"One Hot" Encoding

A representation of info. where one bit is kept high to represent one item of info.

Eg. Encode Apple, Banana, Pear, Orange (four items of info.) in a "One Hot" encoding.

four items => four bits.

b_0	b_1	b_2	b_3	
0	0	0	1	→ encodes Apple
0	0	1	0	→ encodes Banana
0	1	0	0	→ encodes Pear
1	0	0	0	→ encodes Orange

Where do we find one hot encodings?

Eg 1. Keypad entry

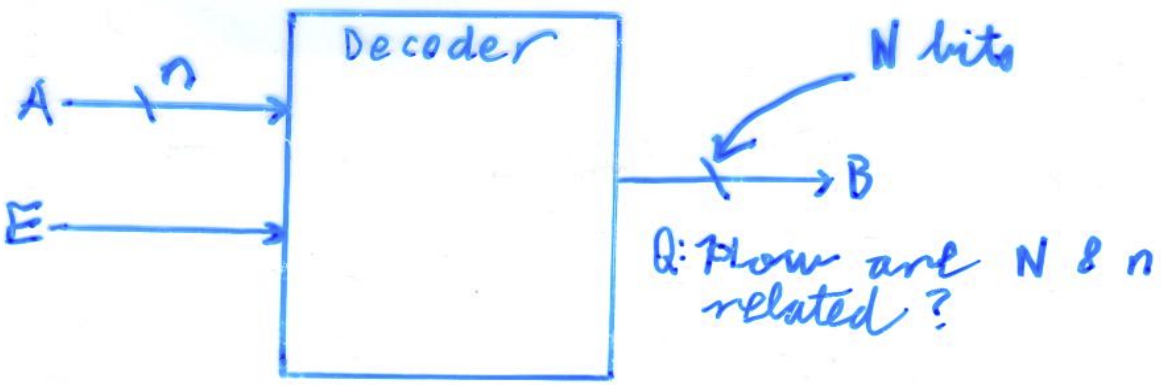
One hot encoding - as long as 1 button is pressed @ a time.

Eg. 2. Status LEDs (see Decoder eg.)

Decoder

A device which produces a one hot encoding for each possible binary encoding of an n (say) bit signal.

Model:

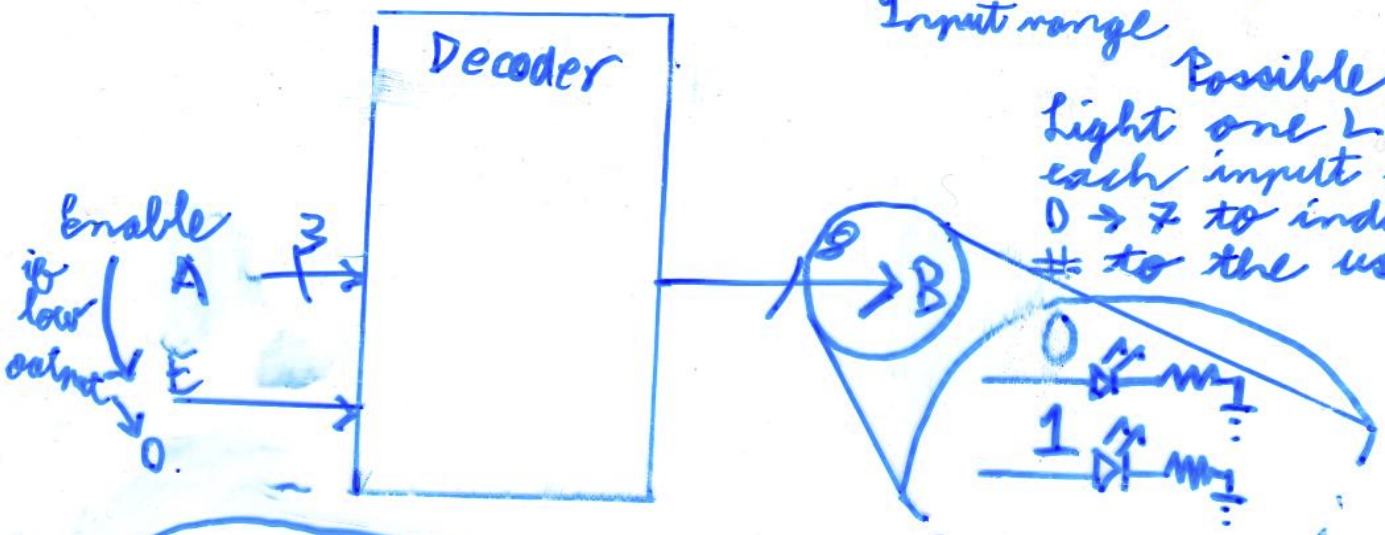


3 → 8 Bit Decoder

000 → 111

0 → 7

Input range

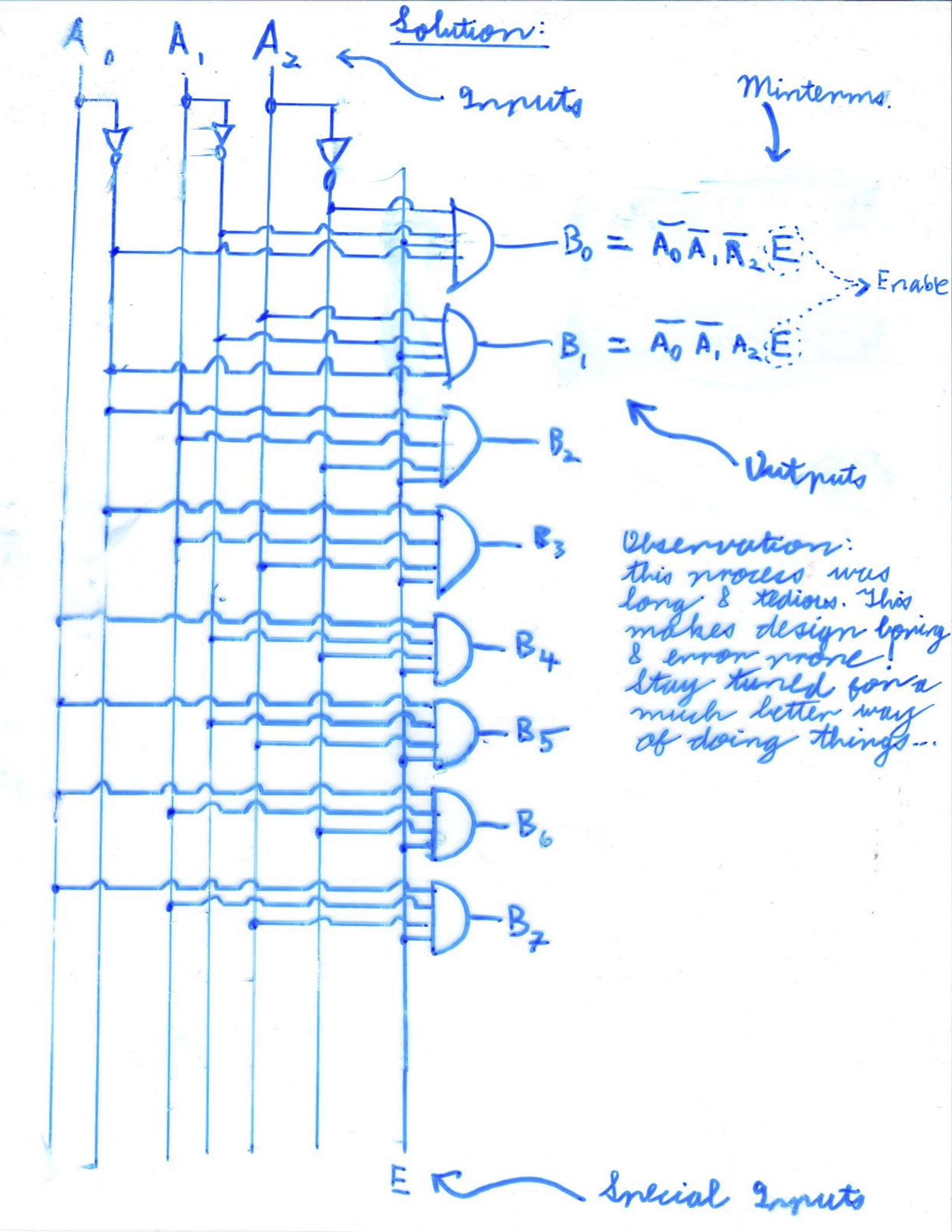


Possible Q:
Light one LED per each input from 0 → 7 to indicate that # to the user.

Decoder

A_0	A_1	A_2	B_0	B_1	B_2	B_3	B_4	B_5	B_6	B_7
0	0	0	1	0	0	0	0	0	0	0
1	0	0	0	1	0	0	0	0	0	0
0	1	0	0	0	1	0	0	0	0	0
0	1	1	0	0	0	1	0	0	0	0
1	0	0	0	0	0	0	1	0	0	0
1	0	1	0	0	0	0	0	1	0	0
1	1	0	0	0	0	0	0	0	1	0
1	1	1	0	0	0	0	0	0	0	1

Another Model


Solution:
A_0
A_1
A_2
Inputs
Minterms
$B_0 = \bar{A}_0 \bar{A}_1 \bar{A}_2 \bar{E}$
Enable
$B_1 = \bar{A}_0 \bar{A}_1 A_2 \bar{E}$
B_2
B_3
B_4
B_5
B_6
B_7
Outputs
Observation:
this process was long & tedious. This makes design boring & error prone! Stay tuned for a much better way of doing things...
E
Special Inputs

Encoder

A device which produces a binary encoding for all one hot encodings of a given number of items of info.

Q: How many bits are needed for a binary encoding of N pieces of info?

Let $f(N)$ be the number of bits needed to encode N pieces of info.

i.e. if we want to encode

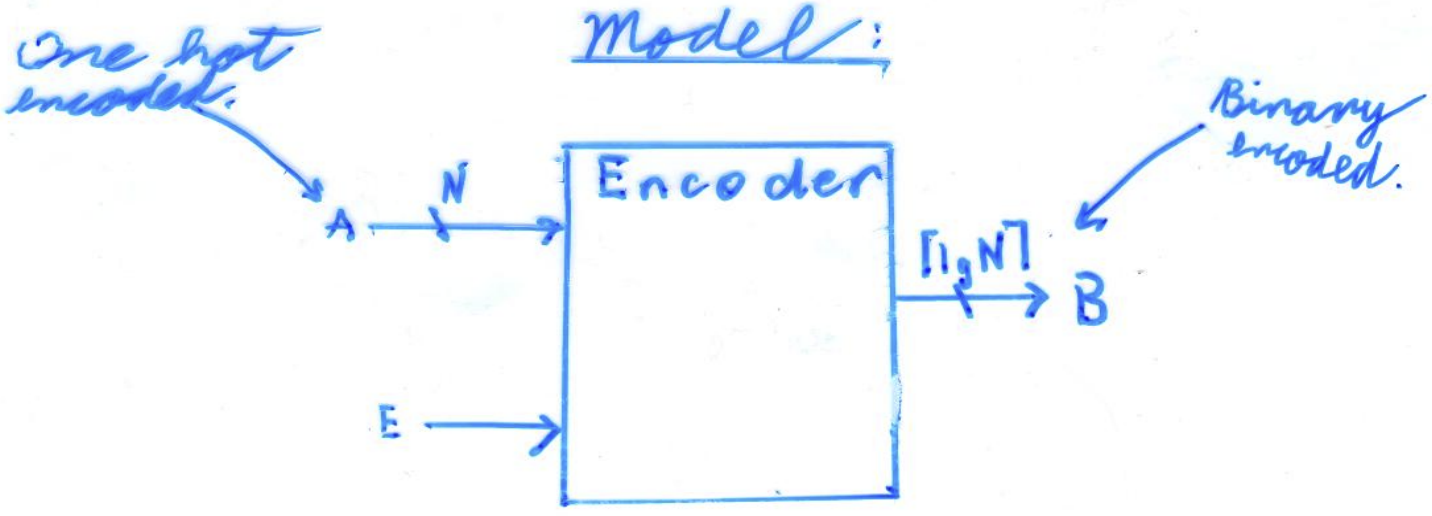
Banana, Pear, Apple... Last thing

item 0, item 1, ..., Extra things, item N-1

A: $f(N) = \lceil \lg N \rceil$ where $\lceil\ \rceil$ is ceiling, $\lg$ is $\log_2$

Y: $\lceil\ \rceil$ → can't have fractional # of bits.
$\lg$ → 2 is the base in binary ⇒ exponentiation by 2 produces weightings in binary.

Model:



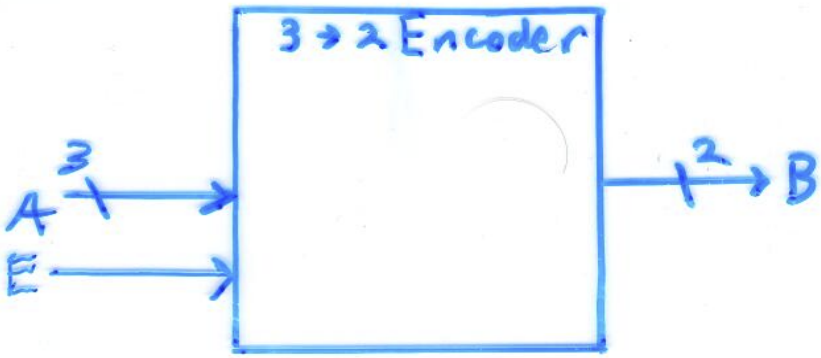
Encoder Example

3- pieces of info.

$f(N) = \lceil \lg N \rceil$

$f(3) = \lceil \lg 3 \rceil = \lceil 1.58 \rceil = 2 \Rightarrow$ 2 bits are necessary for a binary encoding of 3 things.

Model:



Truth Table

A_0	A_1	A_2	B_0	B_1
1	0	0	0	0
0	1	0	0	1
0	0	1	1	0

Assumption - What are we assuming in this truth table?