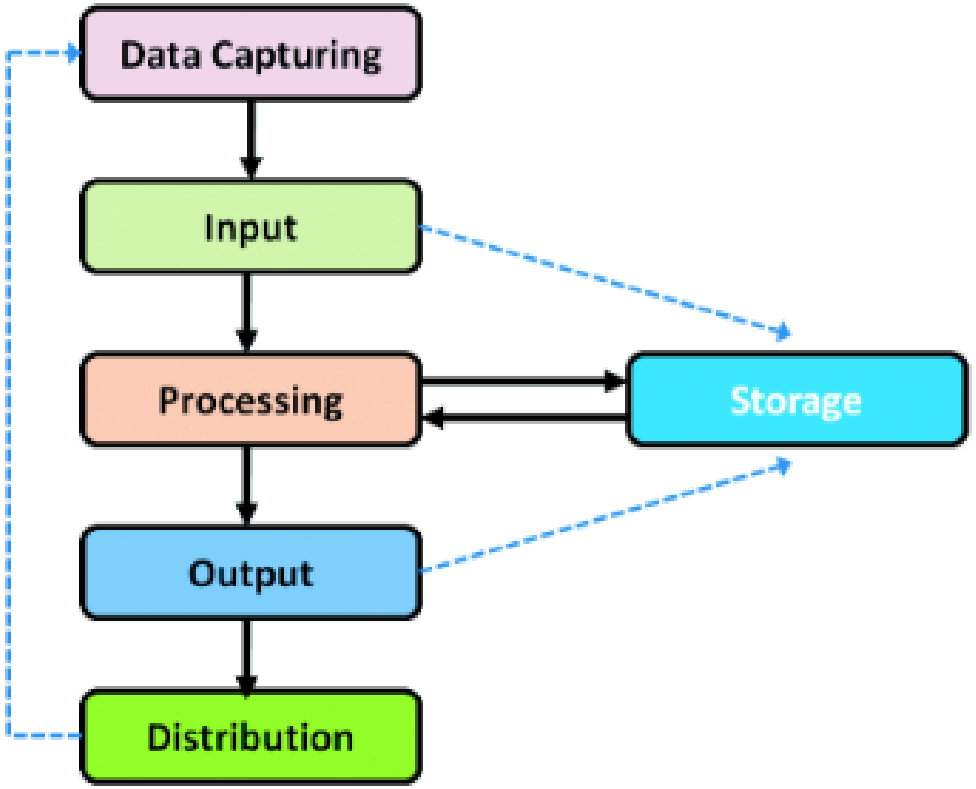
Components of the Computer System

+1 Computer Science

Data processing

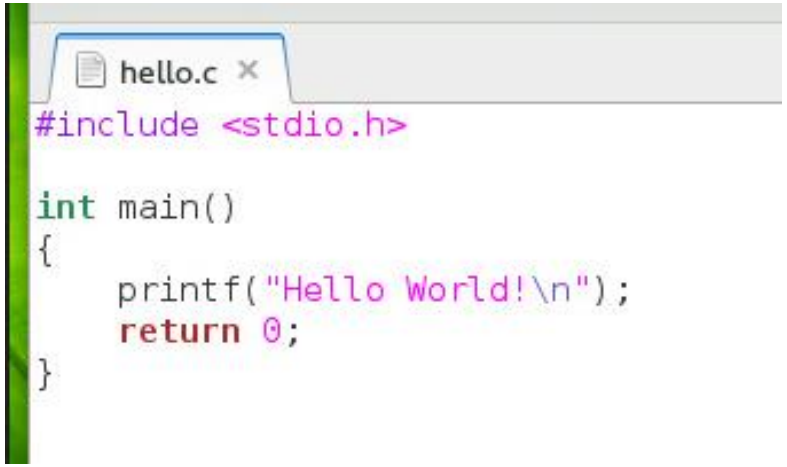
- It is the operation or activities performed on data to generate information
- Data : number, words, amount, quantity
- Information : meaningful and processed form of data. It adds to our knowledge and help to making decisions.
- Data processing proceed through 6 stages

1. Capture data
2. Input of data
3. Storage of data
6. Processing / manipulating data
7. Output of information
8. Distribution of information


Data Capturing
Input
Processing
Storage
Output
Distribution

Data processing

- Capturing Data
  - 1st stage in data processing
  - Collect data in proper order and format by the help of source document
  - Source document : designed to provide data to the computer in collectable format



- Input
  - 2nd stage
  - Data collected through the source document is fed to the computer for processing

- Storage
  - 3rd stage
  - The input data are stored before processing
  - The information obtained processing may also stored
  - Example : RAM

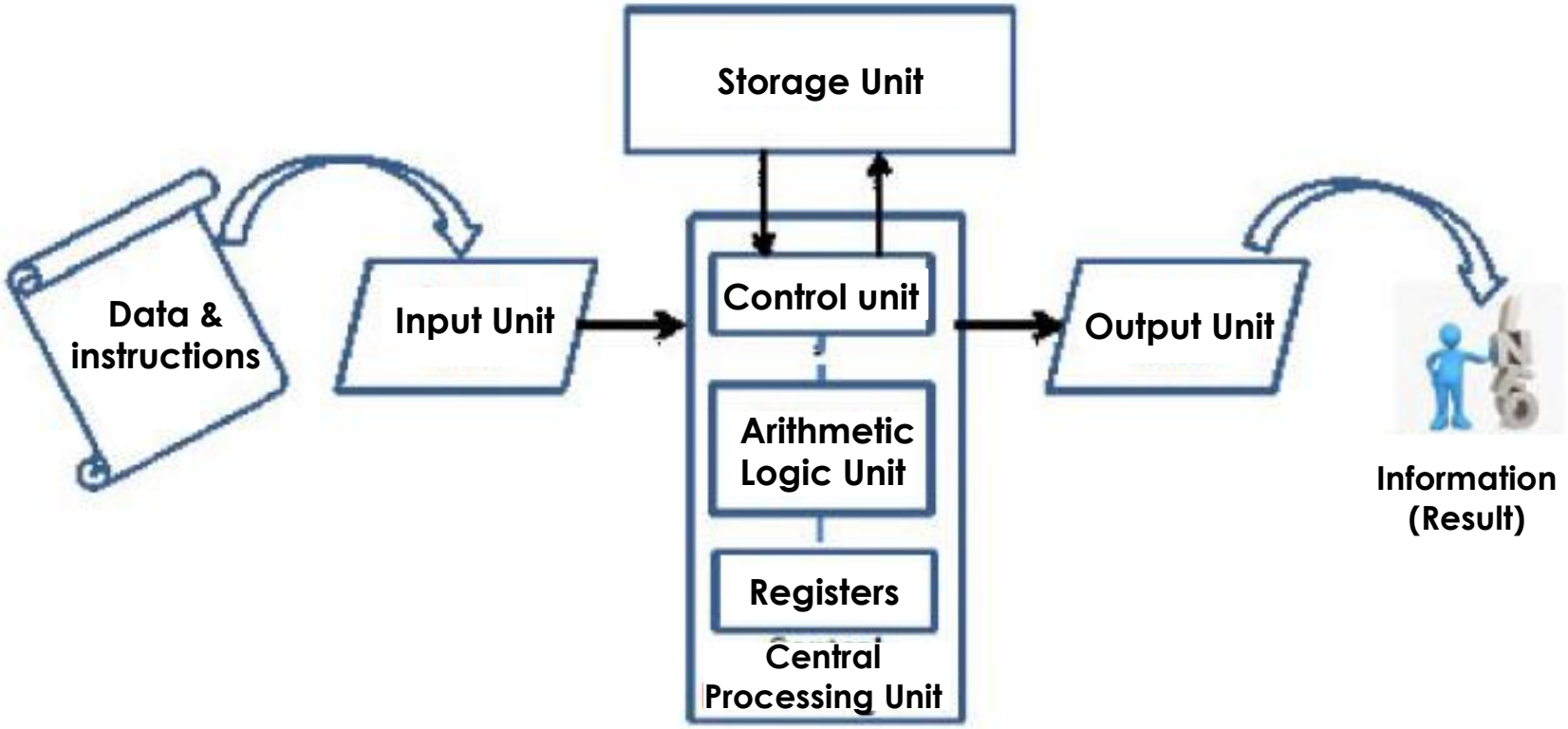
- Process
  - 4rd stage
  - Operations like calculations, classifications, comparison, sorting, filtering, summarising, etc.. may be carried out as part of processing.
  - Example : processor / controllers

- Output
  - 5th stage
  - Processed data obtained in the form of information
  - This output may be stored for future use

- Distribution of information
  - 6th stage
  - Information is distributed to users/beneficiary
  - They take decisions / solve problems according to this information

Functional units of a computer

- Mainly computer have 3 parts (v)
  1. Input unit
  2. Central processing unit
  3. Output unit


Storage Unit
Data & instructions
Input Unit
Control unit
Arithmetic Logic Unit
Registers
Central Processing Unit
Output Unit
Information (Result)

- Input Unit
  - Data & instructions for processing are entered to the computer through the input unit
  - They are stored in memory (storage unit)
  - Data format depends upon the nature of input device (number, text, video, audio, etc..)
  - Commonly used input devices : keyboard, mouse, scanner, mic, digital camera, etc..

- Function of input unit
  1. Accept instructions and data
  2. Convert these instructions and data into computer acceptable form
  3. Supplies the converted instructions and data for processing

- Central processing unit (CPU)
  - Brain of computer
  - All the calculations and comparisons are made inside the CPU
  - Also responsible for activating and controlling of other units

  - CPU functions are performed by 3 components
    1. ALU (Arithmetic Logic Unit)
    2. CU (Control Unit)
    3. Registers

1. ALU (Arithmetic Logic Unit)
   - Perform calculations and logical operations such as comparison and decision making
   - Working ALU

     The data & instructions are transferred to the ALU and processing takes place in it.

     Intermediate result temperedly stored back the storage and retrieve later.

     Result is stored back to the storage unit

2. CU (Control Unit)
   - Central nervous system that manage and coordinates all other units
   - It obtain instructions from the program stored in the memory

3. Registers
   - Temporary storage element
   - A processor register is a quickly accessible location available to a computer's processor
   - Each one is designed to store unique items (memory address, data, instructions, result, etc..)

- Storage Unit
  - Data and instructions are stored before processing
  - Also the information or result after processing are stored

  - Functions of storage unit are
    1. Store data & instructions required for processing
    2. Store intermediate results for ongoing processing
    3. Store Final result

- Storage units are of 2 types
  1. Primary storage
  2. Secondary storage

1. Primary storage
   - Also called main memory
   - CPU can directly access the main memory at very high speed
   - Limited storage capacity

   - Classified into 2
     1. RAM (Random Access Memory) :

        Used to hold instructions, data & intermediate results of processing

     2. ROM (Read Only Memory) :

        Used to hold Instruction for the start-up procedure of the computer

2. Secondary storage

- Also called Auxiliary storage
- Huge storage capacity
- Store data permanently
- Examples : Hard Disk, CD, DVD, Flash drive

- Output Unit
  - Processed data supplied to the outside world
  - Human-readable form
  - Examples: Monitor, Speaker, Printer

  - Functions of Output unit are
    1. Receive the result from CPU in coded form
    2. Convert the coded result to human readable form
    3. Supplies the result to the outside world

Hardware

- Touchable and visible part of a computer
  1) Processor
  2) Motherboard
  3) Peripherals and Ports
  4) Memory
  5) Input / Output devices

- Processor
  - It is an integrated circuit (IC) package consist of millions of transistors and other components fabricated into a single chip
  - Also called Microprocessor
  - Responsible for all calculations , Decision making operations and coordinate the working of the computer
  - Example: Intel core i3, core i5, core i7, AMD Quadcore,etc..

- Registers are located inside the processor
- Important registers are :
  1) A (Accumulator)
  2) MAR (Memory Address Register)
  3) MBR (Memory Buffer Register)
  4) IR (Instruction Register)
  5) PC (Program Counter)

1) A (Accumulator) :
   - Part of ALU
   - Used to store intermediate result
   - Also called Register A

2) MAR (Memory Address Register)
   - Store the address of memory location by the processor

3) MBR (Memory Buffer Register)
   - It hold data read from the memory by the processor

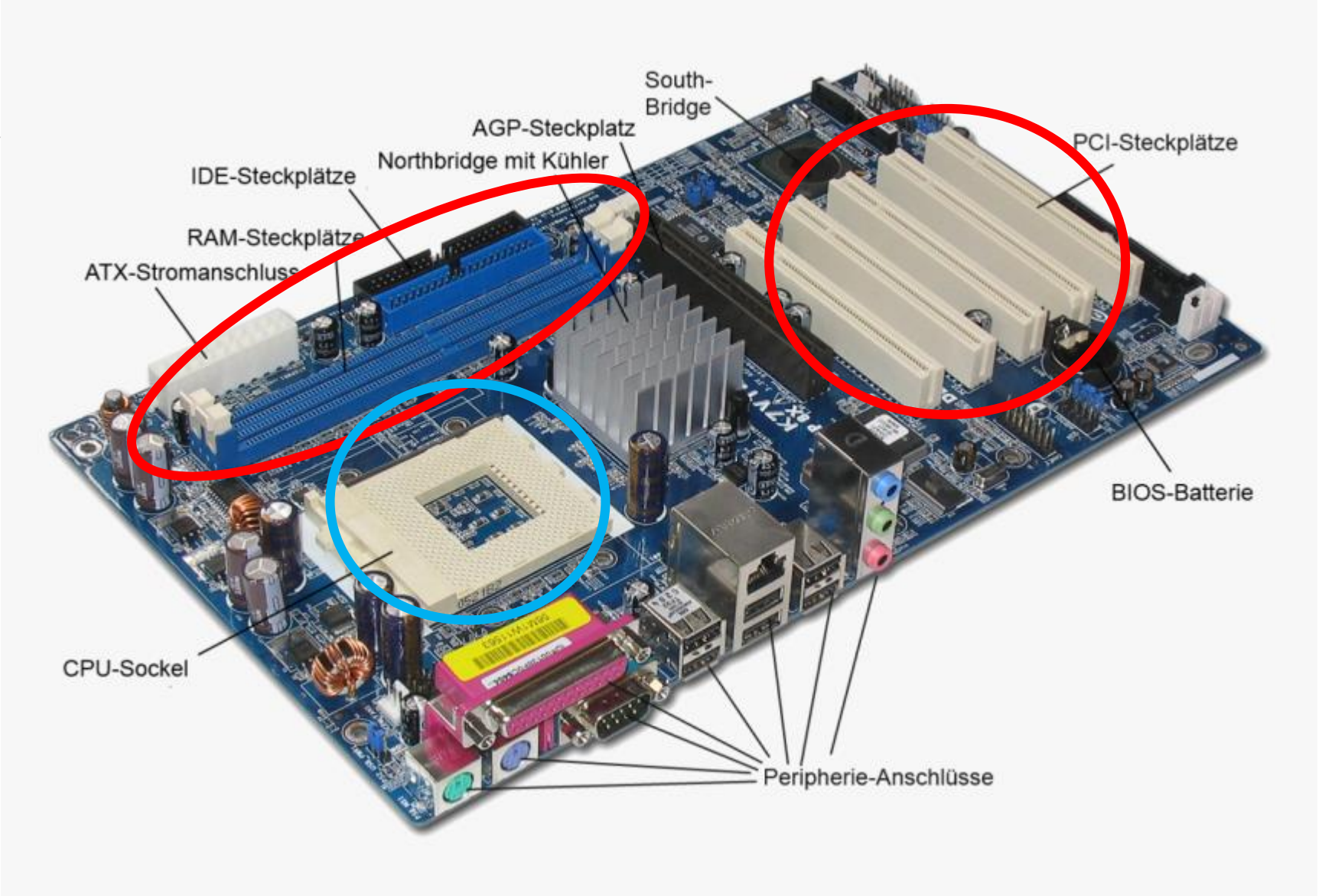
4) IR (Instruction Register)

– Executed instructions are stored by the processor

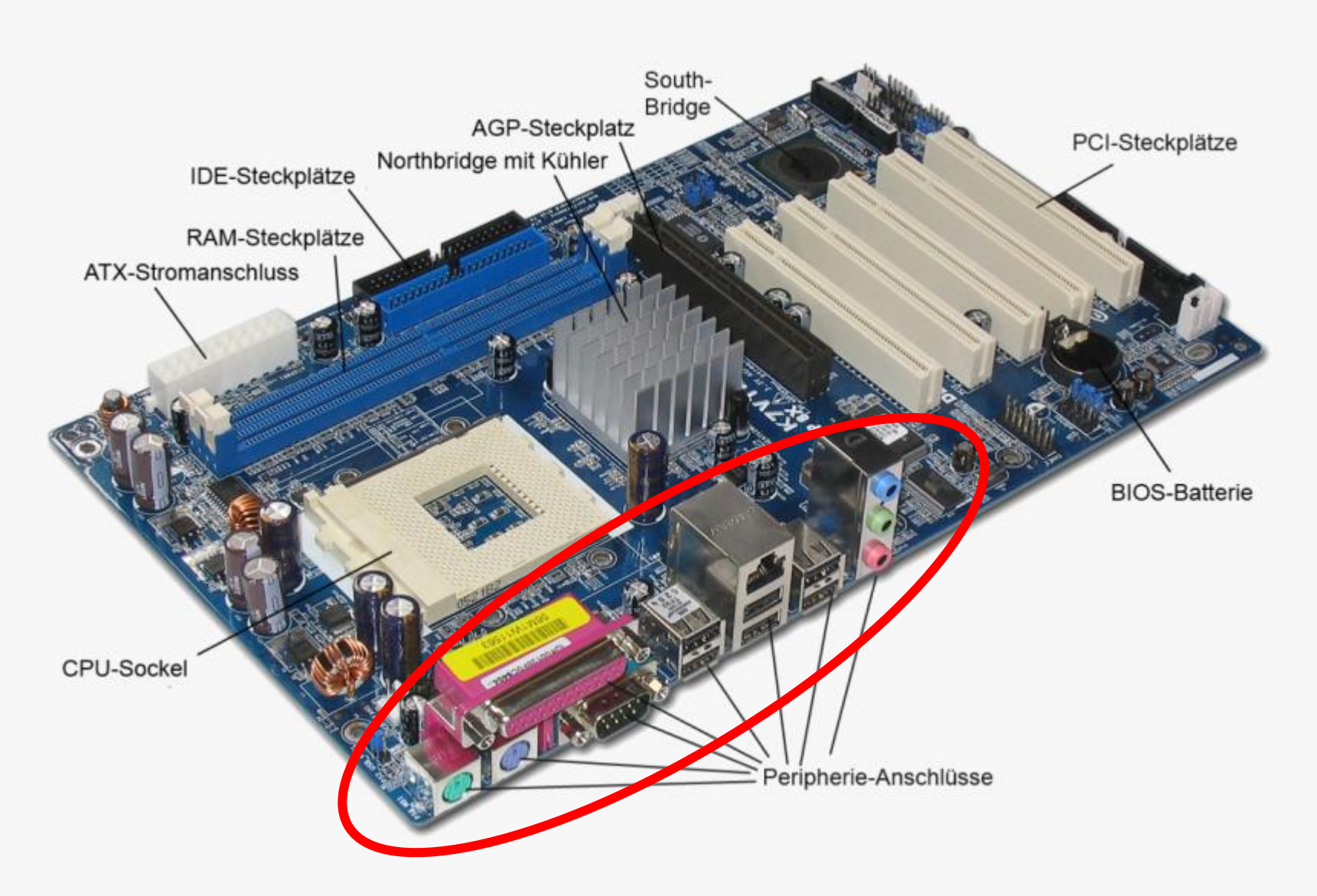
5) PC (Program Counter)

– It hold the address of next instruction to be executed by the processor

- Motherboard
  - Large Printed Circuit Board (PCB)
  - The board consisting of additional expandable slots for memory, graphics card, sound card, etc..


South-
Bridge
AGP-Steckplatz
Northbridge mit Kühler
IDE-Steckplätze
RAM-Steckplätze
ATX-Stromanschluss
PCI-Steckplätze
BIOS-Batterie
CPU-Sockel
Peripherie-Anschlüsse

- Peripherals and ports
  - Peripherals : external devices are connected to the computer.
    - Input/output device, Communication device, Memory device
  - Ports : slots on motherboard used to connect external devices.
    - VGA, PS/2, USB, Ethernet, HDMI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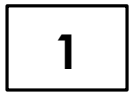
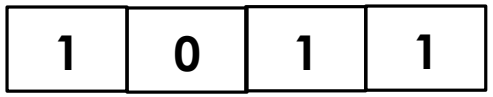
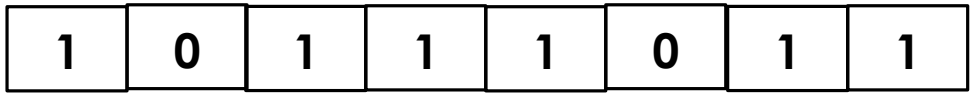
vga
mini dvi
hdmi
audio
optical audio
dvi
thunderbolt
displayport
mini displayport
firewire 400
ps/2
sata
esata
ethernet
firewire 800
usb type A
usb type B
usb type C
usb micro
usb mini

- Memory
  - Used to store data, instructions and information's(results) temporally or permanently.
  - Memory classified into 2
    1. Primary Memory (store data / intermediate results temporally)
    2. Secondary memory (store data / results permanently)

- Different memory measurement units:
  - Binary digit = 1 Bit 

  - 1 Nibble = 4 Bit 

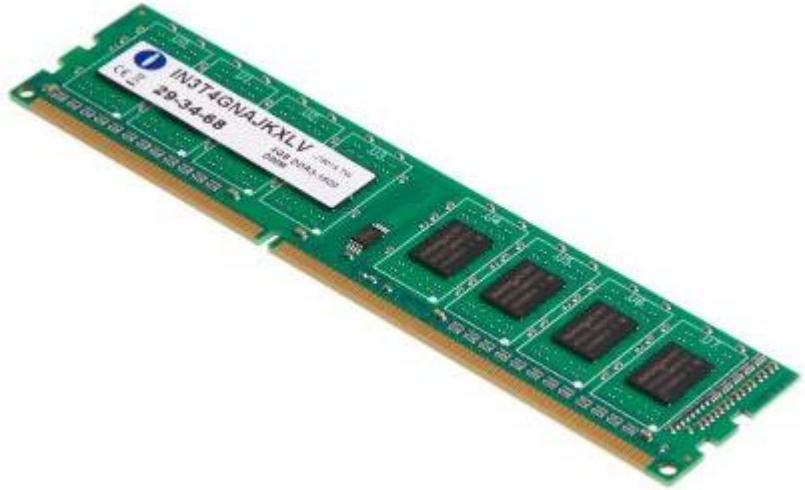
  - 1 Byte = 8 Bit 

  - 1 KB (Kilo Byte) = 1024 Bytes
  - 1MB (Mega Byte) = 1024 KB
  - 1 GB (Giga Byte) = 1024 MB
  - 1TB (Tera Byte) = 1024 GB
  - 1PB (Peta Byte) = 1024 TB

1. Primary Storage
   - Semiconductor memory accessed directly by the CPU
   - Capable of sending & receiving data at high speed.
   - It include 3 type of memory
     1) RAM
     2) ROM
     3) Cache memory

1) RAM

- Microprocessor can directly access
- Support Read & write Operations
- Data or instructions to be processed by the CPU must be placed in RAM
- Volatile memory
- Data lost when power off
- Speed measure in Mega Hertz (MHz)



- A working computer, the RAM contains:
  1. Operating system software (OS)
  2. Currently used Application Software
  3. Data being processed

2) ROM

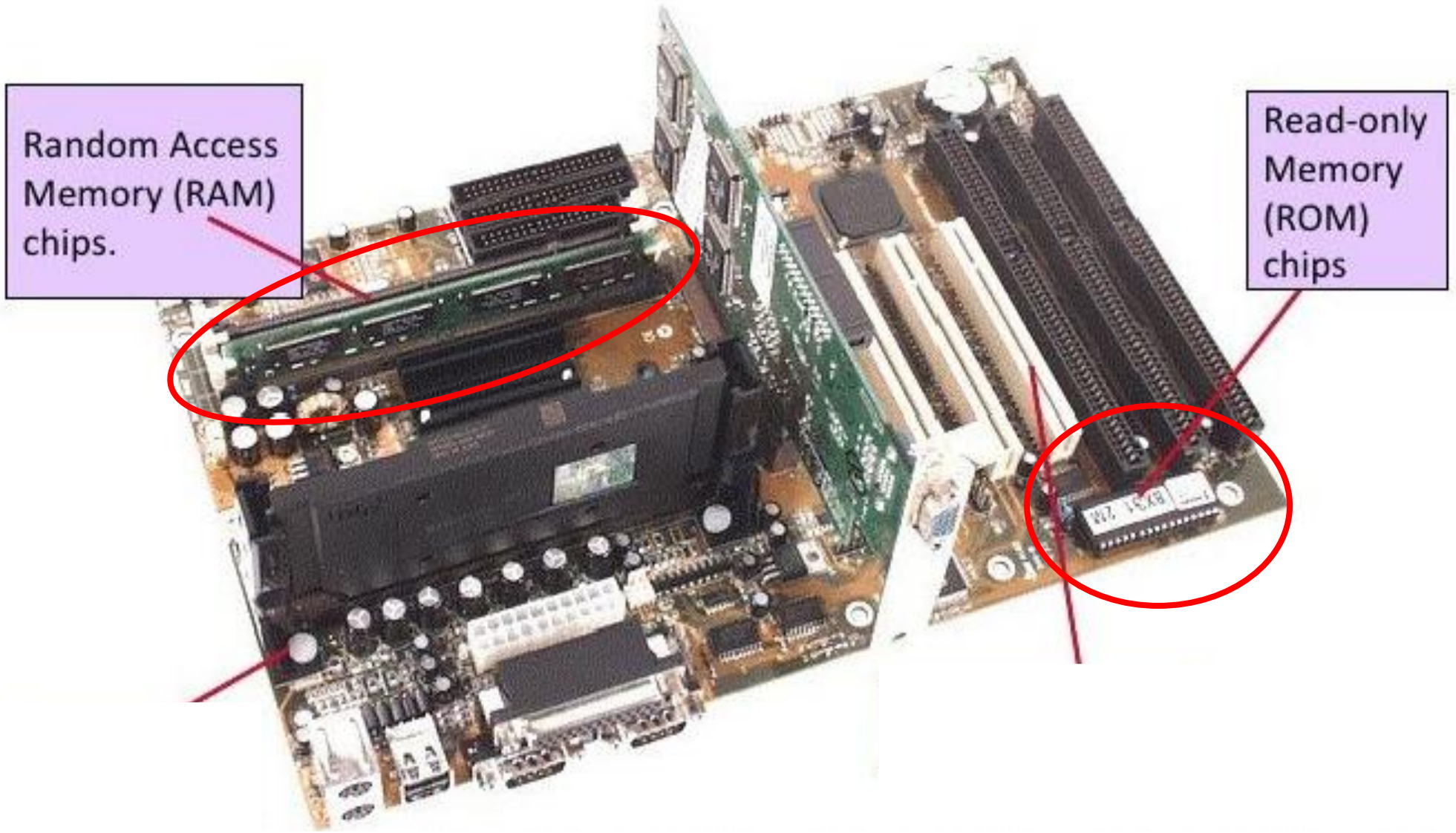
- Only Read Operation
- Non Volatile memory
- Data cannot lose when power off

- ROM contains:
  1. Boot Up Program
  2. BIOS (Basic Input Output System)

- ROM Types
  1. PROM (Programmable ROM)
     - Programmed only 1s time
     - Rewritten not possible
  2. EPROM (Erasable Programmable ROM)
     - rewritten using ultra-violet radiation
  3. EEPROM (Electrically Erasable Programmable ROM)
     - rewritten electrically

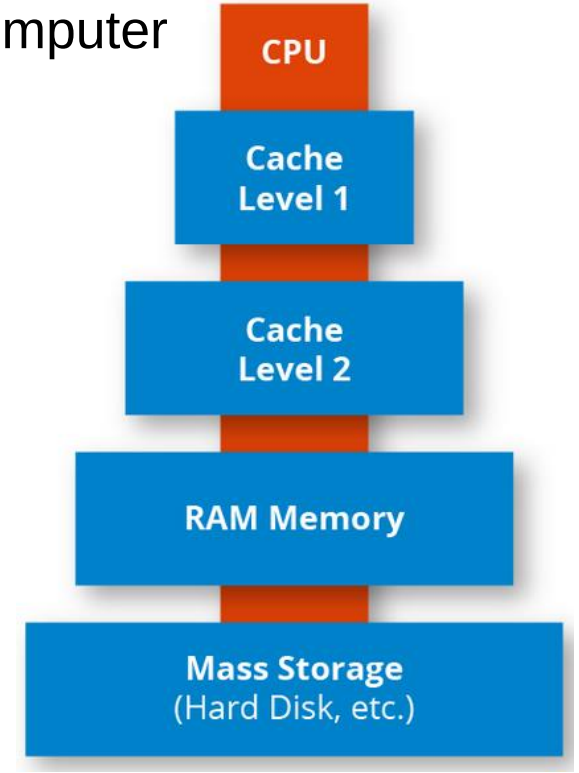
- Difference between RAM & ROM

RAM	ROM
1. Temporary Storage.	1. Permanent storage.
2. Store data in MBs.	2. Store data in GBs.
3. Volatile.	3. Non-volatile.
4.Used in normal operations.	4. Used for startup process of computer.
5. Writing data is faster.	5. Writing data is slower.


Random Access Memory (RAM) chips.
Read-only Memory (ROM) chips

3) Cache Memory

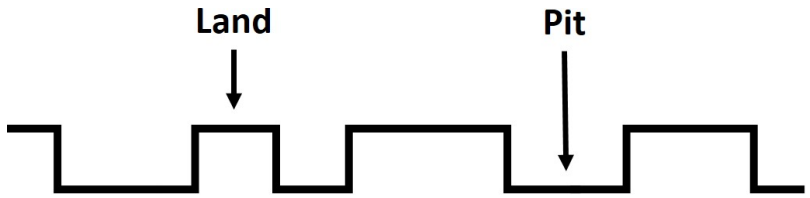
- Small & Fast memory between processor and RAM
- Frequently asked data, instructions, intermediate results, etc… are stored in cache memory.
- This memory make faster the entire working of the computer
- Reduce hanging problems.
- Cache is more expansive than ROM



1. Secondary Storage (Auxiliary Storage)
   - Permanent storage device
   - Store program and data
   - Also used for transferring data or program from one PC to other
   - Processor cannot access directly.
   - Non volatile memory
   - Cheaper & Slower than RAM
   - Categories:
     1. Magnetic storage device
     2. Optical storage device
     3. Semiconductor storage

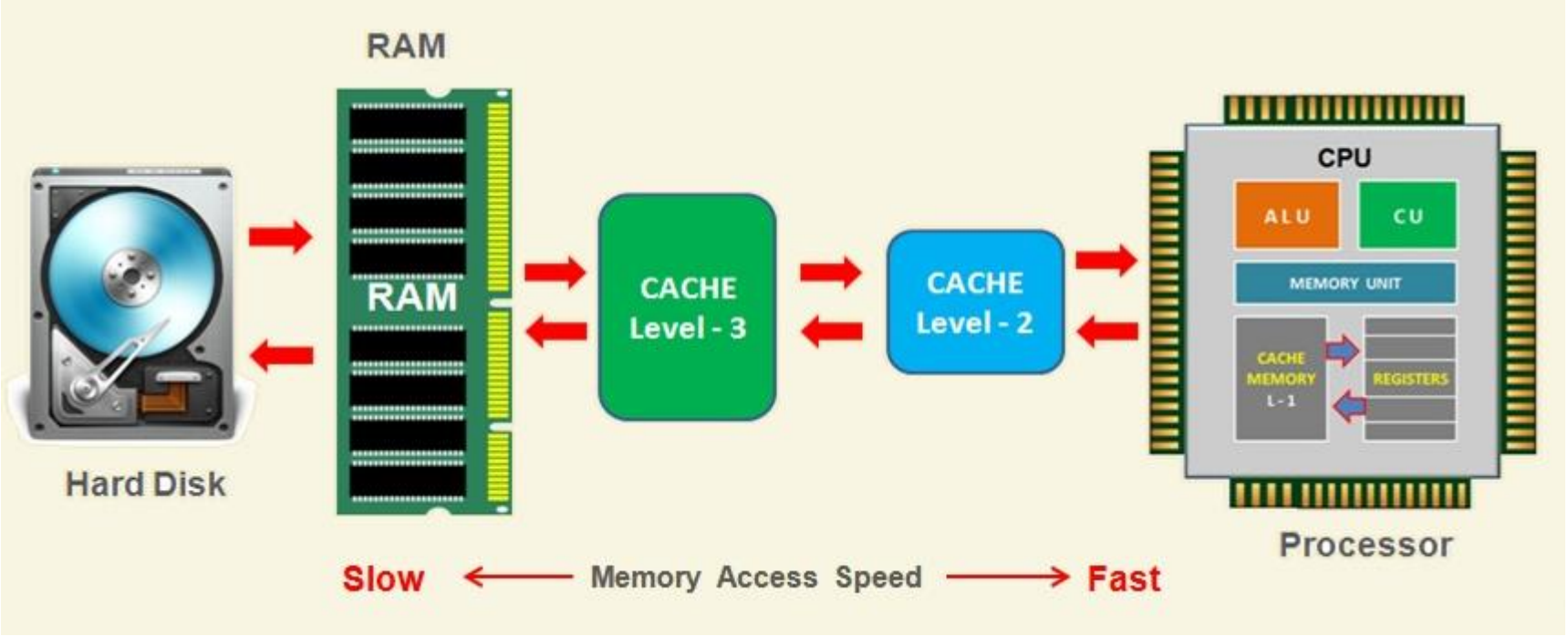
- Categories:
  1. Magnetic storage device
     - Magnetic Tap , Hard disk
     - Data Recorded magnetically in this devoice
     - Read write header is used to access data

2. Optical storage device
   - CD, DVD, Blu-Ray
   - Data read and write using laser beam
   - Aluminium foil between 2 plastic disk
   - Laser beam read pits and lands as 0s and 1s



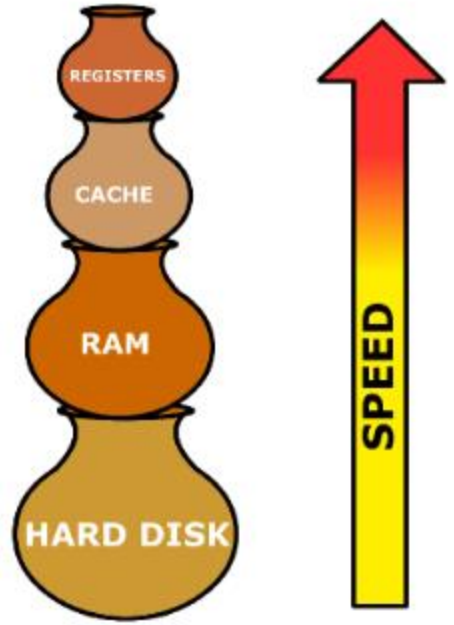
3. Semi-conductor storage
   - Flash drive, SD Card
   - Made by EEPROM Chip
   - Long life

- Role of memories in Computer
  - Memory increase the performance of a computer
  - Memory Hierarchy



- Characteristics of different types of memory

Storage	Speed	Capacity	Relative Cost	Volatile
Registers	Fastest	Lowest	Highest	Yes
Cache	More Fast	Low	Very High	Yes
RAM	Very Fast	Low/Moderate	High	Yes
Hard Disk	Moderate	Very High	Very Low	No



- Input / Output devices
  - Human communicate with computer
  - Input Devices

→ Keyboard
→ Mouse
→ Light pen
→ Touch screen
→ Graphics table
→ Joystick
→ Microphone
→ Scanner
→ Optical Mark reader (OMR)
→ Barcode reader
→ Biometric reader
→ Smart card reader
→ Digital camera

- Input / Output devices
  - Output Devices

→ VDU (visual Display Unit)

→ LCD

→ Printer

→ Plotter

→ 3D Printer

→ Audio Output Device

E-Waste

- Electronic waste
- Refers to electronic products nearing the end of their ‘useful life’
- Discarded computer, office electronic equipment, entertainment device, Mobile phones, TV, Refrigerator,
- Used-products are also considered as e-waste.

- Why should we be concerned about e-waste ?
  - E-waste contain very toxic substances
    - Mercury
    - Lead
    - Cadmium
    - Brominate flame retardants
  - The toxic materials can cause
    - Cancer
    - Reproductive disorders
    - Many other health problems like asthma

- e-waste side effects
  - Mercury
    - PCB & LCD Screen back light
    - baby's - brain growth & nerve system
    - Adults - organ damage, mental problems etc..
  - Lead
    - PCB & Monitor glass
    - Central nerve system, blood system, kidneys
  - Cadmium
    - IC, Resistor, semi-conductors
    - Various type of cancer, Kidney problems
  - Brominate flame retardants
    - PCB, some Plastic
    - Toxin increase the risk of cancer

- e-waste disposal methods
  - Reuse
    - – Second-hand use / Upgrade / modified.
  - Flaming
    - – Burn in specially designed centre at high temperature (900°C – 1000°C)
  - Recycling of e-waste
    - Making or manufacturing new product
    - Monitor, keyboard, laptop, telephone, hard disk, printer, IC’s are recyclable
  - Land filling
    - Widely used and non recommended method

Green Computing / Green IT

- Green computing is the designing, manufacturing, using & disposing of computer and associated components efficiently and effectively with no impact on environment

- Energy Star
  - Conceived by EPA (Environmental protection agency) in 1992
  - Promote energy efficiency in hardware standardisation


energy


energy
ENERGY STAR

- Govt regulations
  - Modify computer users / workers habits
    - Turn off computer when not In use
    - Power on peripheral device only when needed
    - Use power saver mode
    - Use laptop rather than desktop
    - Take print out only if necessary
    - Use LCD rather than CRT monitor
    - Use Hardware/software with Energy star label
    - Use solar energy

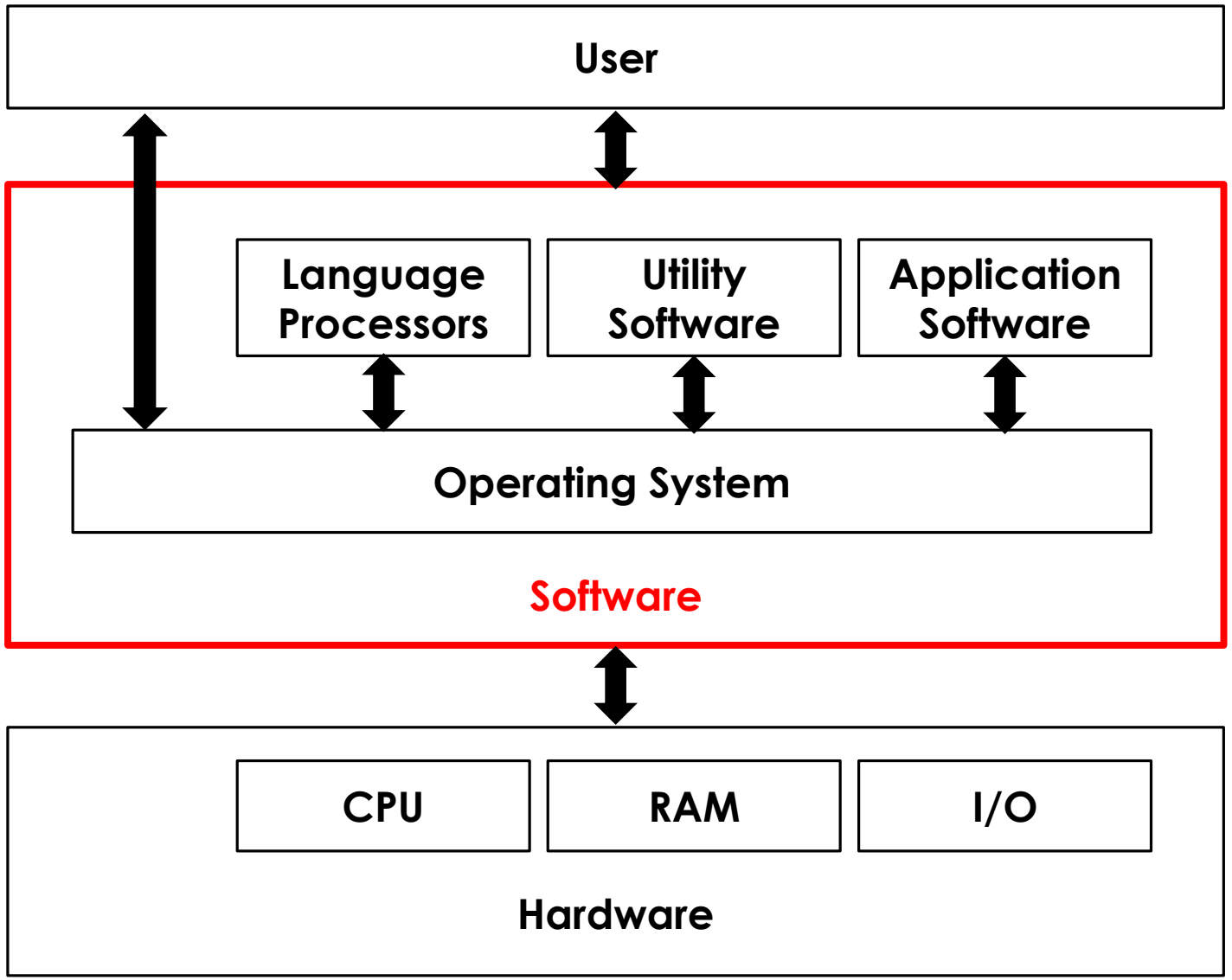
How to make computer green

- Green design :
  - design energy efficient & eco-friendly computers, servers, printers, projectors and other digital devices .
- Green manufacturing :
  - Minimising the waste during the manufacturing of devices
- Green use:
  - Minimise the electricity consumption of computer and other devices
- Green disposal :
  - Reconstructing used computers & properly dispose or recycle unwanted electronics equipment's.

Software

- Software is a collection of data or instructions that tell the computer how to work.
- 2 types of software
  1. System software
  2. Application software

- System Software
- Set of programs designed to control the operations of a computer.
- It Support the running of other software's.
- It communication with other peripheral devices.
- Use :
  - Controlling the operation
  - Move data into out of PC
  - User interface with hardware


User
Language Processors
Utility Software
Application Software
Operating System
Software
CPU
RAM
I/O
Hardware

- Components of system software
  1) Operating system
  2) Language processors
  3) Utility software

1) Operating system

- Set of program that act as an interface between the user and computer hardware
- OS provide an environment for user to execute programs
- OS Control and coordinate the operations of a computer.
- Important system software

- Functions :
  - Process management : take care of allocation & de-allocation processes
  - Memory management : management of primary memory
  - File management : file related activity – naming, sorting, sharing, recovery…
  - Security management : management of device attached to the computer
  - Commands interpretation : understand and execute commands

- Examples :
  - windows xp / 7 / 8 / 10, Linux, Ubuntu, Raspbian etc…

2) Language processors

- Computer language classified into 3
  - Machine language
  - Assembly level language
  - High level language

} Low level language

- Machine Language
  - Binary digits : 0s and 1s
  - Fast execute in machine
  - Difficulty in humans
  - Error detection and corruption is not possible
  - Programmer must study computer architecture

hello world	01101000 01100101 01101100 01101100 01101111 00100000 01110111 01101111 01110010 01101100 01100100
s = a + b	01110011 00111101 01100001 00101011 01100010

- Assembly Language
  - Intermediate level language
  - It is Mnemonic : symbolic name give to an operation
    : ADD , SUB, ADC
  - Easier than machine language
  - Error detection and corruption is possible
  - Programmer must study computer architecture

```
LDA 2000
MOV B, A
LDA 2001
ADD B
STA 3050
HLT
```

- High Level Language
  - English like language
  - Easier than Assembly language
  - Programmer no need to study computer architecture
  - Error detection and corruption is very easy
  - But computer cannot understood the HLL.
  - Compiler / interpreter used (Language translator)
    - Convert HLL to MLL
  - Examples : BASIC, C, C++, Java, Python

- Type of language processor
  - Assembler :
    - translate Assembly language to machine language
    - Program can be executed only after translation
  - Interpreter :
    - Another kinds of language processor
    - HLL - MLL line by line translation
    - Program can be executed only after translation
    - BASIC, Python

- Compiler:
  - Another kinds of language processor
  - It scan the program in a single run
  - If any error in program, compiler provide the list of errors
  - If no error, compiler generate an object file
  - C, C++, Pascal

3) Utility software

- Used to perform general system support and maintenance task
- Task examples :
  1) Detect & remove the computer virus
  2) Disk management
     - Disk Formatting
     - Disk partition
     - Disk Clean-up etc…

- Application Software
  - Software developed for specific application is called application software
  - It include
    1. General purpose software package
    2. Specific purpose software

1) General purpose software package

- Used to perform tasks in a particular application area
- Classified as :
  1) Word processing software
  2) Spreadsheet software
  3) Presentation software
  4) Database software
  5) Multimedia software

1) Specific purpose software

- Highly specialised software design to handle particular tasks.
- Also known as customised software (developed for a single customer)
- Some examples :
  1) Payroll system : employee & salary details in a company
  2) Inventory management system : tracking, orders, sales, deliveries…
  3) Human Resource management system : managing human resource

- Example : google pay, chess game, gmail, flipkart

- Free & Open source Software
  - Gives the user the freedom to use, copy, distribute, examine, change and improve the software.
  - Now a days open software is widely used, reasons :
    1. Acceptable activity
    2. Less overall cost
    3. Vendor independency (No intermediate sale persons)
    4. security

- Free Software Foundation (FSF)
  - FSF define 4 freedoms for free & open source software
    1. To run program for any purpose
    2. To study how to program works and adopt it to your needs
    3. To distribute copies of the software
    4. To improve the program and publish the change
  - Example : GNU / Linux , GIMP, Mozilla Firefox, OpenOffice.org

- Freeware and Shareware
  - Freeware is the copyrighted software which is made available for use, free of cost, for unlimited period.
  - User cannot permit to change in the software
  - Example :
    1. Google chrome
    2. Skype
    3. Avast antivirus
    4. Adobe reader

- shareware is the commercial software that is distributed on a trail basis.
- Shareware gives users a chance to try before buying it.
- All features are not available
- Example :
    1. Photoshop
    2. Kaspersky antivirus
    3. Winzip 7

- Proprietary Software
  - Also known as Non-free software or close software
  - It Is a computer program that is an exclusive property of its developer or publisher
  - Cannot be copied or distributed without licensing agreements.
  - Example :
    1. MS Windows
    2. MS Office
    3. Mac OS

Humanware or Liveware

- Humanware is the Method of adding a human facet into the development of computer programs.
- it is necessary for the proper functioning of hardware and software.
- some humanwares :

1. System Administrator
2. System Managers
3. System Analysts
4. Network Administrator
5. Database Administrator
6. Computer Engineers
7. Computer Programmers
8. Computer Operators

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