Assignment-2 (CS252) by Utkarsh Ranjan

3x8 Decoder with enabler

- The Top-Level entity ThreebyEightDecode take as input
    1. A 3-bit input signal (i)
    2. enabler signal (en)
- It converts this signal into a 8-bit output signal (z)
- Based on the 3 inputs one of the eight outputs is selected.
- The truth table for 3 to 8 decoder is shown in table (1).

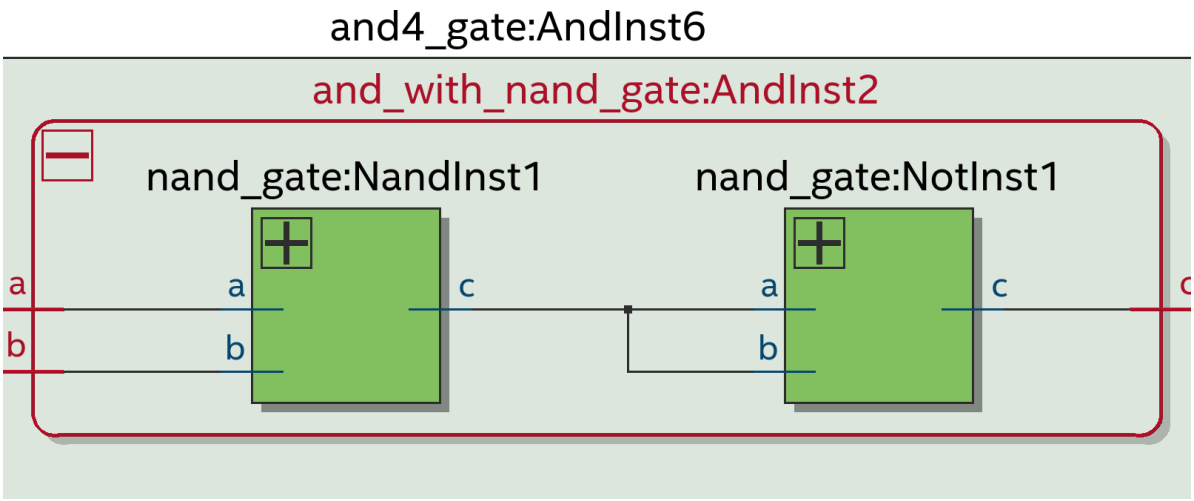
I_1	I_2	I_3	**en**	D_0	D_1	D_2	D_3	D_4	D_5	D_6	D_7
0	0	0	1	1	0	0	0	0	0	0	0
0	0	1	1	0	1	0	0	0	0	0	0
0	1	0	1	0	0	1	0	0	0	0	0
0	1	1	1	0	0	0	1	0	0	0	0
1	0	0	1	0	0	0	0	1	0	0	0
1	0	1	1	0	0	0	0	0	1	0	0
1	1	0	1	0	0	0	0	0	0	1	0
1	1	1	1	0	0	0	0	0	0	0	1
0	0	1	0	1	0	0	0	0	0	0	0
0	1	0	0	1	0	0	0	0	0	0	0
0	1	1	0	1	0	0	0	0	0	0	0
1	0	0	0	1	0	0	0	0	0	0	0
1	0	1	0	1	0	0	0	0	0	0	0
1	1	0	0	1	0	0	0	0	0	0	0
1	1	1	0	1	0	0	0	0	0	0	0

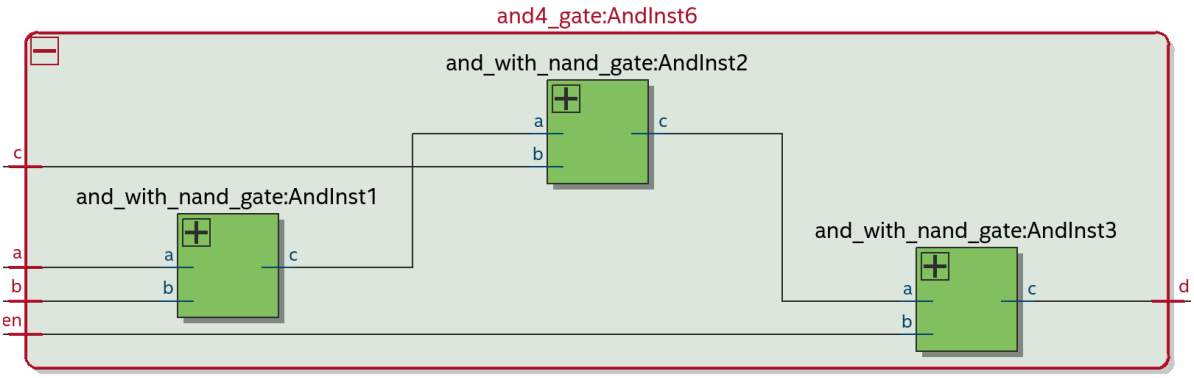
- From the truth table, it is seen that only one of eight outputs (DO to D7) is selected based on three select inputs.
- From the truth table, the logic expressions for outputs (with en == 1) can be written as follows:

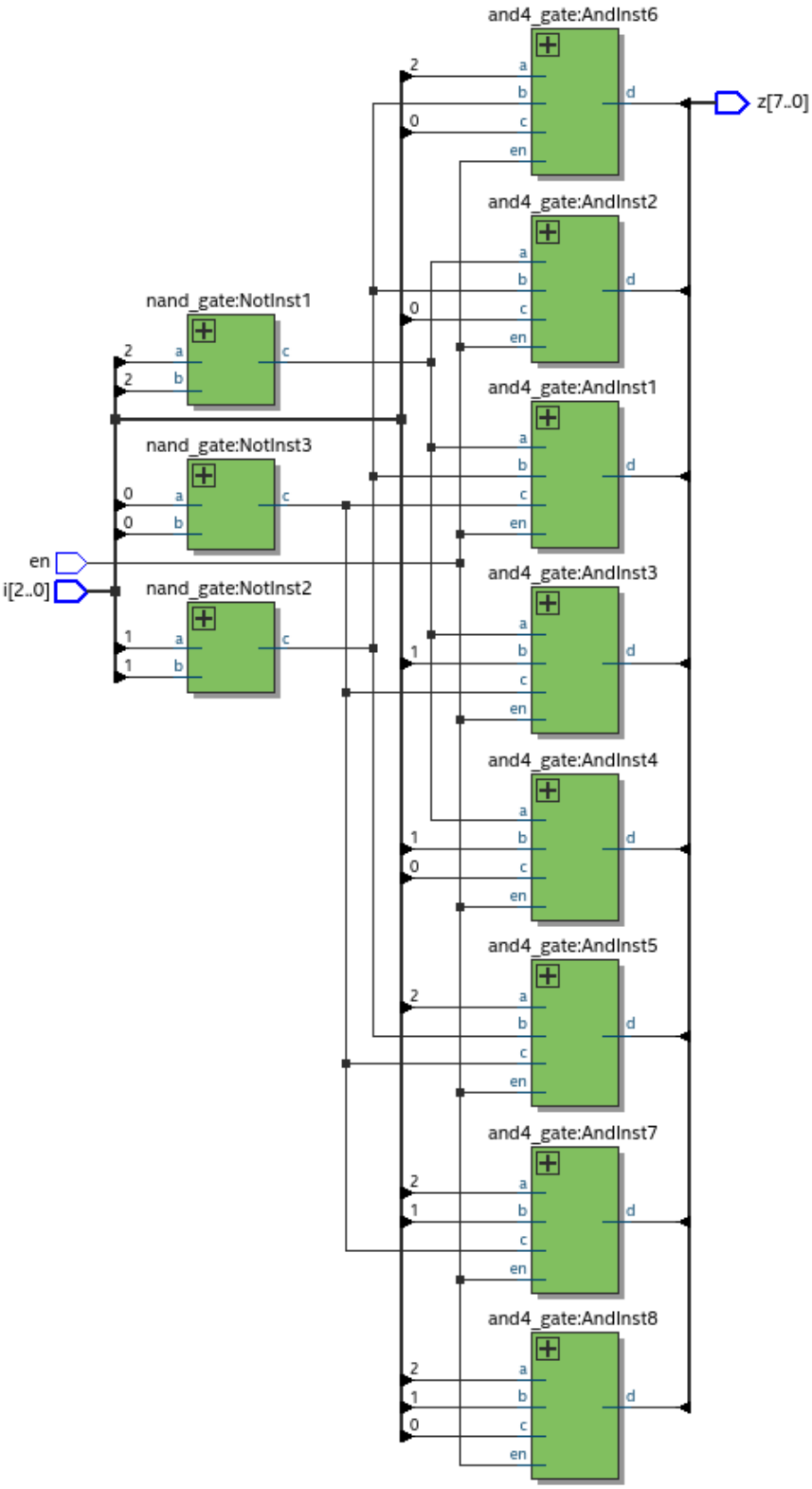
$$D_0 = \bar{A}\bar{B}\bar{C}, \quad D_1 = \bar{A}\bar{B}C, \quad D_2 = \bar{A}B\bar{C}$$
$$D_3 = \bar{A}BC, \quad D_4 = A\bar{B}\bar{C}, \quad D_5 = A\bar{B}C$$
$$D_6 = AB\bar{C}, \quad D_7 = ABC$$

Structural Description

- 3 NOT GATE:
  1. To convert the signals A, B, C to $\bar{A}$, $\bar{B}$, $\bar{C}$
  2. 1 NAND GATE used per NOT gate (achieved my making both inputs of nand gate same i.e, A)
- 3 x 8 = 24 AND GATE:
  1. To perform each of the two And operations - 2 AND GATES were used (each using 2 nand gates)
  2. To And the output thus obtained with the enabler signal - 1 AND GATE was used.
  3. Thus using 3 AND Gates for each ouput, a total of 8 output required 24 and gates.
- Total Number of NAND Gates used = 1 * NOT Gate + 2 * AND Gate = 1 * 3 + 2 * 24 = **51 NAND GATE**






and4_gate:AndInst6
and4_gate:AndInst2
and4_gate:AndInst1
and4_gate:AndInst3
and4_gate:AndInst4
and4_gate:AndInst5
and4_gate:AndInst7
and4_gate:AndInst8
nand_gate:NotInst1
nand_gate:NotInst3
nand_gate:NotInst2
z[7..0]
en
i[2..0]
a
b
c
d
en