Introduction to Computing

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Computer Hardware

Computer Systems

Computer Architecture

Input and Output Devices

Storage Systems

Computer Systems

- Functional components of a computer system
  - Input
  - Main memory
  - Central Processing Unit (CPU)
  - Output
  - Backing storage
  - Peripheral devices

Input

- Take in data for processing by the computer
- Convert real-world data into a machine sensible format
- Examples: Keyboard, webcam, microphone

Main Memory

- Commonly known as RAM (Random Access Memory)
- Two main functions
  - To temporarily store programs currently in use for processing data
  - To temporarily store data
    - Entered through input devices
    - Currently being processing
    - Resulted from processing

CPU

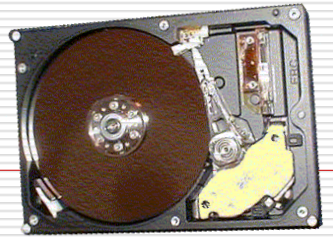
- Often referred to as the processor
- Has two elements
  - Arithmetic/Logic unit (ALU): perform arithmetic operations, e.g. addition, multiplication, etc.
  - Control unit: control the operations of all hardware, including input and output devices, and the CPU

Output

- Translate machine sensible data into human readable form
- Examples: Screens, printers, speakers

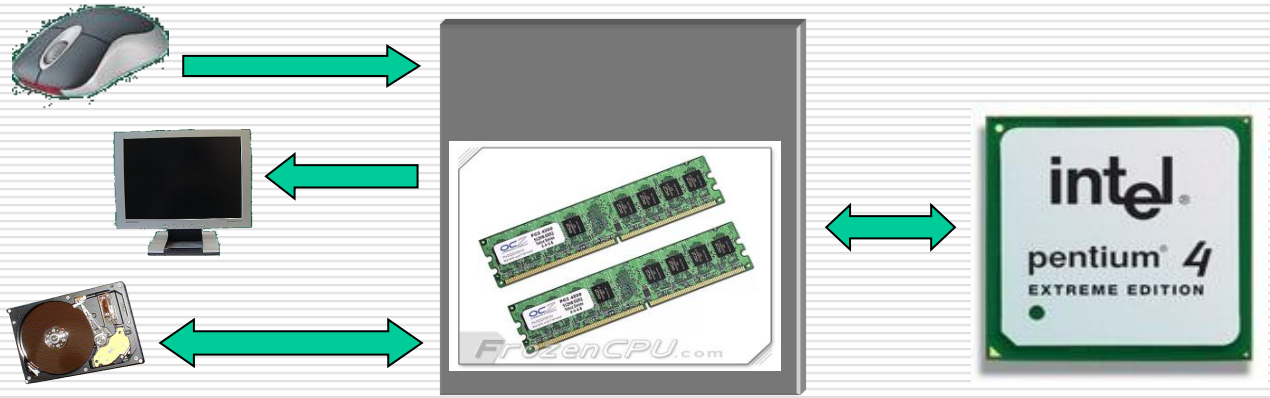
Backing Storage

- Performs a filing function within the computer system
- Important concepts:
  - **Memory volatility**: data will disappear when the power is switched off, e.g. RAM
  - **Retrieval data**: for permanent storage of programs and data files



Peripherals

- Peripherals are devices that are external to CPU and main memory
- e.g. input and output devices, storage devices, etc.



Classification of Computer Systems

- Main frame computers
- Minicomputers
- Microcomputers
- Portable computers
- Pen-based computers

Computer Architecture

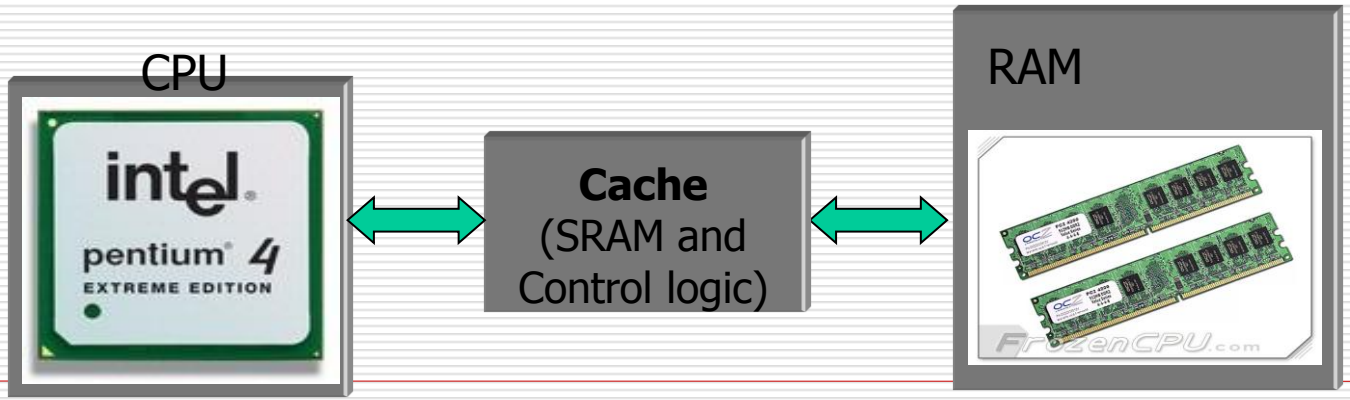
- Three basic components
  - Memory
  - Processor
  - Buses

Memory - RAM

- The working area of a computer
- Store programs and data currently in use
- Measured in Kb, Mb or Gb
- Volatile
- Directly accessed by the CPU
- Types of RAM
  - SRAM, DRAM, EDO RAM, SDRAM, DDR SDRAM

Cache Memory

- Located between CPU and RAM
- Hold copy of frequently used code and data
- Fast in speed but small in size
- Used to improve memory access times



Memory - ROM

- Read Only Memory
- Non-volatile
- Data in ROM cannot be changed by software
- Used in BIOS (Basic Input/Output System)
- CD-ROM

Processor

- The centre of machine power
- Control all the activities of the system
- Registers
  - Registers used in the fetch-execute cycle
  - Index registers: used to hold offset values or counters
  - Stack pointer register
  - Flag or status register

CPU Clock Speed

- Determine how quickly a processor can execute instructions
- Steps to execute a program (a set of instructions)
  - Fetch -> Decoding -> Execute
- Processor activity must be synchronised with clock cycle

Processor Architecture

- A processor consists of a complex collection of component units: registers, counters, arithmetic and logic circuits and memory elements
- All instructions available with a processor is called instruction set
- Two main approaches to computer design:
  - CISC: Complex Instruction Set Computer
  - RISC: Reduced Instruction Set Computer

CISC Architecture

- Longer memory word length should be used to create more complex instruction sets for more powerful processors
- Instructions are different in length
- Instruction execution times are also different

RISC Architecture

- Provide only a small number of different instructions
- Each instruction type can be executed in only one clock pulse
- More complex instructions can take several clock pulses
- Super scalar execution: can execute more than one instruction at a time
- Integral cache memory and branch prediction

Parallel Processing Architecture

- Pipelining
- Processor arrays
- SIMD- Single Instruction Multiple Data
- MIMD – Multiple Instruction Multiple Data
- Parallel processing applications:
  - Weather forecast, image processing, scientific simulations, etc.

Buses

- For communications between parts of the computer system
- A bus is a group of parallel wires, one for each bit of a word
- The system bus connect a computer's processor and its associated components of memory, I/O devices
- A computer usually has several buses
- The width of a bus determines the length of the word can be handled at one time
- Some buses are bi-directional

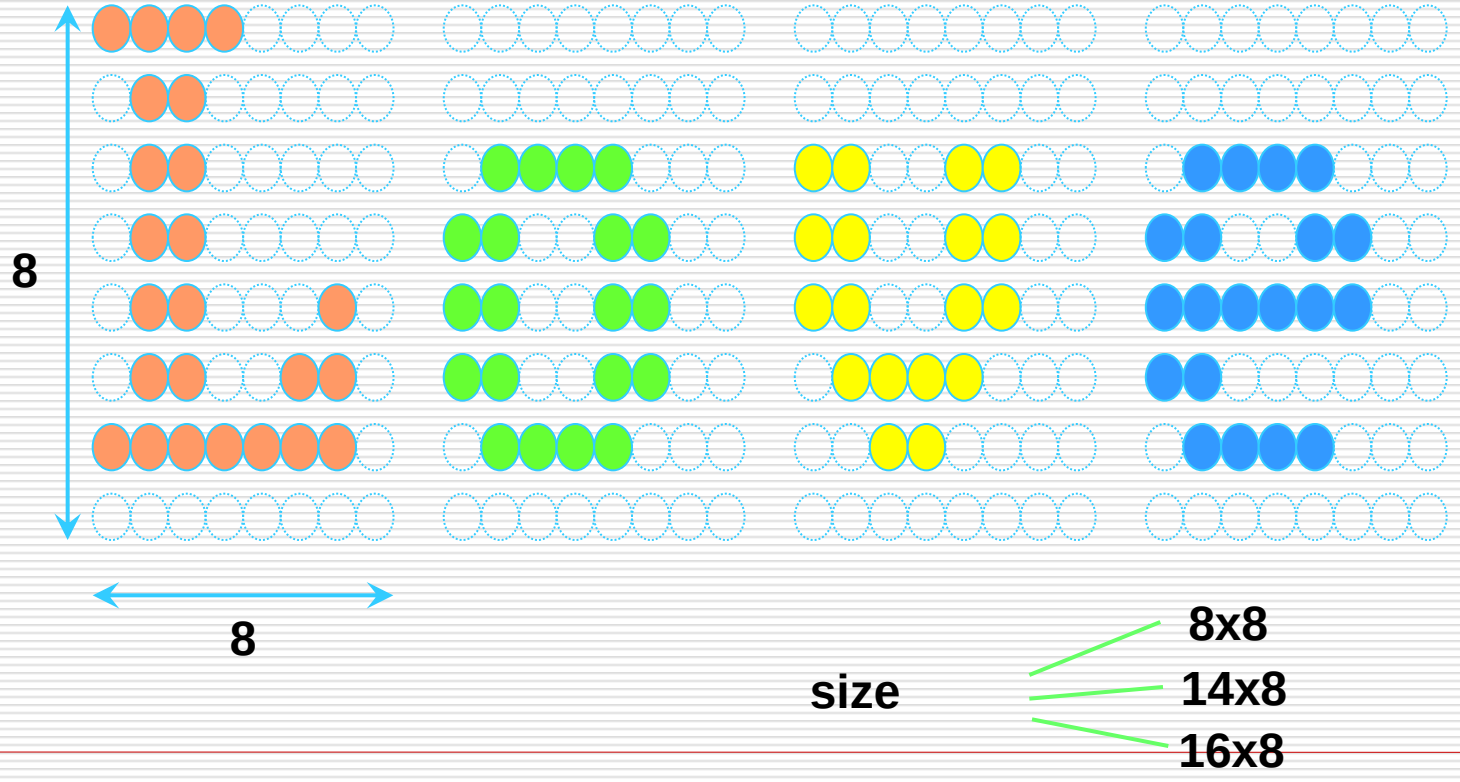
Input and Output Devices (1)

- Input devices
  - Keyboard
  - Mouse
  - Tracker ball
  - Touch screen
  - Digitising tablet
  - Light pen
  - Scanners

Input and Output Devices

- Output devices
  - Visual display unit
    - Dumb and intelligent terminals
    - Text and graphics modes
    - Text mode and dot matrix characters
    - Screen resolution and size
  - Printers
  - Speakers

Dot Matrix Display



Printers

Dot matrix printer

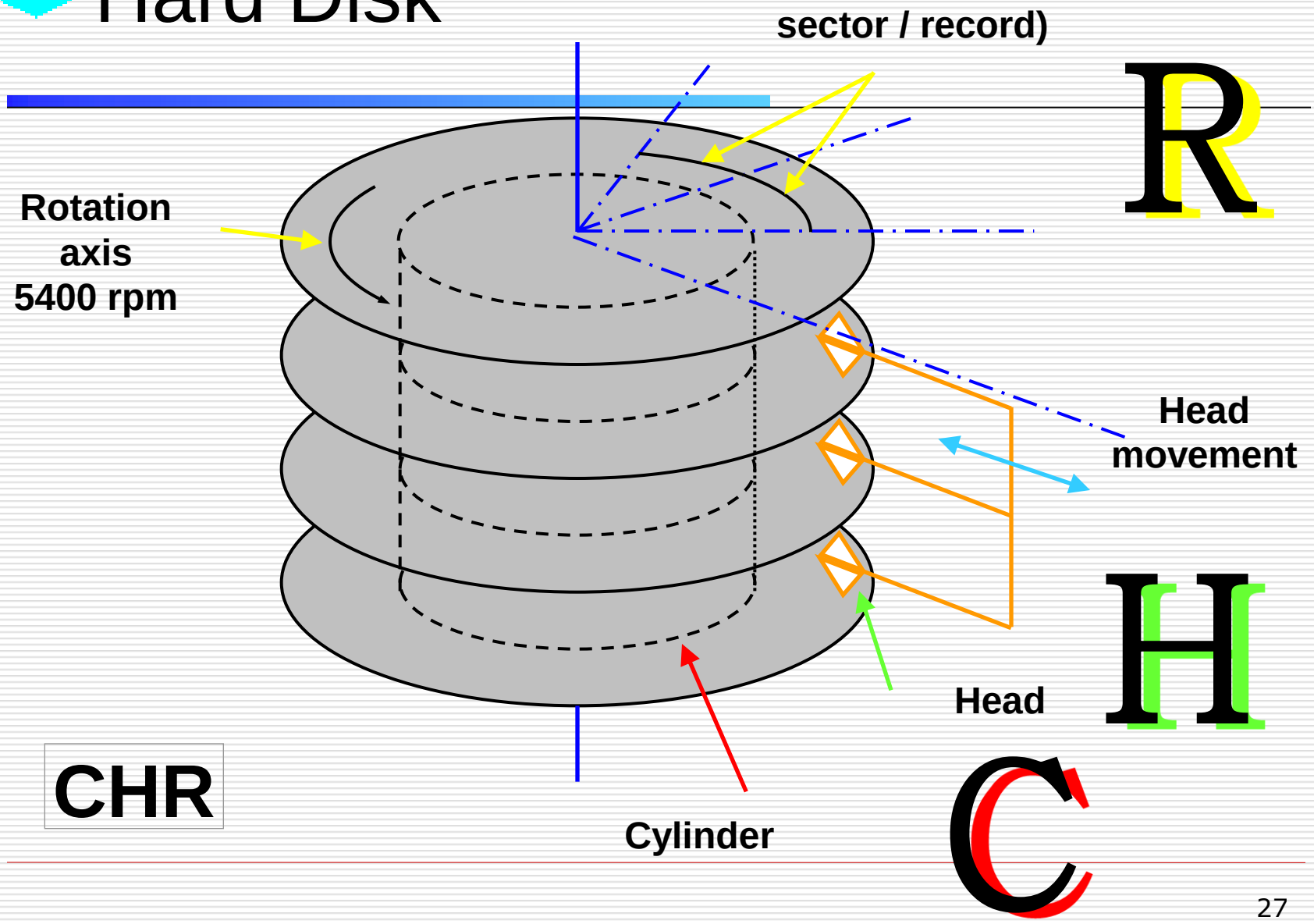
Inkjet printer

Laser printer

Storage Systems

- For backing up data
- Magnetic tape
- Magnetic disk
  - Hard disk
  - Floppy disk
  - Zip disk
- Optical disk
- Flash memory

Hard Disk



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CD-ROM or DVD-ROM