Registers

A flip flop is a 1 bit memory device/cell, to increase memory we have to add more flip flips in the circit.A **Register** is a collection of flip flops. For storing a large number of bits, the storage capacity is increased by grouping more than one flip flops. If we want to store an n-bit word, we have to use an n-bit register containing n number of flip flops.

A register is mainly used for two purposes Data Storage and Data Movement.

The register is used to perform different types of operations. For performing the operations, the CPU use these registers. The faded inputs to the system will store into the registers. The result returned by the system will store in the registers. There are the following operations which are performed by the registers:

Fetch:

It is used

- To take the instructions given by the users.
- To fetch the instruction stored into the main memory.

Decode:

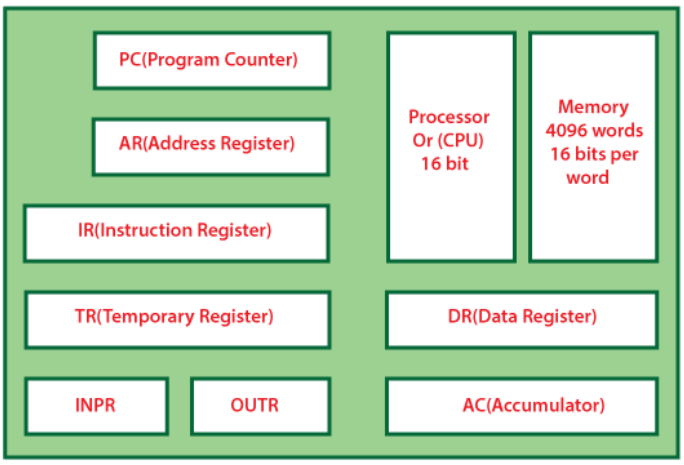
The decode operation is used to interpret the instructions. In decode, the operation performed on the instructions is identified by the CPU. In simple words, the decode operation is used to decode the instructions.

Execute:

The execution operation is used to store the result produced by the CPU into the memory. After storing this result, it is displayed on the user screen.

Types of Registers

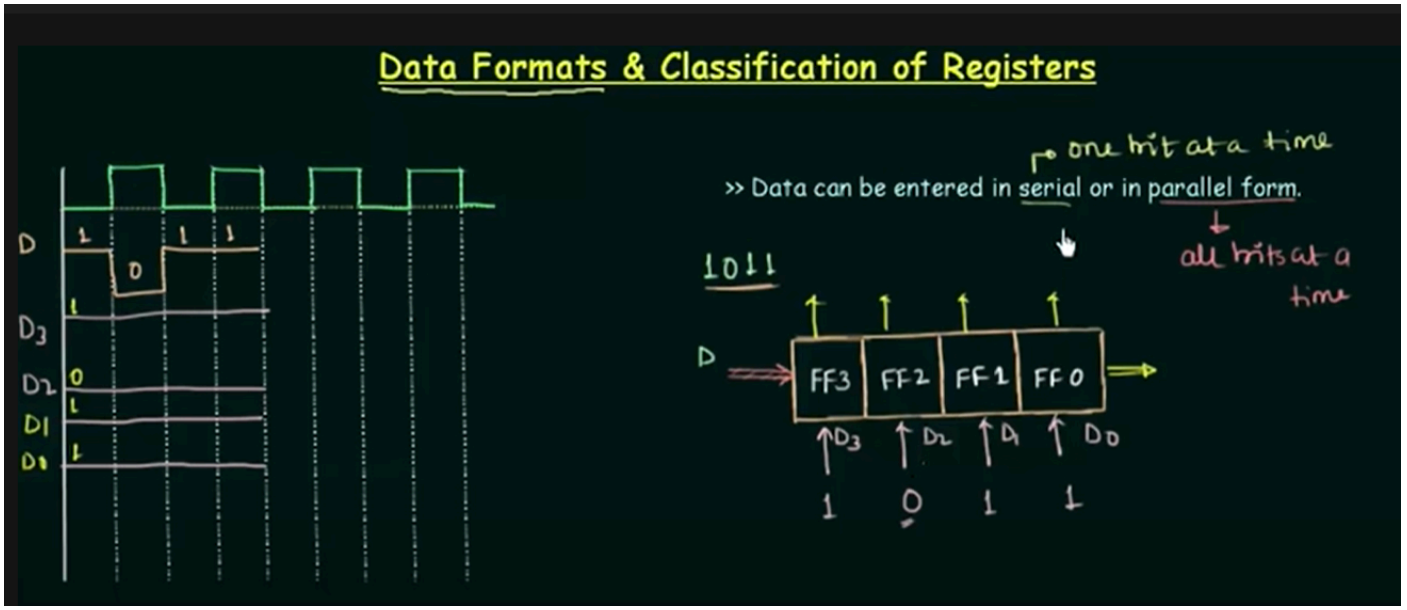
There are various types of registers which are as follows:



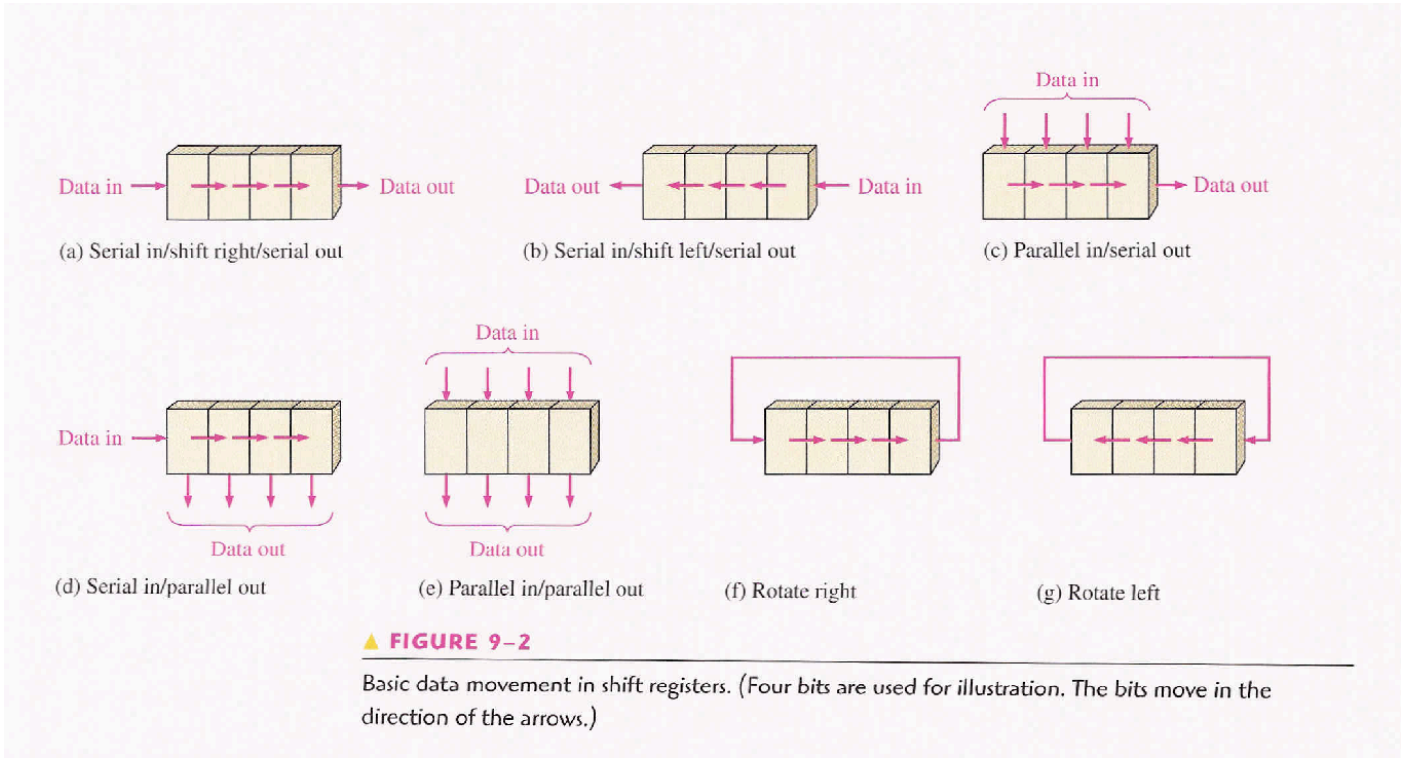
Shift Register

A group of flip flops which is used to store multiple bits of data and the data is moved from one flip flop to another is known as **Shift Register**. The bits stored in registers shifted when the clock pulse is applied within and inside or outside the registers. To form an n-bit shift register, we have to connect n number of flip flops. So, the number of bits of the binary number is directly proportional to the number of flip flops. The flip flops are connected in such a way that the first flip flop's output becomes the input of the other flip flop.

A **Shift Register** can shift the bits either to the left or to the right. A **Shift Register**, which shifts the bit to the left, is known as **"Shift left register"**, and it shifts the bit to the right, known as **"Right left register"**.



The shift register is classified into the following types:



▲ **FIGURE 9–2**

Basic data movement in shift registers. (Four bits are used for illustration. The bits move in the direction of the arrows.)

- Serial In Serial Out
- Serial In Parallel Out
- Parallel In Serial Out

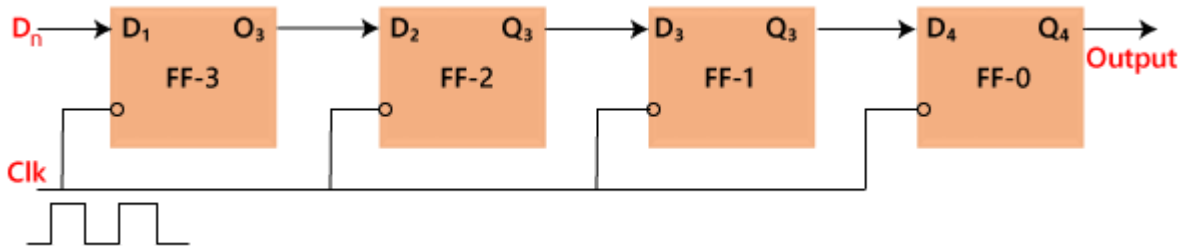
- Parallel In Parallel Out
- Bi-directional Shift Register

Serial IN Serial OUT

In "Serial Input Serial Output", the data is shifted "IN" or "OUT" serially. In SISO, a single bit is shifted at a time in either right or left direction under clock control.

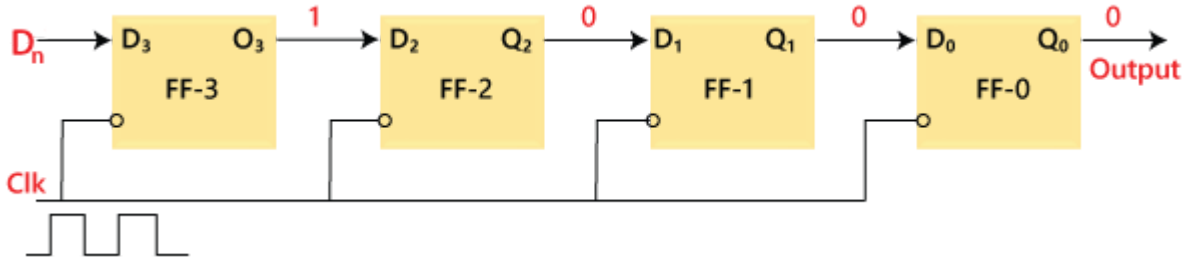
Initially, all the flip-flops are set in "reset" condition i.e. $Y_3 = Y_2 = Y_1 = Y_0 = 0$. If we pass the binary number 1111, the LSB bit of the number is applied first to the Din bit. The D3 input of the third flip flop, i.e., FF-3, is directly connected to the serial data input D3. The output Y_3 is passed to the data input d_2 of the next flip flop. This process remains the same for the remaining flip flops. The block diagram of the **"Serial IN Serial OUT"** is given below.

Block Diagram:

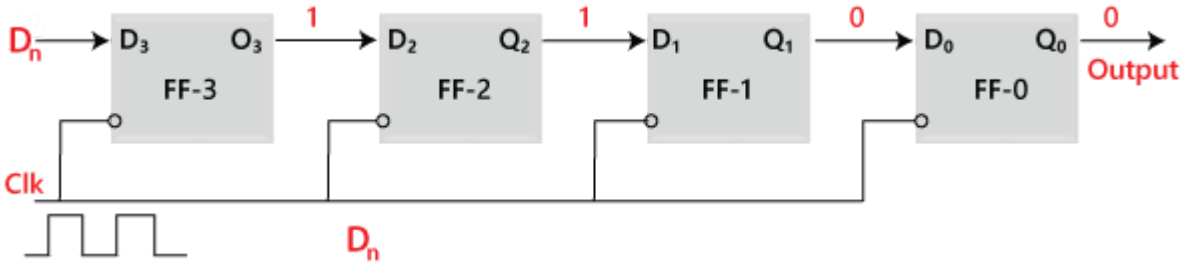


Operation

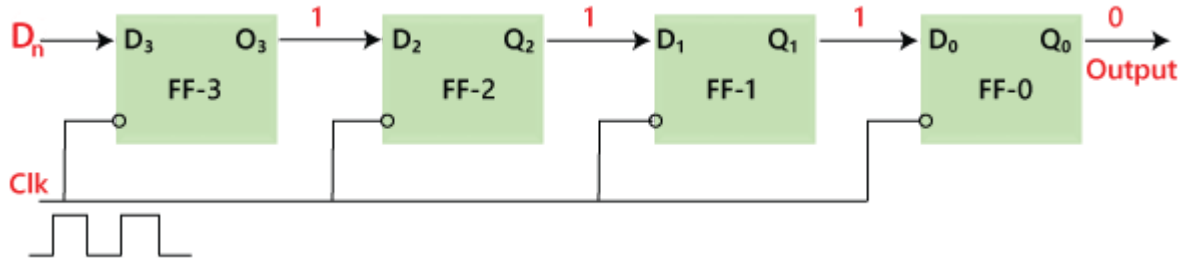
When the clock signal application is disabled, the outputs $Y_3\,Y_2\,Y_1\,Y_0 = 0000$. The LSB bit of the number is passed to the data input D_{in}, i.e., D_3. We will apply the clock, and this time the value of D_3 is 1. The first flip flop, i.e., FF-3, is set, and the word is stored in the register at the first falling edge of the clock. Now, the stored word is 1000.



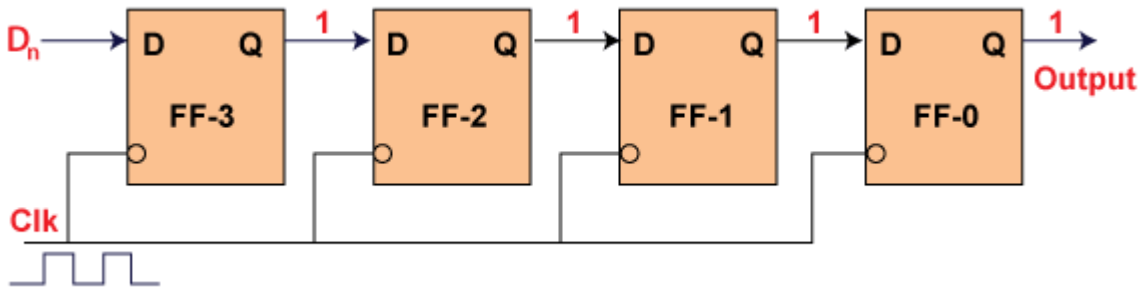
The next bit of the binary number, i.e., 1, is passed to the data input D_2. The second flip flop, i.e., FF-2, is set, and the word is stored when the next negative edge of the clock hits. The stored word is changed to 1100.



The next bit of the binary number, i.e., 1, is passed to the data input D_1, and the clock is applied. The third flip flop, i.e., FF-1, is set, and the word is stored when the negative edge of the clock hits again. The stored word is changed to 1110.



Similarly, the last bit of the binary number, i.e., 1, is passed to the data input D_0, and the clock is applied. The last flip flop, i.e., FF-0, is set, and the word is stored when the clock's negative edge arrives. The stored word is changed to 1111.

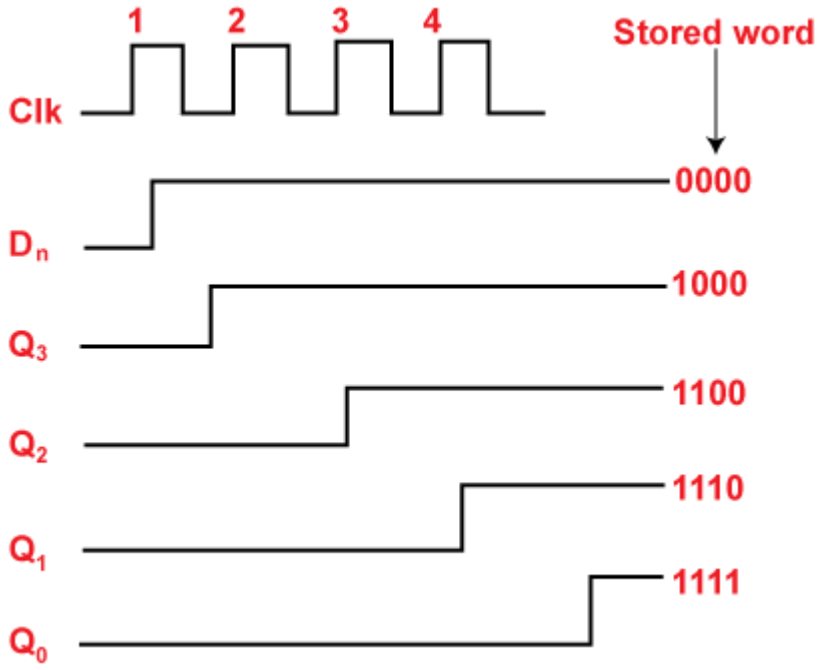


Truth Table

	Clk	$D_n=Q_3$	$Q_3=D_2$	$Q_2=D_1$	$Q_1=D_0$	Q_0
Initially			0	0	0	0
(1)	↓	1	1	0	0	0
(2)	↓	1	1	1	0	0
(3)	↓	1	1	1	1	0
(4)	↓	1	1	1	1	1

→ Direction of data travel

Waveforms


1
2
3
4
Stored word
Clk
0000
D_n
1000
Q_3
1100
Q_2
1110
Q_1
1111
Q_0