



Faculty of Engineering

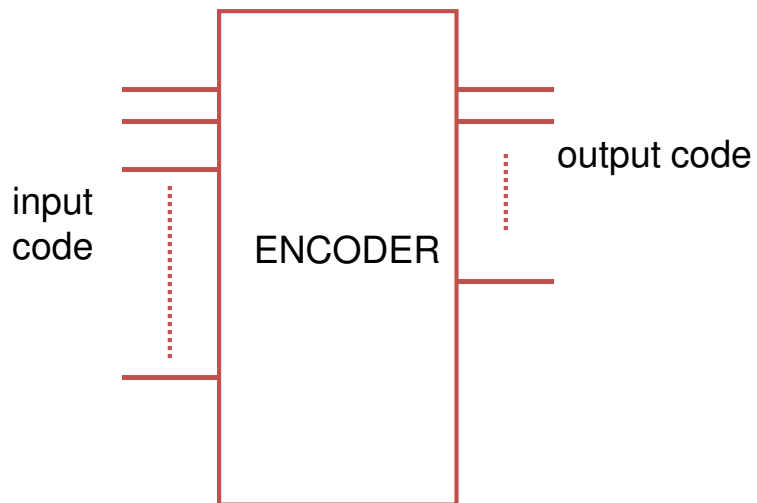
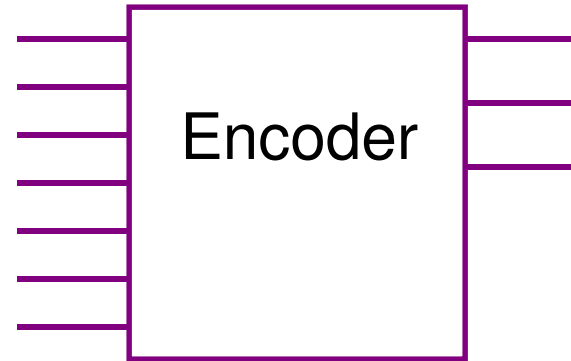
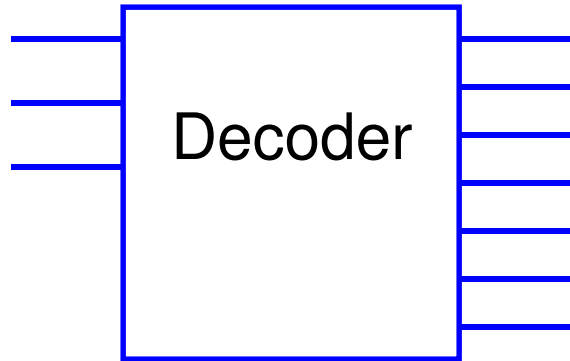
CSE115: Digital Design

Lecture 16: Encoders

Suggested Reading

- Sections 5.5

Encoders vs. Decoders



Inverse function of a Decoder.

Outputs are less than inputs.

Converts input code words into output code words.

Binary Encoders

2^n -to- n encoder: 2^n inputs and n outputs.

Example: $n=3$, 8-to-3 encoder

1-out-of- 2^n

Inputs

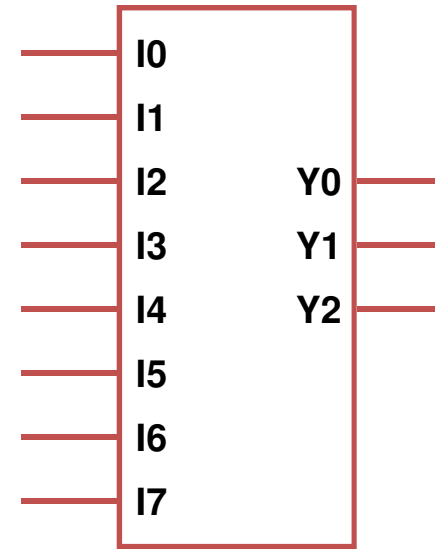
I0	I1	I2	I3	I4	I5	I6	I7
1	0	0	0	0	0	0	0
0	1	0	0	0	0	0	0
0	0	1	0	0	0	0	0
0	0	0	1	0	0	0	0
0	0	0	0	1	0	0	0
0	0	0	0	0	1	0	0
0	0	0	0	0	0	1	0
0	0	0	0	0	0	0	1

Binary Code

Outputs

Y0	Y1	Y2
0	0	0
0	0	1
0	1	0
0	1	1
1	0	0
1	0	1
1	1	0
1	1	1

Binary encoder

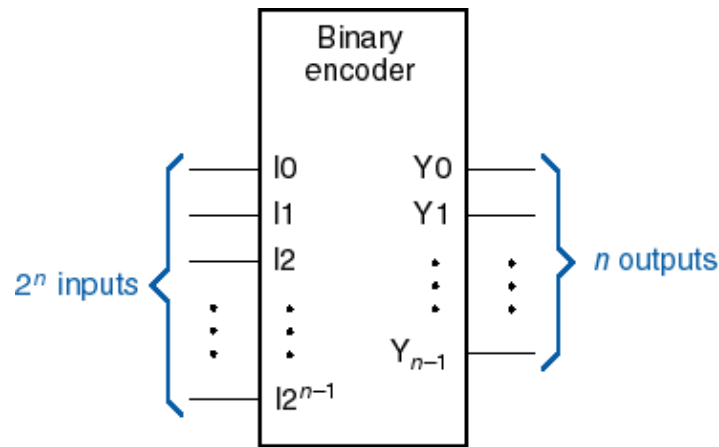


$$\mathbf{Y2} = I1 + I3 + I5 + I7$$

$$\mathbf{Y1} = I2 + I3 + I6 + I7$$

$$\mathbf{Y0} = I4 + I5 + I6 + I7$$

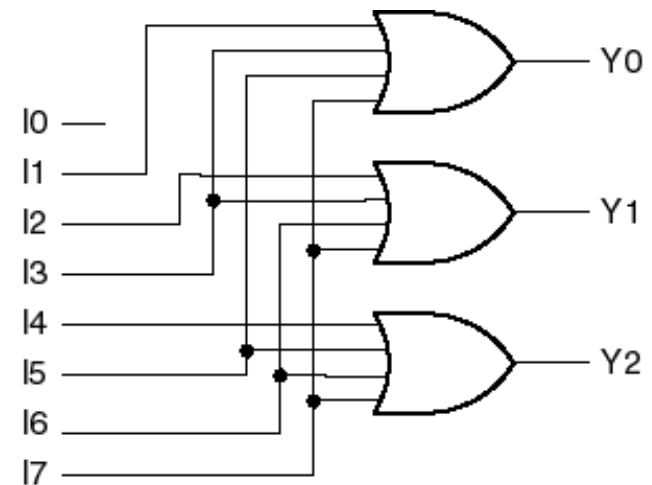
Binary Encoders



$$Y_2 = I_1 + I_3 + I_5 + I_7$$

$$Y_1 = I_2 + I_3 + I_6 + I_7$$

$$Y_0 = I_4 + I_5 + I_6 + I_7$$



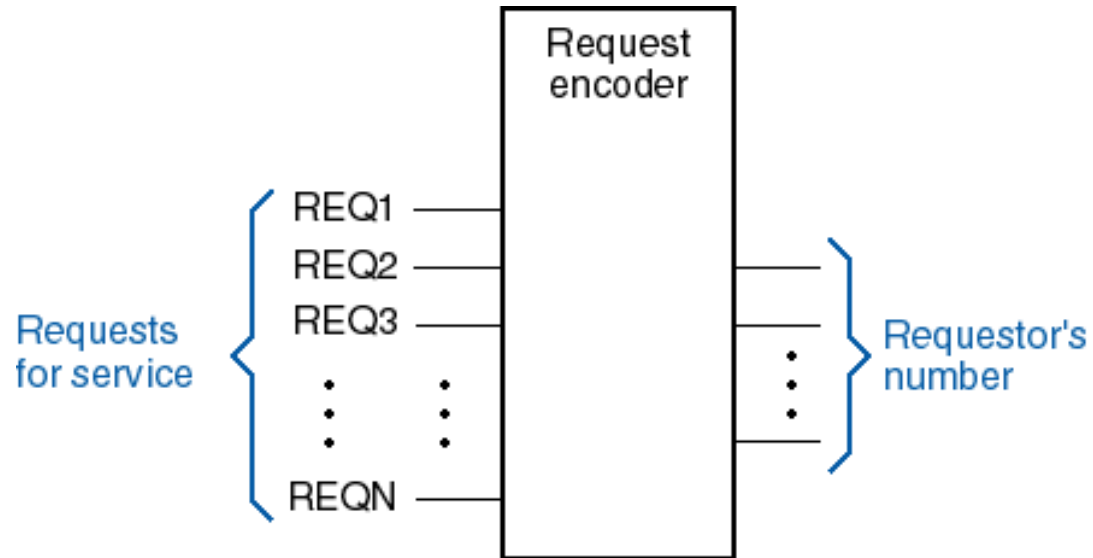
Limitations:

- Only one input can be activated
- I_0 has no effect

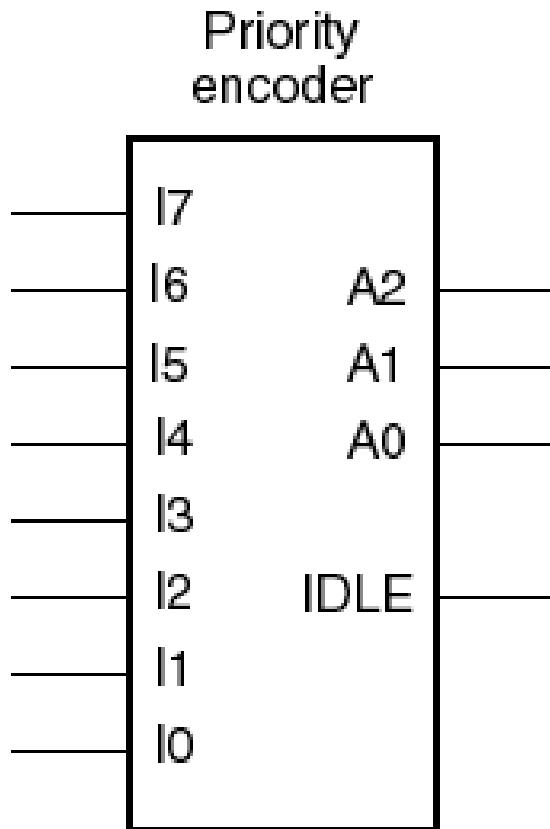
Application:

- Handling multiple devices requests. But, no simultaneous requests.
- Establishing **priorities** solve the problem of multiple requests.

Need Priority in Most Applications



8-Input Priority Encoder



1. Assign priorities to the inputs
2. When more than one input are asserted, the output generates the code of the input with the highest priority

Priority-Encoder Logic Equations

$H7 = I7$ ← (Highest Priority)

$H6 = I6 \cdot I7'$

$H5 = I5 \cdot I6' \cdot I7'$

$H4 = I4 \cdot I5' \cdot I6' \cdot I7'$

$H3 = I3 \cdot I4' \cdot I5' \cdot I6' \cdot I7'$

$H2 = I2 \cdot I3' \cdot I4' \cdot I5' \cdot I6' \cdot I7'$

$H1 = I1 \cdot I2' \cdot I3' \cdot I4' \cdot I5' \cdot I6' \cdot I7'$

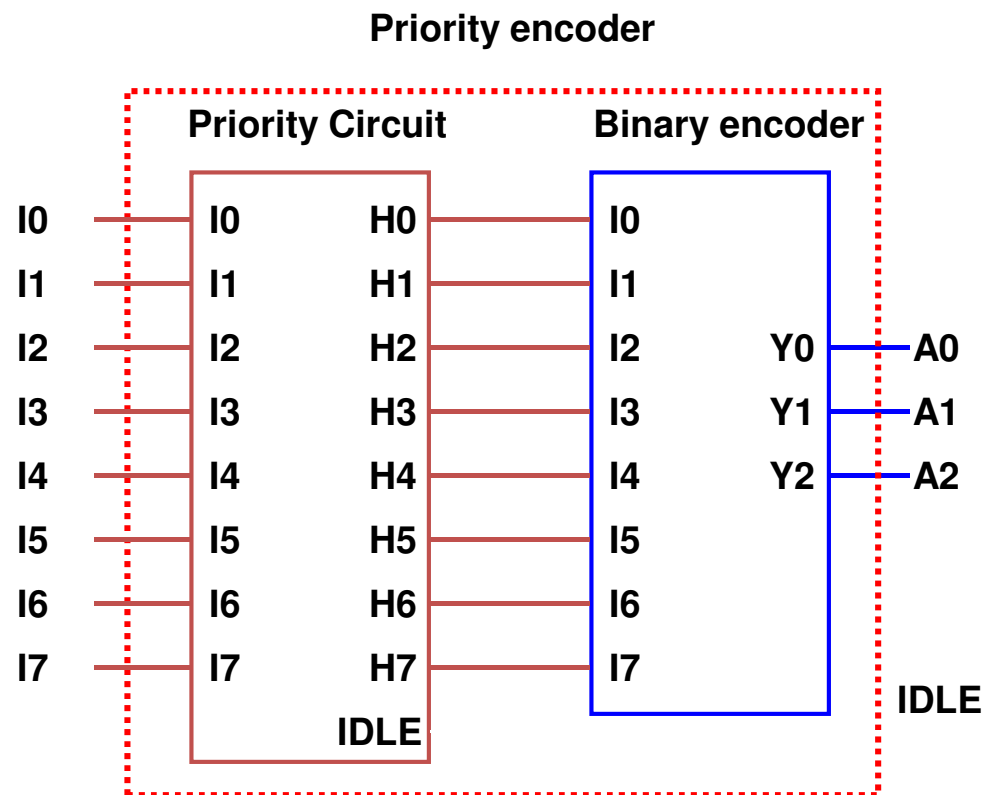
$H0 = I0 \cdot I1' \cdot I2' \cdot I3' \cdot I4' \cdot I5' \cdot I6' \cdot I7'$

$IDLE = I0' \cdot I1' \cdot I2' \cdot I3' \cdot I4' \cdot I5' \cdot I6' \cdot I7'$

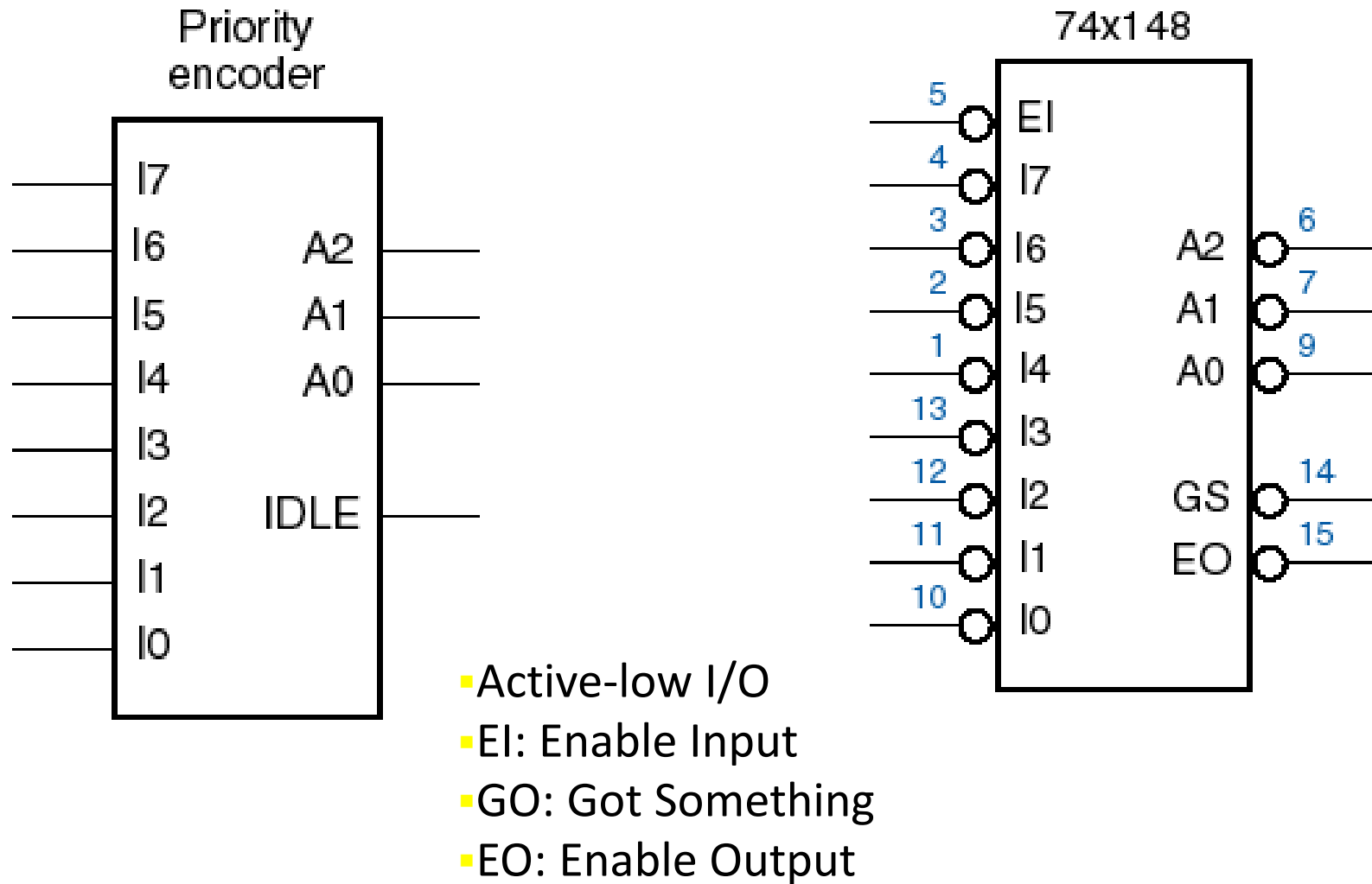
$A0 = I1 + I3 + I5 + I7$

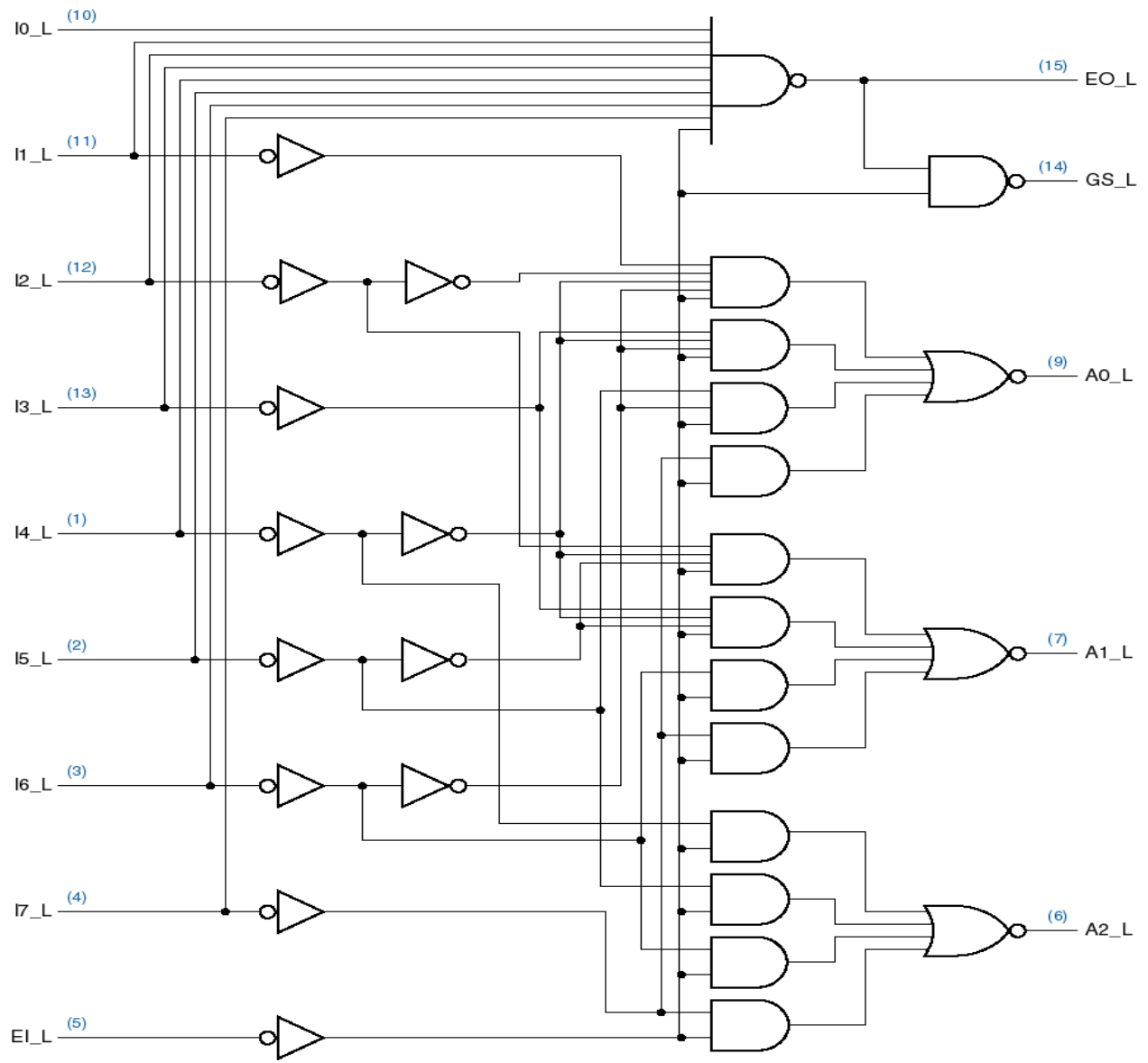
$A1 = I2 + I3 + I6 + I7$

$A2 = I4 + I5 + I6 + I7$

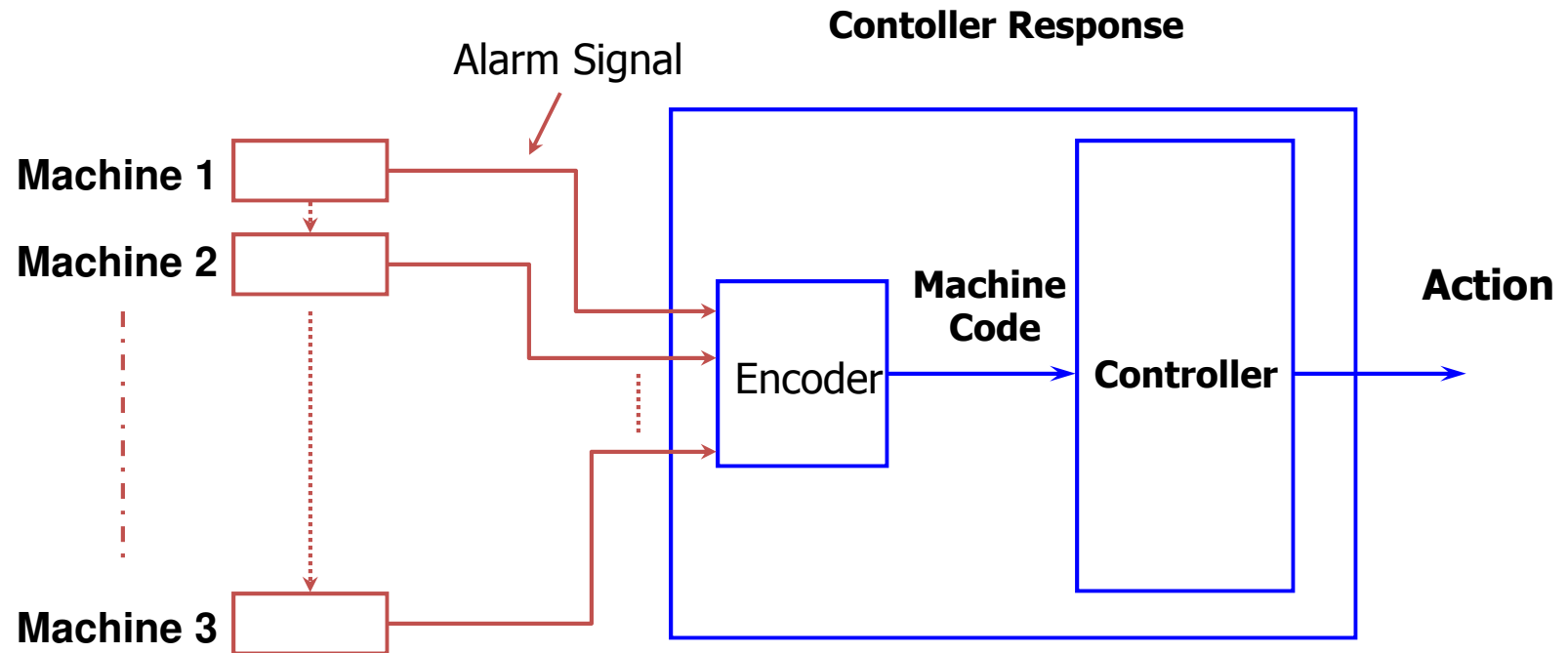


74x148 8-Input Priority Encoder

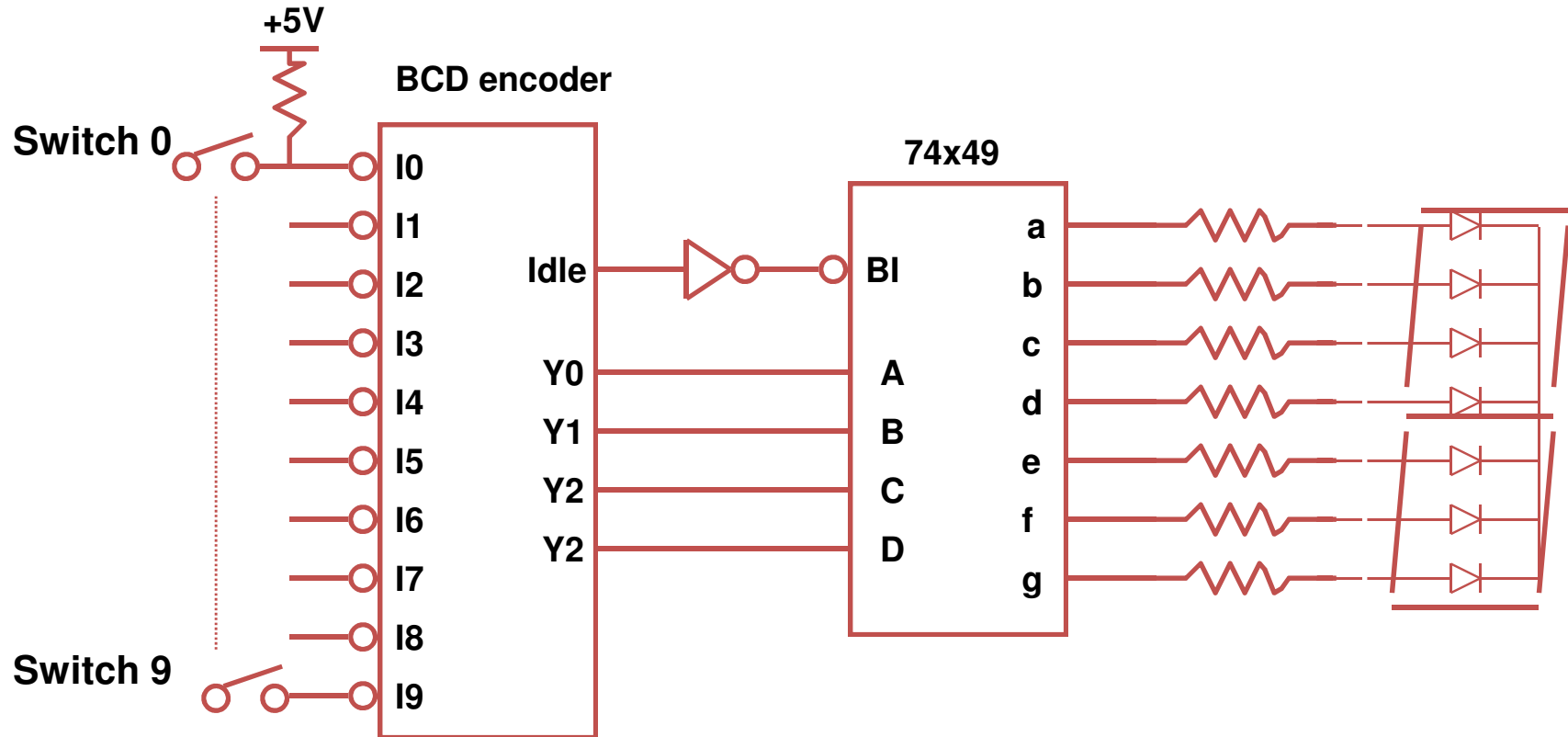




Encoder Application (Monitoring Unit)



BCD Encoder



Cascading Priority Encoders

32-input priority encoder

