Mathematics for Computer Science I

CHAPTER 01 Binary Number System

1.1 : MEMORY DEVICES

Memory Devices

- A memory device is a gadget that helps you record information and recall the information at some later time.

Memory Devices

- Requirement of a memory device:

  A memory device must have more than 1 states

  (Otherwise, we can't tell the difference)

- Memory device in **state 0**

Memory device in **state 1**

The switch is a memory device

The electrical switch is a memory device:

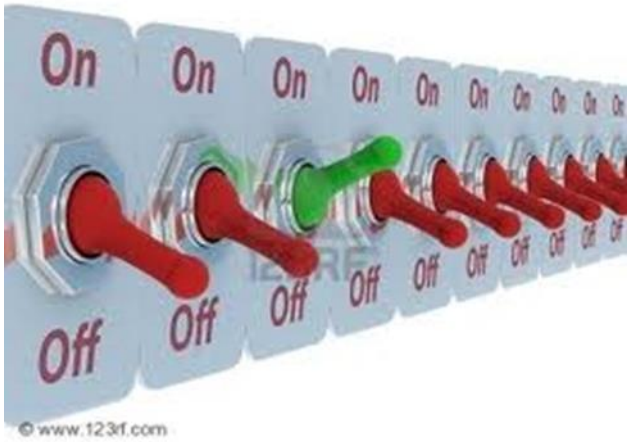
The electrical switch can be in one of these 2 states:

- **OFF** (we will call this state 0)
- **ON** (we will call this state 1)

Memory cell used by a computer

One switch can be in one of 2 states

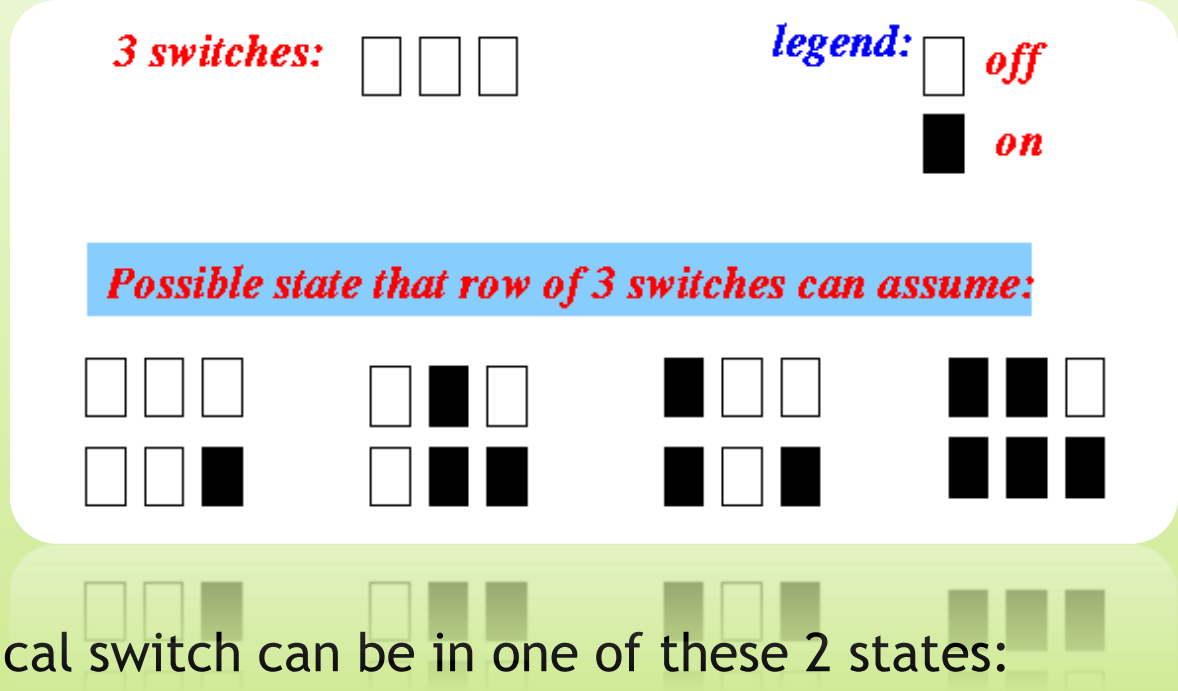
A row of *n* switches:



- can be in one of 2^n states !

Memory cell used by a computer

Example: row of 3 switches



The electrical switch can be in one of these 2 states:

A row of 3 switches can be in one of $2^3 = 8$ states.

The 8 possible states are given in the figure above.

Representing numbers using a row of switches

- We saw how information can be represented by *number* by using a code (agreement)
- Recall: we can use numbers to represent marital status information:

0 = single

1 = married

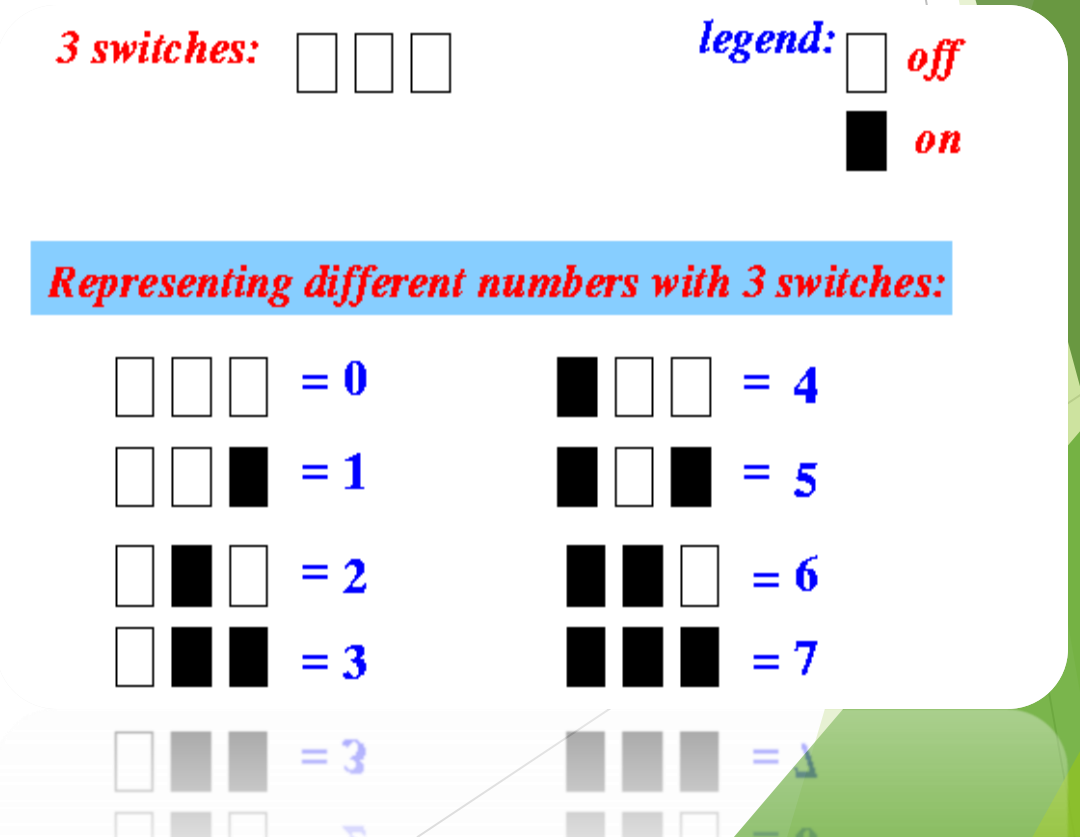
2 = divorced

3 = in relationship

Representing numbers using a row of switches

- We can represent each number using a different state of the switches.

Example:



The binary number system

- The binary number system uses 2 digits to encode a number:

  - 0 = represents no value
  - 1 = represents a unit value

- That means that you can *only* use the digits 0 and 1 to write a *binary number*

  - Example: some binary numbers

    - 0
    - 1
    - 10
    - 1010
    - and so on.

Representing numbers using a row of switches

- To complete the knowledge on how information is represented inside the computer, we will now study:

  • How to use the different states of the switches to represent different *numbers*

- The representation scheme has a *chic* name:

  • the Binary Number System

The binary number system

What is bit?

- A **bit** is a binary digit, the smallest increment of data on a machine.
- A **bit** can hold only one of two values:

  0 or **1**
- Because **bits** are so small, you rarely work with information one **bit** at a time

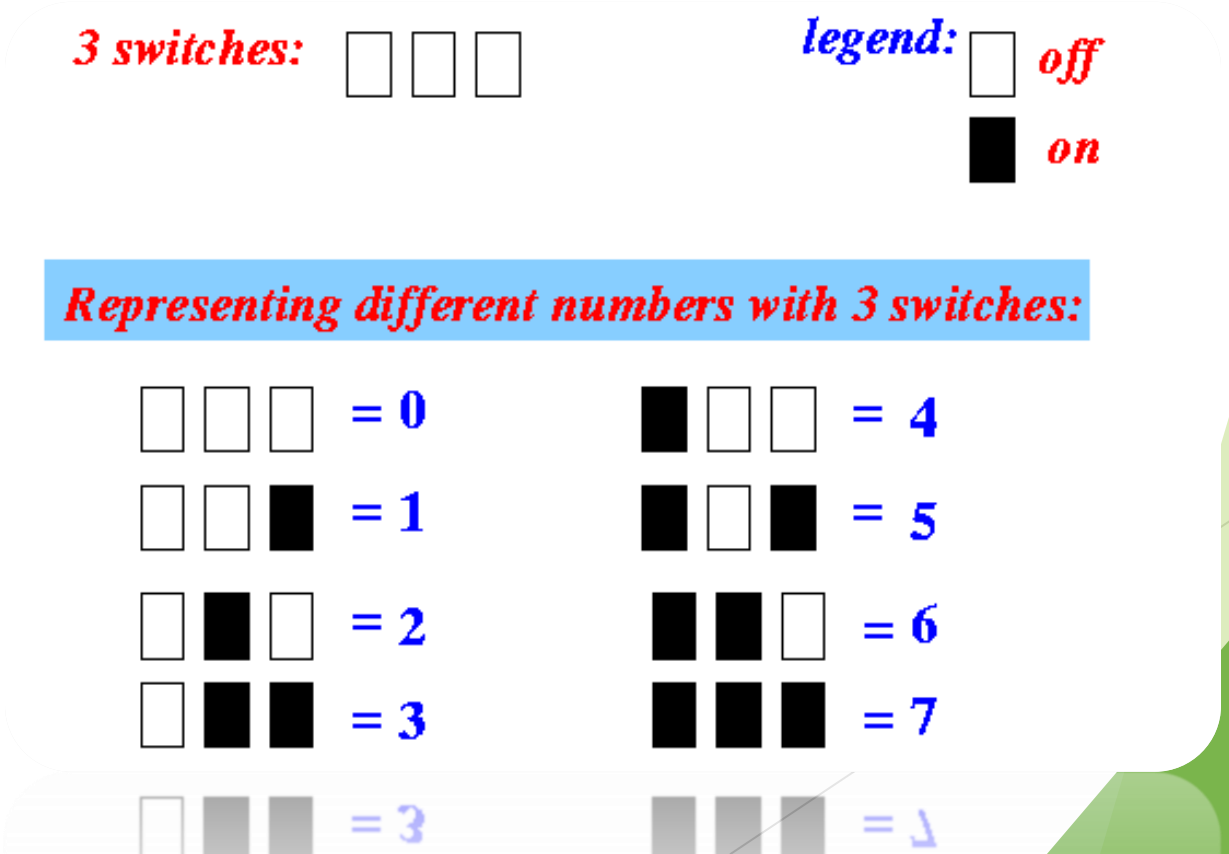
The binary number system

What is byte?

- **Byte** is an abbreviation for "binary term". A single byte is composed of 8 consecutive bits capable of storing a single character

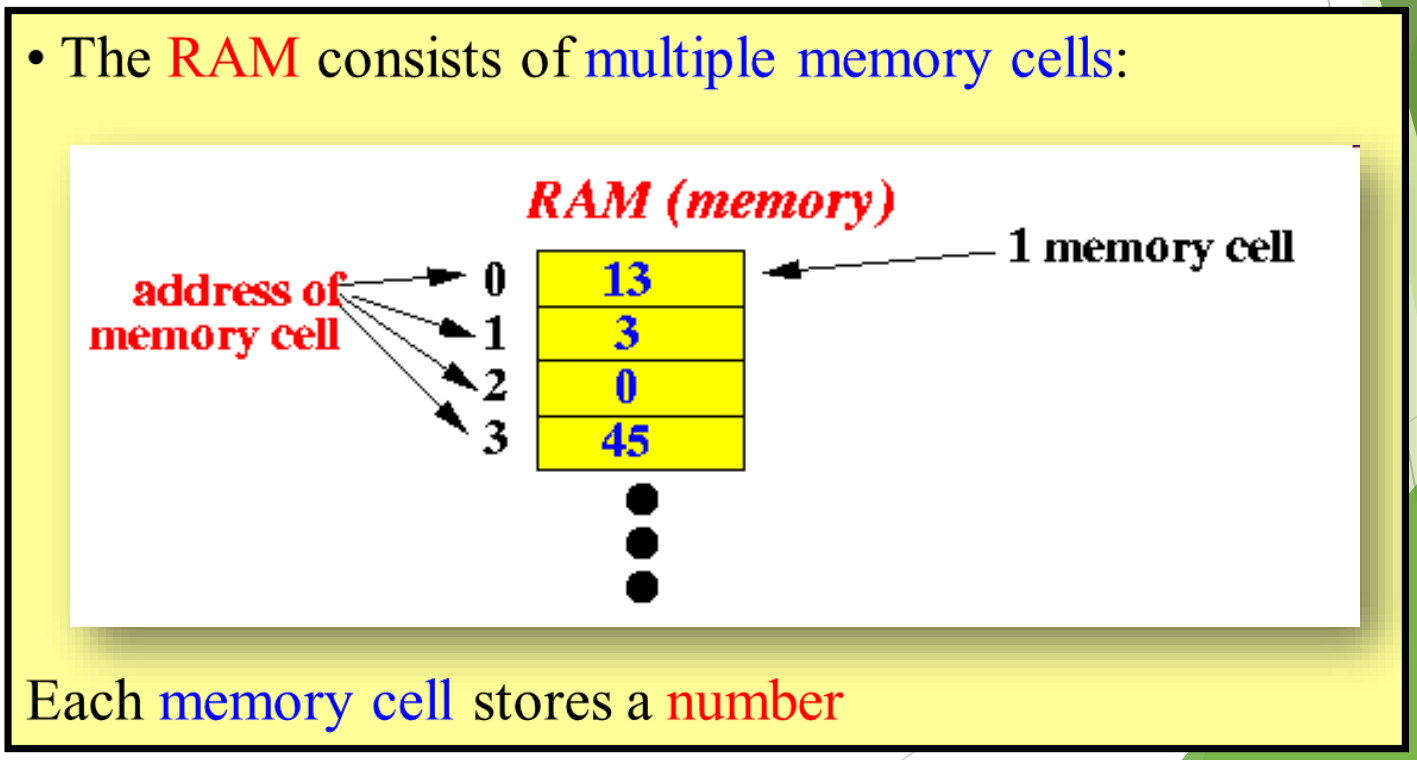
The binary number system

- Now you should understand how the different states of these 3 switches represent the numbers 0-7 using the binary number system:



What does all this have to do with a computer ?

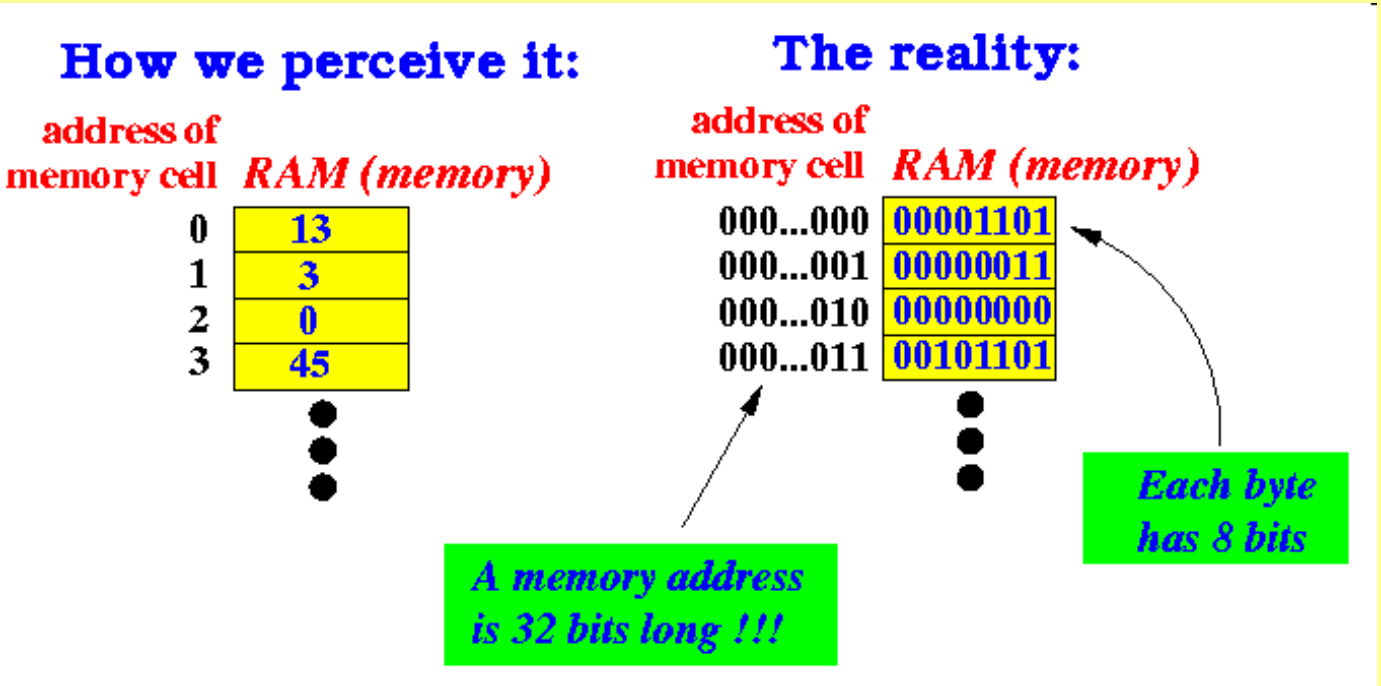
- Recall what we have learned about the Computer RAM memory:



What does all this have to do with a computer ?

- The connection between the computer memory and the binary number system is:

• The computer system uses the binary number encoding to store the number



What does all this have to do with a computer ?

- **Note:** the address is also expressed as a binary number

  A computer can have over 4,000,000,000 bytes (4 Gigabytes) of memory.

  So we need a 32 bites to express the address

END