

### WEEK 3 - WORKED EXAMPLE

Show how the function  $F(A,B,C) = \pi(0,1,2,5)$  could be implemented

- (i) with an 8-to-1 multiplexer (mux)
- (ii) with a 4-to-1 mux plus an inverter

First, draw the truth table. The maxterm list given tells us where the function will be equal to '0'.

	A	B	C	F
0	0	0	0	0
1	0	0	1	0
2	0	1	0	0
3	0	1	1	
4	1	0	0	
5	1	0	1	0
6	1	1	0	
7	1	1	1	

then fill in  
the 1's

A	B	C	F
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	1
1	0	1	0
1	1	0	1
1	1	1	1

Alternatively, as maxterms and minterms are mutually exclusive, the minterms are given by

$$F(A,B,C) = \sum(3,4,6,7)$$

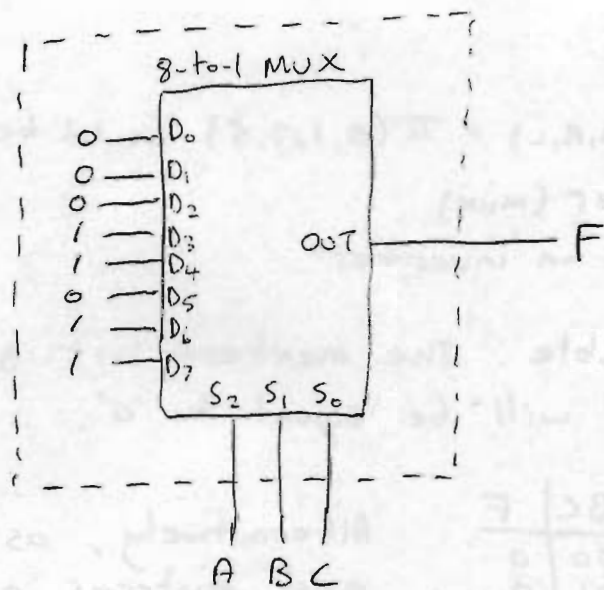
telling us where to put a '1' in the truth table

OR  $F(A,B,C) = \pi(0,1,2,5) = (A+B+C)(A+B+\bar{C})(A+\bar{B}+C)(\bar{A}+B+\bar{C})$

$$F(A,B,C) = \sum(3,4,6,7) = \bar{A}BC + A\bar{B}\bar{C} + A\bar{B}C + ABC$$

Any method can be used to produce the truth table.

- (i) An 8-to-1 mux has three select lines. These can be set to all the possible combinations of the three input variables  $A, B, C$  ( $2^3=8$ ). So if we apply the variables  $A, B, C$  to the select lines  $S_2, S_1, S_0$  of the mux, each of the possible minterms of the function will select one of the eight channels of the mux. We then apply the correct output for  $F$  on each of the mux input channels, to be selected by the input  $A, B, C$ .

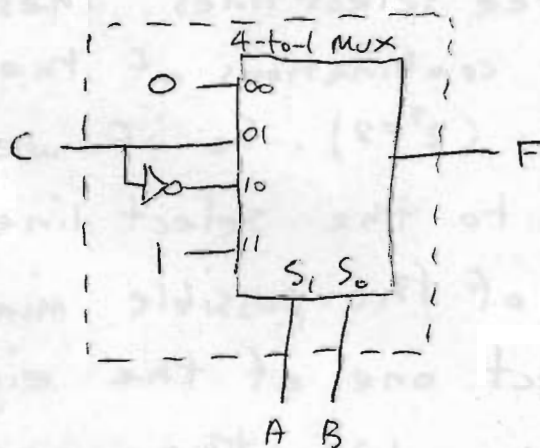


MUX OPERATION			
$S_2$	$S_1$	$S_0$	channel Selected
0	0	0	$D_0$
0	0	1	$D_1$
0	1	0	$D_2$
0	1	1	$D_3$
1	0	0	$D_4$
1	0	1	$D_5$
1	1	0	$D_6$
1	1	1	$D_7$

- (ii) with a 4-to-1 mux, there are only two select lines  $S_1$  and  $S_0$ . Consider taking variables  $A, B$  to these select lines. Observe the output  $F$  on the truth table for each of the four combinations.

when  $A=B=0$ , the output is always '0' independent of  $C$   
 when  $A=0, B=1$ , the output is the same value as the  $C$  input  
 when  $A=1, B=0$ , the output is the inverse value of  $C$   
 when  $A=B=1$ , the output is always 1 independent of  $C$

Applying these conditions gives



MUX OPERATION		
$S_1$	$S_0$	channel selected
0	0	$D_0$
0	1	$D_1$
1	0	$D_2$
1	1	$D_3$

Sometimes it is easier to label the mux inputs with the channel select value for that particular channel as shown.

To an observer outside of the dotted lines, putting each of the combinations of  $A, B, C$  as inputs gives the correct value of  $F$  as the output.