Memory classification:-

Topics covered:- types,organization and working

IT Systems

- Contents
  - What is Memory ?
  - Cache Memory
  - PC Memory Organisation
    - Types

IT Systems

- Memory what is it?
  - Usually we consider this to be RAM, ROM in a computer
  - Memory can be anything which stores information
    - Hard disk
    - CD-ROM
    - DVD
    - All of these are versions of memory
  - For this lecture we will concentrate on the RAM and ROM

IT Systems

- Memory continued
  - Last week we looked at circuits which had a memory
    - Flip-Flops

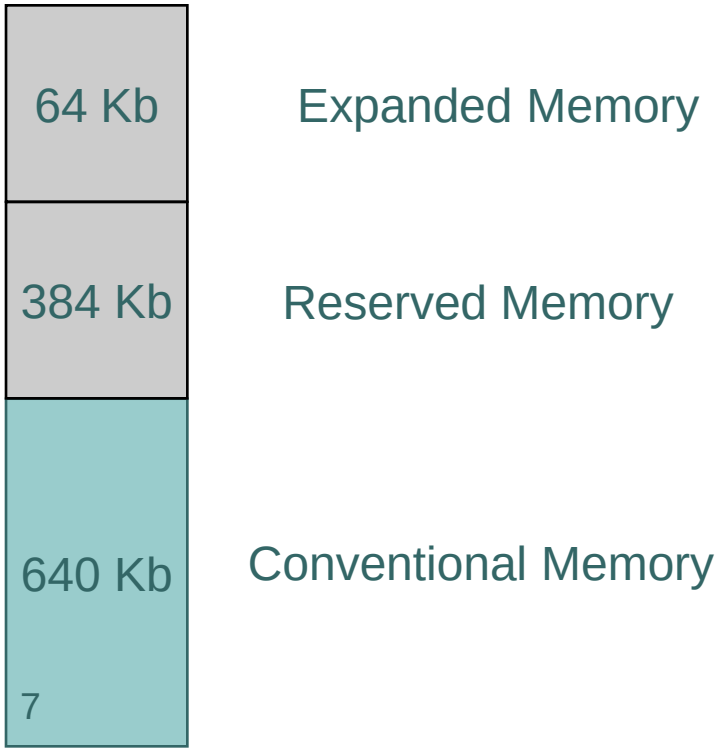
Organising Memory

IT Systems

- Memory continued
  - Last week we looked at circuits which had a memory
    - Flip-Flops
      - These are used within your PC in the cache memory
  - Memory Structure
    - Your PC has a memory structure

IT Systems

- Memory continued



IT Systems

- Memory continued
  - Conventional Memory
    - Applications are loaded into this part of memory, TSR programs and essential drivers like the keyboard
  - Reserved Memory
    - Used by the system, stores Video RAM and system BIOS information
  - Expanded Memory
    - Extends the capability of the processor. Swaps 4 16 kb pages into reserved memory
  - Extended Memory
    - All of the memory above expanded memory
      - Needs a change in processor mode to be accessed

IT Systems

- Processor Modes
  - The processors have three modes of operation
  - Real Mode
    - Legacy mode for 8086, restricts the processor to accessing 1Mb of memory
    - Used for DOS programs
      - Default for the processor
  - Protected Mode
    - Allows the processor to access memory beyond the 1Mb limit
      - Commonly used in Windows Programs
      - Allows multitasking or processes
  - Long Mode
    - Used in 64 Bit processors
      - For addressing large amounts of memory

Types of Memory

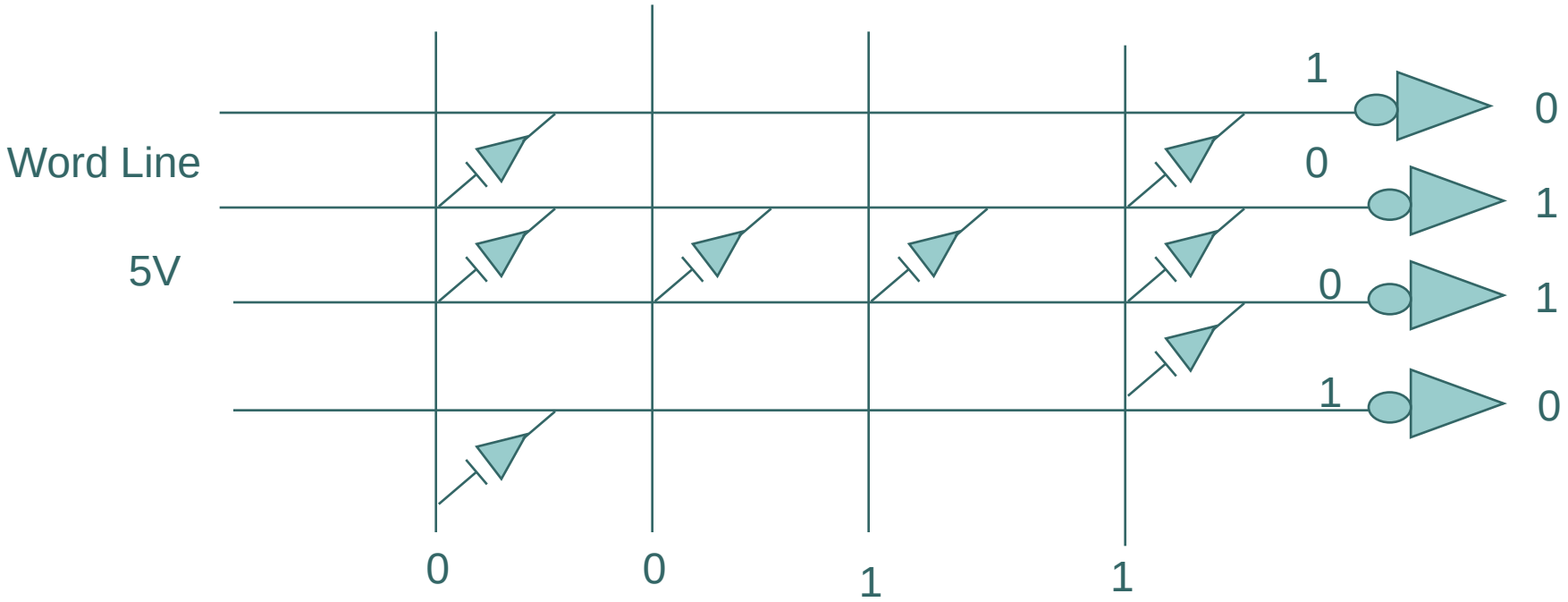
IT Systems

- Types of Memory
  - Random Access Memory (RAM)
    - Values written are lost once power is removed form the memory
  - Read Only Memory (ROM)
    - Data stored is retained even after a loss of power
  - Electronically erasable Programmable ROM (EEPROM)
    - Flash Memory

IT Systems

- ROM Memory
  - Stores a value after the electrical current is removed from the circuit
  - How ?
    - Uses a series of grids and Lines
      - A diode is then used to allow access to that part of the memory
      - When a defined amount of electricity is put into the diode the electricity is allowed to pass
      - A diode will only allow electricity to pass through it in one direction

IT Systems



IT Systems

- ROM
  - Once programmed can not be updated
    - Devices like a Video recorder use this
    - Original BIOS chips were not updatable
      - Modern BIOS has the capability to be updated as new hardware becomes available
  - Updatable ROM
    - ROM can be updated with special hardware

IT Systems

- Programmable ROM (PROM)
  - This kind uses a fuse at the intersection of memory
  - A high voltage is sent through the lines
    - This destroys the fuse at this point
      - Referred to as burning the ROM
    - One off process / can not be reversed
- Erasable PROM (EPROM)
  - Ultraviolet light is shined on the circuit
    - The entire circuit is erased at once

IT Systems

- Electronically EPROM (EEPROM)
  - Electricity sent to the correct part of the circuits will allow re writing of the circuit
  - This method is slow
  - FLASH memory was introduced
    - This was a fast method allowing the rewriting of the memory
    - Modems/ BIOS's use this technology

IT Systems

- Random Access Memory (RAM)
  - Allows the setting or returning of data any where within the dataset
  - Unlike
    - FILO or LILO memory
  - RAM is volatile
    - Once the power is removed the values are lost

IT Systems

- Cache Memory
  - This is high speed memory
    - Usually Static RAM (SRAM)
    - Uses four to 6 transistors to store the bits
    - Needs a stable power supply
      - If a momentarily loss of power happens all data is lost
    - Amount of cache changes as per processor
    - Usually a small amount because
      - It is expensive to manufacture
      - Physically needs more space to store the chip
      - If too much is used it becomes slower to access it

IT Systems

- Cache Memory (continued)
  - This memory allows high speed transfer of data into the CPU
  - This allow for information to be move in and out of registers quickly
  - Ultimately the processor will spend less time waiting for instructions
    - This gives less wasted CPU Cycles

IT Systems

- Cache Memory (continued)
  - Most hard drives use some cache to store data before it is requested to allow a quick response if it is requested
    - Calculating what is needed next is not easy
    - Consider if you accessed a large file at the beginning, it would be worth moving the next part of the file into cache so that when requested it is waiting to be transferred.

IT Systems

- Cache Memory (continued)
  - Processors use 2 levels of cache
  - Example used is a Intel 2800 MHz
    - Level 1 (also called Primary)
      - Very small amount of cache 12kb
      - Fastest Memory
      - Stores recently used data and instructions
    - Level 2 (also called secondary)
      - 512Kb
      - Faster than main memory, but slower than Level 1
      - Stores what can not fit into the smaller Level 1 Cache

IT Systems

- DRAM Memory
  - Dynamic RAM (DRAM)
  - Uses a capacitor and a transistor
    - A transistor is a switch allowing a 1 or 0
    - A capacitor stores electricity for a small time
  - Organised
    - Into a Cell

IT Systems

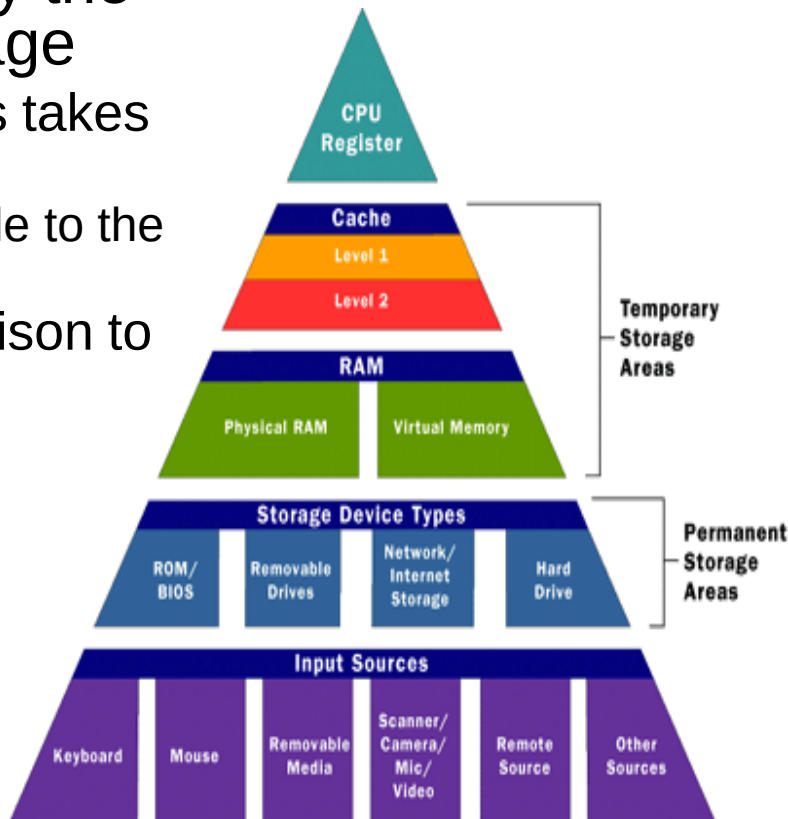
- Memory modules
  - The memory is plugged directly into the motherboard
    - This gives an increased speed in addressing
    - Each memory modules is made of parts
      - Usually referred to with numbers like 8x32
        - This indicates that there are 8 chips, each storing 32 MB on each chip

IT Systems

- Other types of RAM
  - EDO DRAM
    - Extended Data Out DRAM
      - Once the required data is found the searching for the next bit will start
      - Output is about 264 Mbps
  - SDRAM
    - Synchronous DRAM
      - Once the first bit is found reads the data from the entire row. Relies on the fact that data is written in rows
      - Output is about 528 Mbps
  - DDR SDRAM
    - Double Data Rate SDRAM
      - Reads data from memory on the rising clock and falling clock signal. Allowing double capacity over SDRAM
      - Output is about 1056 Mbps

IT Systems

- Virtual Memory
  - This is common on most operating systems
  - As applications take more memory the machine will need additional storage
    - To install additional memory modules takes space
      - Which may physically not be available to the user
    - Also memory is expensive in comparison to hard discs for example



IT Systems

- Virtual Memory
  - When the OS recognises that it is running short on memory
    - Some of this memory is transferred to the hard disc
    - The least used area of memory is transferred to the hard disc
    - The area of the hard disc is referred to as the paging file
      - When data is moved from physical memory to the hard disc it is moved into this file
    - When the system requests this memory
      - It will be re-directed to the paging file, where the data is stored
      - Using virtual memory is slow
      - If virtual memory is over used thrashing can take place
        - Thrashing is when the hard disc is constantly trying to access data but can not before another request is made.