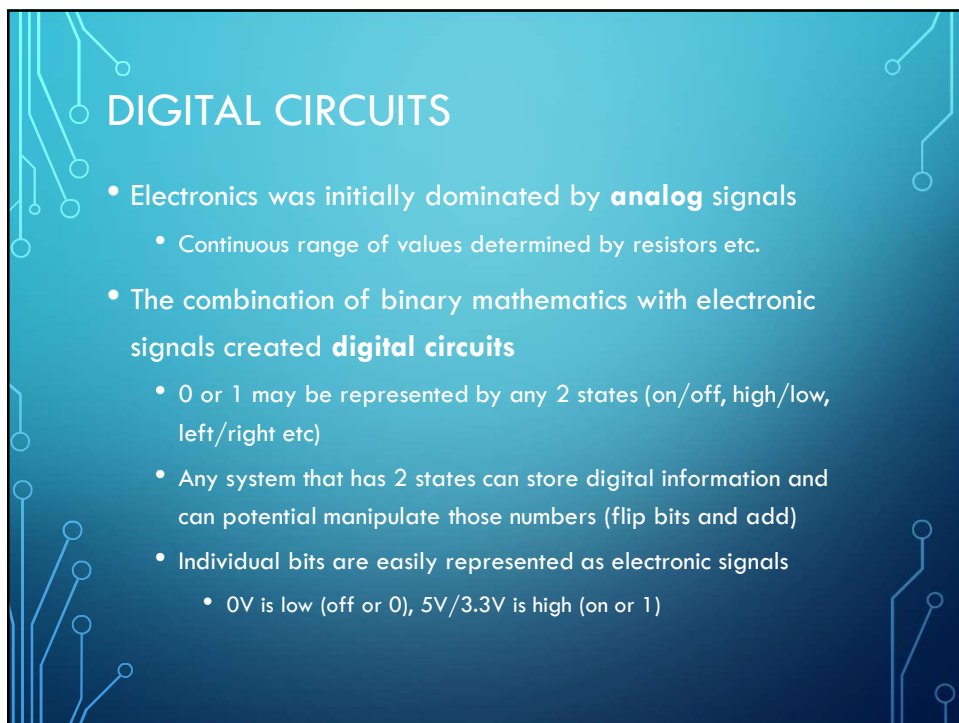


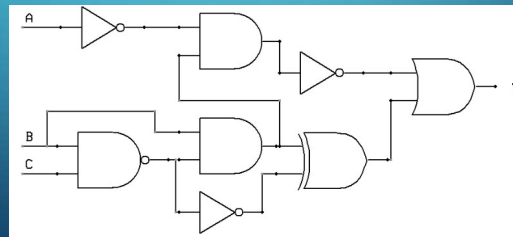
1



2

LOGIC GATES

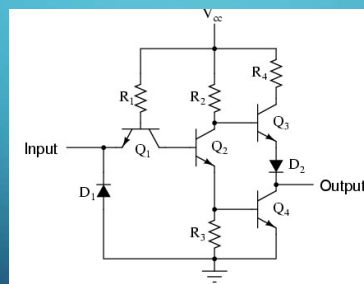
- In order to manipulate binary bits, we will create special circuits that work with logic level voltages (0v, 5v)
- These gates are not displayed as transistors or resistors
 - Simplified to represent the logic only
- Behavior of the gates is summarized by **truth tables**



3

THE NOT GATE (INVERTER)

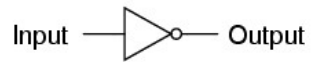
- To flip bits, we need to be able to change a 1 to 0 or a 0 to 1
- A fairly complex circuit is required to do this:



4

THE NOT GATE (INVERTER)

- Instead, the entire circuit is represented as a single gate
- The symbol for a NOT gate



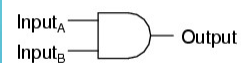
- The truth table is as shown

| Input | Output |
|-------|--------|
| 0 | 1 |
| 1 | 0 |

5

THE AND GATE

- To start the process of combining signals, we need multiple inputs
- The symbol for an AND gate



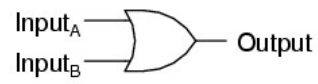
- The truth table is as shown

| A | B | Output |
|---|---|--------|
| 0 | 0 | 0 |
| 0 | 1 | 0 |
| 1 | 0 | 0 |
| 1 | 1 | 1 |

6

THE OR GATE

- The symbol for an OR gate



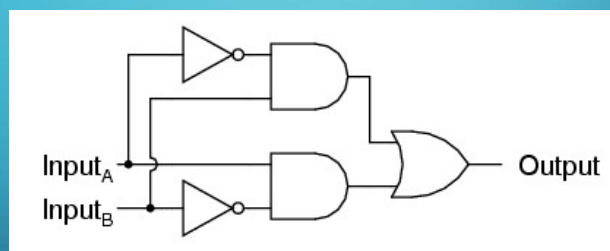
- The truth table is as shown

| A | B | Output |
|---|---|--------|
| 0 | 0 | 0 |
| 0 | 1 | 1 |
| 1 | 0 | 1 |
| 1 | 1 | 1 |

7

COMBINING GATES

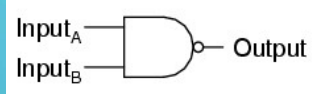
- Create a truth table for the following:



8

THE NAND GATE

- The symbol for a NAND gate



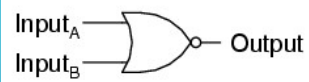
- The truth table is as shown

| A | B | Output |
|---|---|--------|
| 0 | 0 | 1 |
| 0 | 1 | 1 |
| 1 | 0 | 1 |
| 1 | 1 | 0 |

9

THE NOR GATE

- The symbol for a NOR gate



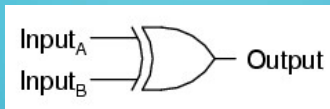
- The truth table is as shown

| A | B | Output |
|---|---|--------|
| 0 | 0 | 1 |
| 0 | 1 | 0 |
| 1 | 0 | 0 |
| 1 | 1 | 0 |

10

THE XOR (EXCLUSIVE OR) GATE

- The symbol for a XOR gate



- The truth table is as shown

| A | B | Output |
|---|---|--------|
| 0 | 0 | 0 |
| 0 | 1 | 1 |
| 1 | 0 | 1 |
| 1 | 1 | 0 |

11

CIRCUIT EQUIVALENCY

- Consider the following:



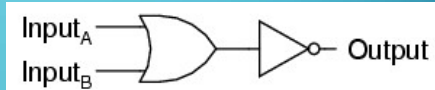
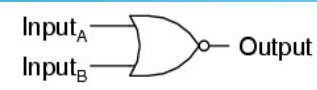
- They both have the same truth table, so are EQUIVALENT

| A | B | Output |
|---|---|--------|
| 0 | 0 | 1 |
| 0 | 1 | 1 |
| 1 | 0 | 1 |
| 1 | 1 | 0 |

12

CONSIDER

- Consider the following:

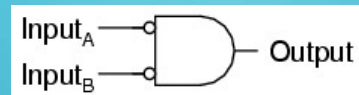


- Are they equivalent?

13

THE NEGATIVE-AND GATE

- The symbol for a Negative-AND gate



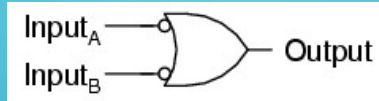
- The truth table is:

| A | B | Output |
|---|---|--------|
| 0 | 0 | 1 |
| 0 | 1 | 0 |
| 1 | 0 | 0 |
| 1 | 1 | 0 |

14

THE NEGATIVE-OR GATE

- The symbol for a Negative-OR gate

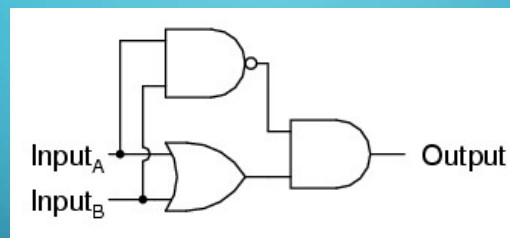


- The truth table is:

| A | B | Output |
|---|---|--------|
| 0 | 0 | 1 |
| 0 | 1 | 1 |
| 1 | 0 | 1 |
| 1 | 1 | 0 |

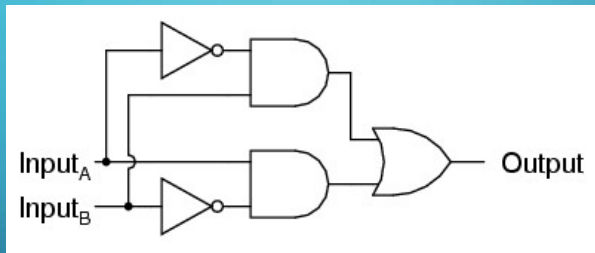
15

WHAT IS THIS EQUIVALENT TO?

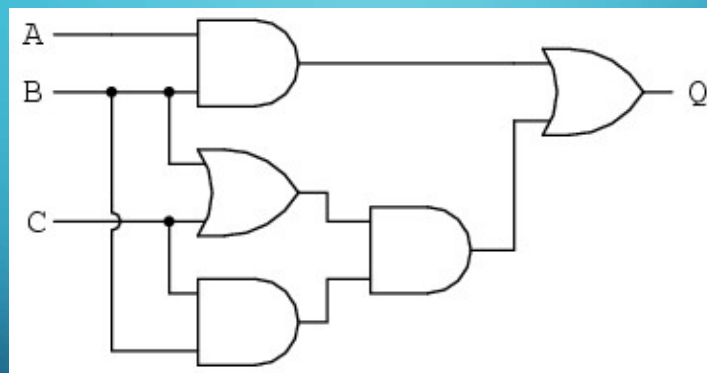


16

WHAT IS THIS EQUIVALENT TO?



17



18