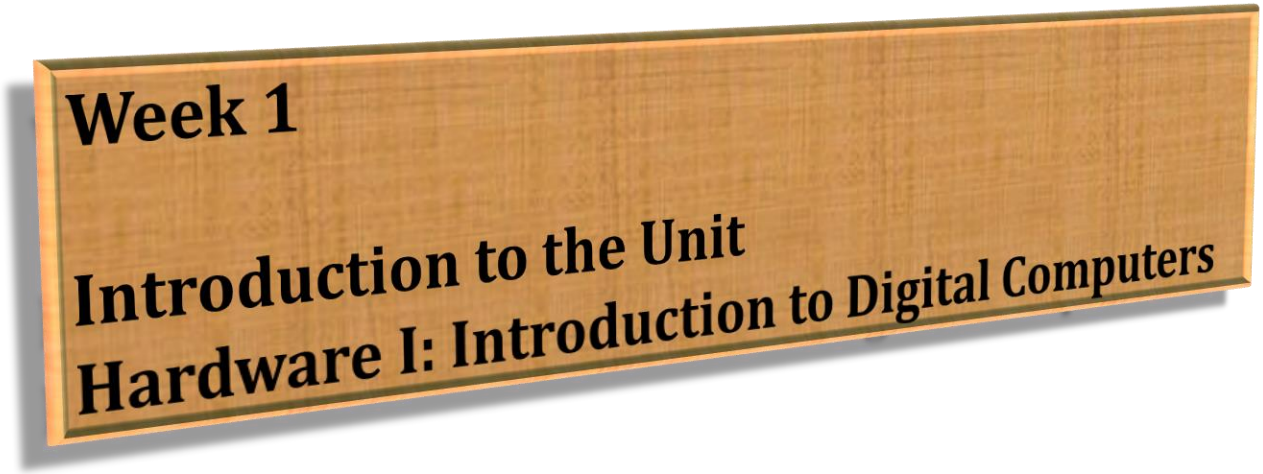
FIT9134
Computer architecture and operating systems

MONASH University
Information Technology



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Welcome to FIT9134

- How this unit will be run (unit guide)
- A small Quiz
- The computing environment, people, history
- Basic Computer Architecture
  - How Stored Program Computers work
  - The Fetch Execute Cycle
  - Interrupts

Online Materials for FIT9134

- These are available via your usual Monash portal :

  my.monash.edu

** Check the FIT9134 Moodle site everyday for announcements, updates, etc...

** Read the ***Unit Guide*** now

Attending classes

- Lecture (1hr duration)
  - 1 normal lecture plus 1 repeat lecture (attend only the one you are enrolled in)
  - *it is not enough to just read the online lecture notes* – attend the lecture, plus download the lecture video recordings

- Labs (3hrs duration)
  - contains compulsory assessable practical tasks (attend only the one you are enrolled in)

Lecture Vs Lab

- in this unit, the lectures/labs are not always directly related

- it is not important to have your weekly lab session before the lecture

Lecture Vs Lab

- materials needed for the lab tasks are typically covered before/during the lab, or during lectures in preceding weeks

- these lectures are particularly essential to the lab tasks (these ***may change*** during the semester – check Moodle):
  - Weeks 2-4
  - Weeks 7-9

Unit Assessment

- Lab 40%
  - weekly lab tasks (~3-4 marks each week)
  - all assessments carried out during the lab sessions
  - assessment criteria: see document on Moodle
- Exam 60%
  - covers both theory and practical concepts

Let's start with a quiz…

- Identify the following pictures!

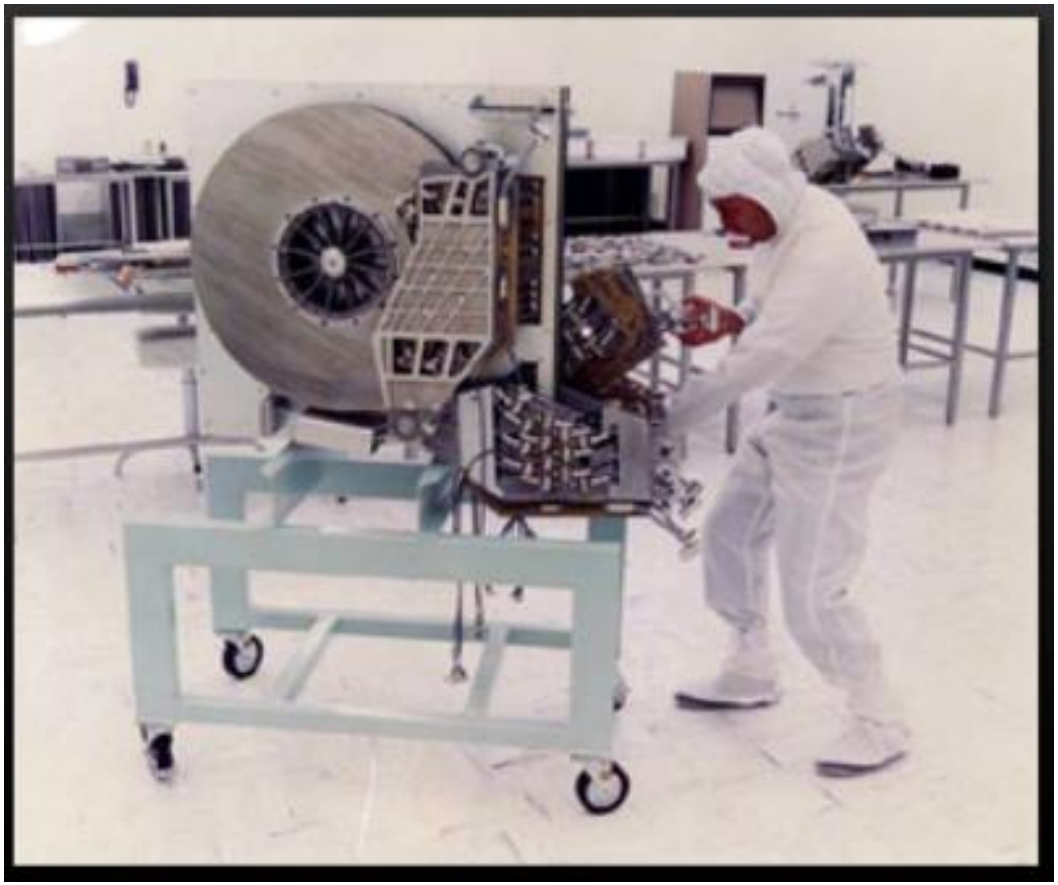
- First, some computer equipment…

Equipment

Equipment

Equipment

Equipment

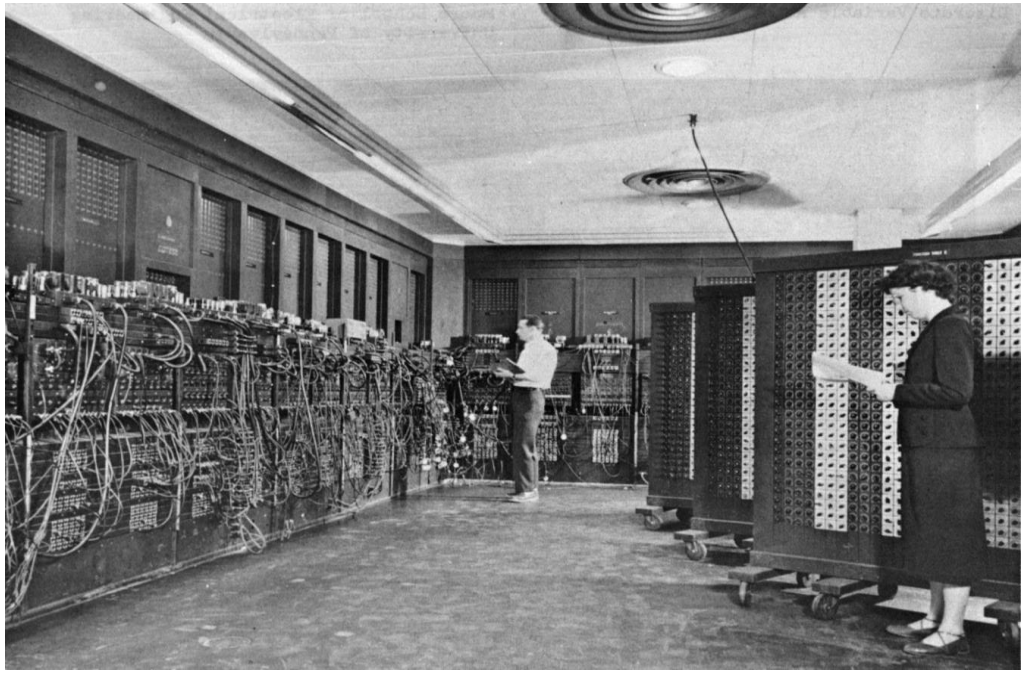


Equipment

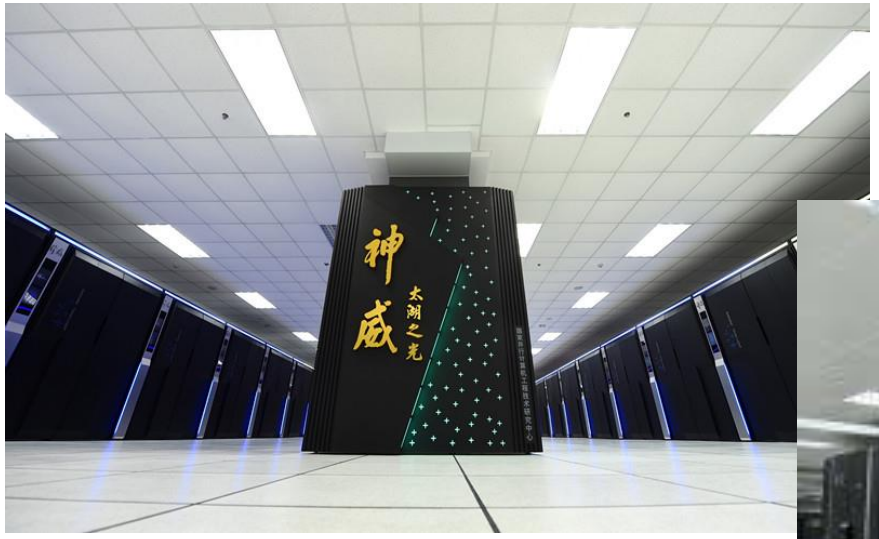

Kingston
2.5V
Warranty Void If Removed
ELPIDA JAPAN
MADE IN CHINA
ASSY IN USA

Equipment

Equipment



Equipment



Quiz

- Now ***some*** key people in computing…

People

People

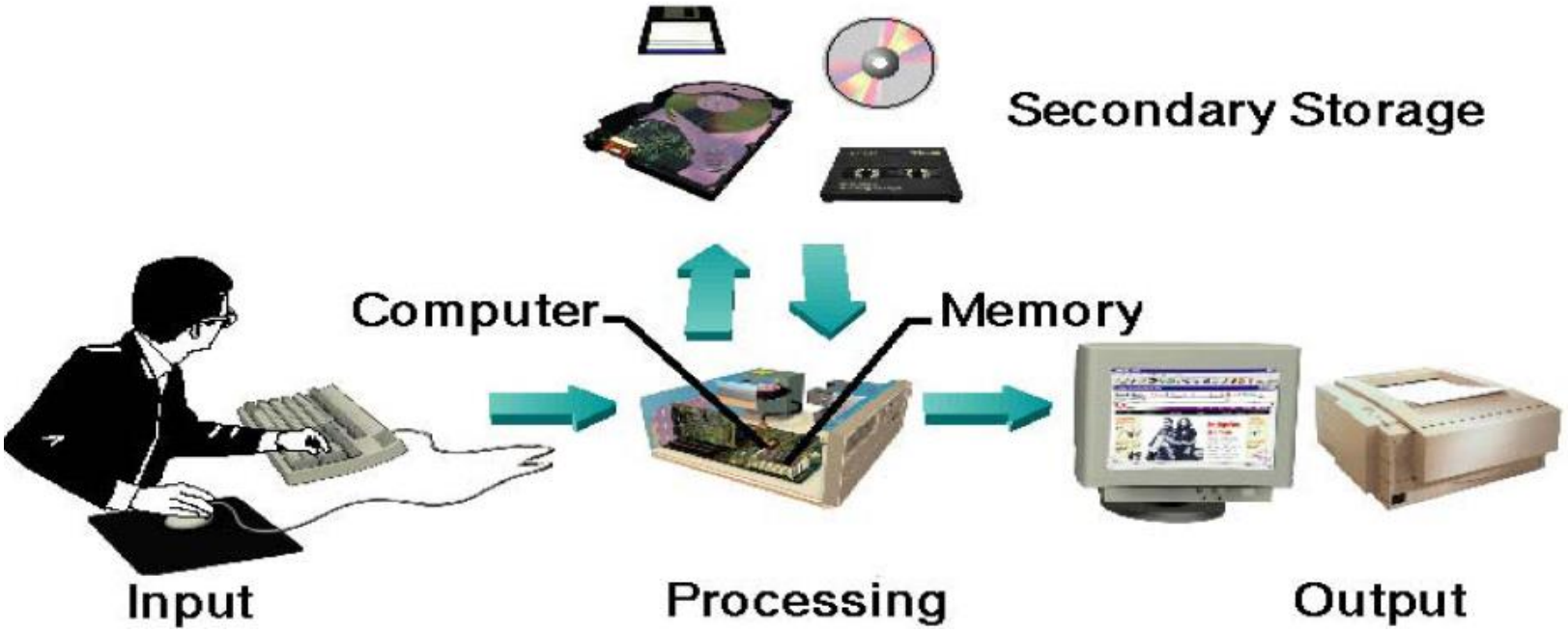
People

People

People

People

The Computing Environment



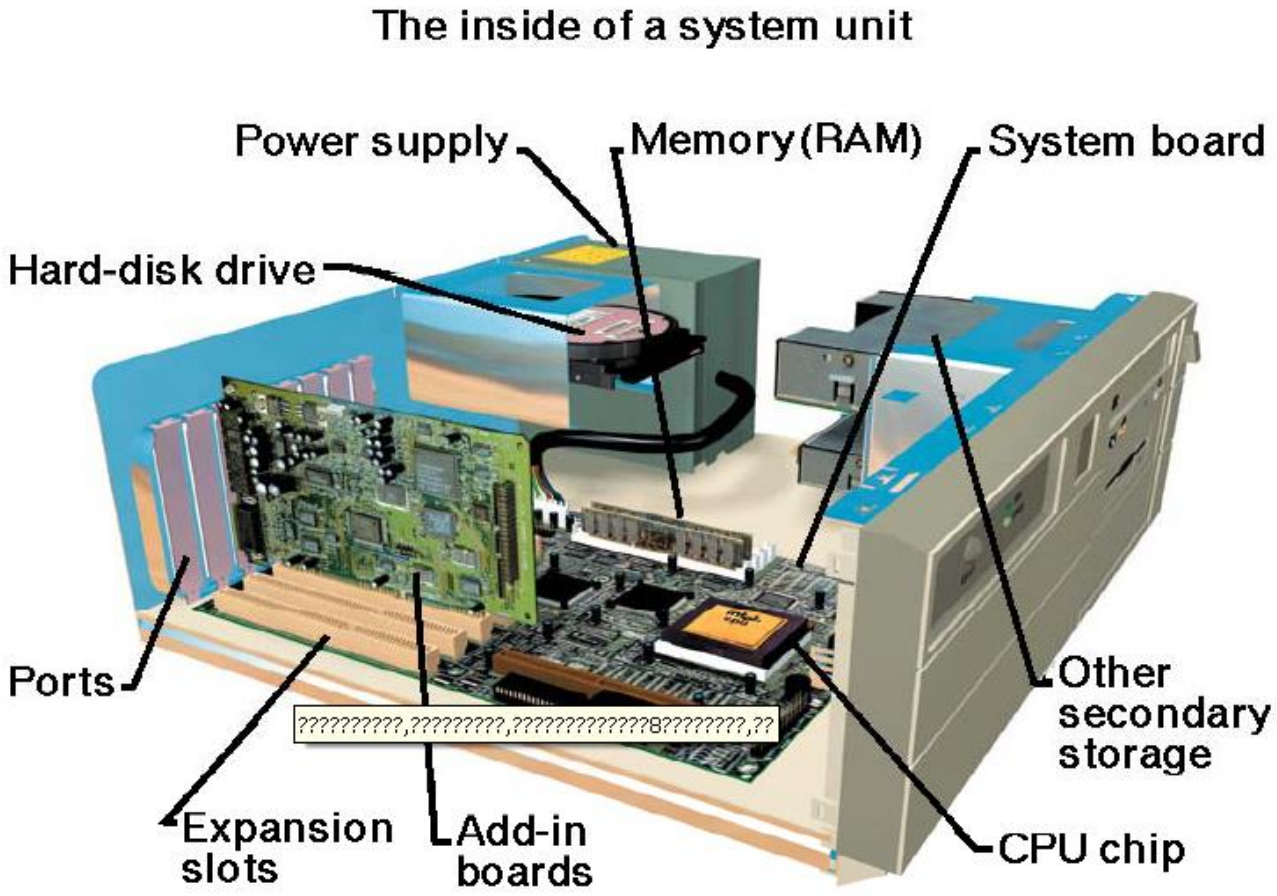
A typical computer today…

Basic components of a modern computer :

- CPU
  - Central Processing Unit
- Primary storage or Main Memory
  - Holds running programs whilst they are being executed
- Secondary storage
  - Holds data and programs permanently
- Bus
  - Connects, and carries signals (Control, Address, Data) to, all components of the system
- Input/Output devices and controllers

Anatomy of a Personal Computer

The System Unit



The von Neumann Architecture

- ENIAC was the first general purpose (programmable) electronic digital computer.
- Programming was done manually (switches and cables).
- This made the programming process cumbersome and inflexible, in particular, the sequence of instructions was executed independently of the results of calculations.
- Things would be a lot easier if – the program could be represented some way in the memory of machine (along with the data), then the computer could get its instructions from the memory, and the program could be modified by modifying the memory…

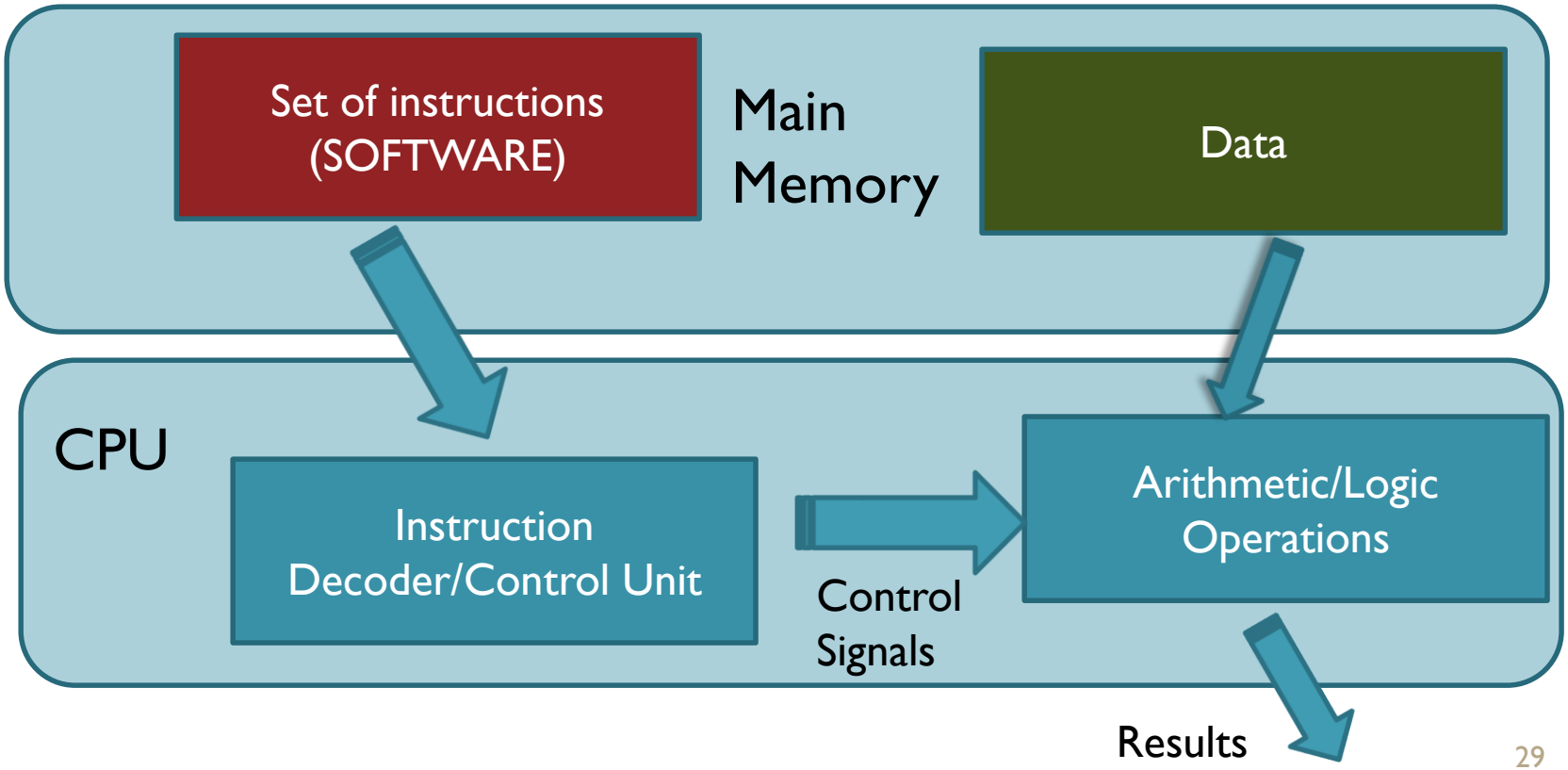
The von Neumann Architecture

- The solution : a "*stored program computer*"
- John Von Neumann, Princeton mathematician, proposed a new architecture which can be considered the architectural ancestor of all modern computers.

- Three concepts underly the architecture:
  - Program instructions and data are stored in a single read/write store (the main memory)
  - The contents of this memory is addressable by memory location, regardless of the type of data contained at the location
  - Execution of program instructions occurs sequentially, unless explicitly modified

How Computers Function

- ***Computers execute instructions***.
- Rather than *hardwiring* the program like ENIAC, modern stored program computers use *software*.



The Language of Computers

- How is 'intangible' software communicated to 'tangible' hardware?
  - Before computers we had for example:
    flashing lights, switches (hardware) and
    Morse code (software)
- With digital computers, hardware responds to electronic pulses at 2 distinct voltage levels (high and low). These are represented in the software as 0s and 1s
- Binary number system ("base 2")
  - Binary Digit (or bit): 0 or a 1
  - 8 bits = 1 'byte', eg. 0100 1001

The Language of Computers

- Series of bits used to represent various data and instructions.

  eg. 1011 could represent decimal number 11,
  or the instruction 'add'

- The fact that 1011 represents 'add' is something (arbitrarily) defined by the manufacturers of the processor or 'machine' and is therefore machine-dependent – this is the language of the machine.
- Machine language is the *lowest level* programming language (closest to the hardware)

- Higher level programming languages (assembly, C, Java, etc.) all have to ultimately be translated into the machine language of the particular processor

The Fetch/Execute Cycle

- ***Cycle***
  - A processor can have several states, However, the following are used in conventional computers
  - ***Fetch***
    - CPU fetches instructions and data from main memory and stores it in special memory locations (Registers).
  - ***Decode***
    - CPU interprets the instruction it just fetched
  - ***Execute***
    - The instruction is carried out (executed) on the data and any temporary result is stored in a register.

- The PC advances through the program using a *program counter*

Interrupts

- Modern computer systems are *interrupt* driven.
- An interrupt is a signal to the processor to suspend its current tasks and deal with whatever caused the interrupt.
- Interrupts can be classified broadly as:
  - Program/Software
  - Timer
  - I/O
  - Other Hardware
- Homework : do some research on ***Interrupts***

Interrupt and Multiprocessing

- The interrupt mechanism can be used to implement one of the key features of all modern computer systems – multiprocessing.
- Multiprocessing is the capacity to have multiple programs in memory and switch the processor between them – gives the illusion of many programs running at the same time.
- The order in which programs are executed can be determined by factors such as priority, time-sharing, I/O-interrupts, etc

Next week…

- Lecture : Introduction to Operating Systems

- Lab : first lab session starts ***THIS*** week, with an introduction to the Linux environment.
  - **Important** : ***every lab class has some assessable practical exercises worth 3-4 marks***. Attendance will also be taken for each class.
  - Lab swaps are generally not permitted, unless in special circumstances (e.g. sickness with medical certificates)
  - Lab exercises ***do not*** normally relate directly to the weekly lectures, unless specified otherwise.