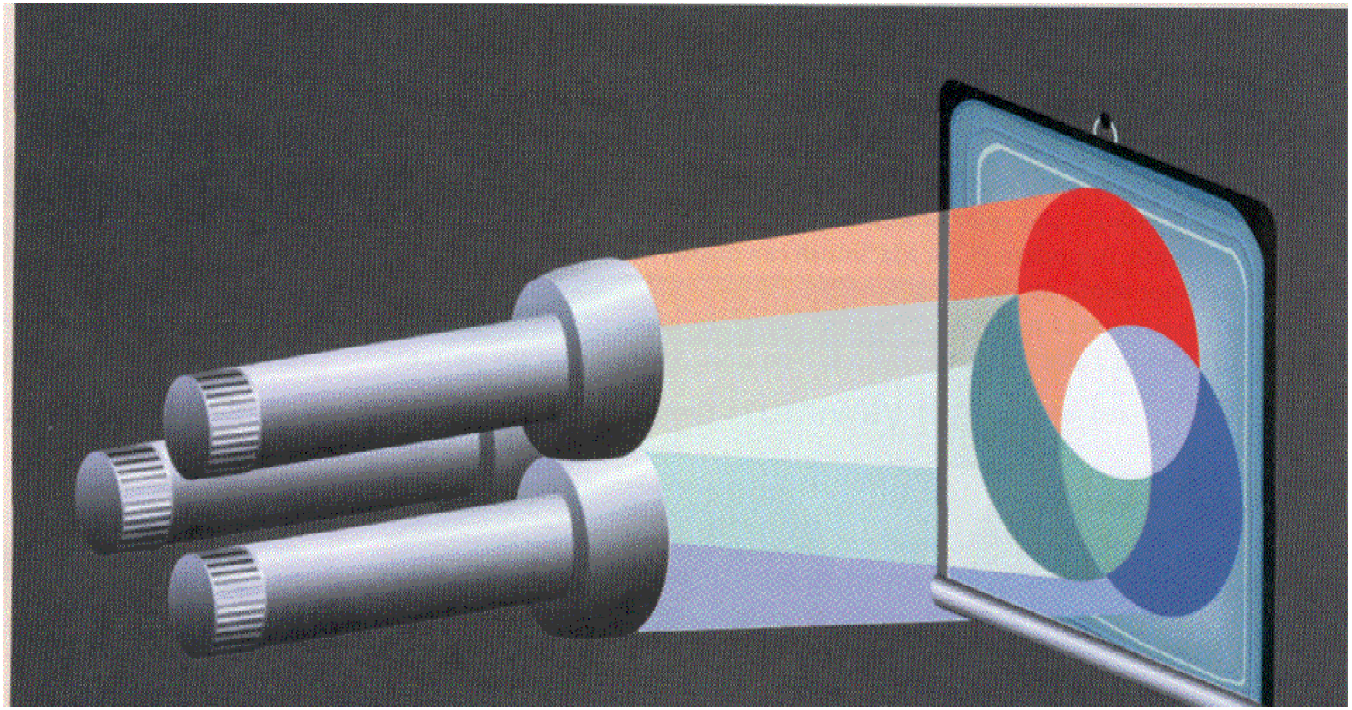
Types of computer monitors

1) CRT's (Cathode Ray Tube)

2) LCD's (Liquid Crystal Display)

CRT's Monitors

Images are displayed with dots (pixels) drawn with light "guns"

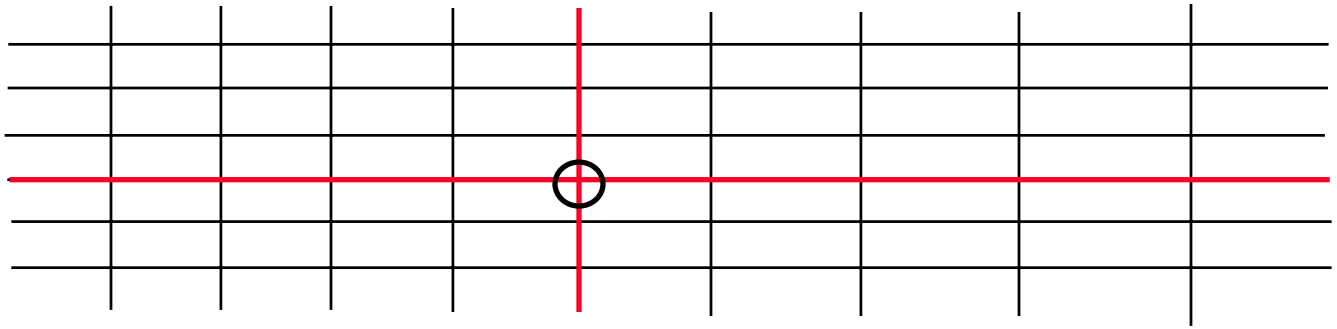


Picture from Computer Confluence by Beekman G.

LCD Monitors

Employ a conductive grid for each row and column

The meeting of a row and column allows light to be emitted (a pixel can be seen)



Determinants Of The Quality Of Monitors

1) Size
2) Resolution
3) Color depth
4) Dot pitch

1) Monitor Quality (size)

Measured diagonally

2) Monitor quality (resolution)

Columns of pixels x Rows of pixels

Col 1, Row 1	Col 2, Row 1	Col 3, Row 1	…	Col [c], Row 1
Col 1, Row 2				Col [c], Row 2
Col 1, Row 3				Col [c], Row 3
:				:
Col 1, Row [r]	Col 2, Row [r]	Col 3, Row [r]	…	Col[c], Row[r]

For a given monitor size, the higher the resolution the sharper the image

3) Monitor Quality (Color Depth)

The number of possible colors that can be displayed for each pixel.

e.g. monochrome (single color) | 1 |

2 possible values

Uses up 1 bit of space

3) Monitor Quality (Effects Of Color Depth)

2 colors

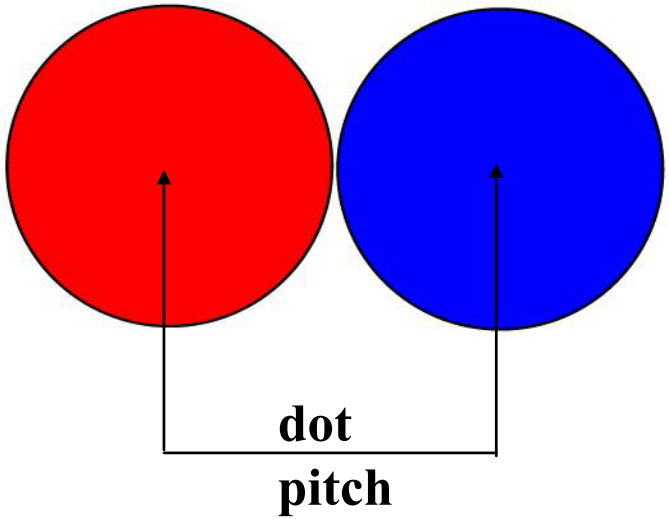
16 colors

256 colors

16 million colors

4) Monitor Quality (Dot Pitch)

Dot pitch is the distance between the center of each color dot (mm)



Refresh rate of monitors

How fast the screen is redrawn

(70 Hz / 70 times per second is usually a good minimum)

All The Basic Parts Together

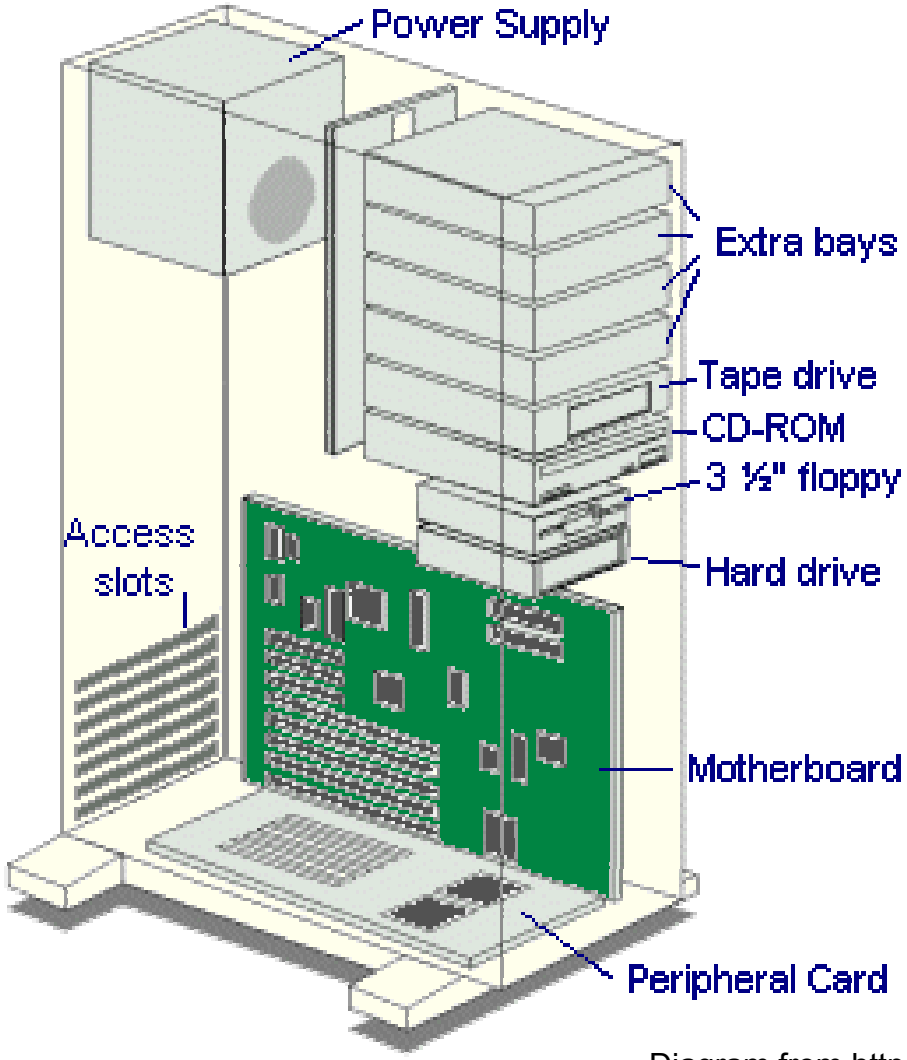


Diagram from http://www.jegsworks.com

The Motherboard

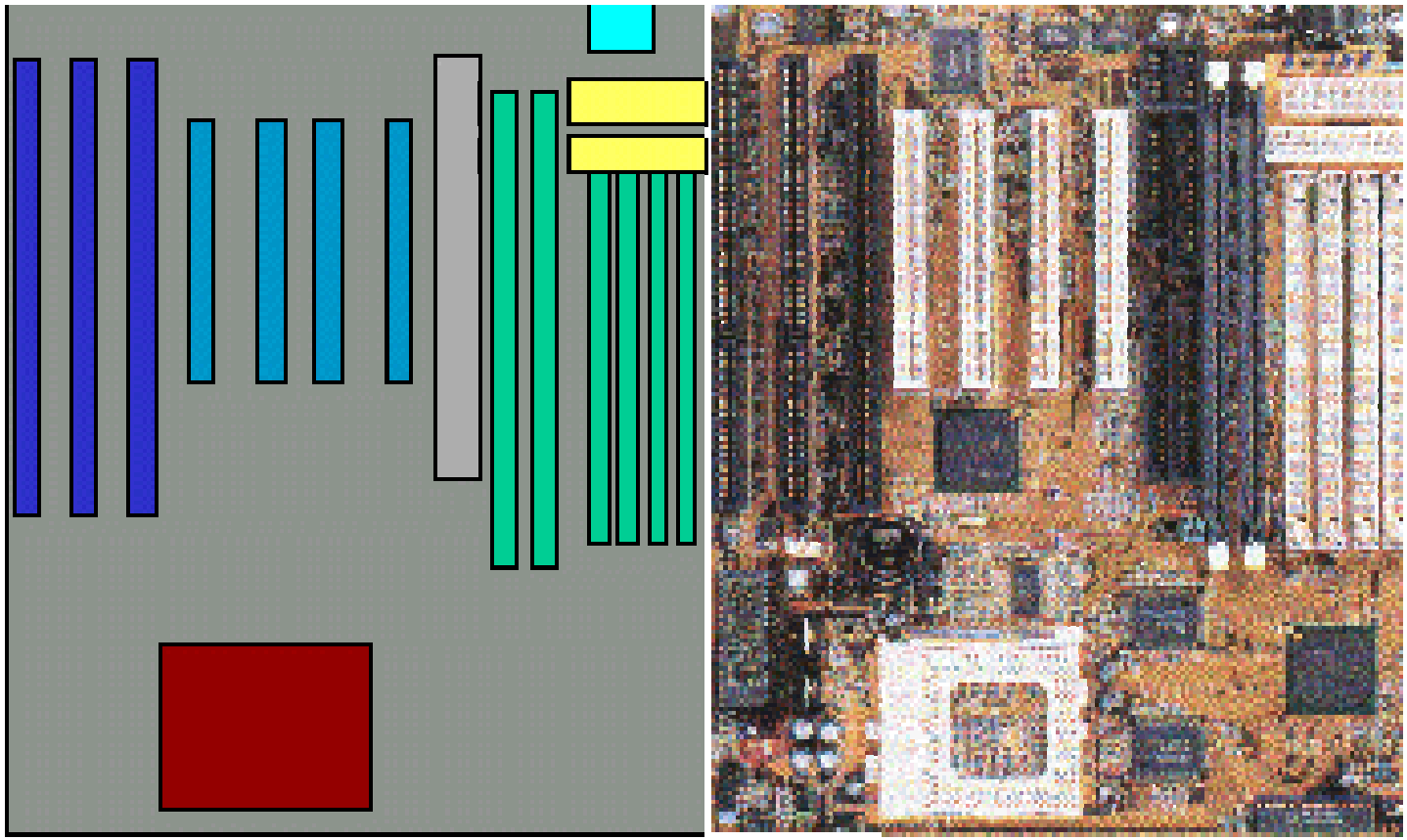


Diagram from http://www.jegsworks.com

Printers

Common types

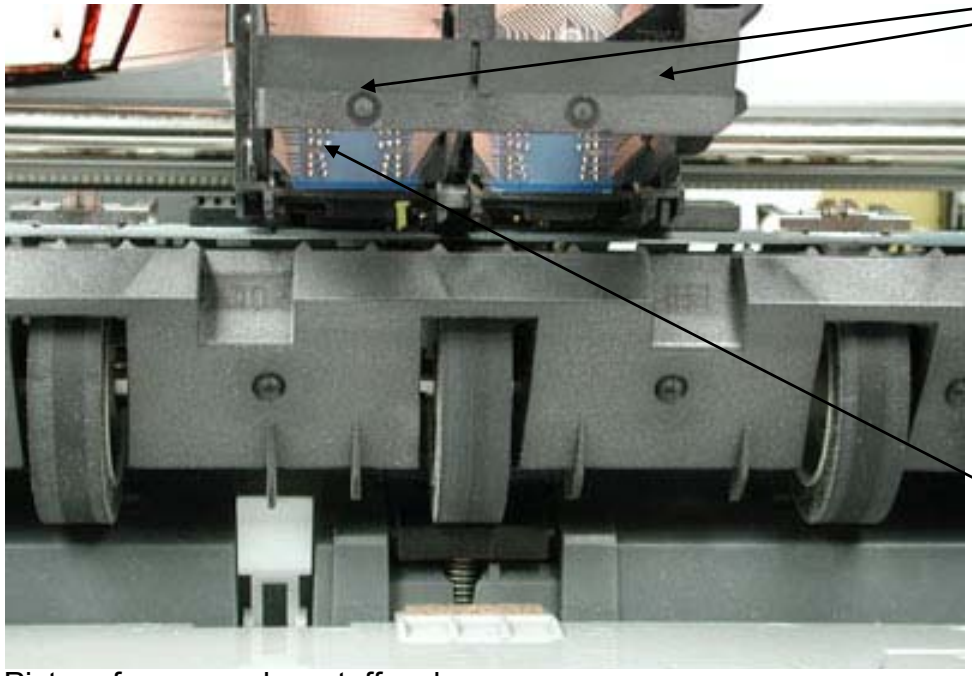
•Inkjet

•Laser

Note: By default on the CPSC network you only have access to text-only printers (do not print formatted text or graphics on them!) You can pay a minimal fee to access the laser printers.

How Inkjet Printers Work.

Use a series of nozzles to spray drops of ink directly on the paper



Picture from www.howstuffworks.com

How Laser Printers Work

Use a laser to produce patterns on an ink drum using static electricity

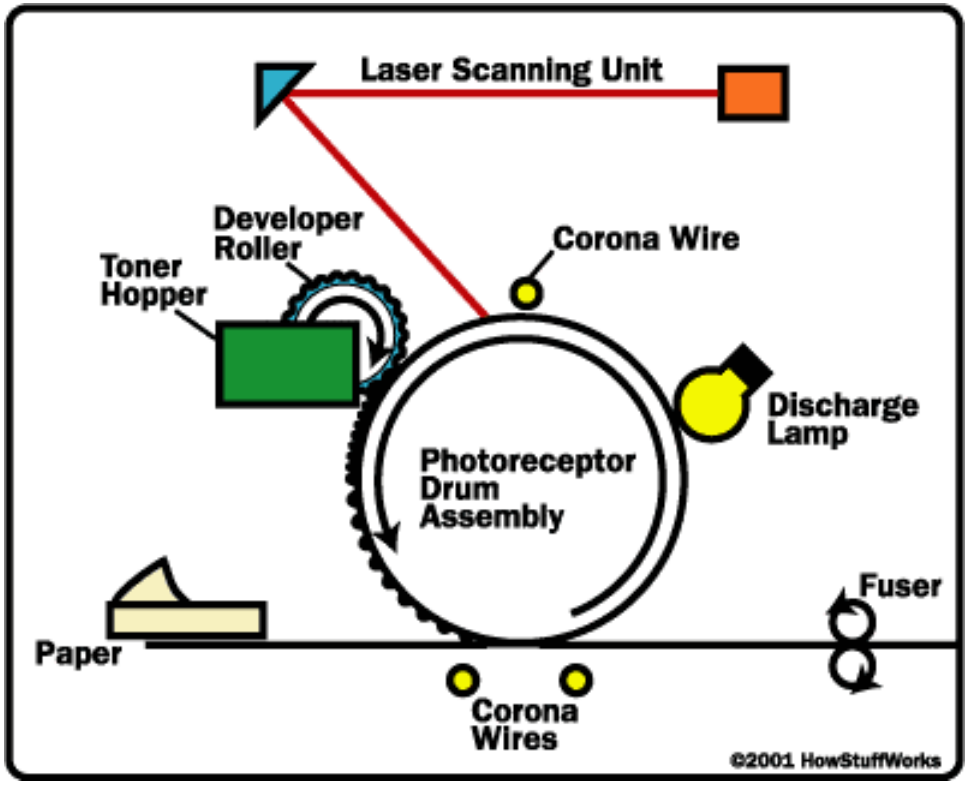
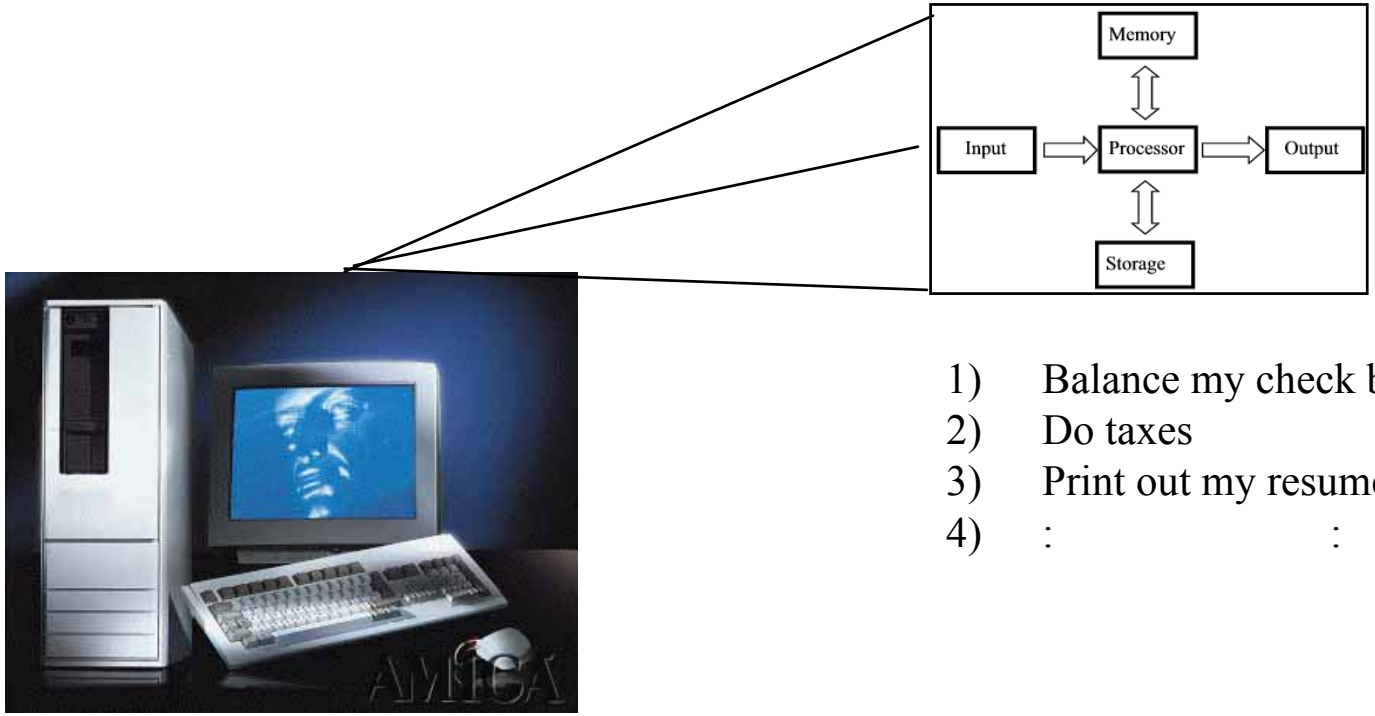


Diagram from www.howstuffworks.com

Software

The instructions that tell the hardware what to do.



1) Balance my check book.
2) Do taxes
3) Print out my resume
4) : :

Categories Of Software

1) Application programs (applications)
2) Operating systems
3) Compilers

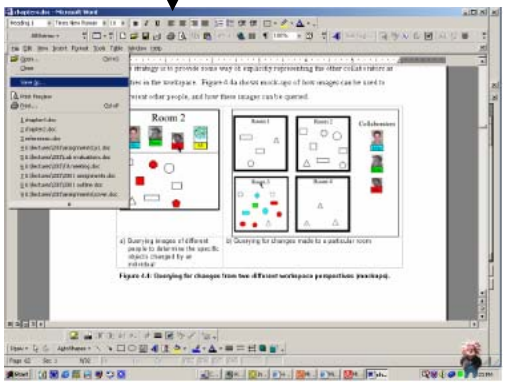
1) Common Types Of Application Programs

1) Word processors
2) Spreadsheets
3) Databases
4) Presentation software
5) Web browsers

2) Operating Systems: What Do They Do?

1) Act an an intermediary between the user and the hardware
2) Manage the resources of the computer
3) Some may act to secure some parts of the computer

Operating Systems: The Intermediary Between The User And The Hardware

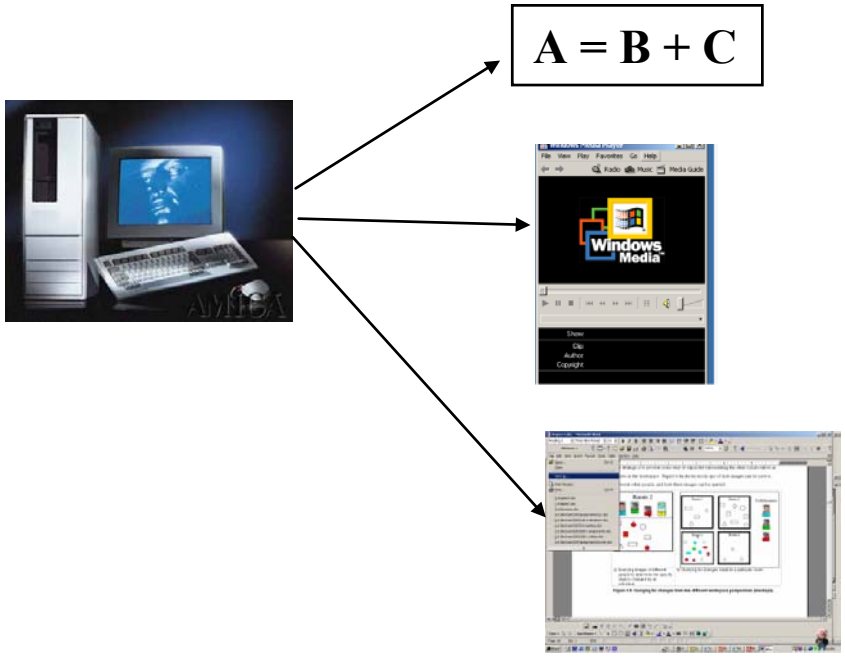


Microsoft Windows

(operating system)

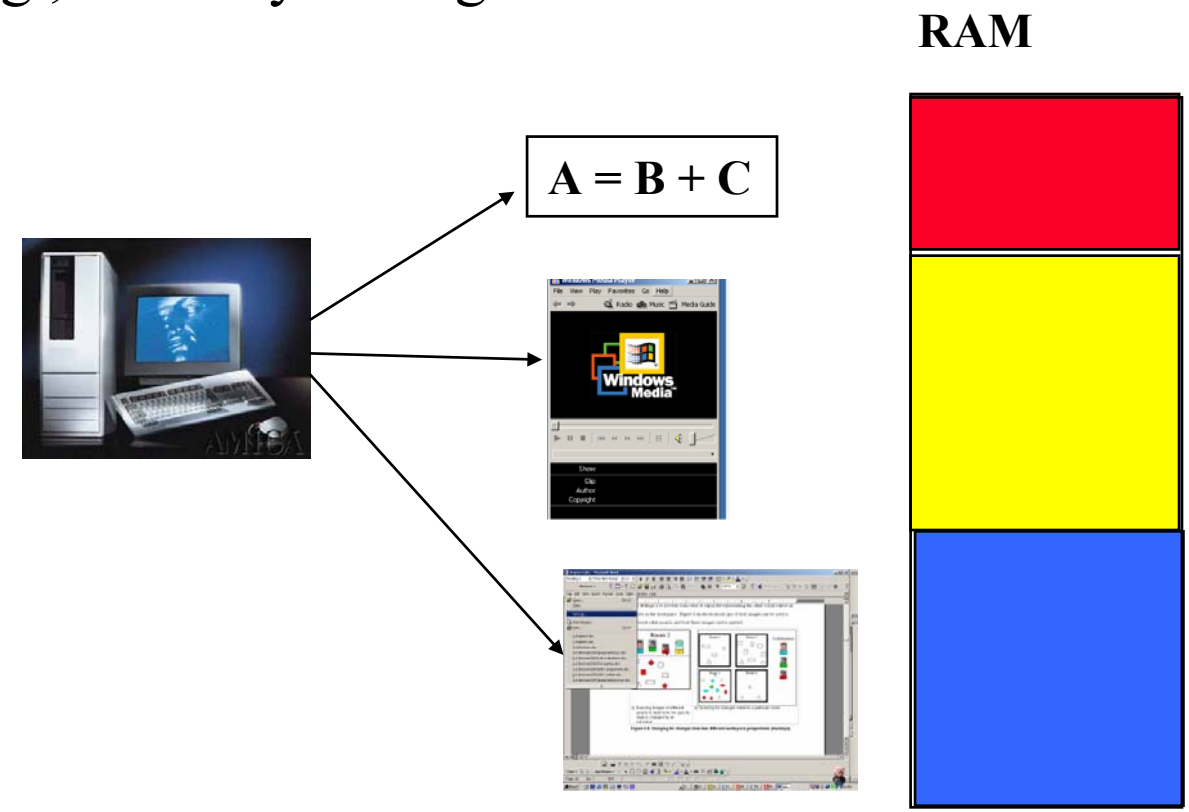
Operating Systems: Manage System Resources (1)

e.g., Processor time



Operating Systems: Manage System Resources (2)

e.g., Memory management

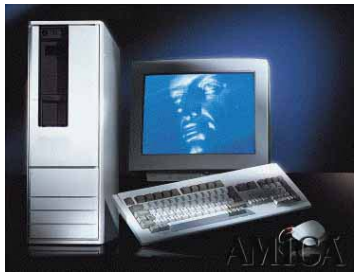


Operating Systems: Securing The Computer (not done)

Single (faceless) user – security less of an issue

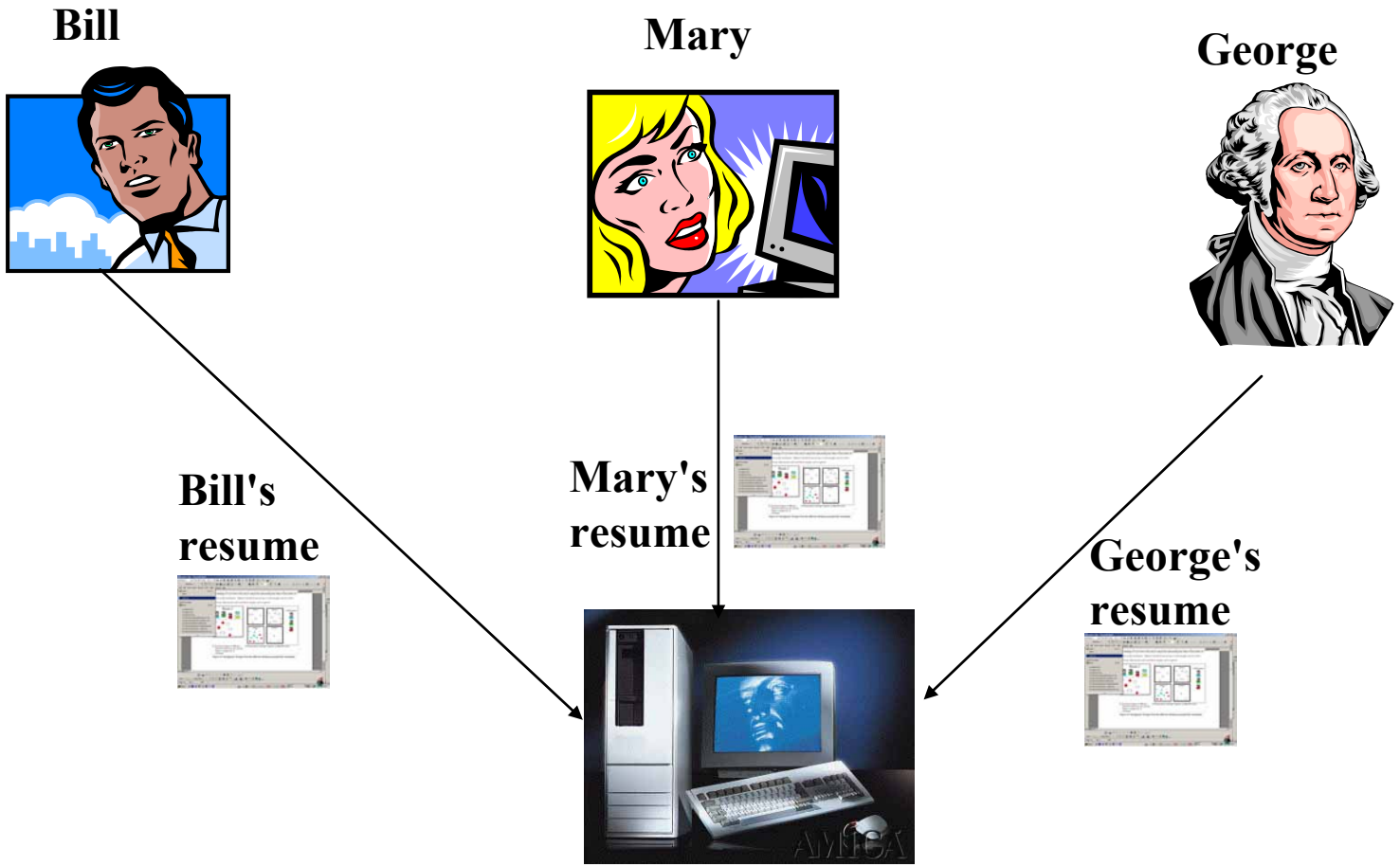
Claude Rains from Phantom of the Opera

My resume



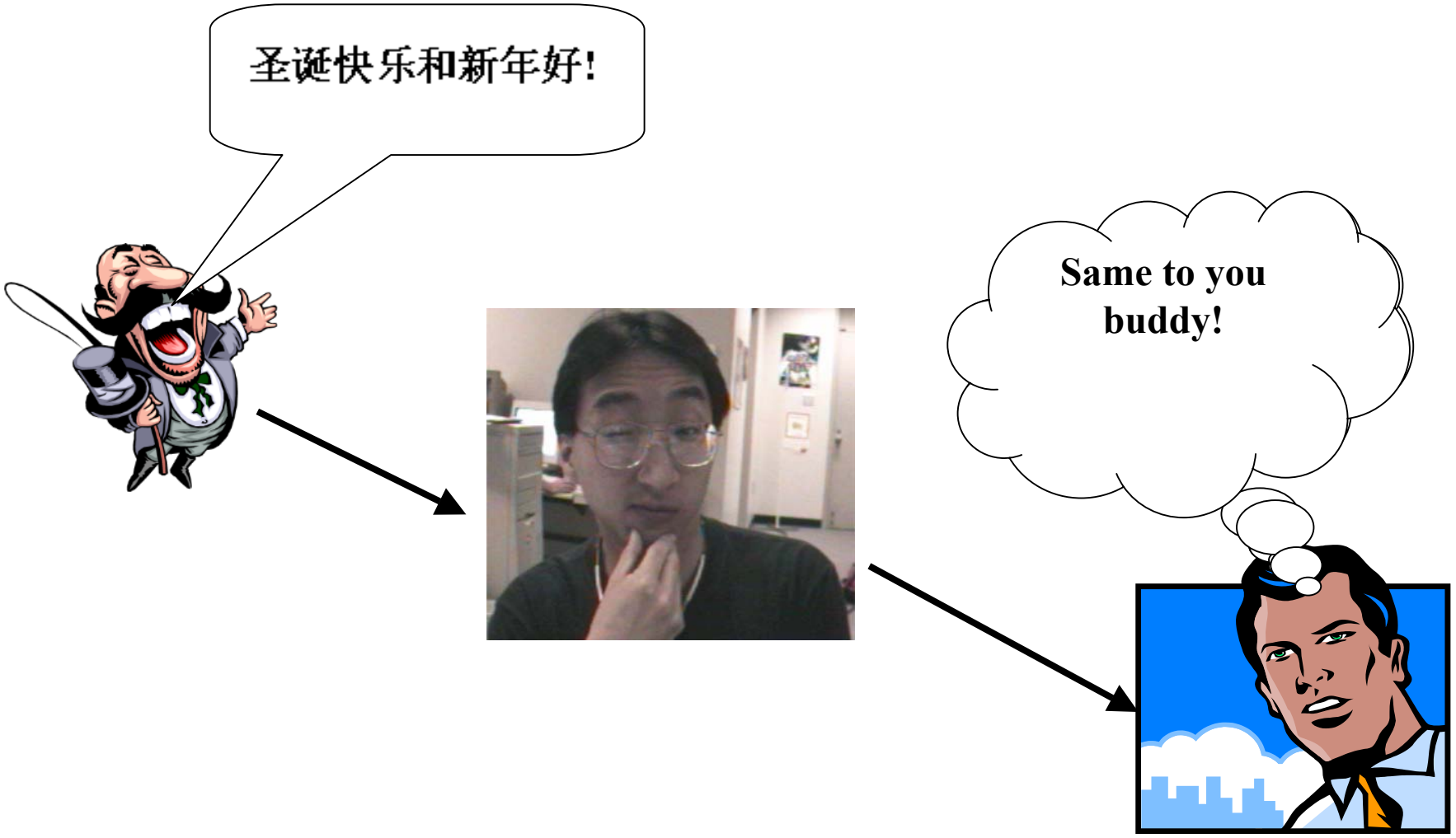
Operating Systems: Securing The Computer (done)

Multiple users – security is more important



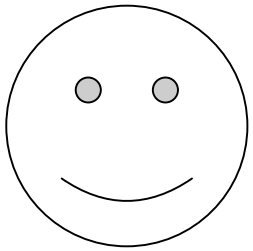
3) Compilers (Real-World)

Real life translation

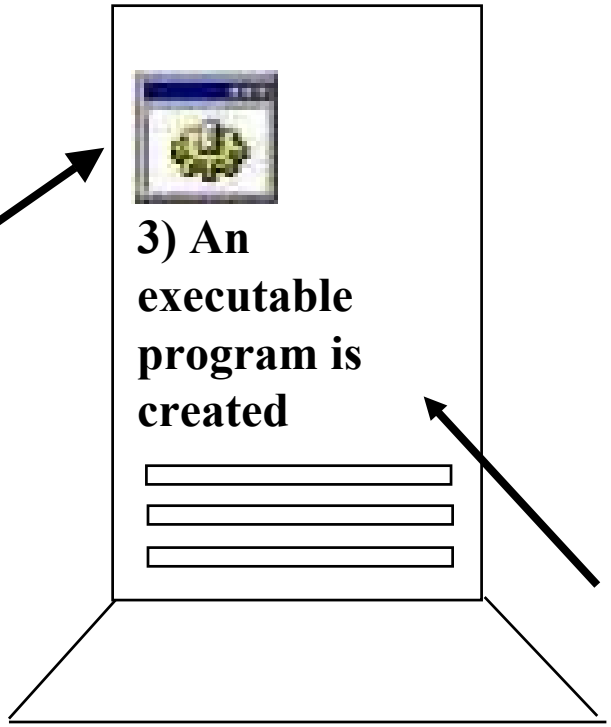


3) Compilers (Computers)

1) A programmer writes a computer program



2) The compiler translates the program into a form that the computer can understand



3) An executable program is created

Anybody who has this executable on their computer can then run (use) it.

Summary

What is hardware?

What are the basic parts of a computer?

- What are some common input devices?
- What is the purpose of the processor? What are some examples of modern processors and their speeds?
- How does computer memory work?
- What are some common types of computer storage devices?
- What are the main types of computer monitors and how do they work?
- What are some of the factors that determine the quality of computer monitors?

What is software?

What are the main categories of software

- What are application programs?
- What do operating systems do?
- What is a compiler?