

CSE 100: Computer Skills

Lecture 3: Computer Hardware -Memory and processing Devices

Shahadat Hussain Parvez

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Memory and Storage Devices

Difference between Memory and Storage

- Everything is lost from the memory when computer is switched off. However, if you save it to your hard disk (storage), you can easily retrieve it.
- Memory is faster than storage
- Memory is smaller than storage
- RAM is akin to memory, while the hard disk is akin to storage

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Memory

- Memory
 - Stores open programs and data
 - Small chips on the motherboard
 - More memory makes a computer faster



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Memory

- Volatile memory
 - Requires power to hold data
 - Random Access Memory (RAM)
 - Data in RAM has an address
 - CPU reads data using the address
 - CPU can read any address

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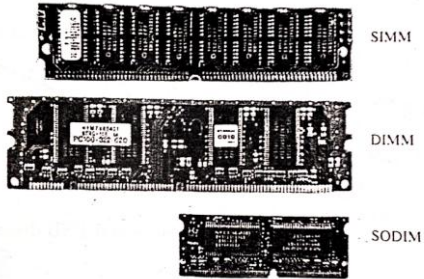
Memory (RAM)

- Different type based on construction include
 - SRAM (Static RAM)
 - Faster (access time 10 ns to 20 ns)
 - DRAM (Dynamic RAM)
 - Slower (access time around 60 ns)
 - Needs regular refreshing
- Different type based on module type include
 - SIMM (Single In-line Memory Module)
 - DIMM (Dual In-line Memory Module)
 - SODIM (Small Outline Dual In-line Memory Module)

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Memory (RAM)



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Memory (RAM)

- Variants of DRAM include
 - EDO DRAM (Extended Data Out DRAM)
 - SDRAM (Synchronous DRAM)
 - DDR SDRAM (Double Data Rate DRAM)
 - RDRAM (Rambus DRAM)

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Memory

- Nonvolatile memory
 - Holds data when power is off
 - Read Only Memory (ROM)
 - Basic Input Output System (BIOS)
 - Power On Self Test (POST)

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Memory (ROM)

- ROM can be of many different types
 - Mask ROM
 - PROM (Programmable ROM)
 - EPROM (Erasable Programmable ROM)
 - EEPROM (Electrically Erasable PROM)

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Memory

- Flash memory
 - Data is stored using physical switches
 - Special form of nonvolatile memory
 - Camera cards, USB key chains, etc uses this type of memory
 - Different from EEPROM because data can not be edited or erased in bytes in flash memory.
 - A whole block of data is accessed at a time
- Available in Different memory sizes
 - Ranges from few hundred megabytes to hundreds of gigabytes

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Describing Storage Devices

- Store data when computer is off
- Two processes
 - Writing data
 - Reading data

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Describing Storage Devices

- Storage terms
 - Media is the material storing data
 - Storage devices manage the media
 - Magnetic devices use a magnet
 - Optical devices use lasers
 - Solid-state devices have physical switches

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Magnetic Storage Devices

- Most common form of storage
- Hard drives, floppy drives, tape
- All magnetic drives work the same



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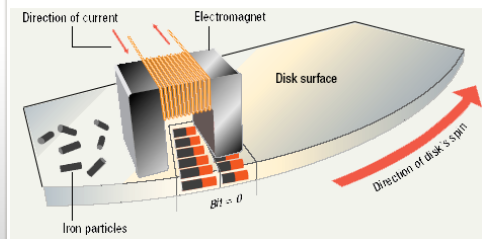
Magnetic Storage Devices

- Data storage and retrieval
 - Media is covered with iron oxide
 - Read/write head is a magnet
 - Magnet writes charges on the media
 - Positive charge is a 1
 - Negative charge is a 0
 - Magnet reads charges
 - Drive converts charges into binary

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Data Retrieval



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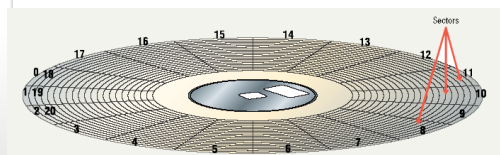
Magnetic Storage Devices

- Data organization
 - Disks must be formatted before use
 - Format draws tracks on the disk
 - Tracks is divided into sectors
 - Amount of data a drive can read

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Tracks and Sectors



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Magnetic Storage Devices

- Finding data on disk
 - Each track and sector is labeled
 - Some are reserved
 - Listing of where files are stored
 - File Allocation Table (FAT)
 - FAT32
 - NTFS
 - Data is organized in clusters
 - Size of data the OS handles

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Magnetic Storage Devices

- Diskettes
 - Also known as floppy disks
 - Read with a disk drive
 - Mylar disk
 - Spin at 300 RPM
 - Takes .2 second to find data
 - 3 1/2 floppy disk holds 1.44 MB

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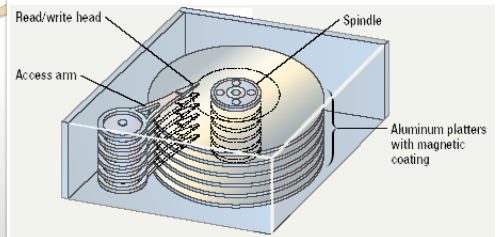
Magnetic Storage Devices

- Hard disks
 - Primary storage device in a computer
 - 2 or more aluminum platters
 - Each platter has 2 sides
 - Spin between 5,400 to 15,000 RPM
 - Data found in 9.5 ms or less
 - Drive capacity greater than 40 GB and up to 5 TB

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Illustrated Hard Disk



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Magnetic Storage Devices

- Removable high capacity disks
 - Speed of hard disk
 - Portability of floppy disk
 - Several variants have emerged
 - High capacity floppy disk
 - Stores up to 750 MB of data
 - Hot swappable hard disks
 - Provide GB of data
 - Connect via USB

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Magnetic Storage Devices

- Tape drives
 - Best used for
 - Infrequently accessed data
 - Back-up solutions
 - Slow sequential access
 - Capacity exceeds 200 GB



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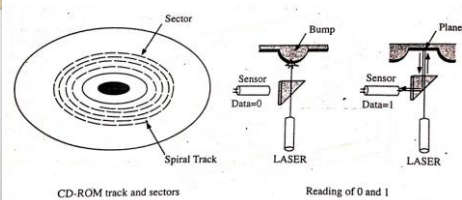
Optical Storage Devices

- CD-ROM
 - Most software ships on a CD
 - Read using a laser
 - Lands, binary 1, reflect data
 - Pits scatter data
 - Written from the inside out
 - CD speed is based on the original
 - Original CD read 150 Kbps
 - A 10 X will read 1,500 Kbps
 - Standard CD holds 650 MB

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Optical Storage Devices



CD-ROM track and sectors

Reading of 0 and 1

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Optical Storage Devices

- DVD-ROM
 - Digital Video Disk
 - Use both sides of the disk
 - Capacities can reach 18 GB
 - DVD players can read CDs

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Recordable Optical Technologies

- CD Recordable (CD-R)
 - Create a data or audio CD
 - Data cannot be changed
 - Can continue adding until full

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Recordable Optical Technologies

- CD Regrettable (CD-RW)
 - Create a reusable CD
 - Cannot be read in all CD players
 - Can reuse about 100 times

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Recordable Optical Technologies

- Photo CD
 - Developed by Kodak
 - Provides for photo storage
 - Photos added to CD until full
 - Original pictures cannot be changed

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Recordable Optical Technologies

- DVD Recordable
 - Several different formats exist
 - None are standardized
 - Allows home users to create DVDs
 - Cannot be read in all players

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Recordable Optical Technologies

- DVD-RAM
 - Allow reusing of DVD media
 - Not standardized
 - Cannot be read in all players

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Solid State Devices

- Data is stored physically
- No magnets or laser
- Very fast
- Smart cards
 - Credit cards with a chip
 - Chip stores data
 - Eventually may be used for cash
 - Hotels use for electronic keys

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Solid State Devices

- Solid-state disks
 - Large amount of SDRAM
 - Extremely fast
 - Volatile storage
 - Require battery backups
 - Most have hard disks copying data

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Processing Devices

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A Look Inside The Processor

- Architecture
 - Determines
 - Location of CPU parts
 - Bit size
 - Number of registers
 - Pipelines
 - Main difference between CPUs is their architecture

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Microcomputer Processors

- Intel
 - Leading manufacturer of processors
 - Intel 4004 was worlds first microprocessor
 - IBM PC powered by Intel 8086
 - Current processors
 - Celeron
 - Pentium
 - Core i3,i5,i7,i9
 - Xeon



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Microcomputer Processors

- Advanced Micro Devices (AMD)
 - Main competitor to Intel
 - Originally produced budget products
 - Current processors
 - Ryzen
 - Athlon FX 64
 - Athlon XP



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Comparing Processors

- Speed of processor
- Size of cache
- Number of registers
- Bit size
- Speed of Front side bus

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Extending The Processors Power

- Standard computer ports
 - Keyboard and mouse ports (PS/2 Port)
 - USB ports
 - Parallel
 - Serial
 - Network
 - Modem
 - Audio
 - Video (VGA, HDMI, DVI)

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Standard Computer Ports



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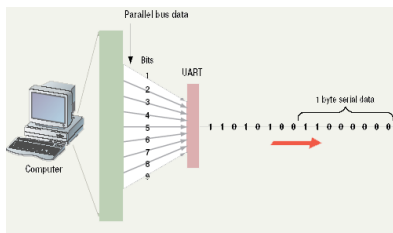
Extending The Processors Power

- Serial and parallel ports
 - Connect to printers or modems
 - Parallel ports move bits simultaneously
 - Made of 8 – 32 wires
 - Internal busses are parallel
 - Serial ports move one bit
 - Lower data flow than parallel
 - Requires control wires
 - UART converts from serial to parallel

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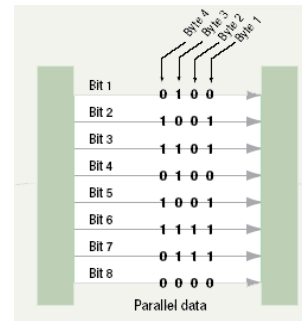
Serial Communications



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Parallel Communications



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Extending The Processors Power

- USB
 - Universal Serial Bus
 - Most popular external bus
 - Supports up to 127 devices
 - Hot swappable

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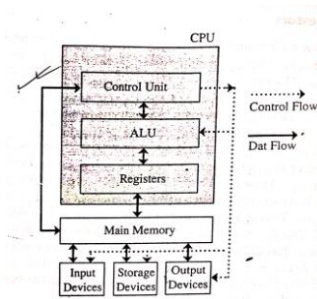
Microprocessor architecture

- A typical microprocessor has 4 basic units
 - Control Unit
 - ALU (Arithmetic Logic Unit)
 - Registers
 - Cache
- They are interconnected
- The interconnections are called buses

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Microprocessor architecture



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Microprocessor Control Unit

- Directs and coordinates the activities of microprocessor
- Instructions main memory are read and brought into microprocessor by the control unit. This is known as instruction-fetch
- After fetching instructions are decoded by control unit to find its meaning
- Once meaning is known the control unit executes the instruction

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Microprocessor ALU

- Performs all mathematical and logical operation under supervision of control unit
- Mathematical operations include addition, subtraction, multiplication and division
- Logical operations include AND, OR, NOT, XOR, etc

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Microprocessor Registers

- Small sized memory within the microprocessor
- Store memory location and data
- Instruction that need to be executed ins stored in the instruction register
- Registers can be 32, 64, or even 128 bits
- Common microprocessors have up-to 32 or higher number of registers

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Microprocessor Cache

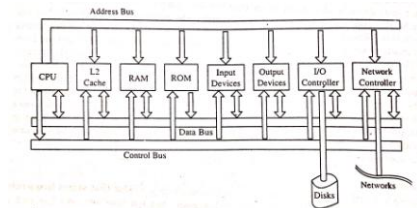
- A little size, very fast memory within microprocessor
- Stores frequently used instructions and data
- Older microprocessor used to have external SRAM act as cache
- Modern microprocessor have built in cache of up-to 512 KB

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Microprocessor Buses

- Three buses: Address, Data, Control
- Different buses can be different bit size



Microprocessor system with bus
 CPU, L2 Cache, RAM, ROM, Input Devices, Output Devices, I/O Controller, Network Controller, Disks, Networks

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Self Study

- Section 3.4.2 : Special Purpose Processor
- Section 3.6 : Specification of PC

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Homework Based on Lecture 2&3

- Questions from Introduction to computers by Mohammed Almgir
- 1, 2, 3, 4, 7, 9, 10, 11, 13, 14, 18, 19, 22, 23, 24, 25, 27, 29, 33, 34, 35, 37, 40, 41, 42, 43, 44, 45, 48, 53, 58, 61, 62, **63, 64, 65, 66, 67, 68, 71, 72, 77, 78, 81**

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