Theory

1. Multiplexer

A multiplexer has multiple input pins, but only has one output pin. This circuit gives an output based on which input pin is chosen.
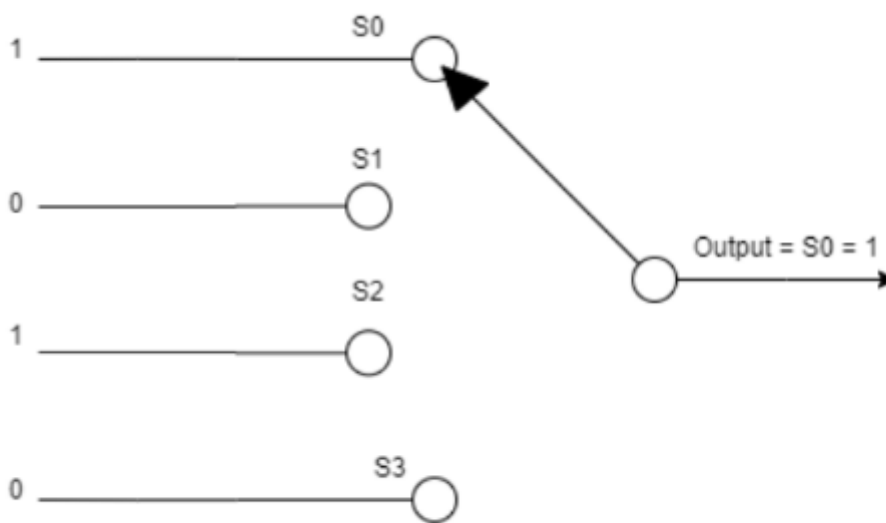

Image 1.1 Rotary Switch

To explain further about how multiplexer works, we can imagine it as a rotary switch that works just like how multiplexers do. In the image above, there are 4 inputs from S0 to S3. Every input (from S0 to S3) has a signal between 1 or 0. The switch now is choosing to input S0, so the output of the rotary switch is the same as S0 (in this case is signal 1). Different from the rotary switch mentioned above, a multiplexer works by using a selector signal.
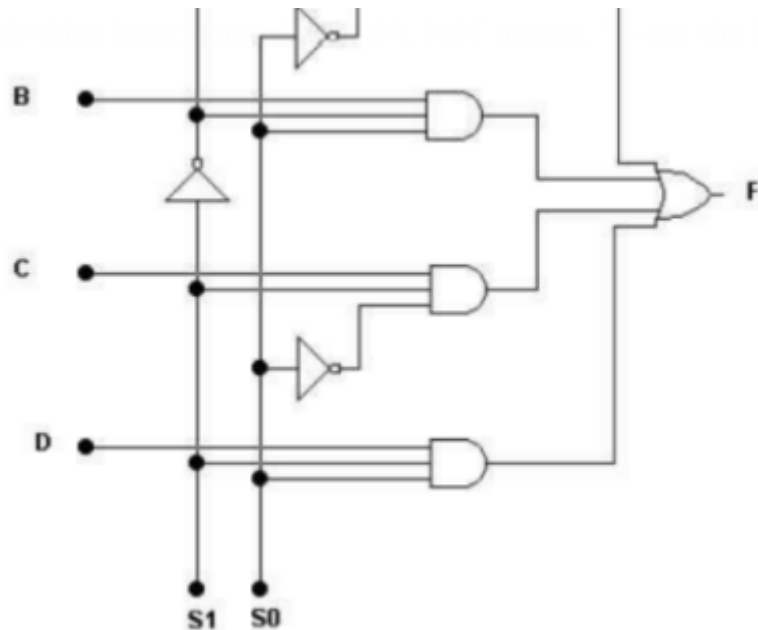
Multiplexers can also be built [...] a, see

Image 1.2 Multiplexer 4 to 1 with logic gates

the image below (image 1.2).

How a Multiplexer Works

1. **Input**: The multiplexer receives multiple inputs, in this case/image above, its **A** to **D**.
2. **Selector**: The selector signals determine which input will be passed to the output. In a 4-to-1 multiplexer, two selector signals (e.g., **S1** and **S0**) are needed to select one of the four inputs.
3. **Output**: Based on the combination of selector signals, the multiplexer forwards the value from the selected input to the output.

For example:

- If **S1 = 0** and **S0 = 0**, input **A** is selected since its the first input (0 index, where 1st = 0, and 2nd = 1,etc).
- If **S1 = 0** and **S0 = 1**, input **B** is selected since its the second input (0 index, where 1st = 0, and 2nd = 1,etc).
- And so on, with different selector combinations choosing different inputs.

Truth Table of a 4-to-1 Multiplexer

S1	S0	Output
0	0	A
0	1	B
1	0	C

S1	S0	Output
1	1	D

Multiplexers are useful in digital applications, especially when managing multiple data sources that need to be routed to a single destination. Remember that to build a custom multiplexer with logic gates, we need to derive the boolean function first with a truth table.

2. Demultiplexer

A demultiplexer is the opposite of a multiplexer; it has one input pin and multiple output pins. The signal or data from the input pin is directed to the selected output pin. A selector signal is also used in a demultiplexer to determine which output pin will receive the input signal. The image below shows a logic gate diagram of a demultiplexer:
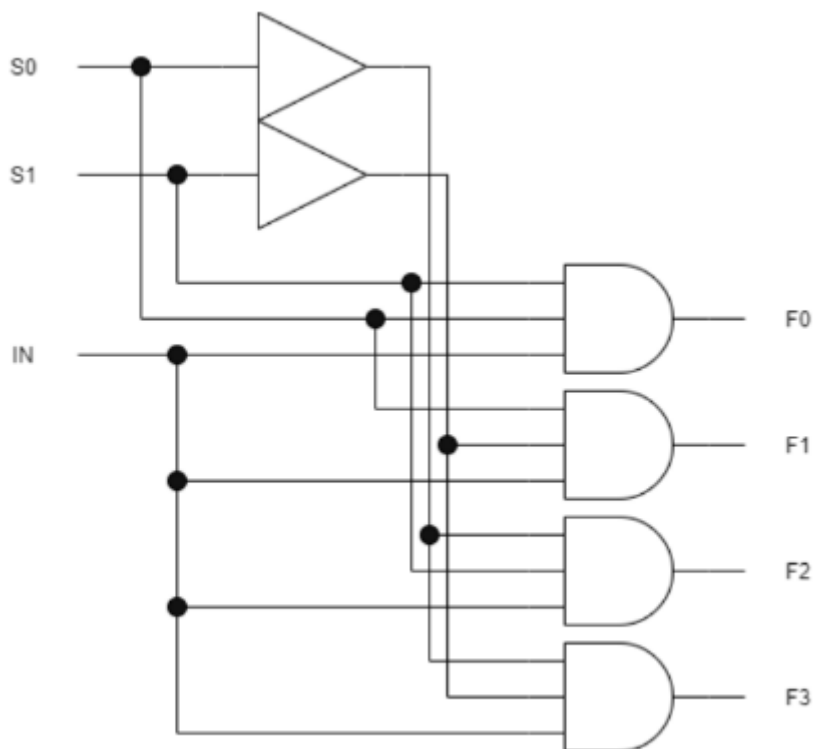

Image 1.3 Demultiplexer 1 to 4 with logic gates

In this diagram, the signal on the **IN** pin will be transmitted to the chosen output. The output will be selected by the signals **S0** and **S1**. In the circuit above, if an output pin is not selected, it will receive a signal of **0**.

How a Demultiplexer Works

1. **Input**: The demultiplexer takes a single input signal from the **IN** pin.
2. **Selector**: The selector signals (**S0** and **S1**) determine which output pin the input signal will be directed to.

3. **Outputs**: The selected output pin receives the input signal, while the other output pins receive a signal of **0**.

Truth Table of a 1-to-4 Demultiplexer

S1	S0	Output 0	Output 1	Output 2	Output 3
0	0	IN	0	0	0
0	1	0	IN	0	0
1	0	0	0	IN	0
1	1	0	0	0	IN

Thus, the demultiplexer enables the distribution of a single input signal to one of several output lines based on the selector signals.

Revision #1
Created 24 October 2024 15:37:28 by DS
Updated 24 October 2024 15:54:06 by DS