INTRODUCTION TO COMPUTER HARDWARE

By

Mr Chilungamo Banda

INTRODUCTION TO COMPUTER HARDWARE

Objectives:

At the end of this section, the candidate will be able to:

- Identify Hardware components

- Troubleshoot common hardware problems

- Replace hardware parts

WHAT IS A COMPUTER?

- A computer is an electronic device, operating under the control of instructions stored in its own memory, that can accept data,(input) process the data according to specified instructions, produce results, and store the results/Information (Output) for future use.

THE INFORMATION PROCESSING CYCLE
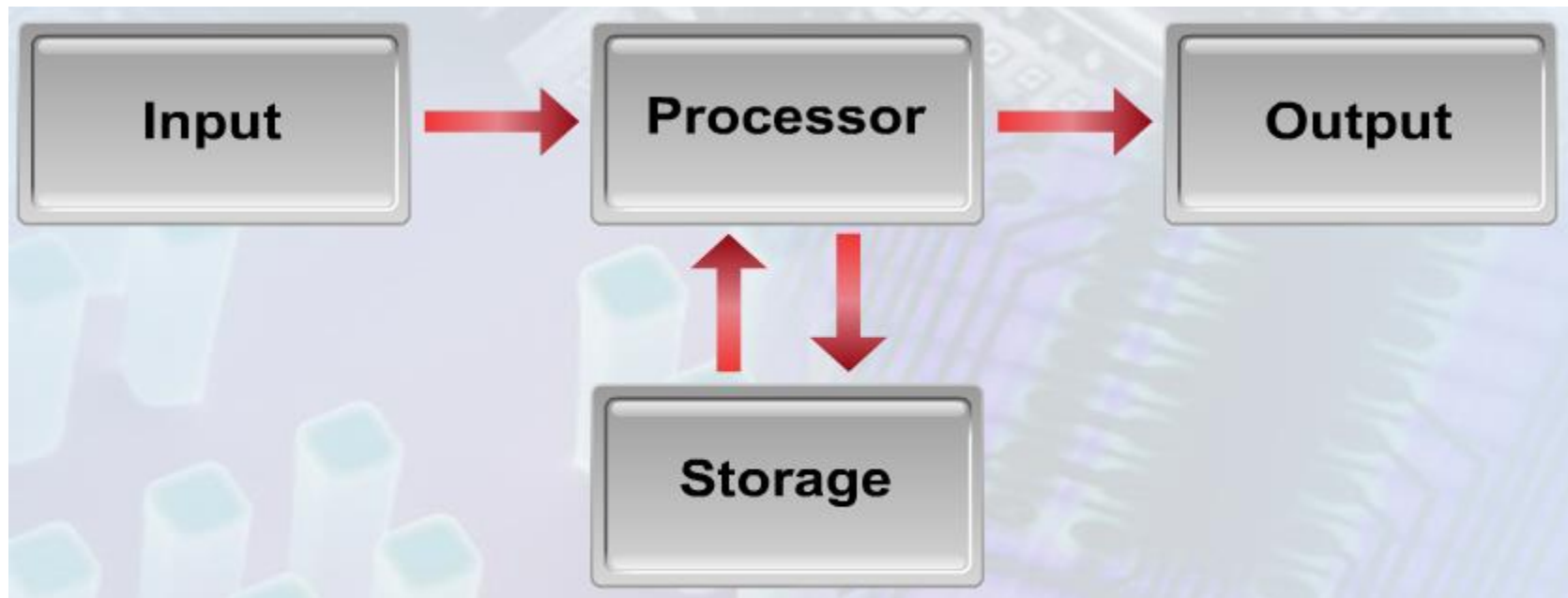
WHAT IS COMPUTER HARDWARE

The collection of physical parts of a computer system.

THE COMPONENTS OF A COMPUTER

- A computer contains many electric, electronic, and mechanical components known as **hardware.**

- These components include input devices, output devices, a system unit, storage devices, and communications devices.

INPUT DEVICES

- An **input device is any hardware component** that allows you to enter data and instructions into a computer.

- Five widely used input devices are the keyboard, mouse, microphone, scanner, and Web cam.

OUTPUT DEVICES

- An **output device is any hardware** component that conveys information to one or more people.

- Three commonly used output devices are a printer, a monitor, and speakers

THE SYSTEM UNIT

- The system unit is a case that contains the electronic components of the computer that are used to process data.

Power Supply
PS/2 Ports
Serial Port
VGA Video
USB Ports
Parallel Port
RJ45 NIC
Audio Jacks
56K Modem

COMPONENTS OF THE SYSTEM UNIT

bus

Expansion card

STORAGE DEVICES

- Storage holds data, instructions, and information for future use. For example, computers can store hundreds or millions of customer names and addresses.

- Storage holds these items permanently.
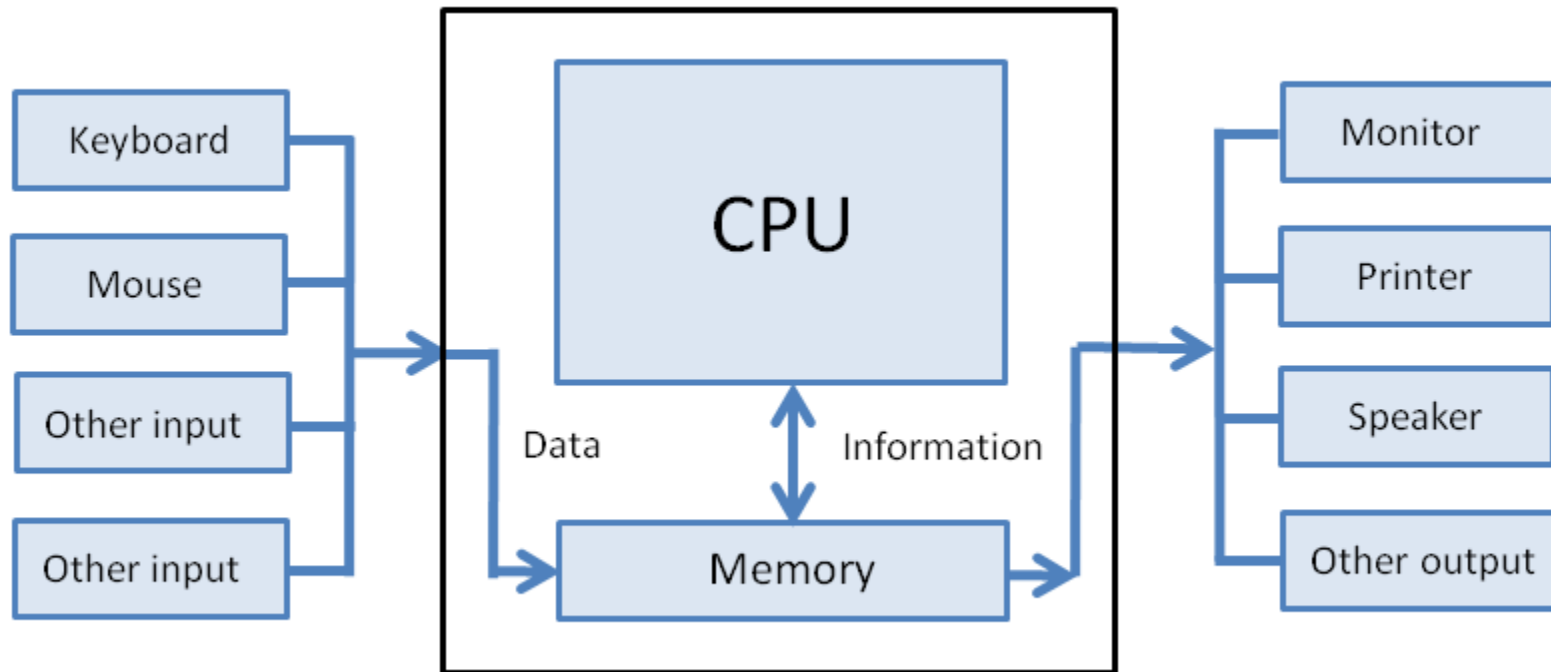
Hard Disk Drive

Memory Card

DVD Drive

Flash Disk

LET'S FIT SOME COMPONENTS TO THE INFORMATION PROCESSING CYCLE NOW

QUIZ

Instructions: Find the true statement below.

Then, correct the remaining false statements so that they are true.

1. A computer is a motorized device that processes output into input.

2. A storage device records (reads) and/or retrieves (writes) items to and from storage media.

3. An output device is any hardware component that allows you to enter data and instructions into a computer.

4. Three commonly used input devices are a printer, a monitor, and speakers.

THE PROCESSOR

- The processor, also called the central processing unit (CPU), interprets and carries out the basic instructions that operate a computer.

- The processor significantly impacts overall computing power and manages most of a computer's operations.
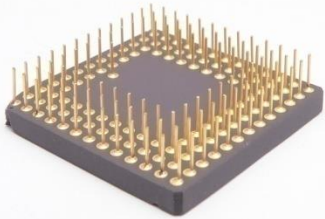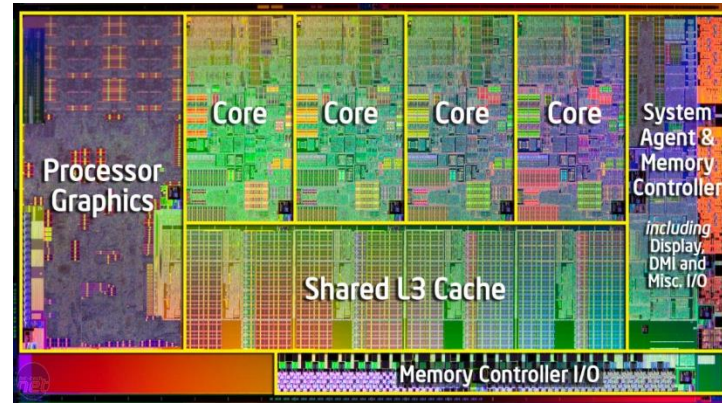
THE PROCESSOR
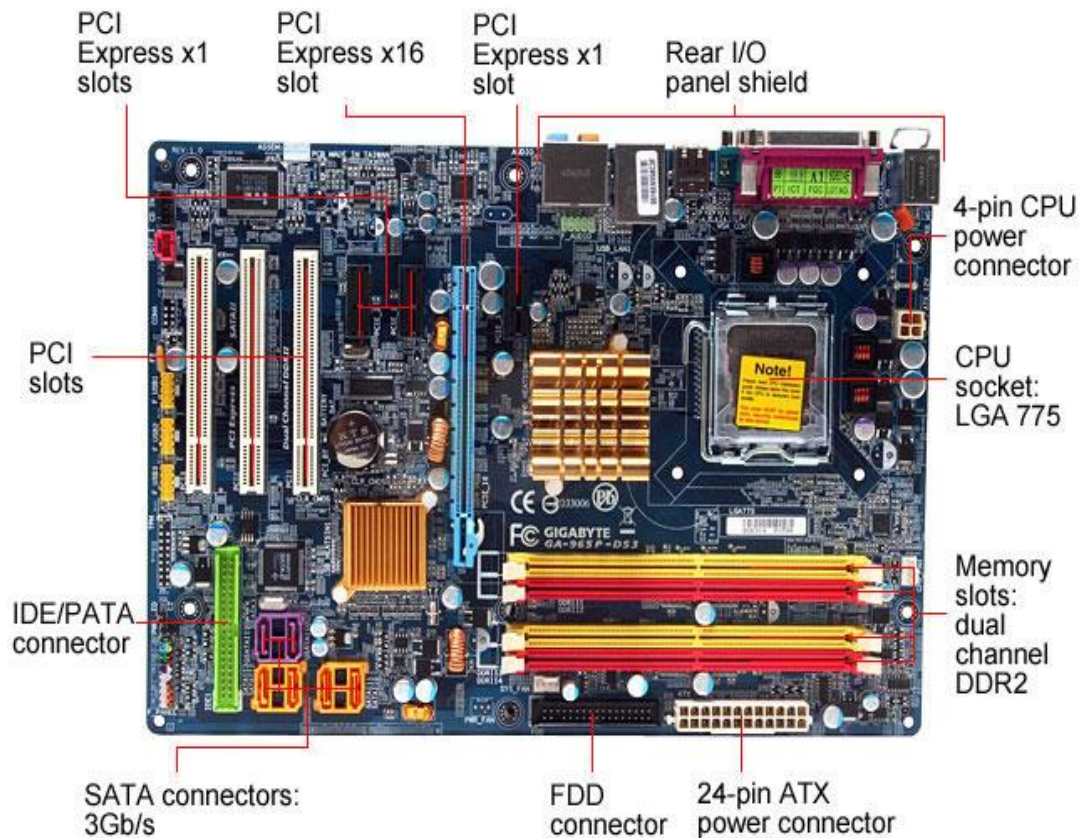
Intel CPU

Bottom of LGA CPU

Inside a quad core CPU

PGA CPU

THE COMPUTER MOTHERBOARD

PCI Express x1 slots

PCI Express x16 slot

PCI Express x1 slot

Rear I/O panel shield

4-pin CPU power connector

PCI slots

CPU socket: LGA 775

IDE/PATA connector

Memory slots: dual channel DDR2

SATA connectors: 3Gb/s

FDD connector

24-pin ATX power connector

- The **motherboard, sometimes called a systemboard**, is the main circuit board of the system unit.

- Many electronic components attach to the motherboard; others are built into it.

- Motherboards come in different form factors

MOTHERBOARD FORM FACTORS

Standard-ATX

Micro-ATX

Mini-ITX

Nano-ITX

Pico-ITX

BTX

NLX

PC Data bus Architecture (Expansion buses)

- The types of expansion buses on a motherboard determine the types of cards you can add to the computer.

- Thus, you should understand expansion buses commonly found in today's personal computers: PCI bus, PCI Express bus, AGP bus, USB, and FireWire bus.
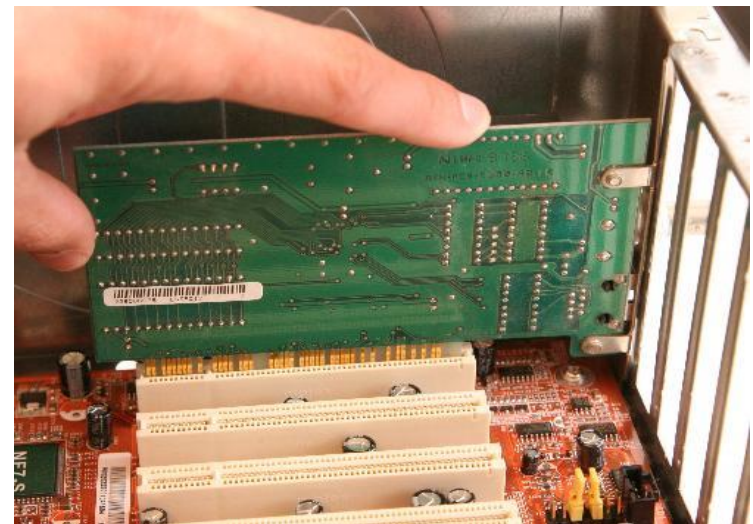
PCI BUS

- The *PCI bus (Peripheral Component* Interconnect bus) is a high-speed expansion bus that connects higher speed devices.
- Types of cards you can insert in a PCI bus expansion slot include video cards, sound cards, SCSI cards, and high speed network cards.
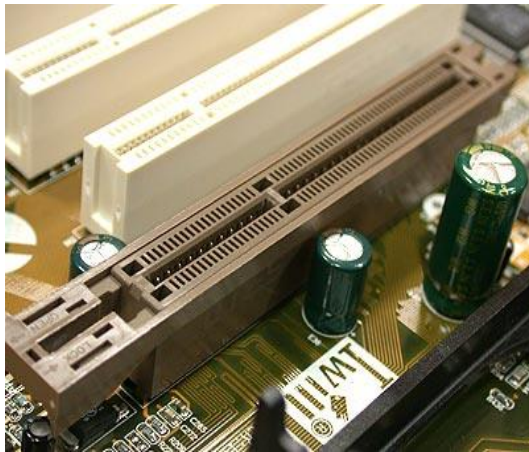

PCI bus slots

PCI adapter Card

PCI card being installed in a PCI bus slot

AGP

• The *Accelerated Graphics Port (AGP) is a bus* designed by Intel to improve the speed with which 3-D graphics and video transmit.

• With an AGP video card in an AGP bus slot, the AGP bus provides a faster, dedicated interface between the video card and memory.

AGP bus slot

AGP adapter card

An AGP video card being installed in an AGP bus slot

PCI EXPRESS

- The *PCI Express (PCIe) bus is an expansion bus* that expands on and doubles the speed of the original PCI bus.
- Nearly all video cards today use the PCI Express bus.
- The Express Card technology used in traditional notebook computers and Tablet PCs also works with PCIe.
- Experts predict the PCI Express bus eventually will replace the PCI bus completely.
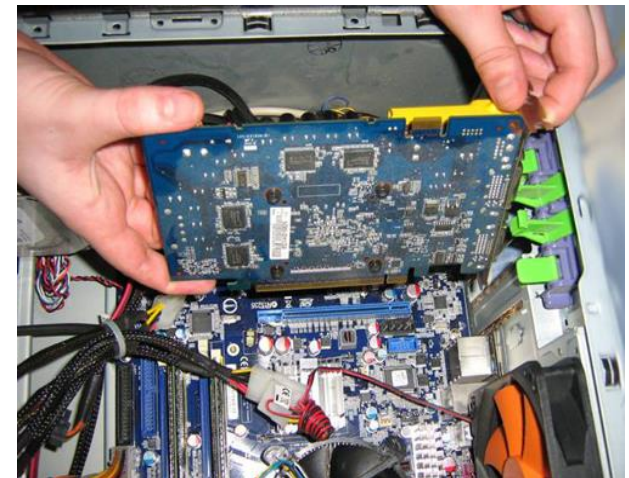
PCI EXPRESS

PCIe Slot

PCIe Video Card

Inserting a PCIe Video card into a PCIe slot
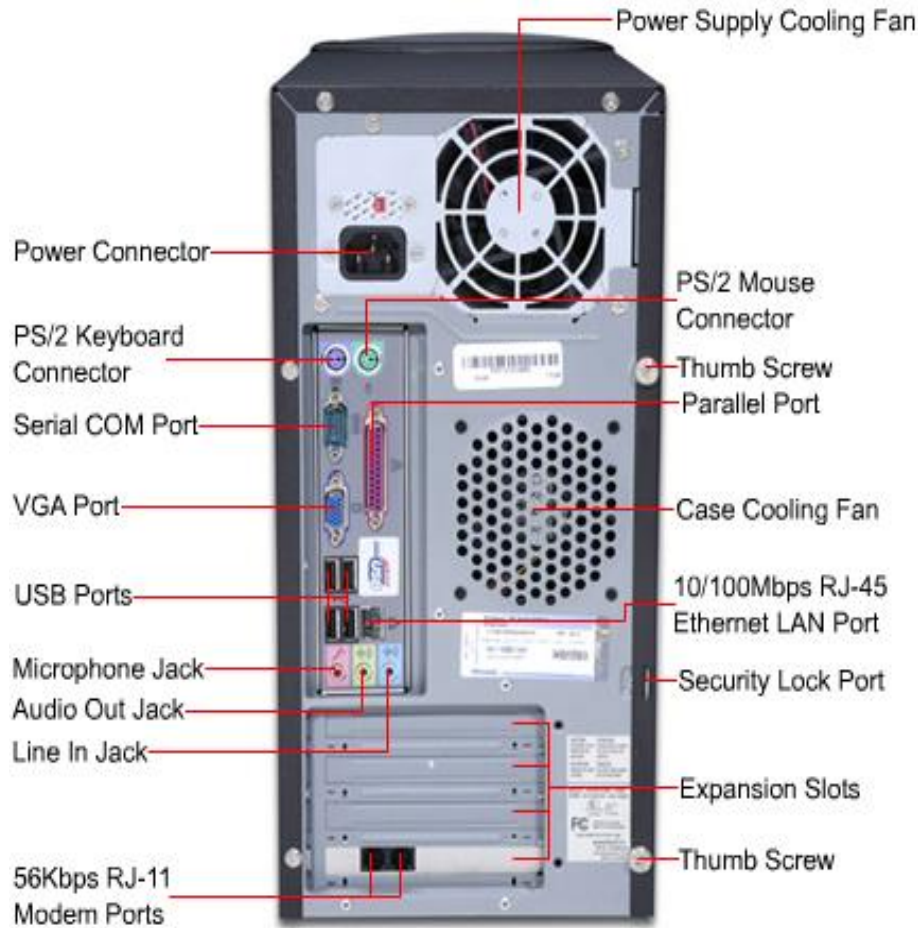
PORTS & CONNECTORS

- A **port** is the point at which a peripheral attaches to or communicates with a system unit so that the peripheral can send data to or receive information from the computer.

- An external device, such as a **keyboard, monitor, printer, mouse,** and **microphone,** often attaches by a cable to a port on the system unit.

- Instead of port, the term **jack sometimes** is used to identify audio and video ports.

PORTS & CONNECTORS

- The front and back of a system unit on a desktop personal computer contain many ports.

- On notebook computers, including netbooks and Tablet PCs, the ports are on the back, front, and/or sides

PORTS & CONNECTORS

Power Supply Cooling Fan

Power Connector

PS/2 Keyboard Connector

Serial COM Port

VGA Port

USB Ports

Microphone Jack

Audio Out Jack

Line In Jack

56Kbps RJ-11 Modem Ports

PS/2 Mouse Connector

Thumb Screw

Parallel Port

Case Cooling Fan

10/100Mbps RJ-45 Ethernet LAN Port

Security Lock Port

Expansion Slots

Thumb Screw

Port Types

| Type	Picture	Type	Picture	Type	Picture
Audio in		HDMI port		Serial	
Cable TV		Headphones		Side surround sound	
Center surround sound/subwoofer		Keyboard		S/PDIF in	
Composite video in		Microphone		S/PDIF out	
Digital Video Interface (DVI)		Monitor		Speaker	
eSATA port		Mouse		S-video	
FireWire		Network		Telephone line in	
FM reception		Rear surround sound		USB	

UNIVERSAL SERIAL BUS PORT (USB)

- A **USB port, short for *universal serial bus port,*** can connect up to 127 different peripherals together with a single connector.
- Devices that connect to a USB port include the following:
  - -mouse, printer, digital camera, scanner, speakers, portable media player, optical disc drive, smart phone, PDA, game console, and removable hard disk.
- -The FireWire port supports Plug and Play.

USB ports on a Laptop

USB port on a Smart phone
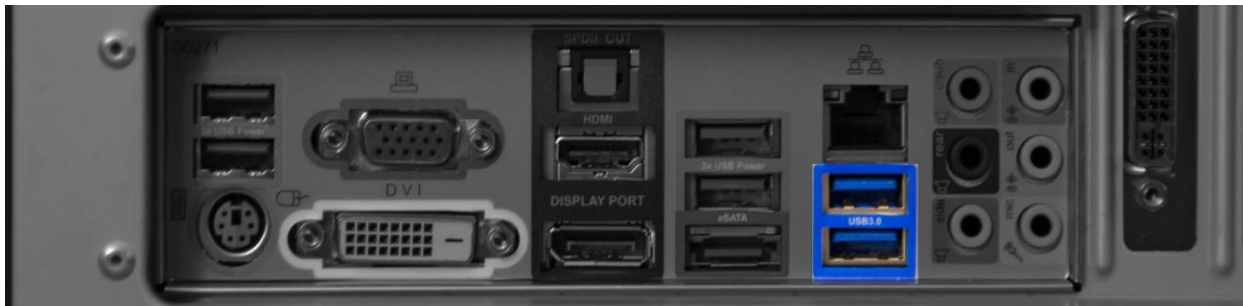
USB ports on a Desktop Computer (colored blue)

A USB Hub

UNIVERSAL SERIAL BUS PORT (USB)

USB Connectors and Ports

|	Connector	Port	Where Used
Type A			Desktop computers, traditional notebook computers, netbooks, and Tablet PCs
Type B			Peripherals (printers, scanners, external hard disks, etc.)
Mini-B			Mobile devices (cameras, phones, handheld game consoles)

FIREWIRE PORT

•**FireWire port is similar to a USB port in** that it can connect multiple types of devices that require faster data transmission speeds, such as digital video cameras, digital VCRs, color printers, scanners, digital cameras
•The FireWire port supports Plug and Play
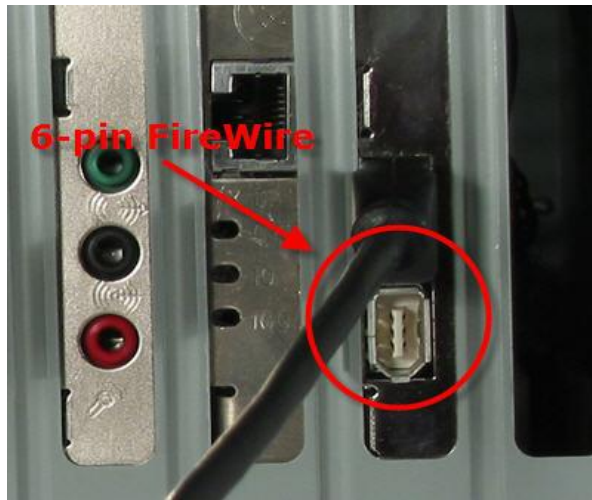
Firewire port
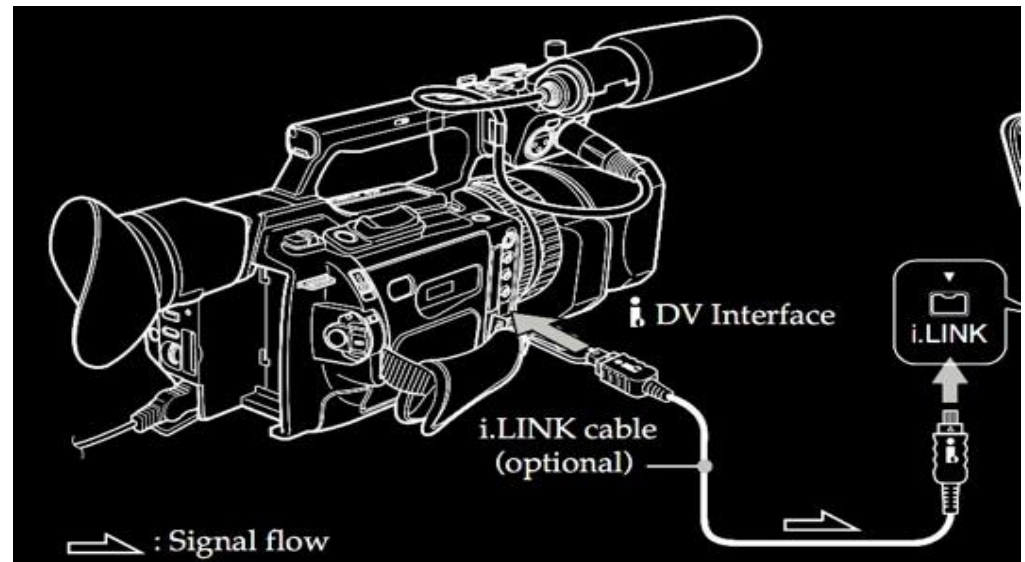
A Video Camera connected a firewire port

MAIN MEMORY

Types of Main Memory

- **R**ead **O**nly **M**emory (ROM)
    - contents are not lost
    - also called non-volatile memory

- **R**andom **A**ccess **M**emory (RAM)
    - contents of memory are lost if the machine is switched off
    - Also called volatile memory

MAIN MEMORY

Type of ROM

- **P**rogrammable **ROM** (PROM)
  - Programmed after manufacture
  - Once they are programmed, cannot be changed (**O**ne **T**ime **P**rogrammable)
- **E**rasable **P**rogrammable **ROM** (EPROM)
  - can be erase by exposing to Ultraviolet (UV) radiation for a few minutes
  - can be reprogrammed
- **E**lectrically **E**rasable and **P**rogrammable **ROM** (EEPROM)
  - Erase electrically not UV
  - No need to take out the IC to erase
- Flash memory
  - Erase whole memory electrically

ROM Usage

- Permanent storage
  - Nonvolatile
- Storage of Systems programs like the (BIOS)

TYPE OF RAM

- There are 3 basic types of RAM
  - **D**ynamic RAM (DRAM)
    - Commonly used as main memory
    - Use capacitor to store data, 1- charged, 0 – discharged
    - Capacitor will lose it charge with time ∴ need to recharge (refresh)
  - **S**tatic RAM (SRAM)
    - Using flip-flop to store data – no need refresh
    - Compare to DRAM – faster but more expensive, more complex and low capacity
  - **N**on-**v**olatile RAM (NVRAM)
    - RAM that is not volatile
    - use internal power source to keep data in RAM during power off

Memory: Comparison

Memory Type	Category	Erasure	Write Mechanism	Volatility
Random-access memory (RAM)	Read-write memory	Electrically, byte-level	Electrically	Volatile
Read-only memory (ROM)	Read-only memory	Not possible	Masks	Nonvolatile
Programmable ROM (PROM)			Electrically	
Erasable PROM (EPROM)	Read-mostly memory	UV light, chip-level		
Electrically Erasable PROM (EEPROM)		Electrically, byte-level		
Flash memory		Electrically, block-level		

Dynamic RAM (DRAM)

☐ Bits stored as charge in capacitors

☐ Charges leak

☐ Need refreshing even when powered

☐ Simpler construction

☐ Smaller per bit

☐ Less expensive

☐ Need refresh circuits

☐ Slower

☐ Main memory

STATIC RAM (SRAM)

- Bits stored as on/off switches

- No charges to leak

- No refreshing needed when powered

- More complex construction

- Larger per bit

- More expensive

- Does not need refresh circuits

- Faster

- Digital
  - Uses flip-flops

SRAM v DRAM

- Both volatile
  - Power needed to preserve data
- Dynamic cell
  - Simpler to build, smaller
  - More dense
  - Less expensive
  - Needs refresh
  - Larger memory units
- Static
  - Faster
  - Cache
  - More expensive

SYNCHRONOUS DRAM (SDRAM)

☐ Access is synchronized with an external clock.

☐ Since SDRAM moves data in time with system clock, CPU knows when data will be ready.

☐ DDR-SDRAM sends data twice per clock cycle (leading & trailing edge)

☐ DDR2-SDRAM sends data four times per clock cycle.

☐ DDR-SDRAM sends data eight times per clock cycle

MEMORY HIERARCHY
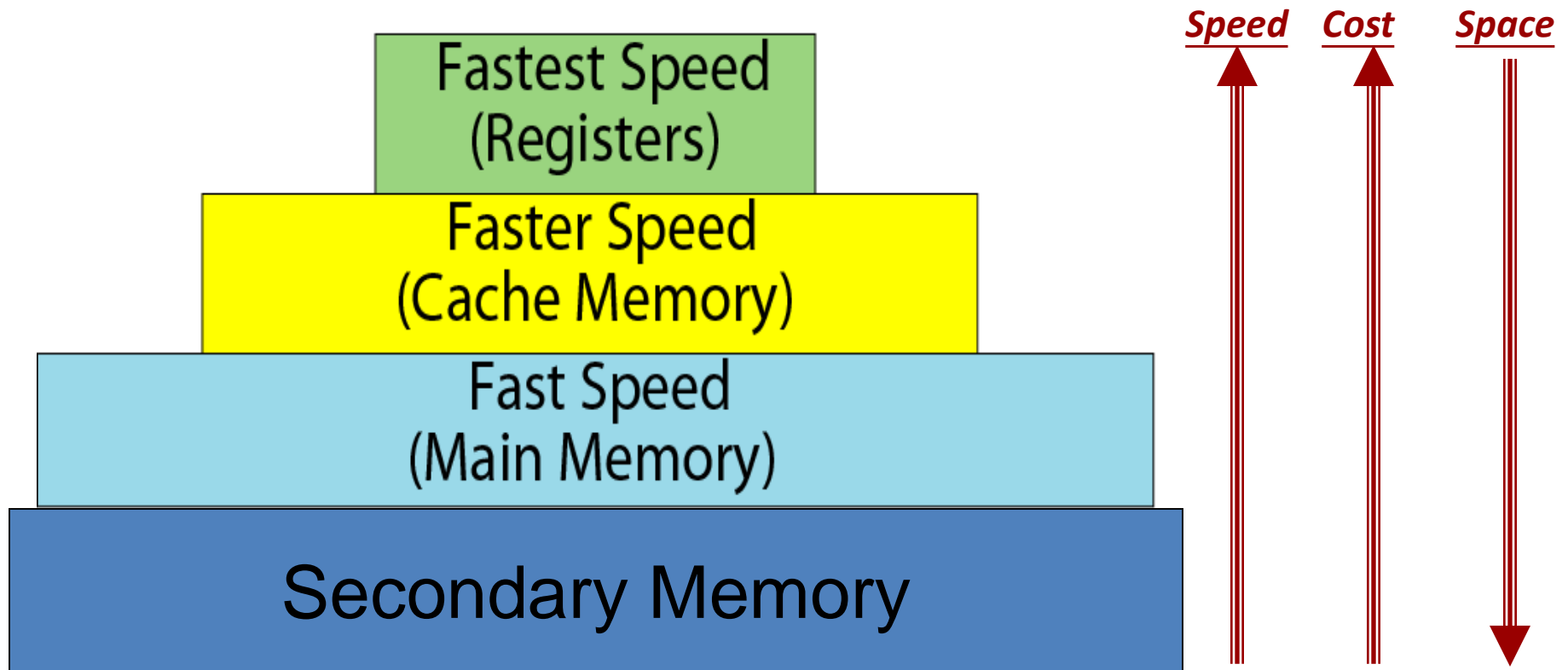
BUILDING YOUR PC

BUILDING YOUR PC

- **Now that you have all your components it's time to put them all together.**

STATIC PRECAUTIONS

An anti-static wrist band is the best way to ensure you don't damage components with static electricity from your body.

The only essentials you will need the before starting are:

- A phillips screwdriver
- A grounded metallic object
- A large flat non-metallic surface (1.5m x 1m or larger)
- An afternoon of uninterupted time

You you may also want:

- An anti-static wrist band or mat
- Cable ties
- A small torch

BUILDING YOUR PC

A typical PC will contain the following parts.
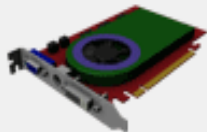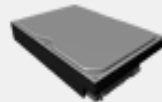

Processor (CPU) | Memory (RAM) | Motherboard | Extra Cooling | Mouse

Graphics card | Hard Drive | Optical Drive | Monitor

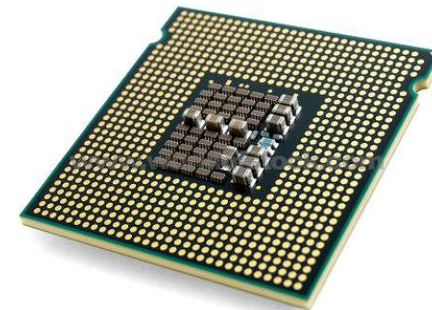Case | Power Supply (PSU) | Operating System (OS) | Keyboard

BUILDING YOUR PC

Choosing Step 1
Processor

- **The processor or CPU (Central Processing Unit) is the brain of your computer and is arguably the most critical component, as a slow processor will always result in a slow computer.**

BUILDING YOUR PC

Choosing Step 2
Memory

- Memory or Random Access Memory (RAM) slots into the motherboard and is where all of the information being used by the processor is stored.

- For example when you start a program, open a picture or play an MP3, it is moved from the hard drive into memory so that the processor can access all the information related to it.

- It does this because memory can be accessed many times quicker than a Hard Drive.

- When the computer is switched off, the information stored in memory is lost.

BUILDING YOUR PC

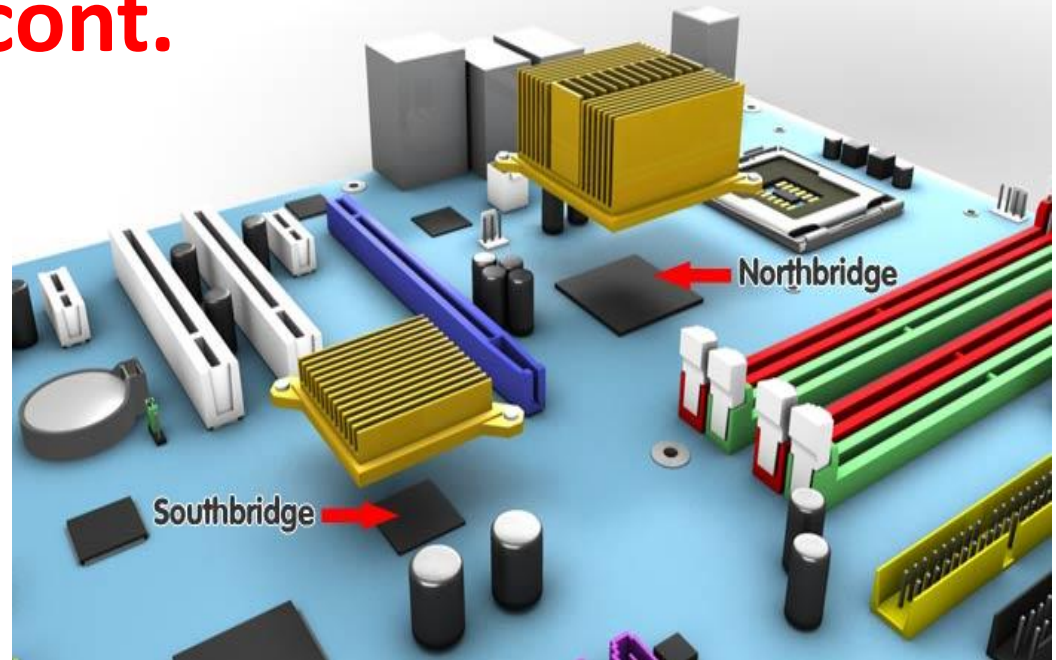## Choosing Step 3 Motherboard

- **The motherboard provides the 'hub' of your computer that everything else plugs into.**

- **It also provides the first level of management, so when the computer is switched on, the motherboard figures out what components are where and how to get them all up and running.**

BUILDING YOUR PC

Choosing Step 3 Motherboard   cont.

- The chip-set is the set of microchips which manage the information exchange between the processor and all the other components in the computer.
- It is made up of 2 main parts, the north-bridge and the south-bridge.
- After the socket type this is the primary way to group motherboards, so for example you will see categories like 'p35', 'x48' or 'Nforce 7'.
- These are the names of the chip-sets on those particular motherboards.

Northbridge

Southbridge

Choosing Step 3 Motherboard   cont.

- Both PCI and PCI-express (PCI-e) slots are used to plug 'card' type components into the motherboard which can then communicate with the processor via the chip-set.

- These include graphics cards, sound cards, TV and various network cards among others.

*colours may vary

PCI-express* 1x

PCI-express* 16x

PCI

BUILDING YOUR PC

Choosing Step 3 Motherboard   cont.

Form Factor (ATX, Micro-ATX, Micro-ITX)

BUILDING YOUR PC

Choosing Step 3 Motherboard   cont.

Integrated Graphics

The graphics ports on the rear I/O panel of a motherboard.

BUILDING YOUR PC

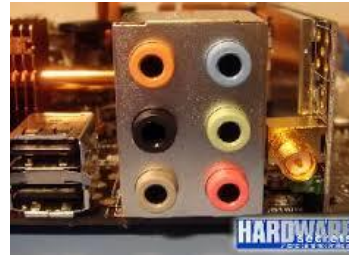## Choosing Step 3 Motherboard cont.

Memory Slots (DIMM)
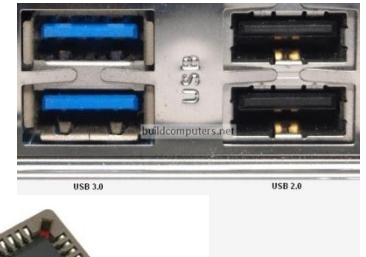
BUILDING YOUR PC

Choosing Step 3 Motherboard   cont.

INTEGRATED SOUND

SATA

USB Ports

PATA (IDE)

BIOS

inspiring
future
gener@tions

Choosing Step 4 Graphics Card

- **The Graphics card takes information from the processor and calculates how to display it on the screen.**

- **Each card has its own processor, referred to as a Graphics processing Unit (GPU) and its own memory referred to as Video RAM (VRAM).**

- **The GPU processes the information and then passes the result to the VRAM where it is stored ready to send to the monitor.**

BUILDING YOUR PC

InstallingStep1: Bios

- Introduction
- **The BIOS (Basic Input/Output System) is the lowest level of software in the PC. It is located on a separate chip on the motherboard and is the first thing that is loaded when we turn the computer on.**
- The BIOS starts by testing each component to make sure everything is operating as it should and that the computer has everything it needs to load the OS. This starting test is called the Power On Self Test, or POST. If any errors are detected during POST, the BIOS will report them either through a series of beeps or by displaying the error on the screen.
- usually when we talk about the BIOS we are really talking about the **BIOS setup**, and the interface that is used to adjust these settings. The BIOS settings are like to core values of the PC and they are used to dictate how the computer will operate at a fundamental level.
- **To access the BIOS setup, you must press a particular key during the POST, usually this is the 'DELETE' key or the 'F2' key, depending on your motherboard.**
- As complicated as all this may sounds, in reality **we don't have to do much in the BIOS setup, almost all of the default values are fine.** There are a few we need to check and may need to be adjusted before we install our OS, but after that we will rarely or never need to come back to the BIOS (unless you intend to overclock that is).
- **Below are descriptions of which setting to check within each of the menus.**
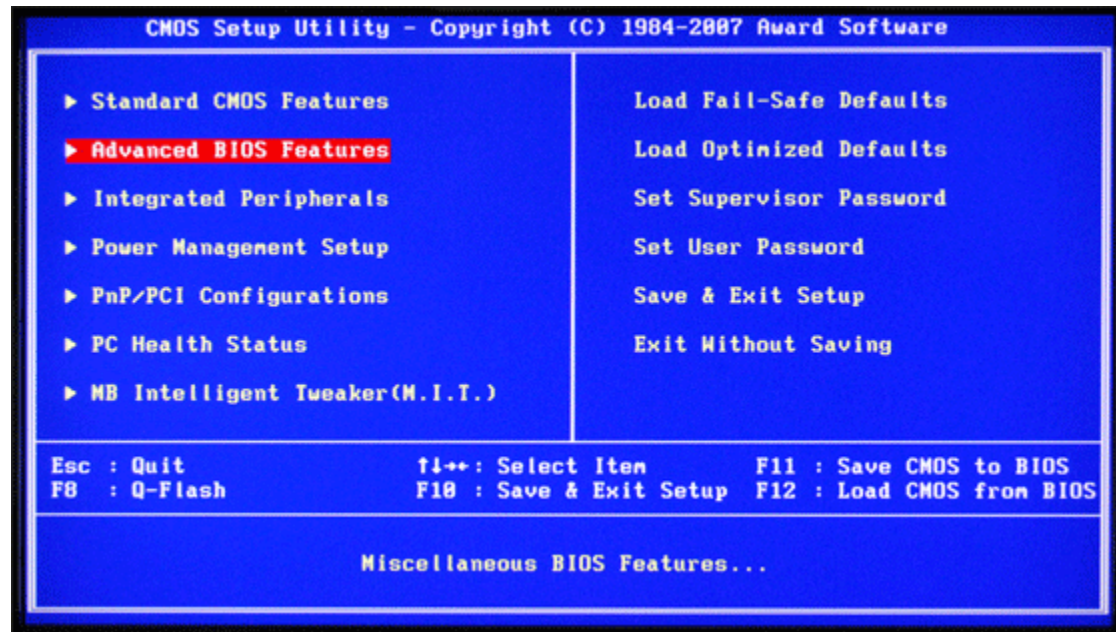
Installing Step2: Operating Systems

- **Installing an operating system (namely windows) is a relatively easy task. It involves 'booting' the computer (which means to starting the computer from) the OS DVD which will then guide you through the installation process in a similar way to installing any piece of software.**

- Before you start you just need to make sure that your first 'boot device' in the BIOS is set to 'CDROM' or 'DVD' so your computer knows to look on the disk before tying to boot from the hard drive.

Installing Step 3: Drivers

- **Drivers are like dictionaries for the operating system to translate the language of a given piece of hardware. They allow the operating system to control that component and understand the information that comes back from it.**

- There are two ways to install drivers. The easy way is to just insert the CD's that came with the various components and let them install by themselves. Although easy, installing drivers this way can mean you get unwanted software on your system that manufacturers include in the install. Although not malicious this software will often run constantly in the background taking up memory. Installing from the CD will also mean you won't be getting the latest drivers.

- The second method for installing drivers is to let windows search for the drivers it needs, allowing it to only take the drivers and skip anything else. It is also recommended that you download the latest drivers from the website of the components manufacturer, often found under the 'support' or 'downloads' section of their site. The following steps will take you through this second method for installing drivers.