The Computer System

- The equipment associated with a computer system.

- **software** The set of instructions that tell a computer what to do.

- **hardware**

- **people**

- Use the power of the computer for some purpose.

A World of Computers

- ❖ What is *computer literacy*?
  - ◆ Knowledge and understanding of computers and their uses
  - ◆ End User Skills
- ❖ Why are computers *important for success*?
  - ◆ Computers are everywhere
  - ◆ Required employment skill
- ❖ What is a *computer*?
  - ◆ Electronic device operating under the control of instructions stored in its own memory
    - ♦ Accepts *data input*: raw facts, figures, and symbols
    - ♦ Processes data into *information output* that is meaningful for people
    - ♦ Produces and stores results for later retrieval
  - ◆ Currently electronics is the fastest technology
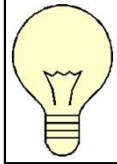
Digital Computer = Binary Processor

- ❖ Computer data is represented and manipulated using the **binary system**
- ❖ Binary = Base 2
- ❖ Each digit in binary is called a **bit**
  - ◆ A bit value can is in one of two states
  - ◆ Represented by 0/1, T/F, On/Off.
- ❖ A group of 8 bits is called a **byte**

0 1 0 0 1 0 1 0

Data and Information Representation

- ❖ A Computer is a collection of millions of electronic switches (On or Off)
- ❖ A *bit* or binary (base 2) digit has one of two values: 1 or 0
- ❖ A *byte* is a group of 8 bits
- ❖ All information is represented in a computer using binary number data
- ❖ Characters are represented using *ASCII Code* with one byte/character

On = 1
Off = 0

- ◆ 'A' = 0100,0001
- ◆ '7' = 0011,0111
- ◆ 'B' = 0100,0010
- ◆ ',' = 0010,1100
- ◆ 'a' = 0110,0001
- ◆ '$' = 0010,0100

Components of the System Unit
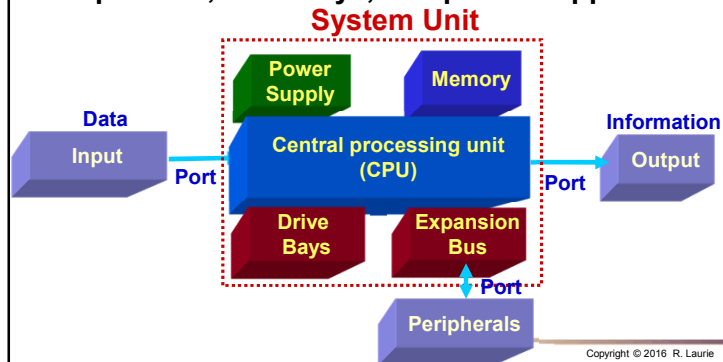
❖ **5 major components of computers systems**
❖ **This section focuses on the CPU, Memory, Expansion, drive bays, and power supplies**

System Unit

	Power Supply	Memory
Data		
Input	Central processing unit (CPU)	Information
Port		Port
		Output
	Drive Bays	Expansion Bus
		Port
	Peripherals	

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Computer Hardware Components

❖ **Processor = Central Processing Unit (CPU)**
   ◆ **The electronic component that interprets and executes the program instructions in the computer**
❖ **Memory = RAM, Cache, ROM**
   ◆ **Memory is fast and temporarily stores instructions and data**
   ◆ **Volatile = Data loss when power off**
❖ **Storage = Hard Drive, CD, DVD, Flash Memory Device**
   ◆ **Storage is slower, but permanent stores instructions and data**
   ◆ **Non-Volatile = Retains data when power off**
   ◆ **Storage device**
      ♦ **Records and retrieves items on storage media**
   ◆ **Storage media**
      ♦ **Physical material on which data and instructions are stored**
❖ **Network**
   ◆ **Communications device that enables computer to send and receive data and instructions to another device via media**
   ◆ **Transmission media may include cables, telephone lines, cellular radio networks, and satellites**

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Categories: Personal Computers

❖ **A personal computer can perform all of its input, processing, output, and storage activities by itself**
❖ **Two popular architectures are the PC and the Apple**
   ◆ **Desktop computer = Designed so all of the components fit entirely on or under a desk or table**

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Mobile Computers and Mobile Devices

❖ **Mobile Computer**
   ◆ **Personal computer you can easily carry and fit on lap**
   ◆ **Examples include:**
      ♦ **Laptop Computer (clam shell)**
      ♦ **Notebook computer (clam shell)**
      ♦ **Tablet PC**
❖ **Mobile Device**
   ◆ **Computing device can hold in hand**
   ◆ **Examples include:**
      ♦ **Smart phones**
      ♦ **PDA's**
      ♦ **Media Players**
      ♦ **Digital Cameras**

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Multi-User Computers
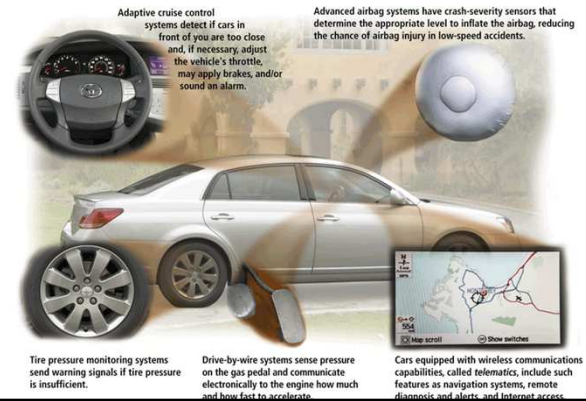
❖ **These computers are shared by many users**

- ◆ **Servers** control access to network resources and provides centralized storage
- ◆ **Web Servers** serve web applications and web pages for World Wide Web using Internet
- ◆ **Mainframe** Powerful, expensive computer that supports thousands of connected users
- ◆ **Supercomputer** Fastest, most powerful, most expensive computer used for applications requiring complex mathematics

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Embedded Computers

❖ **An embedded computer is a special-purpose computer that functions as a component in a product**

Adaptive cruise control systems detect if cars in front of you are too close and, if necessary, adjust the vehicle's throttle, may apply brakes, and/or sound an alarm.

Advanced airbag systems have crash-severity sensors that determine the appropriate level to inflate the airbag, reducing the chance of airbag injury in low-speed accidents.

Tire pressure monitoring systems send warning signals if tire pressure is insufficient.

Drive-by-wire systems sense pressure on the gas pedal and communicate electronically to the engine how much and how fast to accelerate.

Cars equipped with wireless communications capabilities, called *telematics*, include such features as navigation systems, remote diagnosis and alerts, and Internet access.

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Memory Size and Speed

❖ **Storage and memory capacity is expressed in the number of bytes**

- ◆ 1 **Kilo**Byte = 2^{10} or 1024 bytes
- ◆ 1 **Mega**Byte = 2^{20} or 1,048,576 bytes
- ◆ 1 **Giga**Byte = 2^{30} or 1,073,741,824 bytes
- ◆ 1 **Tera**Byte = 2^{40} or 1,099,511,627,776 bytes
  Bus speeds
- ◆ 1 **Kilo**Hertz = 10^3 or 1 milliSecond
- ◆ 1 **Mega**Hertz = 10^6 or 1 microSecond
- ◆ 1 **Giga**Hertz = 10^9 or 1 nanoSecond

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Inside the Case of a Desktop Computer
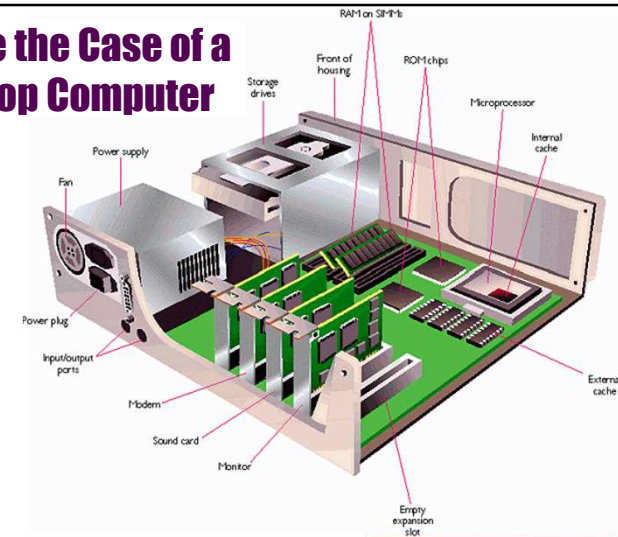
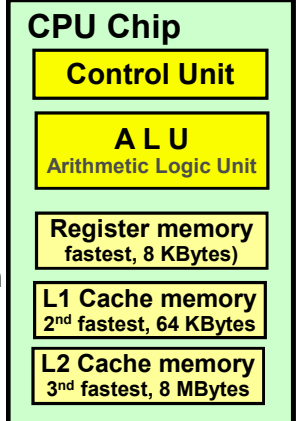Copyright © 2016 R. Laurie   12

Power Supply

- ❖ **What is a power supply?**
  - ◆ Converts AC Power into DC Electric Power
  - ◆ Fan keeps system unit components cool
- ❖ **Over time, the system unit collects dust**
  - ◆ The power supply usually draws dust in
  - ◆ Airfilters can help minimize dust
- ❖ **Caution: Never open a System Unit with power connected!**
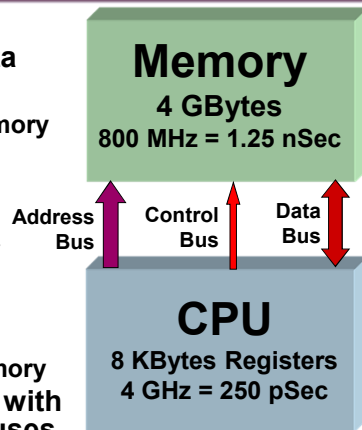
The Central Processor Unit (CPU)

- ❖ **The CPU contains 5 major functional components**
  - ◆ Control unit
  - ◆ Arithmetic/logic unit (ALU)
  - ◆ Register memory
  - ◆ L1 Cache memory
  - ◆ L2 Cache memory
- ❖ **CPU interacts closely with memory**
- ❖ **Memory, however, is not part of the CPU**
- ❖ **Called Microprocessor**

CPU Chip

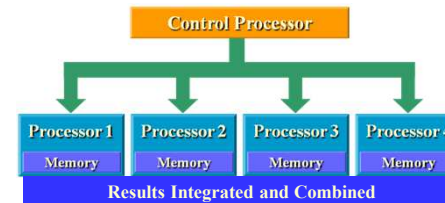| Control Unit |
| A L U
 Arithmetic Logic Unit |
| Register memory <br> fastest, 8 KBytes) |
| L1 Cache memory
 2nd fastest, 64 KBytes |
| L2 Cache memory
 3nd fastest, 8 MBytes |

RAM & ROM Memory

- ❖ **Stores program instructions and data**
- ❖ **RAM**
  - ◆ Random-access memory
  - ◆ Volatile memory
- ❖ **ROM**
  - ◆ Read-only memory
  - ◆ Non-volatile memory
- ❖ **CMOS**
  - ◆ BIOS = Basic Input/Output System
  - ◆ Battery or Flash Memory
- ❖ **CPU communicates with memory via three buses**

Memory
4 GBytes
800 MHz = 1.25 nSec

Address Bus   Control Bus   Data Bus

CPU
8 KBytes Registers
4 GHz = 250 pSec

Parallel Processing

- ❖ **Parallel Processing**
  - ◆ Allows parallel activities to occur simultaneously using multiple processors
  - ◆ Single-core processors have one processor on chip
  - ◆ Dual-core processors have two processors on chip
  - ◆ Quad-core processors have four processors on chip
  - ◆ Multi-core processor have ≥ 2 processors on chip

Control Processor

| Processor 1 | Processor 2 | Processor 3 | Processor 4 |
| Memory | Memory | Memory | Memory |

Results Integrated and Combined

Volatile and Nonvolatile Storage

❖ **How does volatility compare?**
  ◆ Memory is volatile—holds data and instructions temporarily
  ◆ Storage medium is nonvolatile—contents retained when power is off

Power	ON	OFF
Screen Display	Display appears	Display disappears
Memory (most RAM) (chips on motherboard)	Data and instructions	Data and instructions erased
Storage Medium (floppy disks, Zip disks, hard disks, CDs)	Contents available to user	Contents retained

Volatile rows: Screen Display, Memory
Nonvolatile row: Storage Medium

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What is Storage?

❖ **Holds data, instructions, and information for future use**
❖ **Also called secondary storage or auxiliary storage**
❖ **Storage medium is physical material used for storage**

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Storage Sizes

❖ **What is capacity?**
  ◆ Number of bytes (characters) a storage medium can hold

| Kilobyte (KB) | 1 thousand | 2^{10} or 1024 bytes |
Megabyte (MB)	1 million	2^{20} or 1,048,576 bytes
Gigabyte (GB)	1 billion	2^{30} or 1,073,741,824 bytes
Terabyte (TB)	1 trillion	2^{40}
Petabyte (PB)	1 quadrillion	2^{50}
Exabyte (EB)	1 quintillion	2^{60}
Zettabyte (ZB)	1 sextillion	2^{70}
Yottabyte (YB)	1 septillion	2^{80}

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Hard Drive Disk - MBR Partitioning

❖ **Hard Drive partitioning**
  ◆ Creation of one or more *logical drives* on hard disk
  ◆ The disk stores the information about the partitions in *partition table*
  ◆ Partition editor to create, resize, delete, and manipulate the partitions
❖ **MBR = *Master Boot Record***
  ◆ BIOS firmware systems 1983
  ◆ Primary partitions <= 4
  ◆ 1 Extended partition can be created instead of primary
  ◆ Many logical partitions within extended partition
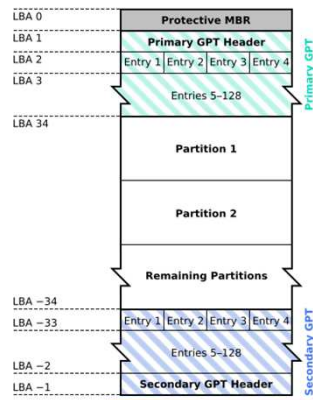 ◆ 32 bits for storing (LBA) *Logical Block Addresses*

Physical Drive
Extended Partition
Logical Partition 6
Logical Partition 5
Logical Partition 4
Logical Partition 3
Logical Partition 2
Logical Partition 1
Primary Partition
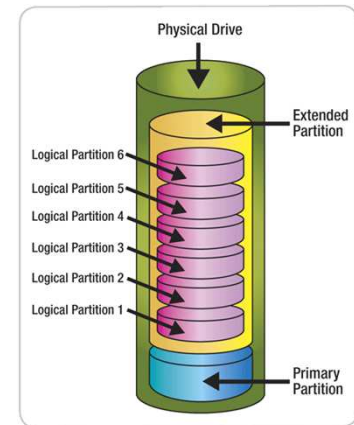
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Hard Drive Disk - GPT Partitioning

❖ **GUID Partition Table (GPT)**
  ◆ **Uses 128 bit globally unique identifiers (GUID)**
  ◆ **GPT uses 64-bit values for addressing purposes (Logical Block Addresses or LBA)**
  ◆ **Can address 9.4 zettabytes (ZB)**
❖ **Used on most computers sold after 2010 with Windows 8+**
  ◆ **Unified Extensible Firmware Interface (UEFI) computer systems utilize GPT typically for hard drive partitioning**
❖ **Partition Formatting**
  ◆ **NTFS for Windows > 2000**
 ◆ **HFS+ for Mac OSX**
  ◆ **exFAT for USB Drives (Mac/Win)**

GUID Partition Table Scheme

LBA 0	Protective MBR
LBA 1	Primary GPT Header
LBA 2	Entry 1 Entry 2 Entry 3 Entry 4
LBA 3	
	Entries 5–128
LBA 34	
	Partition 1
	Partition 2
	Remaining Partitions
LBA −34	
LBA −33	Entry 1 Entry 2 Entry 3 Entry 4
	Entries 5–128
LBA −2	
LBA −1	Secondary GPT Header

Primary GPT / Secondary GPT

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Longevity of Digital Storage Media

The physical media on which it is stored has a limited physical lifetime
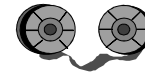
	Magnetic tape *Sequential Access*	**1 yr.**
	Videotape *Sequential Access*	**1–2 yrs.**
	Magnetic disk *Random Access*	**5–10 yrs.**
	Optical disk *Random Access*	**30 yrs.**
	Microfilm *Sequential Access*	**300 yrs.**

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Optical Disc Storage Capacities

❖ **CD-ROM, CD-R, CD-R/W**
  ◆ **700 MB per side**
❖ **DVD**
  ◆ **4.7 GB or 4700 MB: single side, single layer**
  ◆ **8.5 GB: single side, double layer**
  ◆ **17 GB: double side, double layer**
❖ **Blu-Ray or BD-ROM**
  ◆ **25 GB: single side, single layer**
  ◆ **50 GB: single side, double layer**
  ◆ **100 GB: double side, double layer**
❖ **Record and R/W**
  ◆ **DVD Record has several formats**
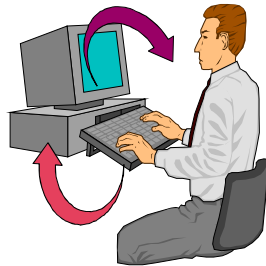
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Data Transfer Rates

❖ **What is the data transfer rate of a CD drive?**
  ◆ **1X: 150 KBps = Music CD play rate**
  ◆ **4X: 4 x 150 KBps = 600 KBps**
  ◆ **24X: 24 x 150 KBps = 3,600 KBps or 3.6 MBps**
  ◆ **48X: 48 x 150 KBps = 7,200 KBps or 7.2 MBps**
  ◆ **75X: 75 x 150 KBps = 11,250 KBps or 12.25 MBps**
❖ **What is the data transfer rate of a DVD drive?**
  ◆ **1xDVD: 1.32 MBps = Video play rate or about 9xCD**
  ◆ **4xDVD: 5.28 MBps = Greater then 36xCD**
❖ **What is data transfer rate of Blu-ray drive?**
  ◆ **1xBluRay: 36MBps**

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Computer Input and Output

- ❖ It is from the computers perspective that Input/Output devices are defined
- ❖ Input data using input devices such as keyboard or mouse
- ❖ Output information that is the result of processing data to output devices like a monitor and printer

Expansion Slots and Adapter Cards

- ❖ What is an expansion slot?
  - ◆ Socket on the motherboard that can hold an adapter card
  - ◆ Plug and Play = the computer automatically configures cards when installed
  - ◆ Desktop computers: PCI, PCIe, AGP, USB
  - ◆ Notebook computers: PC Card, Express Card
- ❖ What are adapter cards?
  - ◆ Special function cards installed in expansion slots or a computer
  - ◆ Modem, Network Card, TV-Tuner, MIDI, Memory, and other I/O Cards

Input Peripheral Devices

Keyboard	Numeric Keypad	Pointing Device	Remote Control
Joystick	Touch Screen	Scanner	Graphics Tablet
Microphone	Digital Camera	Webcams	Light Pens

Output Peripheral Devices

CRT Monitor	TFT Monitor	Laser Printer	Inkjet Printer
Dot Matrix Printer		Speakers	
Plotters		Multimedia Projectors	

Peripheral Devices Connect via Ports

1. **Video Port = connects monitor**
2. **Keyboard/Mouse Port = PS/2 Port**
3. **Serial Port = 9 or 25 pins, mouse, modem**
4. **Parallel Port = 25 holes, LPT1, LPT2**
5. **Game Port = joystick**
6. **USB Ports = Universal Serial Bus**
7. **Fire Wire Port = High Speed Port**
8. **Audio In Port = Microphone**
9. **Audio Out Port = Speakers**
10. **MIDI (Musical Instrument Digital Interface) port**
11. **eSATA port**
12. **SCSI port**
13. **IrDA (Infrared Data Association) port**
14. **Bluetooth port**
15. **HDMI port (High-Definition Multimedia Interface)**
16. **DVI port (Digital Video Interface)**
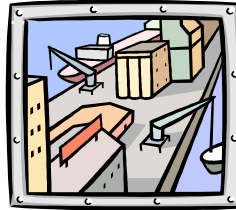
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Networks and the Internet

❖ **A network is a collection of computers and devices connected together via communications devices and transmission media**

❖ **The Internet is a worldwide collection of networks that connects millions of businesses, government agencies, educational institutions, and individuals**

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