1.1 – Fundamentals of Computer Systems

Candidates should be able to:

a. Define a computer system
b. Describe the importance of computer systems in the modern world
c. Explain the need for reliability in computer systems
d. Explain the need for adherence to suitable professional standards in the development, use and maintenance of computer systems
e. Explain the importance of ethical, environmental and legal considerations when creating computer systems

What is a computer system?

"A Computer System is a combination of components designed to process and store data. It comprises at least one input device, a processing unit, an output device, and a storage device, and may contain a communications device".

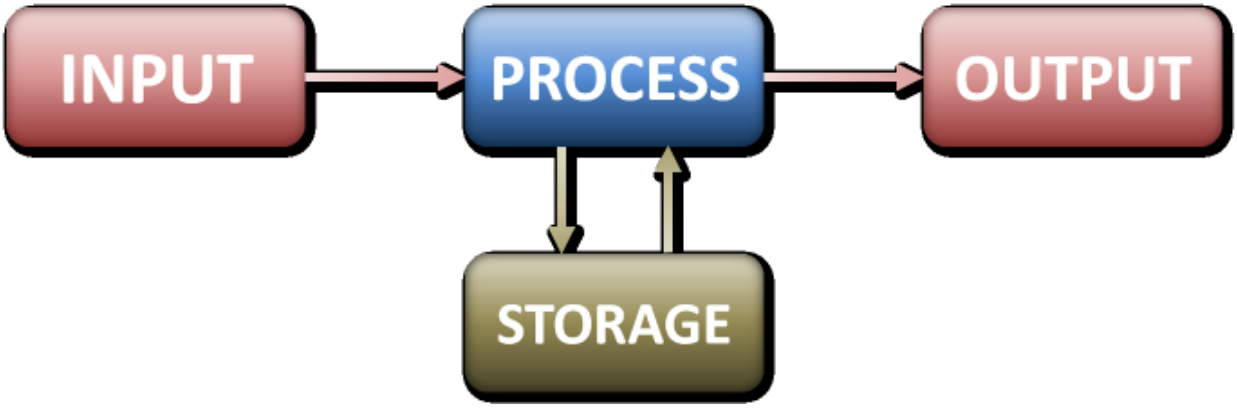
- A computer system is made up of **hardware** and **software** components & is capable of:
  - data **input** - using input devices
  - data **processing** - using a microprocessor, typically the Central Processing Unit (CPU)
  - data **output** - using output devices

- It may also be capable of:
  - data **storage** - so data can be stored for later use
  - data **transmission** - so data can be transferred to another computer system

Hardware *- The physical parts that can be touched and seen*
(if you can pick it up and throw it out of the window... it's hardware!)

Software *– Programs made up of sequences of instructions that tell the hardware what to do*

The basic model of a Computer System is built on ***Inputs***, ***Processes***, ***Storage*** & ***Outputs***:



1. Data is ***input*** into the computer via an appropriate input device (e.g. keyboard, mouse, microphone, touch screen etc...)
2. The data is processed by the computer (it is modified in some way)
3. The results of the processing are output by an appropriate output device (e.g. monitor, speakers, printer etc...)
4. Data may be stored for later use, and may be used for other processes. It may also be transmitted to other computer systems via communications devices.

Although this model applies to a personal computer, you should realise that it also applies to other equipment which uses computer technology, such as mobile phones, games consoles, mp3 players and so on.

What is hardware?

Hardware refers to any component that has a physical presence and can therefore be touched. Hardware devices can be divided into five types:

- ***Input Devices*** - these include any kind of device which can be used for getting data into the computer system from the outside world. Some examples include: keyboard, mouse, microphone, heat sensors, switches, touch screens, digital cameras, scanners and so on.

- ***Processing Devices*** - this usually refers to the Central Processing Unit (CPU) which carries out program instructions.

- ***Storage Devices*** - these include any device which will store data until it is needed for processing. This can include temporary storage devices, like the computer's memory (RAM), or long-term storage devices (ROM) like hard-drives, DVD drives or tape drives, etc.

- ***Communication Devices*** - these deal with the transfer of data from one computer system to another and include routers which link networks and modems which allow computers to communicate data via the Internet. For example: Modem, Network card, WiFi card, Router, Bluetooth devices, Infrared devices

- ***Output Devices*** - these include any devices which can provide data in a useful format to a user. For example: computer monitor, speakers, printer, headphones, LED, buzzer, motor

Peripheral Devices

These are hardware devices which fit in to one of the above categories but are external to the main body of the computer. They are typically connected by cables (USB, Network, Firewire etc.) or wirelessly (Bluetooth, wireless network links etc.). Examples include keyboards, mice, scanners, printers, external hard-drives etc.

Reliability of Computer Systems

"Reliability is the probability of a device performing adequately for the period of time intended under the operating conditions encountered." – NASA

Standards & Protocols

Ethical Issues

Employment - computer systems often either replace jobs directly (automated production lines, warehousing etc.) or lead to improvements in efficiency which can lead to job losses.

Environmental Issues

One of the main environmental considerations when creating computer systems is weather to upgrade an existing system or replace it with a new one.

Environmental advantages of installing a new system:

Power consumption - Modern computers tend to be smaller and more efficient, as well as having better 'sleep' systems so they use far less power when not in use. Modern computer systems usually include a LCD monitor which have 1/5 the typical power consumption of older cathode ray tube (CRT) monitors.

Environmental disadvantages of installing a new systems:

- **Use of resources** - one study suggests that making the average PC requires 10 times its weight in chemicals and fossil fuels. Compare this to cars or refrigerators which require 1-2 times their weight.
- **Health risks** - discarded computer equipment is usually either dumped in landfill sites or recycled, often in poorly managed facilities in developing countries. Some of the hazards include:
    - Lead in cathode ray tubes and in solder.
    - Arsenic in older cathode ray tubes.
    - Antimony trioxide as a flame retardant.
    - Polybrominated biphenyls (PBBs) as flame retardants (in plastic casings, cables and circuit boards).
    - Selenium in circuit boards.
    - Cadmium in circuit boards and semiconductors.
    - Chromium and cobalt in steel.
    - Mercury in switches and housing.

Alternatives to dumping/recycling:

- **Refurbishing/upgrading** - this can often be a better option than throwing it away, the majority of computer systems disposed of are far from their real end-of-life and could go on to give as much as 6,000 additional hours of use with motherboard, RAM, CPU and hard-drive upgrades.
- **Sending to developing countries** - many charities will ship old computer equipment to countries in the developing world where 99% of children leave school without ever having seen or touched a computer in the classroom.

Legal Issues

The Data Protection Act:

- Computer systems can hold huge quantities of information and global networks are able to share and distribute this information around the world in seconds. In order to control this development and to protect people's right to privacy, the Data Protection Act was introduced.
- Out of the 8 basic principles of the Data Protection Act the following should be considered when creating computer systems:
    - Any personal data on the computer system should be kept **secure** against loss, damage and unauthorised and unlawful processing.
    - Any personal data on the computer system should **not be kept longer than necessary**.
    - Any personal **data on the computer system should be accurate and up-to-date.**

The Computer Misuse Act - 1990

- Under this law, the following offences are classified as hacking and are illegal:
    - Unauthorised access or attempted access to computer data. This covers any unauthorised access to any program or data held in a computer, even if it is just to look at the information.
    - Unauthorised access to computer systems for the purpose of carrying out crimes - i.e. spying, blackmail, and fraud. This covers cases where someone access the system with the intention of using the information for a criminal purpose.
    - Unauthorised changing of computer data - i.e. deleting or altering files. This covers cases where the original information is altered in some way, either by deleting it or altering it in some way. It also covers spreading computer viruses.
- When a computer system is created it should therefore incorporate security features such as data encryption, firewalls, user ID's and passwords to minimise the risk of hacking. Anti-virus software should also be installed.

The Copyright, Designs and Patents Act - 1989

- Unauthorised copying of computer software is a criminal offence. This Act covers stealing software, using illegally copied software and manuals, and running purchased software on more machines than the license allows.
- When a computer system is created all the software used should be fully licensed, including the operating system, utility software and application software.