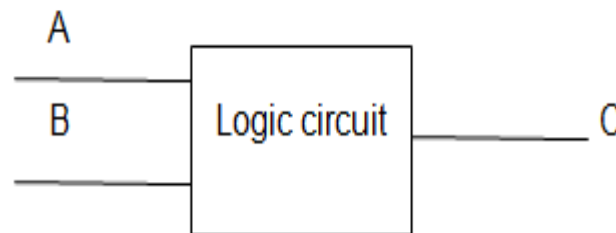


# Digital Logic

# Digital Logic

- A logic circuit makes decisions – it receives two or more inputs and determines the output from the inputs
- This process is performed using digital logic, which is based on digital switches called gates
- A single binary digit, 1 or 0, can be used to represent true/on/high (1) or false/off/low (0)
- Let's look at the example below:



# Logic Gates

- A logic gate is an electronic circuit in a device that enables a digital system to make a decision based the inputs
- There are usually two inputs to the circuit and one output
- Two digital signals are input
- The gate compares the signals
- The gate makes a decision
- A new signal is output based on the decision
- Input to and output from a gate must be one of two states:
  - 1 – also referred to as on or high
  - 0 - also referred to as off or low

# Types of Logic Gates

- Logic gates include:
  - AND
  - OR
  - NOT
  - NAND
  - NOR
- Before we look at each type, let's take a look at truth tables

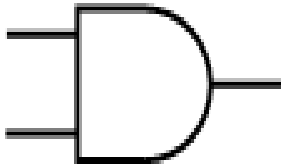
# Truth Tables

- A truth table shows the logic rules of a logic gate
- It lists all combinations of input and the resulting output
- A and B represents two truth values: TRUE (1) or FALSE (0)
- The output C is TRUE only when both A is TRUE and B is TRUE
- The following truth table shows all the possible combinations of inputs A and B and the output C
- We will see that each type of logic gate has a corresponding truth table

<b>A</b>	<b>B</b>	<b>C</b>
False	False	False
False	True	False
True	False	False
True	True	True

# AND Gate

- An AND gate will give a high output only if all of the inputs are high
- The standard symbol for an AND gate is shown below:



- The corresponding truth table is:
  - A + B are input and the output is C
  - Output is always 0 except when two inputs are 1

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

# OR Gate

- An OR gate will give a high output if either of the inputs is high
- The standard symbol for an OR gate is shown below:

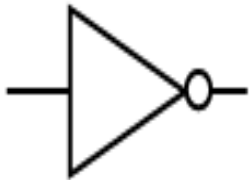


- The corresponding truth table is:
  - A + B are input and the output is C
  - Output is always 1 except when two inputs are 0

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

# NOT Gate

- A NOT gate has only one input. It will give a high output if the input is low
- The standard symbol for a NOT gate is shown below:

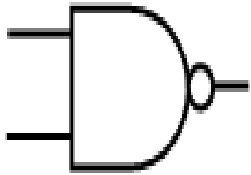


- The corresponding truth table is:

A	C
0	1
1	0

# NAND Gate

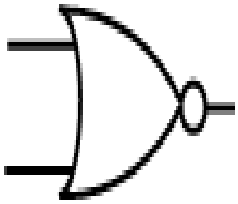
- This is a NOT-AND gate which is equal to an AND gate followed by a NOT gate
- The output of a NAND gate is high if the inputs are low
- The standard symbol for an NAND gate is shown below:



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

# NOR Gate

- Is a NOT-OR gate which is equal to an OR gate followed by a NOT gate
- The output of a NOR gate is high if the inputs are low
- The standard symbol for a NOR gate is shown below:



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

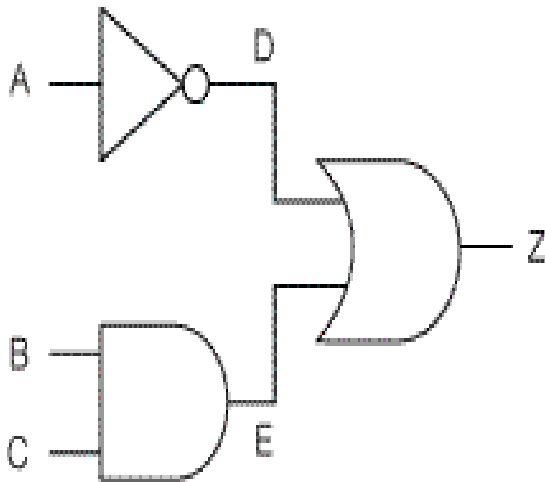
# Summary of Logic Gates

- The truth table below compares the logical functions of the two-input logic gates that we have discussed:

A	B	AND	OR	NAND	NOR
0	0	0	0	1	1
0	1	0	1	1	0
1	0	0	1	1	0
1	1	1	1	0	0

# Complex Logic Gates

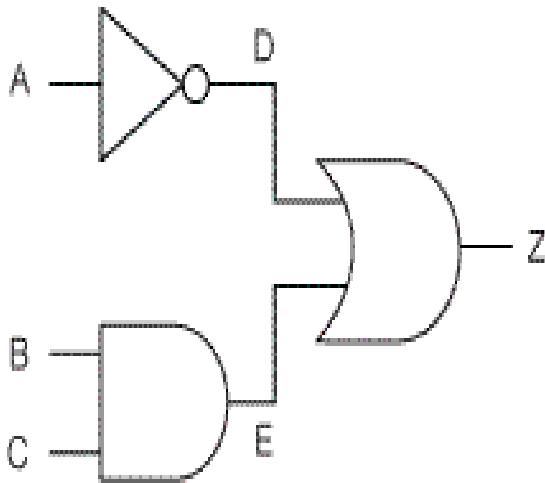
- A combination of different logic gates can be used to produce a complex logic system in a device such as a burglar alarm
- There are three inputs and eight possible outputs:



A	B	C	D	E	Z
0	0	0			
0	0	1			
0	1	0			
0	1	1			
1	0	0			
1	0	1			
1	1	0			
1	1	1			

# Complex Logic Gates

- A combination of different logic gates can be used to produce a complex logic system in a device such as a burglar alarm
- There are three inputs and eight possible outputs:



A	B	C	D	E	Z
0	0	0	1	0	1
0	0	1	1	0	1
0	1	0	1	0	1
0	1	1	1	1	1
1	0	0	0	0	0
1	0	1	0	0	0
1	1	0	0	0	0
1	1	1	0	1	1