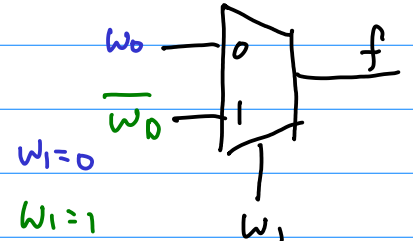
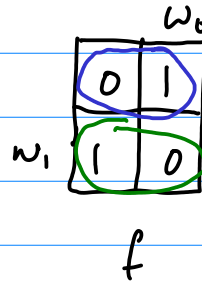
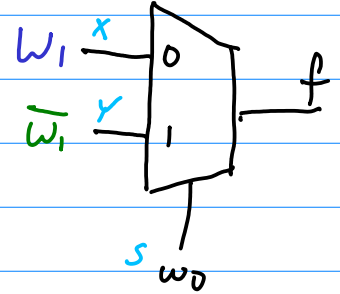
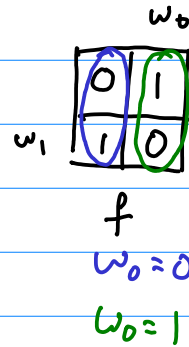
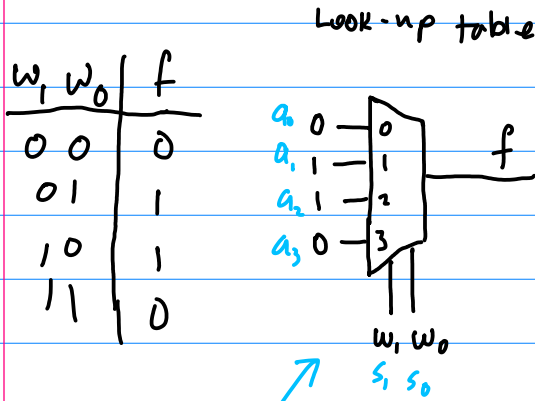


# Using multiplexers to implement logic

eg. Two-variable problem

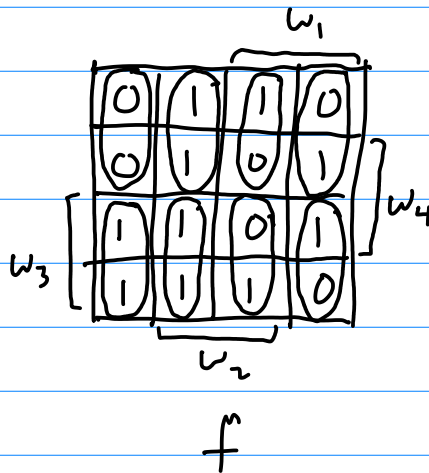
But can we use a 2:1 mux?



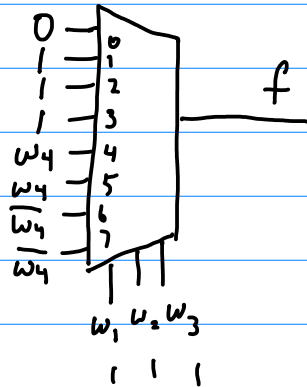
$f = \bar{s}_1 \bar{s}_0 a_0 + \bar{s}_1 s_0 a_1 + s_1 \bar{s}_0 a_2 + s_1 s_0 a_3$   
 $f = \bar{w}_0 w_1 + w_0 \bar{w}_1$

Another example

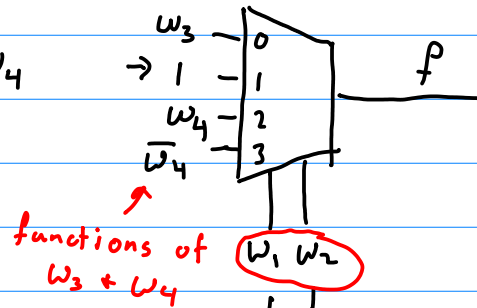
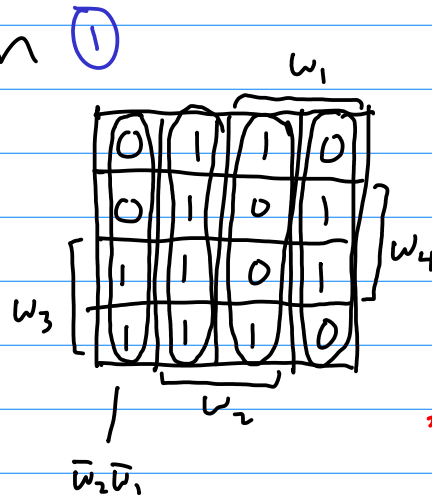
- a 4-variable problem



8:1 mux

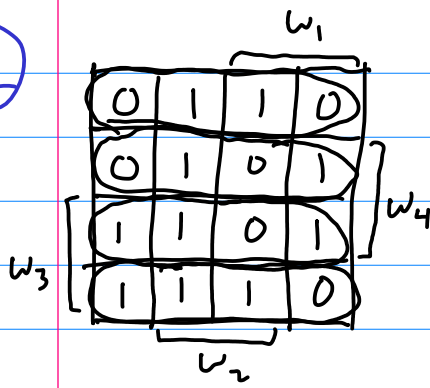


Same problem again but let's try a 4:1 mux

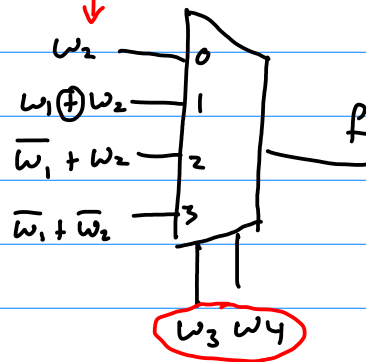


# Other possibilities

2



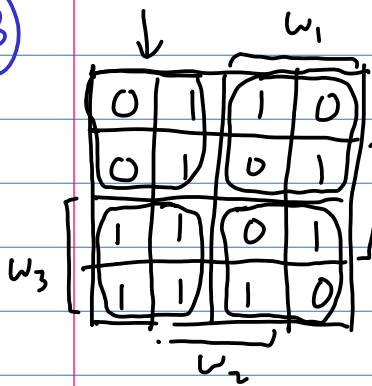
functions of  $w_1 + w_2$



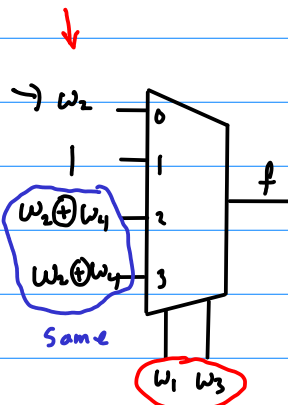
Possibilities

- $w_1 w_2$  ✓
- $w_1 w_3$
- $w_1 w_4$
- $w_2 w_3$
- $w_2 w_4$
- $w_3 w_4$  ✓

3

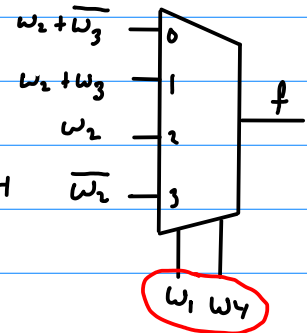
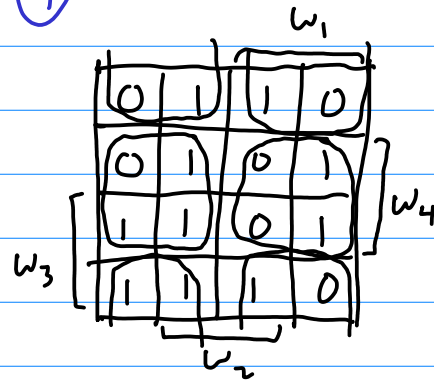


functions of  $w_2 + w_4$

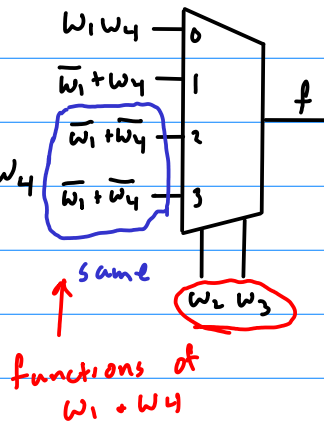
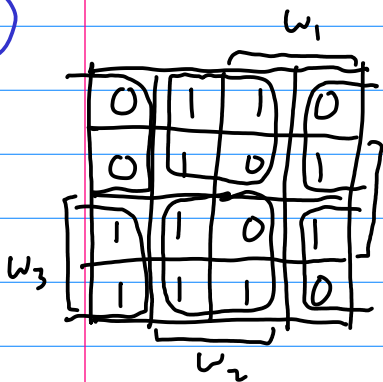


functions of  $w_2 + w_3$

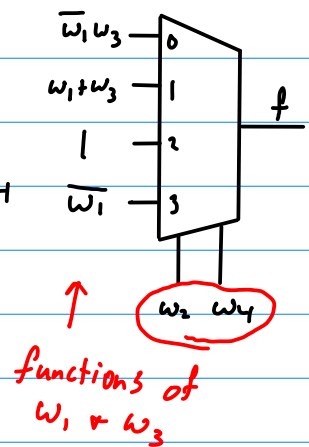
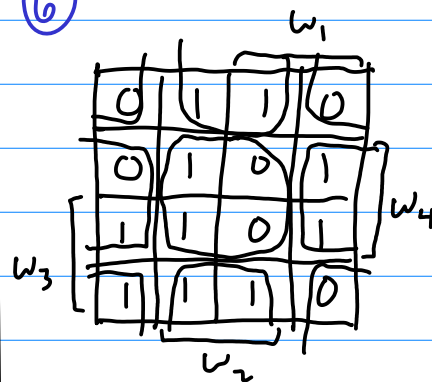
4



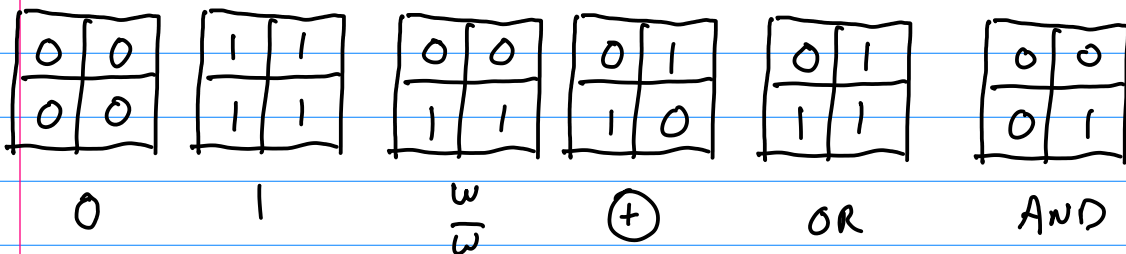
5



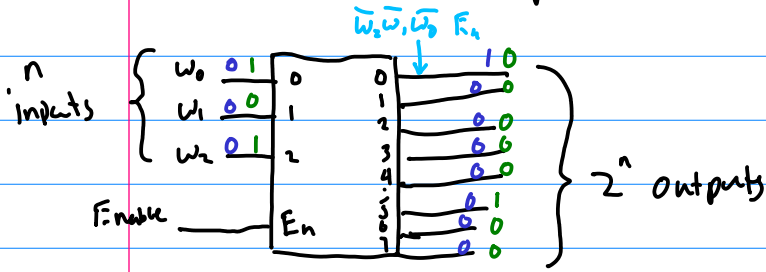
6



Possibilities



# Decoder / demultiplexer



## Decoder

Binary value in -

"one-hot" encoding

exactly one output is "active" (logic 1 here)

In  $Enable = 1$  does it  
 $Enable = 0$  all inactive

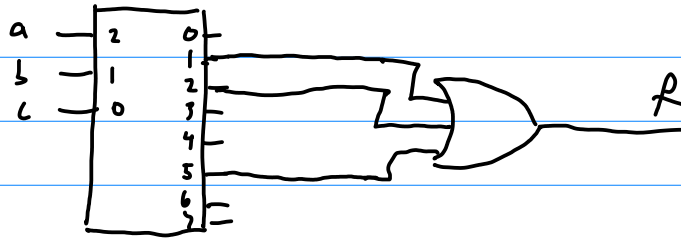
As a demultiplexer think of

Enable as input (signal)

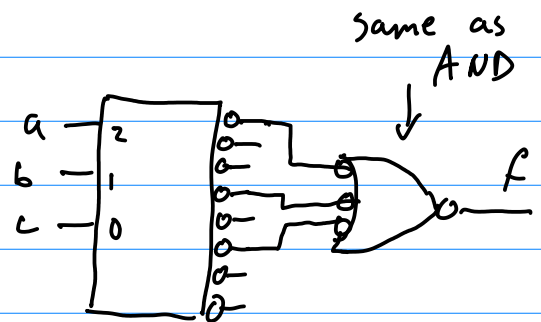
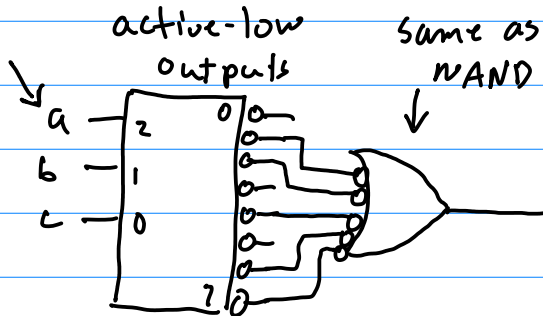
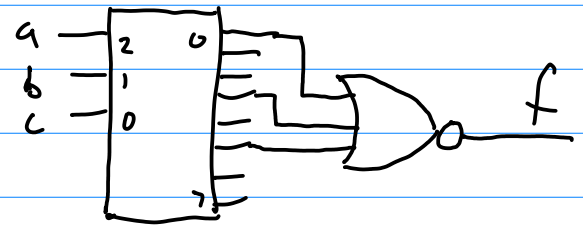
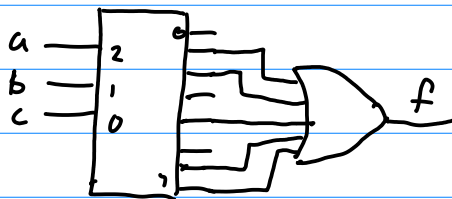
$w_2 w_1 w_0$  then select where the signal goes

## Implement the function

a	b	c	f
0	0	0	0
→	0	0	1
→	0	1	0
	0	1	1
	1	0	0
→	1	0	1
	1	1	0
	1	1	1

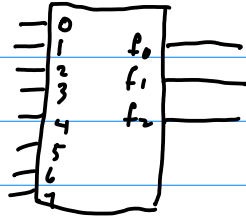


abc	f	$\bar{f}$
000	0	1
001	1	0
010	1	0
011	0	1
100	1	0
101	0	1
110	1	0
111	1	0



# Binary Encoder

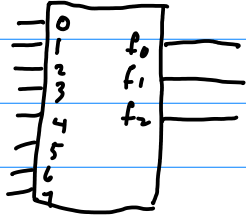
Expect one-hot encoding  $2^n$  inputs



$n$  outputs  
 Binary value corresponds to which line is active

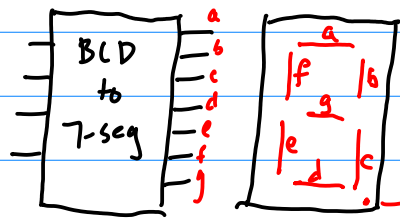
# Priority Encoder

not necessarily one-hot  $2^n$  input



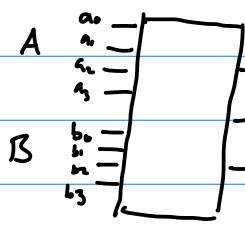
$n$  outputs  
 binary value corresponds to the highest numbered input that is active

# Code Converters



DP decimal point

# Arithmetic Compare

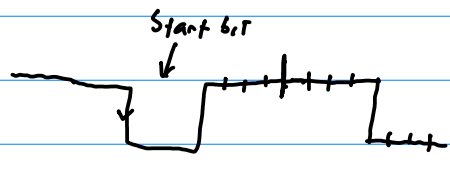


$A > B$   
 $A = B$   
 $A < B$

One-hot encoding

# Majority Detector

Eg. RS-232



$f =$  majority of eg. 3 samples  
 $011 \rightarrow f=1$   
 $100 \rightarrow f=0$