

Combinational Logic I

Learning Objectives

1. Generate a POS or SOP Boolean expression from a truth table.
2. Build a logic circuit from a Boolean expression.
3. Create a truth table from a Boolean expression or logic circuit.
4. Build a multiplexor out of primitive logic gates.

Electronics Basics

Short

Draw a closed switch:

_____ at any point on a _____ is the same

Example

Draw a simple switched circuit

Transistors are _____ controlled _____.

Draw the circuit using a transistor

Draw the simplified circuit

There are many types of transistors:

triode tube, BJT: _____, FET: _____

triode tube	BJT	FET
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MOSFET Transistor

M _____ O _____ S _____ F _____ E _____ T _____

3 terminals: _____

Gate voltages are either _____ or _____.

Draw a PMOS Closes when gate = _____	Draw an NMOS Closes when gate = _____
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TRANSISTOR CIRCUIT	SWITCH REPRESENTATION
IN = 0 OUT = ?	
IN = 1 OUT = ?	

This circuit is a _____

Truth Table

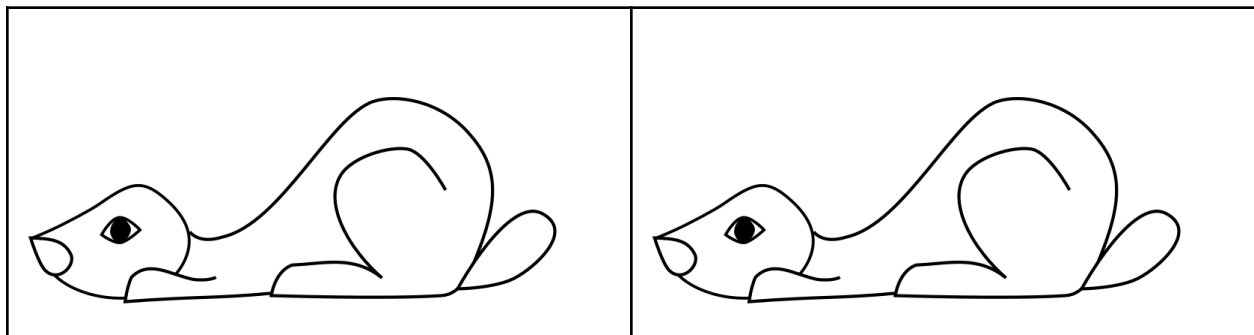
<p>A truth table represents the _____</p> <p>of a logic circuit.</p> <p># of inputs: _____</p> <p># of outputs: _____</p> <p># of columns: _____</p> <p># of rows: _____</p>	<p>Draw the truth table for an inverter</p>
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“Not” A can be written as: _____

Logic Operations

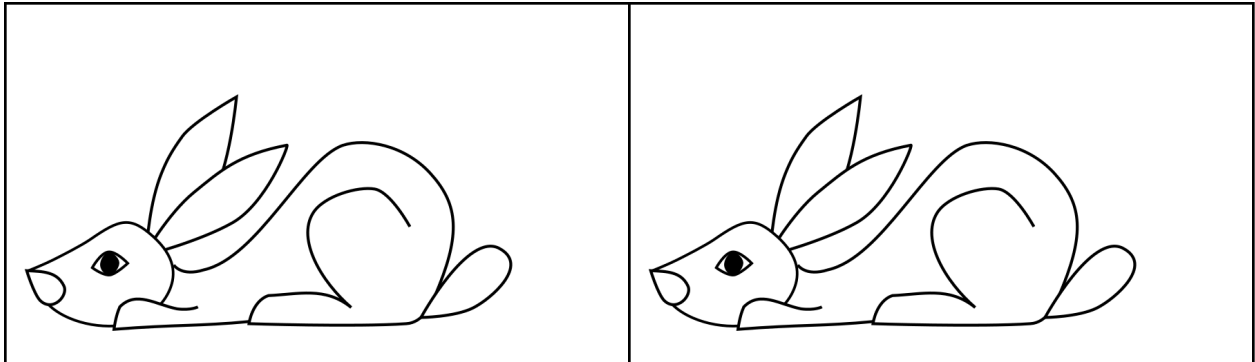
Rabbit Analogy

Say “P” is any statement. E.g. P = “The rabbit has floppy ears”



This sentence is either _____ or _____

Say "Q" is another statement. Q = "The rabbit has patched fur"



Now form the compound sentences:

P and Q

The rabbit has _____





The rabbit has _____


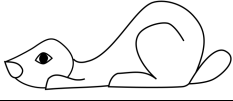


P or Q

The rabbit has _____

The rabbit has _____

Truth Tables

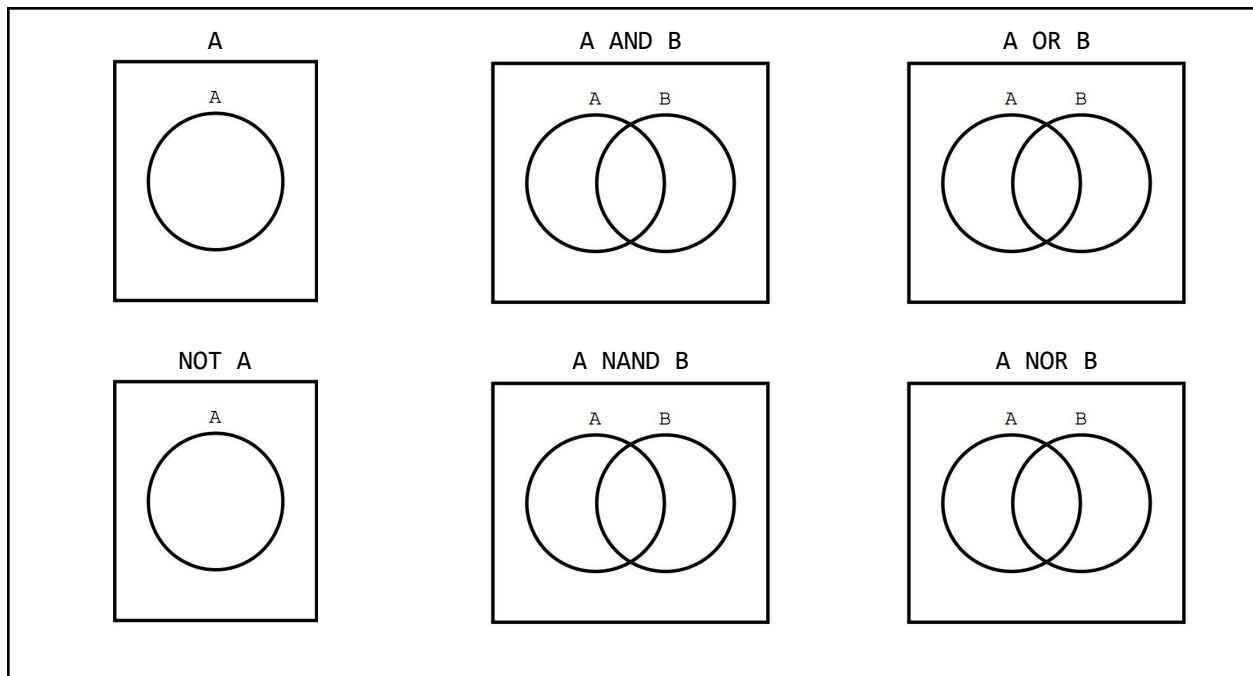
	Has floppy ears? (P)	Has patched fur? (Q)	Has floppy ears AND patched fur? (P AND Q)
			
			
			
			

	Has floppy ears? (P)	Has patched fur? (Q)	Has floppy ears OR patched fur? (P OR Q)
			
			
			
			

The rabbit analogy was adapted from a lesson in the Cartoon Guide for Computer Science, 1st Ed. © 1983 p 102-104

Venn Diagrams

Shade the appropriate areas on the Venn diagrams



Logic Gates

BUFFER

Draw the schematic here:	Complete the truth table: <table border="1" style="width: 100%; border-collapse: collapse; margin-top: 10px;"> <tr> <th style="width: 50%;">A</th> <th style="width: 50%;">Out = A</th> </tr> <tr> <td>0</td> <td>0</td> </tr> <tr> <td>1</td> <td>1</td> </tr> </table>	A	Out = A	0	0	1	1
A	Out = A						
0	0						
1	1						

NOT (Inverter)

Draw the schematic here:	Complete the truth table: <table border="1" style="width: 100%; border-collapse: collapse; margin-top: 10px;"> <tr> <th style="width: 50%;">A</th> <th style="width: 50%;">Out = A'</th> </tr> <tr> <td> </td> <td> </td> </tr> <tr> <td> </td> <td> </td> </tr> </table>	A	Out = A'				
A	Out = A'						
(the _____ indicates inversion)							

AND

Draw the schematic here:	Complete the truth table: <table border="1" style="width: 100%; border-collapse: collapse; margin-top: 10px;"> <tr> <th style="width: 33%;">A</th> <th style="width: 33%;">B</th> <th style="width: 33%;">Out =</th> </tr> <tr> <td>0</td> <td>0</td> <td> </td> </tr> <tr> <td>0</td> <td>1</td> <td> </td> </tr> <tr> <td>1</td> <td>0</td> <td> </td> </tr> <tr> <td>1</td> <td>1</td> <td> </td> </tr> </table>	A	B	Out =	0	0		0	1		1	0		1	1	
A	B	Out =														
0	0															
0	1															
1	0															
1	1															

NAND

Draw the schematic here:	Complete the truth table: <table border="1" style="width: 100%; border-collapse: collapse; margin-top: 10px;"> <tr> <th style="width: 33%;">A</th> <th style="width: 33%;">B</th> <th style="width: 33%;">Out =</th> </tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> </table>	A	B	Out =												
A	B	Out =														

OR

Draw the schematic here:	Complete the truth table:		
	A	B	Out =

NOR

Draw the schematic here:	Complete the truth table:		
	A	B	Out =

XOR

Draw the schematic here:	Complete the truth table:		
	A	B	Out =

XNOR

Draw the schematic here:	Complete the truth table:		
	A	B	Out =