ECE/CS 252
Intro to Computer Engineering

Week 04 Discussion

1

1

Logic Gates

AND   OR   XOR

NOT

NAND   NOR   XNOR

2
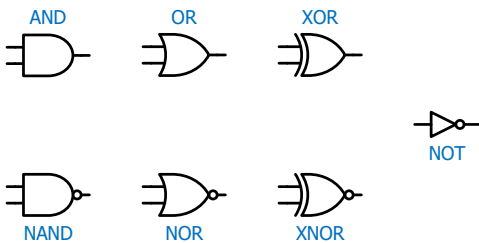
2

Build Logic Circuit From Equation

- F = ABCD

- $F = \overline{A + B\overline{C}} \cdot D$

3

3

Build Logic Circuit From Truth Table

- Can easily create a functionally correct (but perhaps inefficient) circuit by "reading" truth table
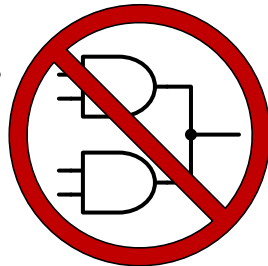 - "When does the output need to equal 1?"

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

4

4

Don't Connect Gate Outputs Together!

- Causes <u>contention</u>!
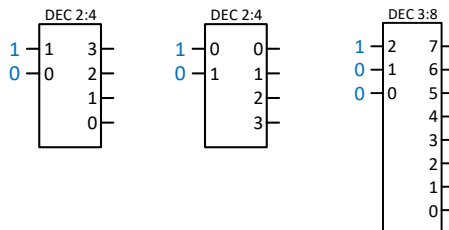- What happens if one gate outputs a 1 and the other outputs a 0?
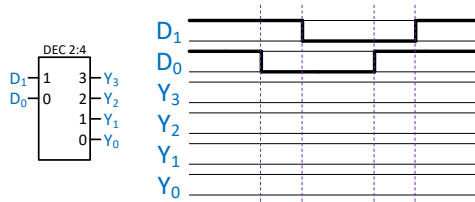
5

5

Decoders

- What are the output values?

```
   DEC 2:4          DEC 2:4            DEC 3:8
1 — 1    3 —     1 — 0    0 —      1 — 2    7 —
0 — 0    2 —     0 — 1    1 —      0 — 1    6 —
         1 —              2 —      0 — 0    5 —
         0 —              3 —              4 —
                                           3 —
                                           2 —
                                           1 —
                                           0 —
```

6

6

2

Decoder Waveform

- Complete the waveform for the decoder shown

DEC 2:4

D_1 — 1   3 — Y_3
D_0 — 0   2 — Y_2
        1 — Y_1
        0 — Y_0

D_1
D_0
Y_3
Y_2
Y_1
Y_0

7

7

Decoders

- What must the input values be?

DEC 3:8

2   7 — 0
1   6 — 1
0   5 — 0
     4 — 0
     3 — 0
     2 — 0
     1 — 0
     0 — 0

DEC 3:8

2   7 — 0
1   6 — 0
0   5 — 0
     4 — 0
     3 — 1
     2 — 0
     1 — 0
     0 — 0

8

8
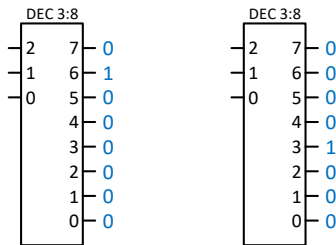
Multiplexer Operation

- Multiplexers make a choice!

MUX 2:1

D_1 — 1
D_0 — 0   Y

S

Hardware Analogy

D_1

Y

D_0

S

Software Analogy

if (S == 1)
  Y = D_1
else
  Y = D_0

9

9
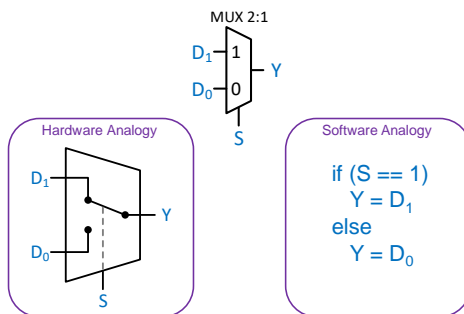
Multiplexer Waveform

- Complete the waveform for the multiplexer shown

MUX 2:1

D_1 — 1
D_0 — 0
— Y
S

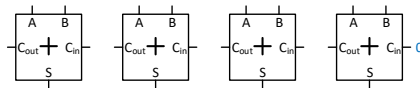D_1
D_0
S
Y

10
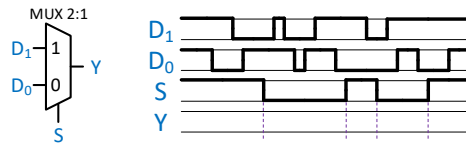
10

Adders

- A Full Adder processes **<u>one column</u>** (a single bit position) of a binary addition

- Connect the adder inputs so that it performs the computation K + M, where K=5 and M=6

A   B
C_{out} + C_{in}
S

A   B
C_{out} + C_{in}
S

A   B
C_{out} + C_{in}
S

A   B
C_{out} + C_{in} 0
S

11

11

Wrapping Up

- Up Next:
  - Sequential Circuits
  - Flip-Flops
  - Finite State Machines
  - Registers
  - Memory

- **Remember the homework!**
- **Remember your videos and reading**
  - **Including the video quiz!**

- Questions?

12

12