Ch. 1: Computer System

part I

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Chapter 1 Computer System

- Computer Classification
- Data Representation in Computer System
- Components of Computer System
  - Hardware
  - Software
  - Peopleware

Computer Classification

- Classified by data handling
- Classified by work purposes
- Classified by size

Classified by data handling

1. Analog Computer

- continuous (approximate) values
- real time processing

Phillips Hydraulic Computer

2. Digital Computer

- Discrete Value
- Data are represented as 0 and 1
- More accuracy than analog computer

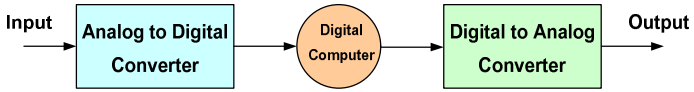
Personal Computer

Ref: http://www.itsavvy.in/computer-classification

Classified by data handling

3. Hybrid Computer

- A merge between an analog computer and a digital Computer
- Uses Converter b/w analog and digital



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Ref: http://www.itsavvy.in/computer-classification

Classified by work purposes

1. General Purpose Computer

- Desktop computer, notebook computer, mobile devices

2. Special Purpose Computer

- Embedded Computer
- Elevator, washing machine, car

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Ref: http://selfhf.com/infolthought/blog/archives/000042.html

Classified by Capacity

1. Embedded Computer
2. Microcomputer, Personal Computer
3. Workstation, Server
4. Mainframe
5. Supercomputer

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Embedded Computer

- Computers that are a part of a machine or device
- Execute a program that is stored in non-volatile memory

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Microcomputer, Personal Computer

- **Microcomputers are the most common type of computers used by people today**
  - Desktop computers, Notebook computers, Game consoles, Mobile devices



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Workstation

- **High-end microcomputer designed for technical or scientific applications.**


- **They are optimized for the visualization and manipulation of different types of complex data and also multitasking**
  - **3D mechanical design, engineering simulation , (e.g. computational fluid dynamics), animation and rendering of images, and mathematical plots**

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Server

- **Powerful computer that performs certain service (request) for client computer.**
  - File Server
  - Game Server
  - Mail Server
  - Web Server

Mainframe

- **High reliability and security**
- **Emphasizes on reliable of transactions**
- **High hardware and computational utilization rates to support <u>massive throughput (very large number of transaction)</u>**
  - Example: transactions for bank.
- **Run uninterrupted for long periods of time.**


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Supercomputer

- **Emphasizes on speed of calculation**
- **Scientific and engineering problems (high-performance computing) with high precision**

Fujitsu K Computer, @Kobe, Japan

Cray Titan, @Oak Ridge, USA

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DATA REPRESENTATION IN COMPUTER SYSTEM

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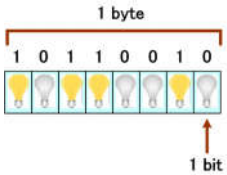
Data representation in Computer System

- **Bit** is the basic unit of information in computing and digital communications (value of 0 or 1)
- **Byte** unit of information most commonly consists of eight bits. Historically, the byte was the number of bits used to encode a single character of text in a computer.



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Data representation in Computer System

Bit – Byte examples

0	**1 bit**
1	**1 bit**
1011	**4 bit**
10100011	**8 bit or 1 byte**

Binary = base 2
Decimal = base 10

ASCII Character Code

Binary	Decimal	Character
0010 1010	42	*
0010 1011	43	+
0011 0001	49	1
0011 0010	50	2
0100 0001	65	A
0100 0010	66	B
0100 0011	67	C
0100 0100	68	D

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Data Capacity

1 Kilobyte (KB)	1024 Bytes (2^{10} Bytes)
1 Megabyte (MB)	1024 Kilobytes
1 Gigabyte (GB)	1024 Megabytes
1 Terabyte (TB)	1024 Gigabytes
1 Petabyte (PB)	1024 Terabytes

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Hardware

- **The collection of physical elements that constitute a computer system**

1. **Input Unit**
2. **Central Processing Unit**
3. **Output Unit**
4. **Memory, Storage**
   - Primary Storage, Main Memory
   - Secondary Storage

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COMPONENTS OF COMPUTER SYSTEM

- **Hardware**
- **Software**
- **Peopleware**

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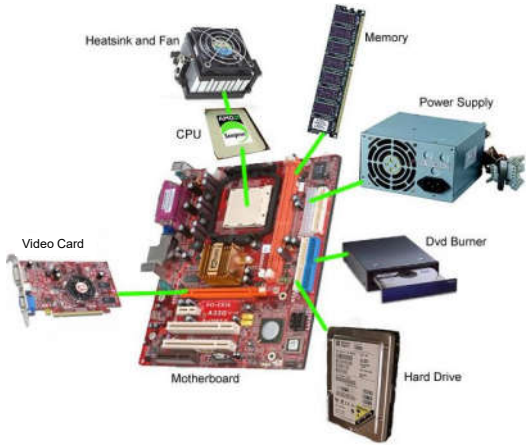
Computer Hardware



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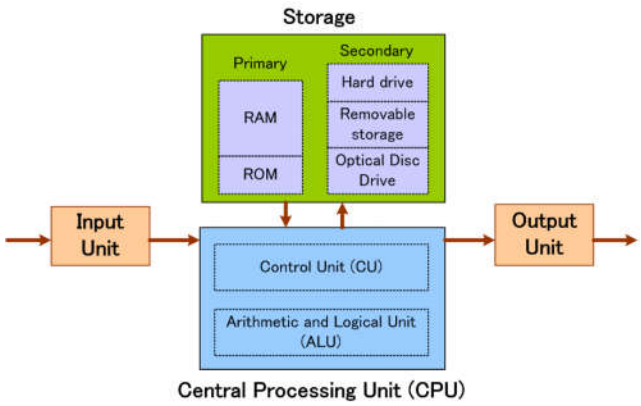
Computer Components



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Input Unit

1. Keyboard
2. Mouse
3. Touch pad
4. Scanner
5. Microphone
6. Fingerprint reader
7. Barcode reader

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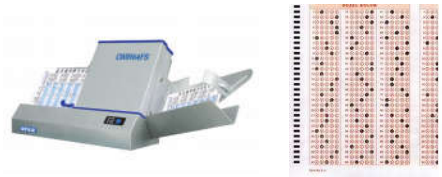
Input Unit

8. Magnetic Ink Character Recognition: MICR

9. Optical Mark Reader: OMR



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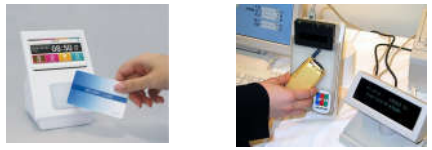
Input Unit

10. QR code reader

11. Contactless smart card reader



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Central Processing Unit

Central Processing Unit (CPU)

- **The hardware within a computer that carries out the instructions of a computer program**
- **Performing the basic**
  - arithmetical,
  - logical, and
  - input/output
- **Microprocessor**
  - More than one processor in a chip, multiprocessor.

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Central Processing Unit

- **CU: Control Unit**
  - Extracts instructions from memory and decodes and executes them calling on the ALU when necessary
- **ALU: Arithmetic Logic Unit**
  - Performs arithmetic and logical operations

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Output Unit

- **Soft Copy**
  - **Monitor**
    - Cathode Ray Tube (CRT)

    - Liquid Crystal Display (LCD)

  - **Speaker**

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Output Unit

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Output Unit

- **Hard Copy**
  - **Printer**
    - Impact Printer : *Dot matrix printer*

    - Non-impact Printer : *Laser, Inkjet printer*

  - **Plotter**

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Memory or Storage Unit

- **Primary / Main Memory**
  - **ROM: Read Only Memory**
  - **RAM: Random Access Memory**
- **Secondary Memory**
  - **SAS: Sequential Access Storage**
  - **DAS: Direct Access Storage**

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Primary / Main Memory

- **ROM (Read Only Memory)**
  - Read Only (sort of)
  - Non-volatile (Requires no power to maintain data)
- **RAM (Random Access Memory)**
  - Allows stored data to be accessed directly in any random order.
  - Store data and instruction temporarily to be calculated by CPU
  - Volatile (Requires power to maintain data)

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SAS: Sequential Access Storage

- **A class of data storage devices that read their data in sequence.**
- **Slower access to non serial data.**

Examples

- **Paper Tape**
- **Punch Card**
- **Magnetic Tape**

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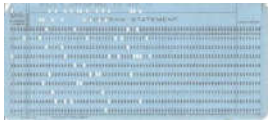
SAS: Sequential Access Storage



Punch Card

Magnetic Tape

Paper Tape

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DAS: Direct Access Storage

- **Relatively low access time relative to its capacity**
- **The access methods: Sequential, Indexed and Direct.**

- **Magnetic**
  - Hard Disk
  - Diskette or Floppy Disk
- **Optical**
  - Compact Disc (CD)
  - Digital Versatile Disc (DVD)
  - Blu-ray Disc (BD)
- **Solid State**
  - USB Flash Drive
  - Solid State Drive (SSD)

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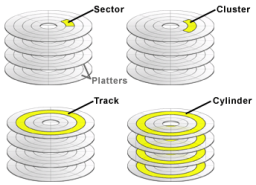
Magnetic Disk Details

- **Sector:** smallest unit of data that can be read or written from a disk. Typically, sectors are 512 bytes in size, but other sizes including 1024 and 2048 are common.
- **Cluster:** A cluster is the smallest unit of data that a file system can allocate for a file. (e.g. 512 – 4,096 bytes for NTFS)



- **Track:** A track is a concentric ring of sectors on a platter.
- **Cylinder:** A cylinder is a group of tracks in all the platters

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Ref: http://www.sweetscape.com/010editor/manual/EditingDrives.htm

CD and DVD

- The data is stored on the disc with a laser or stamping machine, and can be accessed when the data path is illuminated with a laser while spinning.
- CD storage capacity: 650 – 870 MB
- DVD storage capacity: 4.7 – 17 GB

- **CD-ROM**
- **CD-R**
- **CD-RW**
- **DVD-ROM**
- **DVD-R**
- **DVD+R**
- **DVD-RW**
- **DVD+RW**
- **DVD-RAM**

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Blu-ray Disc

- Optical disc storage medium designed to supersede the DVD format.
- Blu-ray Disc uses a 405 nm "blue" laser diode.

- **Single layer: 25 GB**
- **Double layer: 50 GB**
- **Triple layer (BDXL): 100 GB**
- **BD-R (Blu-ray Disc Recordable)**
- **BD-RE (Blu-ray Disc Rewritable)**

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Solid State Storage

- No Moving part
- Faster as data can be retrieved directly from various locations
- More expensive per unit of storage than HDDs.
- i.e. USB Memory, SD Card, Solid State Drive (SSD)

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A Motherboard (Mainboard)

- **The Motherboard is the primary circuit board of a personal computer containing the circuitry for the central processing unit, keyboard, mouse and monitor, together with slots for other devices.**

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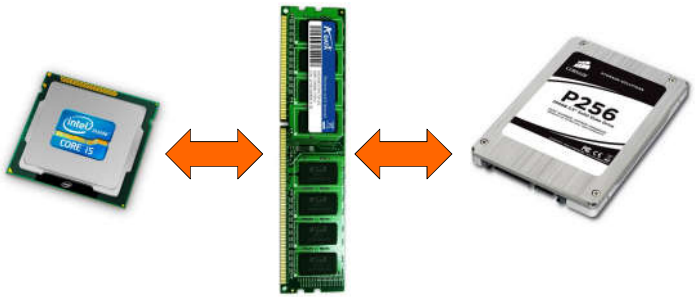
RAM and HDD



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SOFTWARE

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Software

- **Computer software, or just software, is any set of machine-readable instructions (most often in the form of a computer program) that directs a computer's processor to perform specific operations.**

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Software Classification

- **System Software**
  - Operating System
  - Language Translator
  - Utility Software
- **Application Software**
  - Special Purpose Software
  - Package Software

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Programming Language

- **A programming language is an artificial language designed to communicate instructions to a machine, particularly a computer.**
- Programming language generations
  - **Machine Language**
  - **Assembly Language**
  - **High-level Language**
  - **Very High-level Language**
  - **Natural Language**

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Ref: http://www.webopedia.com/TERM/F/fourth_generation_language.html

Machine Language: 1st Generation (1GLs)

- **In binary form (digital code).**

  11110000 11000111

- **The only language which CPU (Machine) can execute (understand),**
- Referring to any memory location in RAM.
- Using very detailed instructions.
- Machine(CPU) Dependent

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Assembly Language: 2GLs

- **A symbolic language. A group of binary code equals one symbol**
  - Symbolic programming language
- **Translated into machine language by an Assembler**

MOV CL, 37h — **Assembly Language**

↓

Load CL with 55 decimal (37 hex) — **B1 37**

↓

Machine Language — **10110001 00110111**

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High Level Language: 3GLs

- **Meaningful language and more programmer-friendly.**
- **it may use natural language elements**
  - e.g. include, case, do, if, else, for, goto
- **To be translated by a Compiler or an Interpreter**
- **For example**, FORTRAN, BASIC, Pascal, C, Java

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Very High Level Language: 4GLs

- **Designed to reduce**
  - programming effort
  - the time it takes to develop software,
  - and the cost of software development.
- User specify **what** needs to be done without having to specify **how** it is to be done
- **For example**, Python, Ruby, SQL

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4GL Example – SQL Query

SELECT MONTH, DAYLIGHT, TEMP

FROM STATS

ORDER BY TEMP DESC;

"Pick MONTH, DAYLIGHT, and TEMP data from table STATS, sorting them in descending order"

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Translator

Program translator translates source code of programming language into machine language-instruction code

1. **Assembler**
   - An assembler translates the symbolic codes of programs of an assembly language into machine language instructions

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Translator

2. **Interpreter**
   - Interpreter directly executes the program from its source code. Due to this, every time the source code should be inputted to the interpreter. In other words, each line is converted into the object codes.
3. **Compiler**
   - Compilers are the translators, which translate all the instructions of the program into machine codes, which can be used again and again

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Ref: http://my.safaribooksonline.com/book/programming/c/9788131760314/basics-and-introduction-to-c/section_1.7

System Software

- **Software designed to operate the computer hardware and to provide a platform for running application software**

➢ **Utility Software**

- small, powerful programs with a limited capability, they are usually operated by the user to maintain a smooth running of the computer system
- e.g. Anti-virus software, Backup software, Disk defragmenter, File manager, Network utility

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System Software

- **Operating System**

- **a collection of software that manages computer hardware resources**
- Provides common services for computer programs.
- The operating system acts as an intermediary between programs and the computer hardware
- For example, **Microsoft Windows, OS X, Solaris, Linux**

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Application Software

- **Application software is all the computer software that causes a computer to perform useful tasks**

- **Special Purpose Software**
  - Special Purpose application software is very specific in its use for example engineering related application.
- **Package Software**
  - A collection of computer programs —usually application software or programming software— of related functionality
  - For example MS office Suite

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PEOPLEWARE

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Peopleware

- **Peopleware can refer to anything that has to do with the role of people in the development or use of computer software and hardware systems**

Peopleware classification

- **Administrative staff**
- **Technical staff**
- **Operational staff**

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Peopleware

Administrative Staff

- **Manage resources to maximize benefits to the organization**
- **Determine planning & standards within the organization**
- **Example**
  - Manager
  - Chief Officer

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Peopleware

Technical staff

- Use technical knowledge to analyze, design, create, and maintain computer system.
  - **Responsibilities**
    - System Analysis & Design
    - Problem Solving
    - Program Design and Coding
    - Technical Support
  - **Example:**
    - System Analyst
    - Programmer
    - Software Engineer
    - Network Administrator
    - Computer Technician

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Peopleware

Operational staff

- **Uses provided software or packages**
- **Technical knowledge not required**
- **Perform non-technical tasks in an organization**
  - User / End User
  - Computer Operator
  - Data Entry Operator

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