Course Overview

- Defining a personal computer
- Instruction Set Architecture
- Basic Processing Unit
- Input/Output organisation
- The memory system
- Software
  - Assembly process (high-level language → machine language)
  - Assembly language
  - Operating System
- Samphire simulator
- Raspberry PI

Defining a PC

A general purpose tool built around a microprocessor.

"General purpose" meaning that you can do many different things with it, e.g. typing documents, sending e-mail, playing games. Not all computers are like this, e.g. a controller for the air conditioning in the room that has an air sensor for CO_2 levels.

A PC can take information from a person, from a device or from the network, and processes it.

On the inside

The main components of a typical desktop computer:

- *Central processing unit* — The microprocessor of the computer system. Oversees everything.
    - Nowadays you get many dedicated processors distributed throughout the machine (e.g. one in the graphics card)
- *Memory* — Very fast storage use to hold data. It connects directly to the microprocessor. There are several kinds:
    - *Random-access memory* — Used to temporarily store info that the computer is currently working with
    - *Read-only memory* — A permanent type of memory storage used for important data that doesn't change
- *Basic input/output system* — A type of ROM used by the computer to establish basic communication when the computer is first turned on
- *Cache memory* — Extremely fast memory used to store frequently used data. Different technology to the RAM (static instead of dynamic)

- *Virtual memory* — Space on a hard disk used to temporarily store data and swap it in and out of RAM as needed.
- *Motherboard* — The main circuit board that all other internal components are connected to. The CPU and the memory are usually on the motherboard. Other things (e.g. a sound card) can be built into the motherboard or connected through a secondary connection.
- *Power supply*
- *Hard disk*
- *Operating system* — The basic software that allows the user to interface with the computer and the computer to manage itself.
- *Integrated Drive Electronics (IDE) Controller* — The primary intergace for the hard drive, CD-ROM and floppy disk drive.
- *Peripheral Component Interconnect Bus*
- *SCSI* — Pronounced "scuzzy", stands for small computer system interface. It's a method of adding additional devices to the computer, like hard drives or scanners.
- Couple more here

Peripherals

Interaction with components is called input/output. E.g. keyboard, mouse, removable storage.

From power up to Shutdown

- You press the On button on the computer and on the monitor.
    1. You see the BIOS software go through the power-on self-test (we don't actually see this any more, because it's no longer shown). On many machines, the BIOS displays text describing info like the

amount of memory installed and the type of hard disk you have. During this boot sequence, the BIOS does a lot to get your computer ready to run.

2. The BIOS determines whether the video card is operational. Most video cards have a miniature BIOS of their own for initialisation purposes. If they don't, there is usuall video-driver information on another ROM on the motherboard that the BIOS can load.

3. The BIOS checks whether this is a cold boot or a reboot (using the Restart option). It checks the value in a special memory address. A reboot skips the rest of POST.

4. During a cold boot, the BIOS verifies RAM by performing a read/write test of each memory address. It checks for a keyboard and a mouse. It looks for a PCI bus and checks all the PCI cards if it finds one. If the BIOS finds any errors during the POST, it notifies you with a series of beeps or a text message displayed on the screen. An error at this point is almost always a hardware problem.

5. The BIOS displays some details about your system:
   - Processor
   - Floppy and hard drive
   - Memory
   - BIOS revision and date
   - Display
   - Any special drivers, such as the ones for SCSI adapters, are loaded from the adapter and the BIOS displays the information

6. The BIOS looks at the sequence of storage devices identified as boot devices in the CMOS Set Up

7. Boot is short for bootstrap, as in lift yourself up by. Boot refers to the process of launching the operating system. The BIOS tries to initiate the boot sequence from the first device using the bootstrap loader.

8. The bootstrap loader loads the operating system into memory and allows it to begin operation. It does this by setting up the divisions of memory that hold the operating system, user information and applications. Finally, it turns control of the computer over to the operating system.

9. Once loaded, the operating system's tasks fall into six broad categories:
   - Processor management — Breaking the tasjs down into manageable chunks and prioritising them before sending to the CPU
   - Memory management —
   - Device management — providing an interface between each device connected to the computer, the CPU and the applications
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