CS200 - Computer Organization

Logic Design

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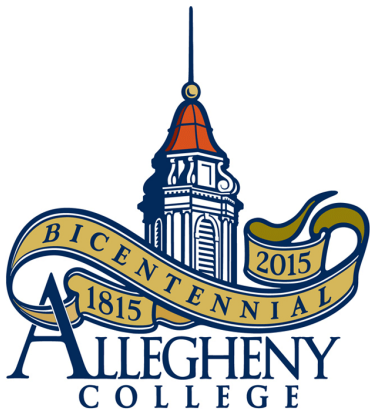
August 21, 2020



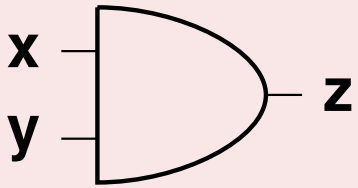
Basic Terminologies

- Transistor: A device that can be used to design gates.
- Gate: A device that is used to do a basic operation on bit(s).
- Circuits: A combination of one or more gates designed to pdo a more complicated task.
- Integrated circuit: (also called a chip) A piece of silicon on which many gates have been embedded using chip fabrication.

Fundamental Gates

- Digital logic has the following fundamental gates:
  - AND
  - OR
  - NOT
  - NAND
  - NOR
  - XOR

AND Gate

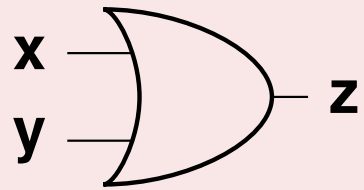


$$z = x \wedge y$$

Table 1: Truth table for AND Gate

x	y	z
0	0	0
0	1	0
1	0	0
1	1	1

OR Gate

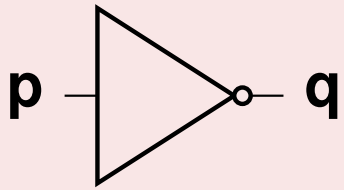


$$z = x \vee y$$

Table 2: Truth table for OR Gate

x	y	z
0	0	0
0	1	1
1	0	1
1	1	1

NOT Gate



$$q = \neg p$$

Table 3: Truth table for NOT Gate

p	q
0	1
1	0

Practice Exercises

- Exercise: Develop a circuit for the following expressions:
  1. $z = (a \wedge \neg b) \vee (p \wedge \neg q)$
  2. $z = (\neg a \vee b) \wedge (\neg p \vee q)$

Use Case

- If it is raining and (assuming you have both an umbrella and a raincoat) then ”get ready to leave”
- If it is raining and (assuming you have either an umbrella or a raincoat but not both) then ”avoid getting wet”
- If it is raining and (assuming you don’t have neither an umbrella nor a raincoat but not both) then ”avoid getting wet”
- If it is not raining then ”go out and have fun”

Use Case

```
if (first && (second && third)){
  printf("get ready to leave\n");
}
else if (first && (second||third)){
  printf("avoid getting wet!\n");
}
else if (first && !(second||third)){
  printf("stay home\n");
}
else if (!first){
  printf("no rain, have fun!\n");
}
```

Full gates.c code is in the GitHub repo.

Practice Exercise

Convert gates.c program into a digital circuit.

Next class

- More discussion on NAND, NOR, and XOR gates...

Reading Assignment

- Principles of Computer Hardware by **Alan Clements**: Chapter 02 - 2.1 to 2.3;

Questions

Do you have any questions from this class discussion?