Multiplexers

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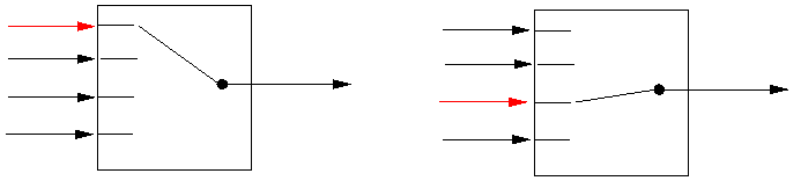
Multiplexers

- Multiplexers (MUX) are digital switches
- Select one of many inputs and route it to a single output
- Used to route data, control, and address signals in digital systems
- Think of a mux as a multi-position switch



Multiplexer Symbol

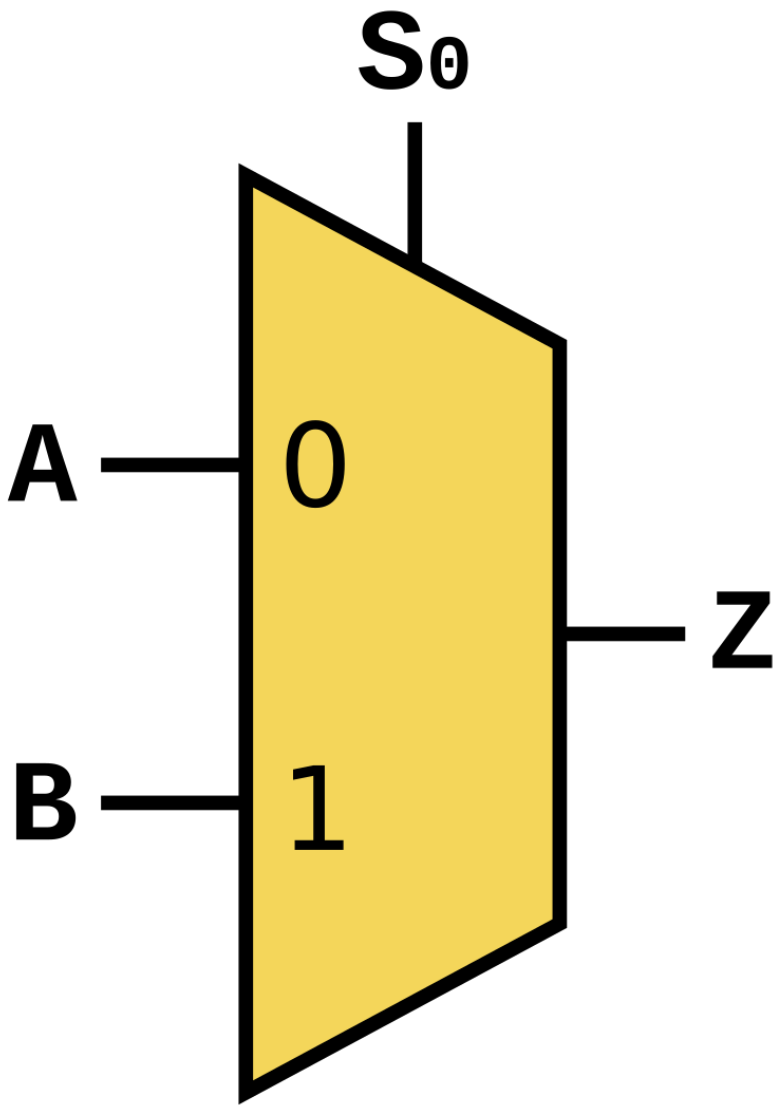
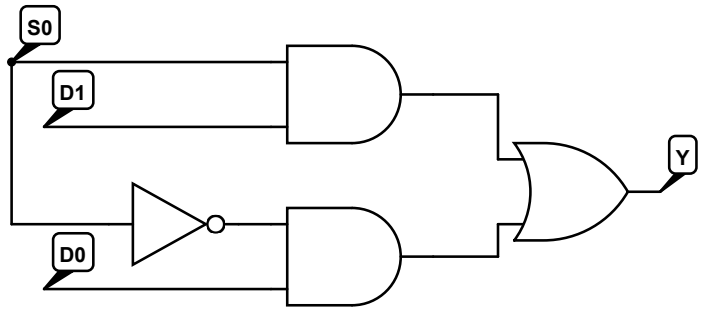


Figure: Multiplexer Symbol

2-to-1 Multiplexer Schematic



S	D1	D0	Y
0	X	D0	D0
1	D1	X	D1

2-to-1 Multiplexer in Verilog

```
module mux2to1(
    input wire d0, d1,   // 8-bit input data
    input wire sel,      // Select line
    output reg y         // 8-bit output
);

always @(*) begin
    if (sel)
        y = d1;
    else
        y = d0;
end
endmodule
```

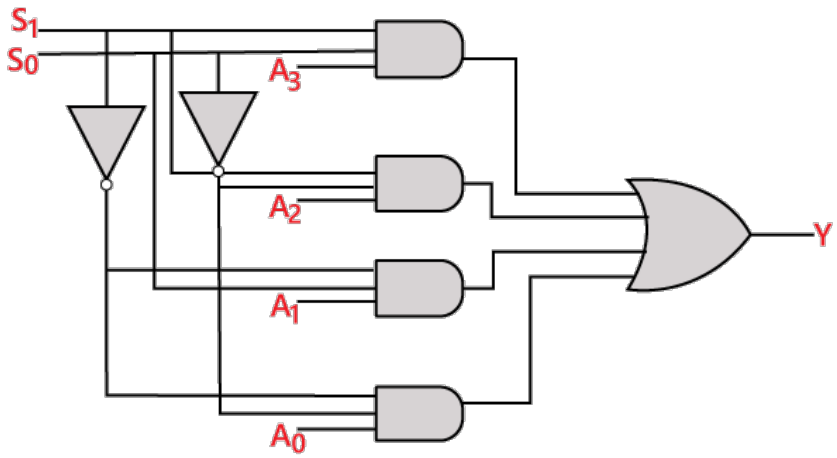
2-to-1 Multiplexer in Verilog

- Verilog implementation of a 2:1 multiplexer
- Uses a ternary operator for selection

```
module mux2to1(
input wire d0, d1,   // 8-bit input data
input wire sel,              // Select line
output wire y        // 8-bit output
);

assign y = sel ? d1 : d0; // if sel is 1, output d1
endmodule
```

Multiplexer Schematic



S1	S0	D3	D2	D1	D0	Y
0	0	X	X	X	D0	D0
0	1	X	X	D1	X	D1
1	0	X	D2	X	X	D2
1	1	D3	X	X	X	D3

Multiplexer Schematic

- Select one of the inputs based on the select lines
- The select lines determine which input is connected to the output

4-to-1 Multiplexer in Verilog

```
module mux4to1(
    input wire [3:0] d,      // 4 1-bit inputs
    input wire [1:0] sel,    // 2-bit select line
    output reg y             // 1-bit output
);

always @(*) begin
    case(sel)
        2'b00: y = d[0];
        2'b01: y = d[1];
        2'b10: y = d[2];
        2'b11: y = d[3];
        default: y = 1'bx;   // undefined for invali
    endcase
end
endmodule
```