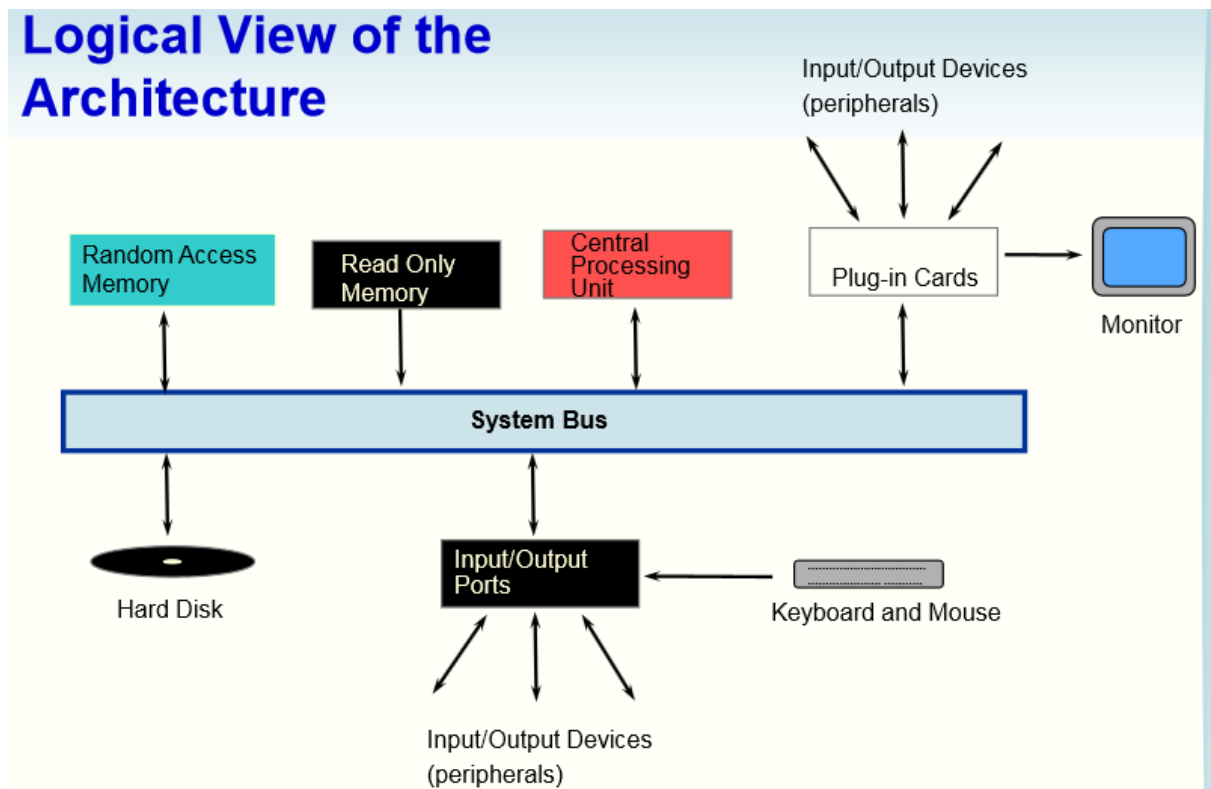Computing Notes

Computer Architecture

- A computer is an electronic machine that accepts data (input), manipulates the data according to some rules (process), produce results (output) and stores the results for future use (storage).

- Use stored-program concept – load data from memory and execute

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Parallel Computing

- Simultaneous execution of the same programmed task on multiple processors in order to obtain faster results.

- Same instruction – all processors execute same instructions at same time

- Multiple instruction – each process executes different instructions

- Many algorithms are sequential, must be redesigned for parallel hardware, and careful programming required in parallel system

- In general, easy to build parallel hardware but difficult to design parallel software

Distributed/Grid Computing

- Single task executed on more than one computer

- Aim to solve massive computational problems using large numbers of **heterogeneous** computers

Computer clusters

- Group of connected computers, uses **homogeneous** hardware

- Increased reliability and performance

- Popular for computationally expensive problems like drug discovery, financial modelling etc.

- Clusters made of dedicated hardware, whereas distributed system not dedicated hardware

Embedded System

- Special purpose system design to perform a few dedicated functions

- Handheld computers share elements with embedded systems but not true

- Examples:

    o Audio like mp3 players and telephone switches for interactive voice response systems

    o Avionics, such as flight control hardware/software and other integrated systems in aircraft and missiles

    o Cellular telephones and telephone switches

    o Industrial controllers for remote machine operation

    o Engine controllers and antilock brake controllers for cars

    o Home automation products , such as thermostats, air conditioners, sprinklers, and security monitoring systems

    o Household appliances , including microwave ovens, washing machines, TV sets, DVD players and recorders, digital musical instruments

    o Medical equipment (especially those embedded in people!)

    o Computer peripherals such as routers and printers

- Designed for specific task, not general purpose

- Limited hardware resources

- Software called firmware and stored in read-only memory rather than a disk drive

- Very reliable and can recover if error occurs

RFID

- Radio Frequency Identification

- Identification method, relying on storing and retrieving data using RFID tags

- Most RFID tags contain at least two parts.

    o One is an integrated circuit for storing and processing information, modulating and demodulating a (RF) signal, and other specialized functions.

    o The second is an antenna for receiving and transmitting the signal.

- A technology called chip – less RFID allows for discrete identification of tags without an integrated circuit, thereby allowing tags to be printed directly onto assets at a lower cost than traditional tags.

- Passive – tags with no internal power source

- Active or Semi-passive – require a power source

- Active tags

    o More reliable

    o Range can be hundreds of metres, and have larger memories, but bigger and more expensive

    o Used in passports, transportation, product tracking etc.

- Issues

    o Lack of standards – frequencies in USA incompatible with Europe

    o Security

    o Privacy concerns – could gather sensitive data about individual

Digital Revolution and Network Computing

- Each 1 called bit, byte is a group of 8 bits

- Original ASCII used 7 bits and then 8 bits, but could not represent all languages

- 16-bit representation, called Unicode, handles all languages, and is widely used

- Can encode everything, including sounds and pictures, into bytes

Encoding sound

- Takes samples at intervals of the analogue values, and gives a digital value

- Analogue can only be approximated, parameters are

    o Accuracy of value representation (Quantisation)

- o How often samples are taken

- Sampling rate should be at least twice the frequency of any perceptible variation in value

- If sampling rate too low, called aliasing

Images and Video

- Aim to divide an image into pixels, and encode each pixel using 3 8-bit values, one for red, green and blue

- Often use compression to store and transmit images

- Compression can either be lossless or lossy

    - o Lossless – png, tiff

    - o Lossy – JPEG, Mp3 etc

- Lossless compression

    - o Use sophisticated algorithms but all depend on redundancy, or repeated symbols in the data, can't compress random data

    - o Use Run-Length encoding, replace run of letters with symbol

- Lossy Compression

    - o Eye cannot distinguish fine detail

    - o Uses discrete cosine transform

Encoding and Decoding

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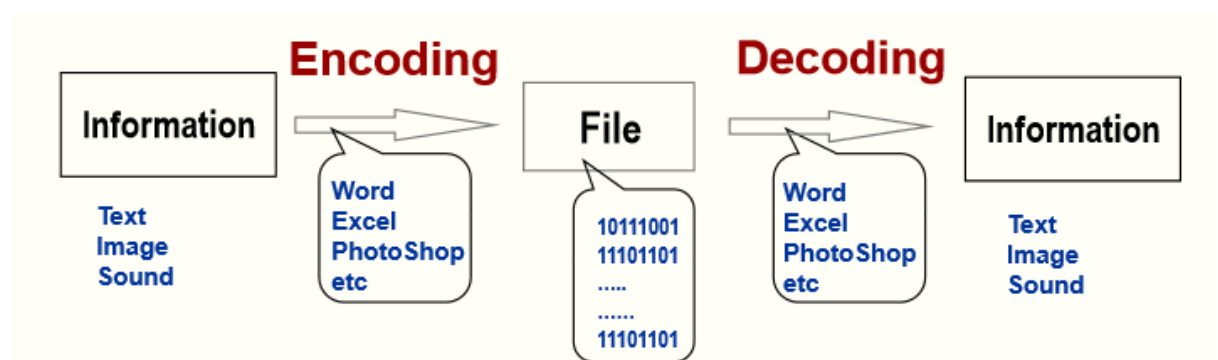
The Internet

- Connection of computers to a large network

- Began in 1960s as military system