Computer Architecture

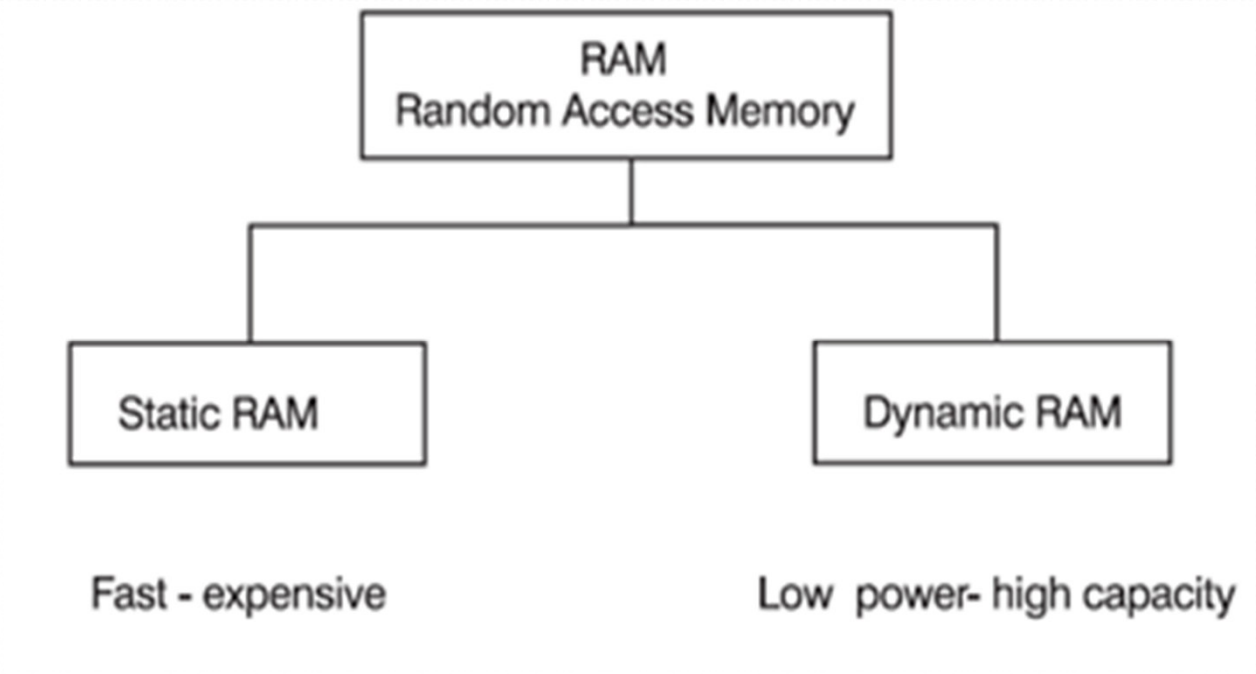
Lecture 3
Registers and Memories

Asst. Lect.:Noor H. Hassoon

Registers and Memories

Two types of RAM:

- Ram chips can be designed in two different forms which we call static RAM (SRAM) and dynamic RAM (DRAM), as seen in following figure.



Registers and Memories

Static RAM (SRAM):

- SRAM is a type of RAM (cache memory) and it is a volatile memory, which looses its data when the power is turned off. In a SRAM, each bit that stores data is made up of four or six transistors that make up a flip-flop.

- There are additional transistors that are used to control read and write accesses of storage cells. Even though typical SRAMs use six transistors to store each bit, there are SRAMs that use eight, ten or more transistors to store a single bit

Registers and Memories

- When the number of transistors is reduced, the size of the memory cell decreases. Each SRAM cell can be in three different states called read, write and standby.

- A cell is in the reading state when data has been requested and it is in writing state when the data in the cell is modified. The cell is in the standby state when it is idling.

Registers and Memories

Dynamic RAM (DRAM)

- DRAM is also a volatile memory that uses separate capacitors to store each bit. Capacitors when not charged represent the value 0 of a bit and when charged represent the value 1. Since the capacitors discharge with time, they need to be refreshed periodically to maintain the values stored in them.

- Each memory cell in a DRAM consists of a capacitor and a transistor and these cells are arranged in a square array.

Registers and Memories

- DRAMS are widely used for main memories in personal computers and game stations since they are cheaper. DRAMs are manufactured as integrated circuits (ICs) that come in plastic packages with metal pins that could be connected in to busses.

- Currently there are DRAMs in the market that are manufactured as plug-in modules, which are easier to handle. Single In-line Pin Package (SIPP), Single In-line Memory Module (SIMM) and Dual In-line Memory Module (DIMM) are some examples of such modules.

Registers and Memories

The basic difference between Static and Dynamic RAM lies mainly in structure and work principal.

1. Firstly the main difference in the structure varies due to transistor and capacitor number and setting as just three to four transistors are required for a Dynamic RAM, but six to eight MOS transistors are necessary for a Static RAM.

2. Secondly Dynamic RAM memory can be deleted and refreshed while running the program, but in case of Static RAM it is not possible to refresh programs.

Registers and Memories

3. Data is stored as a charge in a capacitor in Dynamic RAM, where data is stored in flip flop level in Static RAM.

4. For refreshing a data another capacitor is required in case of Dynamic capacitor, but no refreshing option is available in Static RAM.

5. A Dynamic RAM possesses less space in the chip than a Static RAM.

Registers and Memories

6. Dynamic RAM is used to create larger RAM space system, where Static RAM create speed- sensitive cache.
7. Static ram is 4 times more expensive than Dynamic RAM.
8. Dynamic RAM consumes less power than Static RAM.
9. For accessing a data or information, Static RAM takes less time than Dynamic RAM.
10. Dynamic RAM has higher storage capacity. In fact it can store 4 times than Static RAM.

Registers and Memories

Memory Organization:

- A memory contains a number of cells or registers that, themselves store a number of bits. The memory organization is always quoted as number of locations x bits stored in each, so this memory would have an organization of anywhere between 16 * 1, 16 * 4 or 16 * 8.

Registers and Memories

- Static RAMs usually store 8 bits in each location so a typical chip size would be 131072 * 8 giving a total storage capacity of 1 048 576 bits. This is often referred to as 128K * 8.
-
- Dynamic RAMs store either 1 or 4 bits in each location. One bit in each is very popular, so a typical chip organization would be 1048576*1 which, as we can see, would actually hold the same total number of bits as the example SRAM – it's just the organization that has been changed.

Registers and Memories

Read Only Memory (ROM)

- It is used to store programs and data that need not to be altered, i.e. permanent storage. Programs and data stored in ROMs can only be read by the CPU. Special equipment is used to write programs and data into the ROMs.

Types of ROM

- There are different variations on the classic ROM chips which were manufacturer produced and could not change. The most common are:

Registers and Memories

1. Programmable Read-Only Memory (PROM)

- This type of ROM can be re-programmed by using a special device called a PROM programmer. Generally, a PROM can only be changed/updated once.

2. Erasable Programmable Read-Only Memory (EPROM)

- This type of ROM can have its contents erased by ultraviolet light and then reprogrammed by an RPROM programmer.

Registers and Memories

- This procedure can be carried out many times; however, the constant erasing and rewriting will eventually render the chip useless.

3. Electrically Erasable Programmable Read-Only Memory (EEPROM)

- This type of ROM works in a similar way to Flash memory in that it can its contents can be 'flashed' for erasure and then written to without having to remove the chip from its environment.

Registers and Memories

- EEPROMs are used to store a computer system's BIOS, and can be updated without returning the unit to the factory.
- In many cases, BIOS updates can be carried out by computer users wishing a BIOS update.

Registers and Memories

Flash Memory

- Flash memory is an example of quite a recent type of storage technology known as solid state devices. This type of portable storage has become very popular because of its low price and high storage capacity compared to its rivals, e.g. floppy disk.

Registers and Memories

- Unlike ROM, flash memory can be read form and written to and unlike RAM does not require power to retain its data.

- Although these devices typically cannot hold as much data as hard disks, CD-ROMs and DVDs, the storage capacity is continually increasing.


The End