UNIVERSAL SHIFT REGISTER

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1 Introduction

A **unidirectional shift register** is a register that can capable of transferring data in only one direction. Whereas the register that is capable of transferring data in both left and right direction is called a **bidirectional shift register**.

In digital circuits, a shift register is a cascade of flip flops, sharing the same clock, in which the output of each flip-flop is connected to the 'data' input of the next flip-flop in the chain, resulting in a circuit that shifts by one position the 'bit array' stored in it, 'shifting in' the data present at its input and 'shifting out' the last bit in the array, at each transition of the clock input.

More generally, a shift register may be multidimensional, such that its 'data in' and stage outputs are themselves bit arrays: this is implemented simply by running several shift registers of the same bit-length in parallel.

A **universal shift register** can shift data in both left and right.It has other functionalists too.

2 Types

Shift registers can have both parallel and serial inputs and outputs. These are often configured as:

1. Serial in Parallel out (SIPO)
2. Parallel in Serial out (PISO)

There are also types that have both serial and parallel input and types with serial and parallel output. There are also **bidirectional** shift registers which allow shifting in both directions.The serial input and last output of a shift register can also be connected to create a **circular shift register**.

3 The Block Diagram

A simple block diagram can demonstrate the Universal shift register.

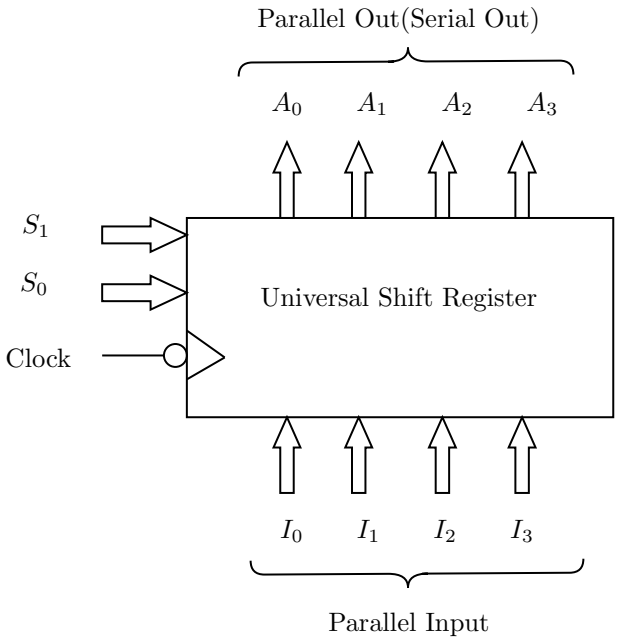

Figure 1: Block diagram of 4-bit universal shift register

In the 4-bit universal shift register,there are four parallel inputs and four parallel outputs,which can also be used for serial outputs.Universal shift register has a common clock that controls the built-in components such as D flip-flop.
There is two selection bits for a universal shift register.These two selection bits control the operations of a universal shift register.

S_1	S_0	Register Operation
0	0	No change
0	1	Shift Right
1	0	Shift Left
1	1	Parallel Load

Table 1: Operations of a universal shift register

4 Components

A universal shift register is basically constructed with two components. They are:

1. Multiplexer
2. D flip-flop

4.1 Multiplexer

Multiplexer is a basic component of universal shift register.It is used for selecting the operations for the universal shift register.

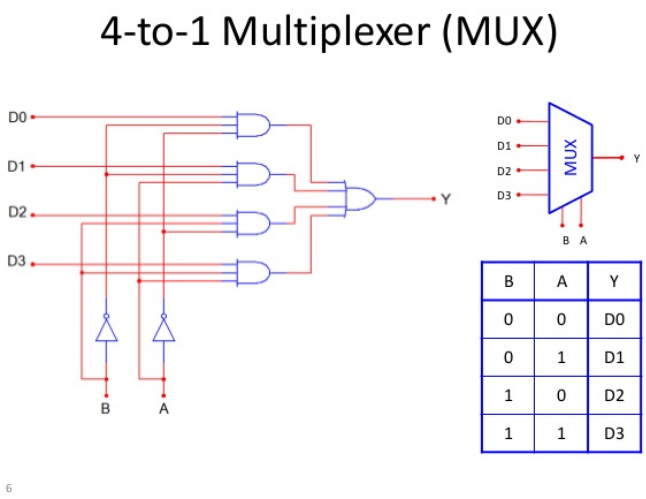

Figure 2: 4 to 1 multiplexer

In the following figure,we can see the basic circuit,block diagram and truth table of a 2 to 4 multiplexer.It has two selection bits A and B for selecting $D0, D1, D2, D3$.

Instead of the multiplexer, a 2 to 4 decoder can be used.

4.2 D Flip-flop

D flip-flop is used in universal shift register for storing data.It has a clock which controls the operations of the flip flop.

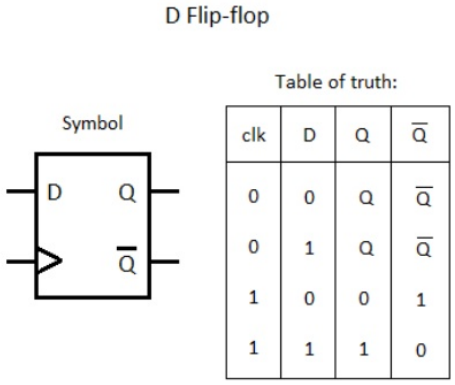

Figure 3: D Flip-flop

In this flip-flop, when clock is cleared that means $clock = 0$,there is no effect of changing input data, D on the output data,Q.But when is clock is changed to 1,the output data,Q will be followed by input data D.

A J-K flip-flop can be replaced with D flip-flop.

5 Working Procedure

In this section,we are going to discuss the working procedure of a universal shift register.

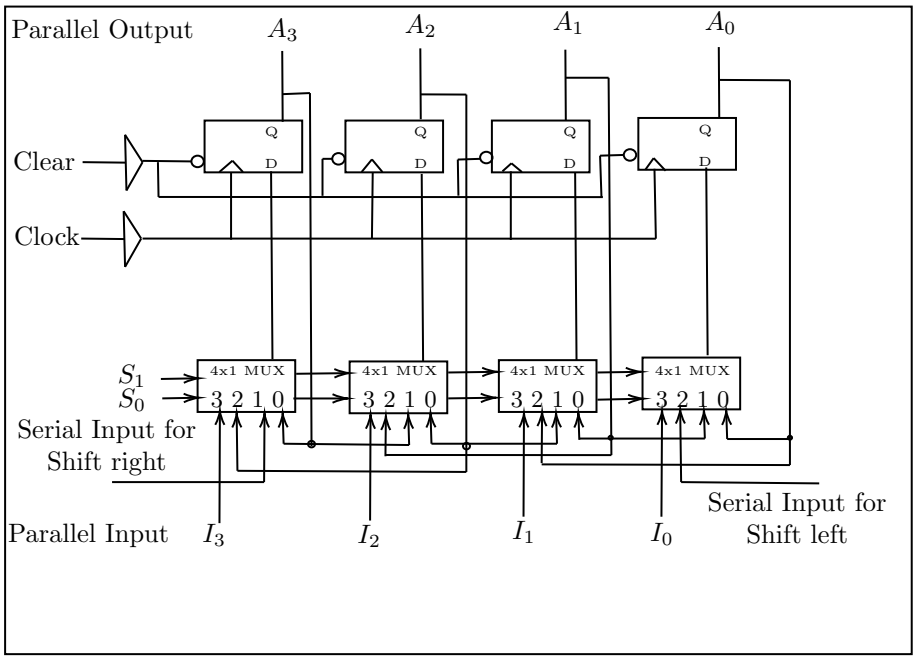

Figure 4: Circuit diagram of universal shift register

In the following figure, we can see the circuit diagram of a 4-bit universal shift register. There are four parallel inputs and four serial outputs.Two inputs for selection bits and input for serial input for serial left and right.There is also a common clock and clear option for four D flip-flops.

5.1 Storing Data

Universal shift register can be used as storing data.When $S_1 = 0$ and $S_0 = 0$ the outputs of the universal shift register will not change.

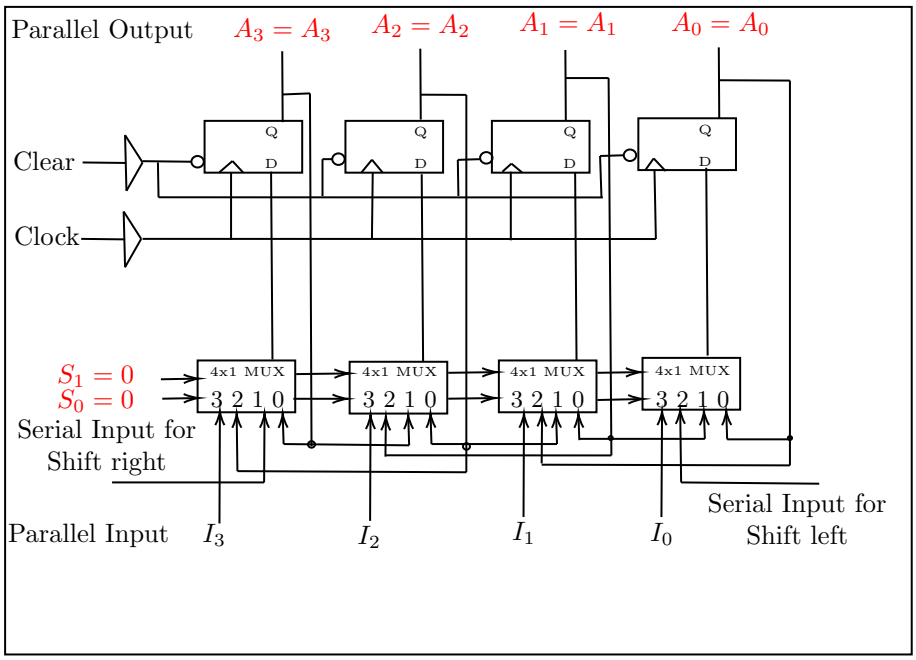

Figure 5: Storing data by universal shift register

We can see from the figure that,outputs of the universal shift register will not be effected if selection bits, $S_1 = 0$ and $S_0 = 0$.This configuration can be used to store information for different purposes in electrical devices.

5.2 Right Shifting

We can shift data to right by universal shift register.When $S_1 = 0$ and $S_0 = 1$ the outputs of the universal shift register will be shifted right and the last bit will take data from **serial input for shift right**.

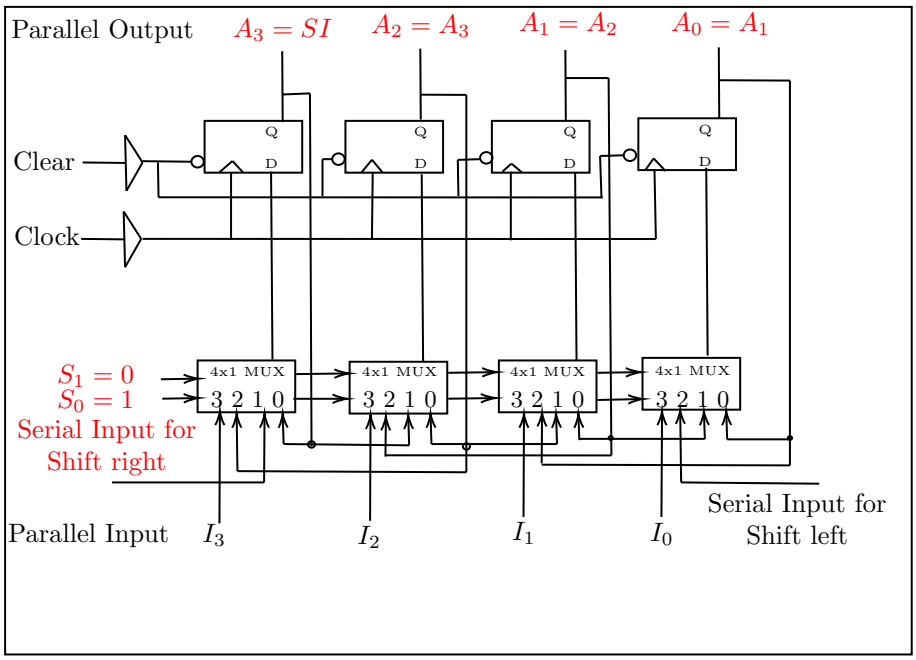

Figure 6: Right shifting data by universal shift register

We can see from the figure that,outputs of the universal shift register will be shifted right if selection bits, $S_1 = 0$ and $S_0 = 1$.This configuration can be used for serial communication between electrical devices.

5.3 Left Shifting

We can shift data to left by universal shift register.When $S_1 = 1$ and $S_0 = 0$ the outputs of the universal shift register will be shifted left and the first bit will take data from **serial input for shift left**.

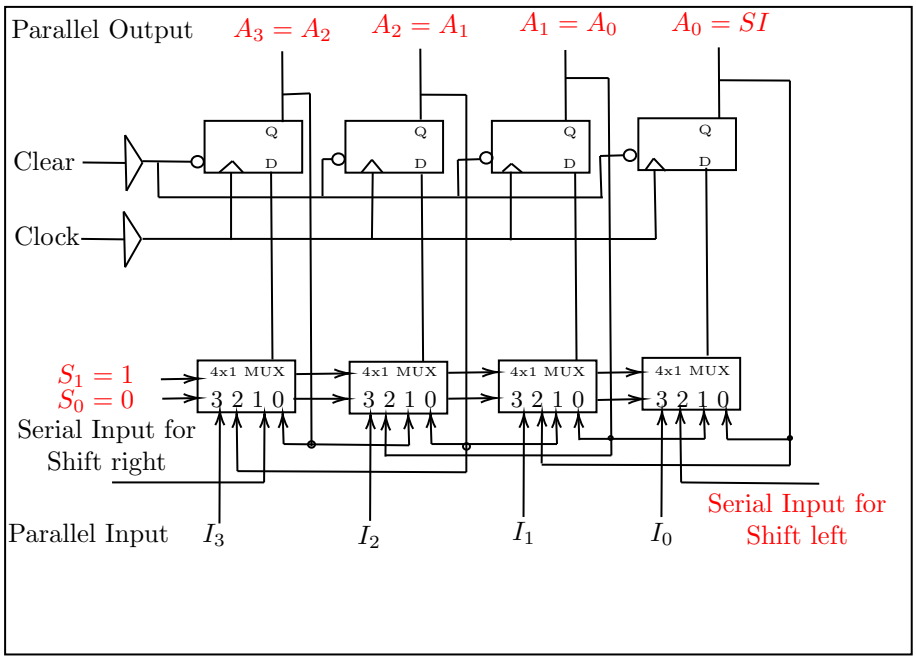

Figure 7: Left shifting data by universal shift register

We can see from the figure that,outputs of the universal shift register will be shifted left if selection bits, $S_1 = 1$ and $S_0 = 0$.This configuration can be used for serial communication between electrical devices.

5.4 Parallel Loading

Data can be parallelly loaded by universal shift register.When $S_1 = 1$ and $S_0 = 1$ the outputs of the universal shift register will be parallelly loaded from parallel inputs.

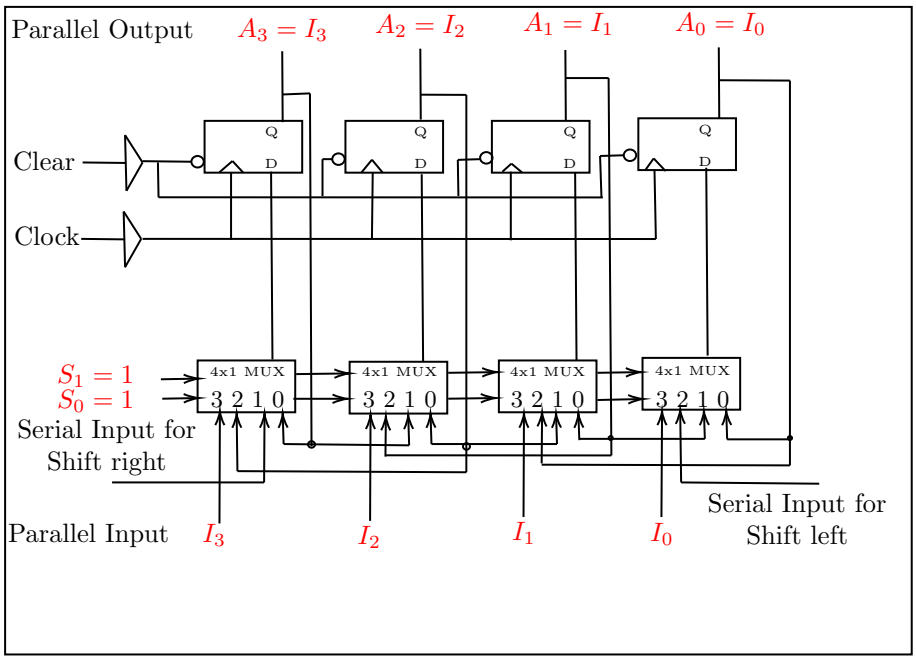

Figure 8: Parallel loading data by universal shift register

We can see from the figure that,outputs of the universal shift register will be parallelly loaded from parallel input if selection bits, $S_1 = 1$ and $S_0 = 1$.This configuration can be used for transferring data.

6 Uses of Universal Shift Register

We can use **Universal Shift Register** in different purposes :

- Temporary data storage
- Data transfer
- Data manipulation
- As counters.
- Serial communication of micro controller unit
- Multiplying binary numbers
- Storing ALU's operands, intermediate results and final results

7 Conclusion

Universal shift register is very useful for transferring data, storing and for serial communication.We can use it instead of individual shift register, D flip-flop.In practical use, IC 74194 (4 bit), IC 74198 (8 bit) are used in various devices that receive serial format data. Though now a days it is being replaced by more advanced chips, universal shift register still has great importance in the field of electronics.