Lecture 8

Data In The Computer

Representing Data

We have all seen computers do seemingly miraculous things with all kinds of sounds, pictures, graphics, numbers, and text. It seems that we can build a replica of parts of our world inside the computer. You might think that this amazing machine is also amazingly complicated - it really is not. In fact, all of the wonderful multi-media that we see on modern computers is all constructed from simple ON/OFF switches - millions of them - but really nothing much more complicated than a switch. The trick is to take all of the real-world sound, picture, number etc data that we want in the computer and convert it into the kind of data that can be represented in switches, as shown in Figure 1.

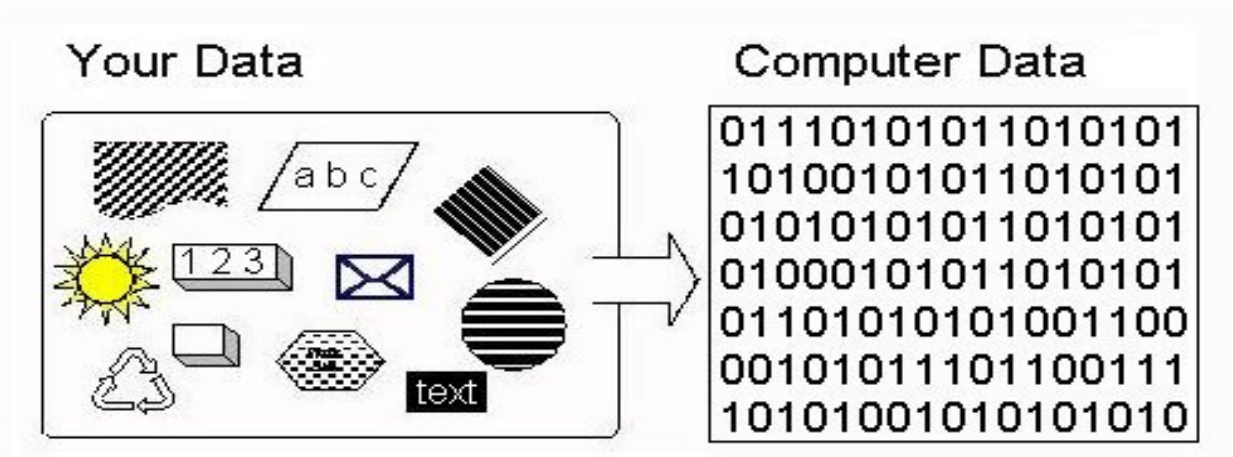
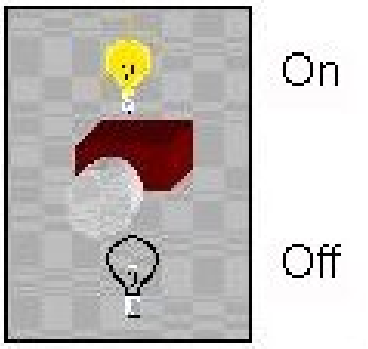


Figure 1: Representing Real-World Data In The Computer

Binary and Switches. Binary is a mathematical number system: **a way of counting.** We have all learned to count using ten digits: 0-9. One probable reason is that we have ten fingers to represent numbers. The computer has switches to represent data and switches have only two states: ON and OFF. Binary has two digits to do the counting**: 0 and 1 - a natural fit to the two states of a switch (0 = OFF, 1 = ON).**

Bits and Bytes One binary digit (0 or 1) is referred to as a *bit*, which is short for ***bi****nary digi****t***. Thus, one bit can be implemented by one switch, as shown in Figure 2.



In the following table, we see that bits can be grouped together into larger chunks to represent data.

0	1 bit
1	1 bit
0110	4 bits
01101011	8 bits

For several reasons which we do not go into here, computer designers **use eight bit chunks called *bytes*** as the basic unit of data. A byte is implemented with eight switches as shown in Figure 3.

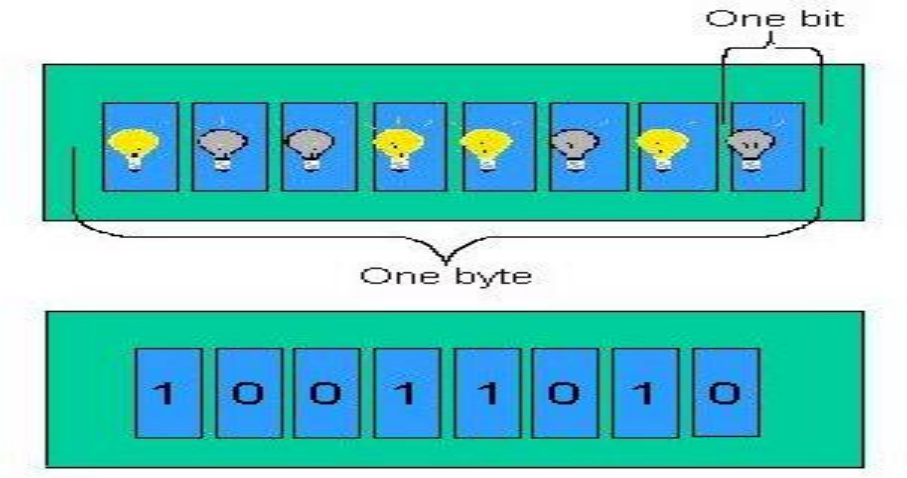


Figure 3: Implementing a Byte

Computer manufacturers express **the capacity of memory and storage in terms of the number of bytes it can hold**.

A kilobyte (KB) is **1,024 bytes**, not one thousand bytes as might be expected, because computers use binary (base two) math, instead of a decimal (base ten) system. Computer storage and memory is often measured in megabytes (MB) and gigabytes (GB). A medium-sized novel contains about 1 MB of information.

kapasite	sembol		deger
1 bit	Bit	=	0 **veya** 1
1 byte	Byte	=	8 bit
1 Kilobyte	KB	=	1024 bytes
1 Megabyte	MB	=	1024 KB
1 Gigabyte	GB	=	1024 MB
1 Terabyte	TB	=	1024 GB
1 Petabyte	PB	=	1.024 TB

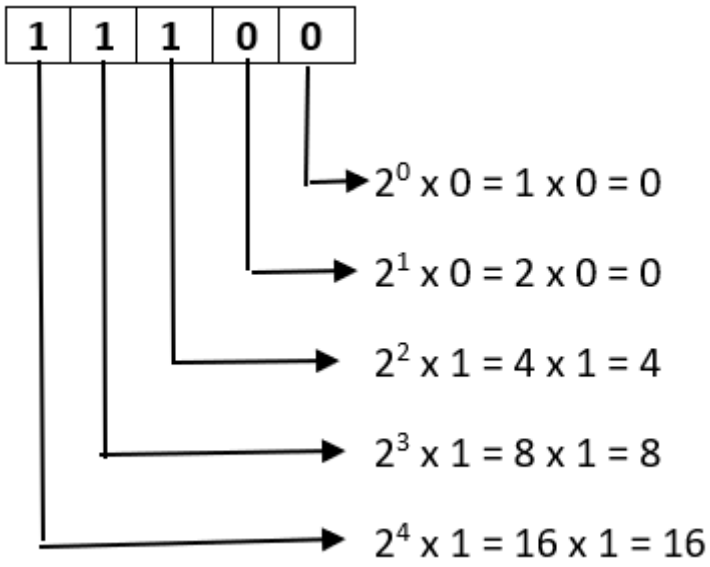
Decimal to Binary Conversion

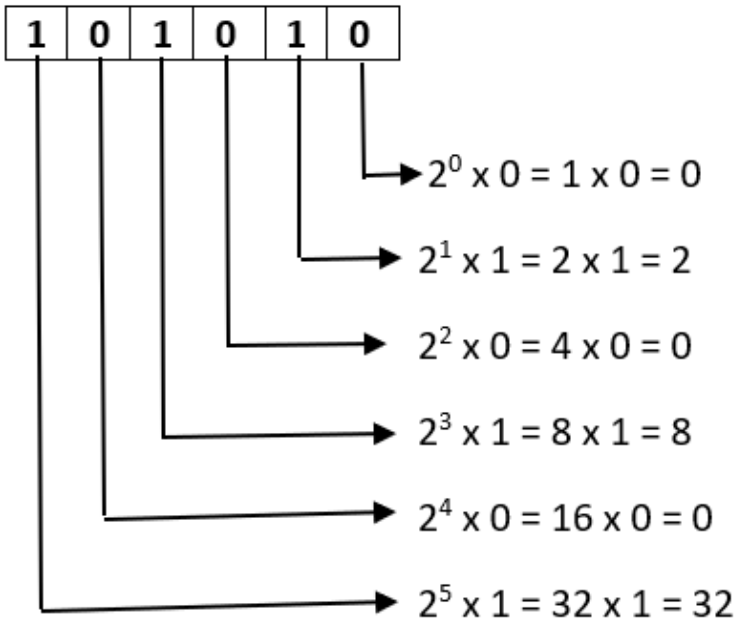
In the decimal to binary conversion, we convert a given base-10 number into an equivalent base-2 number

Decimal	Binary
0	0000
1	0001
2	0010
3	0011
4	0100
5	0101
6	0110
7	0111
8	1000
9	1001

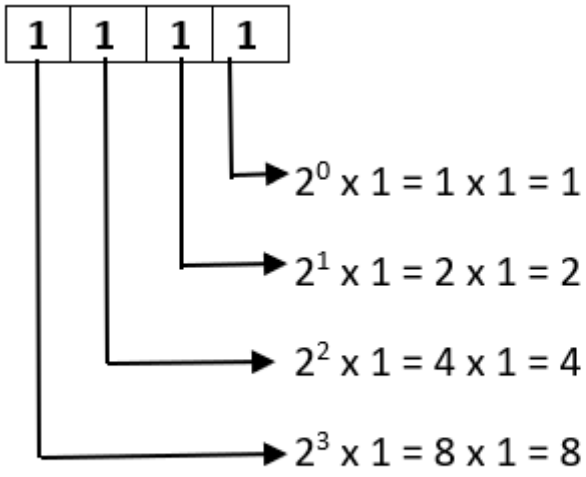
.

Binary to Decimal Conversion



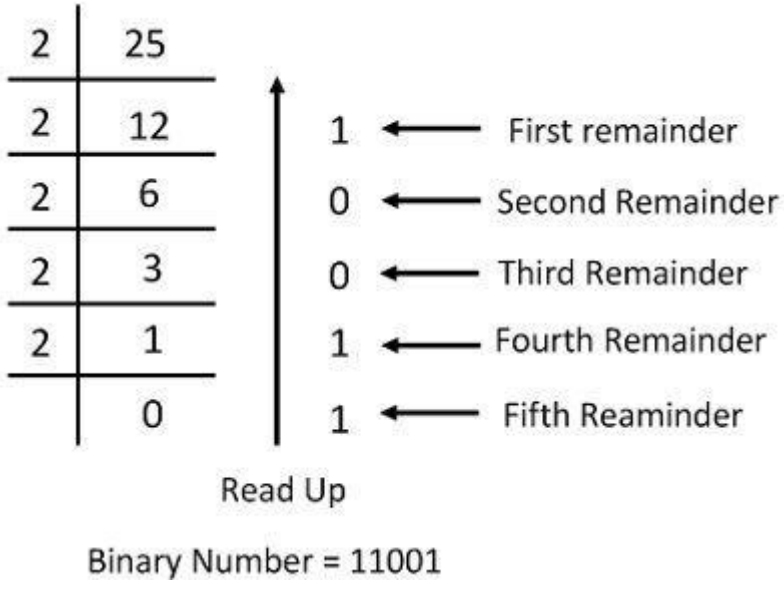


Resultant decimal number= 0+2+0+8+0+32 = **42**



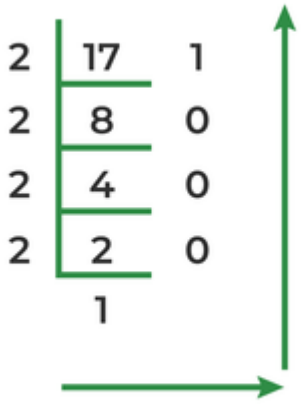
Resultant decimal number= 1+2+4+8 = **15**

Decimal to Binary Conversion



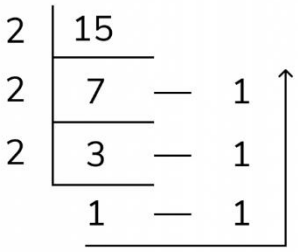
Binary Number = 11001

Decimal number : 17



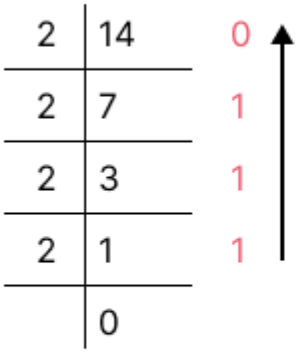
Binary number : 10001

Input: 15



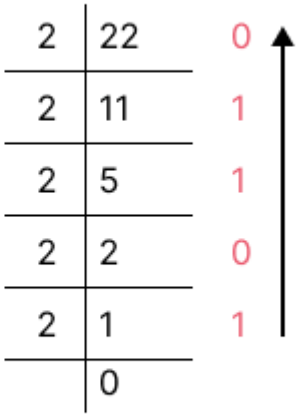
Binary number: 1111

Let the decimal number be : 14



$(14)_{10} = (1110)_2$

Let the decimal number be : 22



$(21)_{10} = (10110)_2$