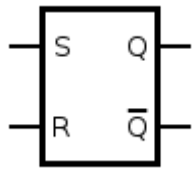
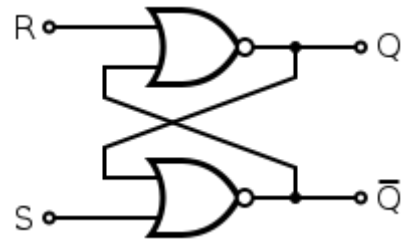


Computer System Architecture
COMP201Th
Lecture: 11
Latches and Flip Flops

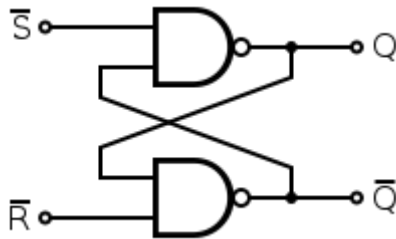
- Latches and flip-flops are the building blocks of sequential circuits in the same way gates are the building blocks of combinational circuits.
- While gates had to be built directly from transistors, latches can be built from gates and flip-flops can be built from latches.
- Latch:
 - Latch is an electronic logic circuit with two stable states i.e. it is a bistable multivibrator.
 - Latch has a feedback path to retain the information.
 - Latch can store one bit of information as long as the device is powered on.
- Flip Flops:
 - A flip flop is a circuit that has two stable states and can be used to store state information.
 - Flip Flops are used as data storage elements. A flip flop is a device which stores a single bit of data, one of its two states represent a “1” and the other represents a “0”.
 - Flip flops are fundamental building blocks of digital electronics system used in computers, communications and many other types of systems.
 - **Difference between Latch and Flip-flop:** The difference is that **a latch does not have a clock signal, whereas a flip-flop always does.**
 - **SR Latch:**
 - The simplest memory element consists of two cross-coupled NOR gates.
 - Inputs S (set) and R (reset) are normally 0.
 - Asserting S (i.e. setting $S=1$) will make output $Q=1$.
 - Asserting R (i.e. setting $R=1$) will make $Q=0$.
 - An SR latch is an asynchronous device i.e. it works independently of control signals and relies only on the state of the S and R inputs.
 - SR latches can also be made from NAND gates, but the inputs are swapped and negated.



Circuit Symbol for SR Latch



SR latch from 2 NOR gates



SR latch from 2 NAND gates

S	R	Q	\bar{Q}
0	0	Latched	
0	1	0	1
1	0	1	0
1	1	Metastable	

Truth Table for SR Latch