Classic Logic Gates

TAMU Cyclotron REU

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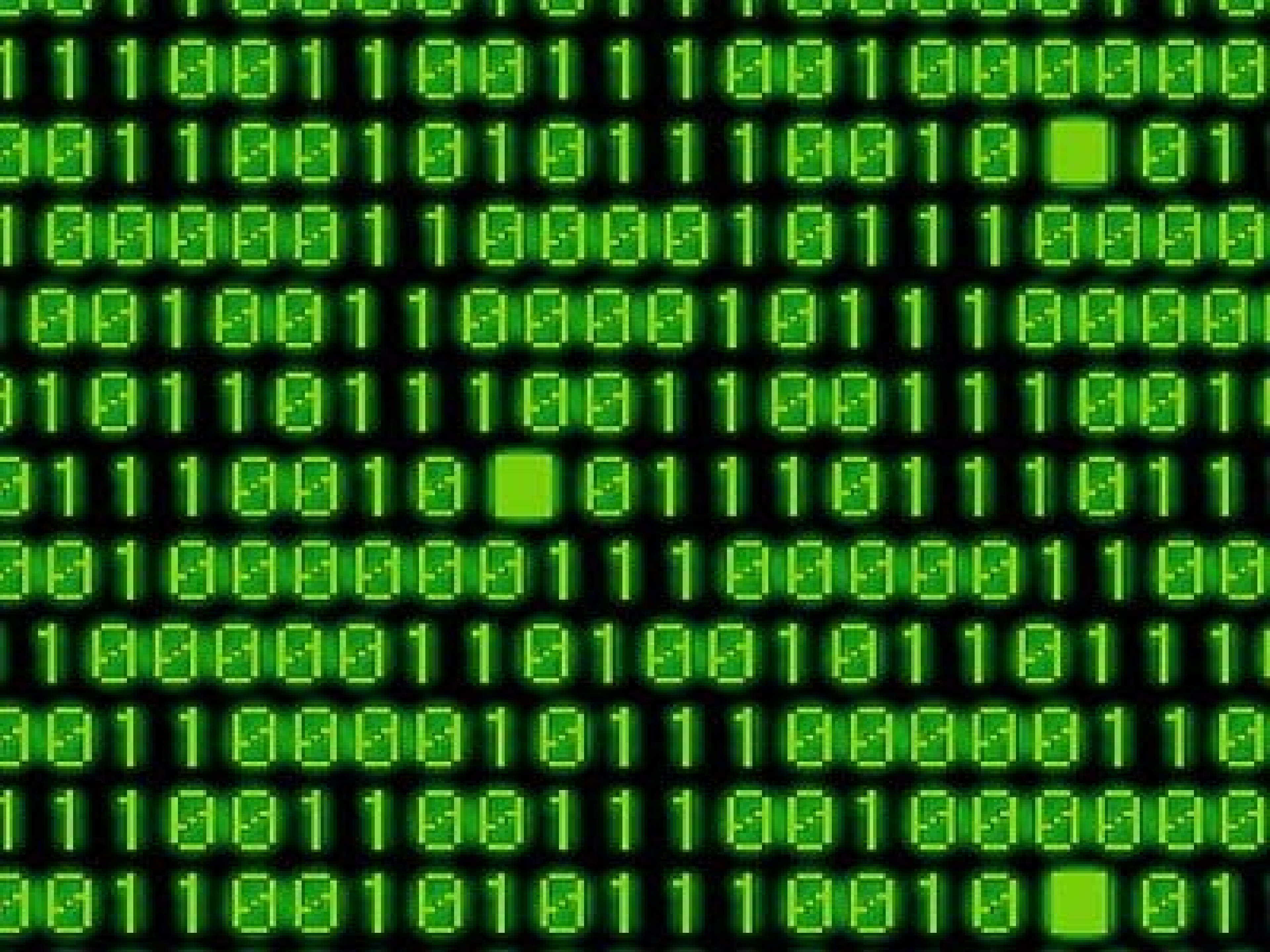
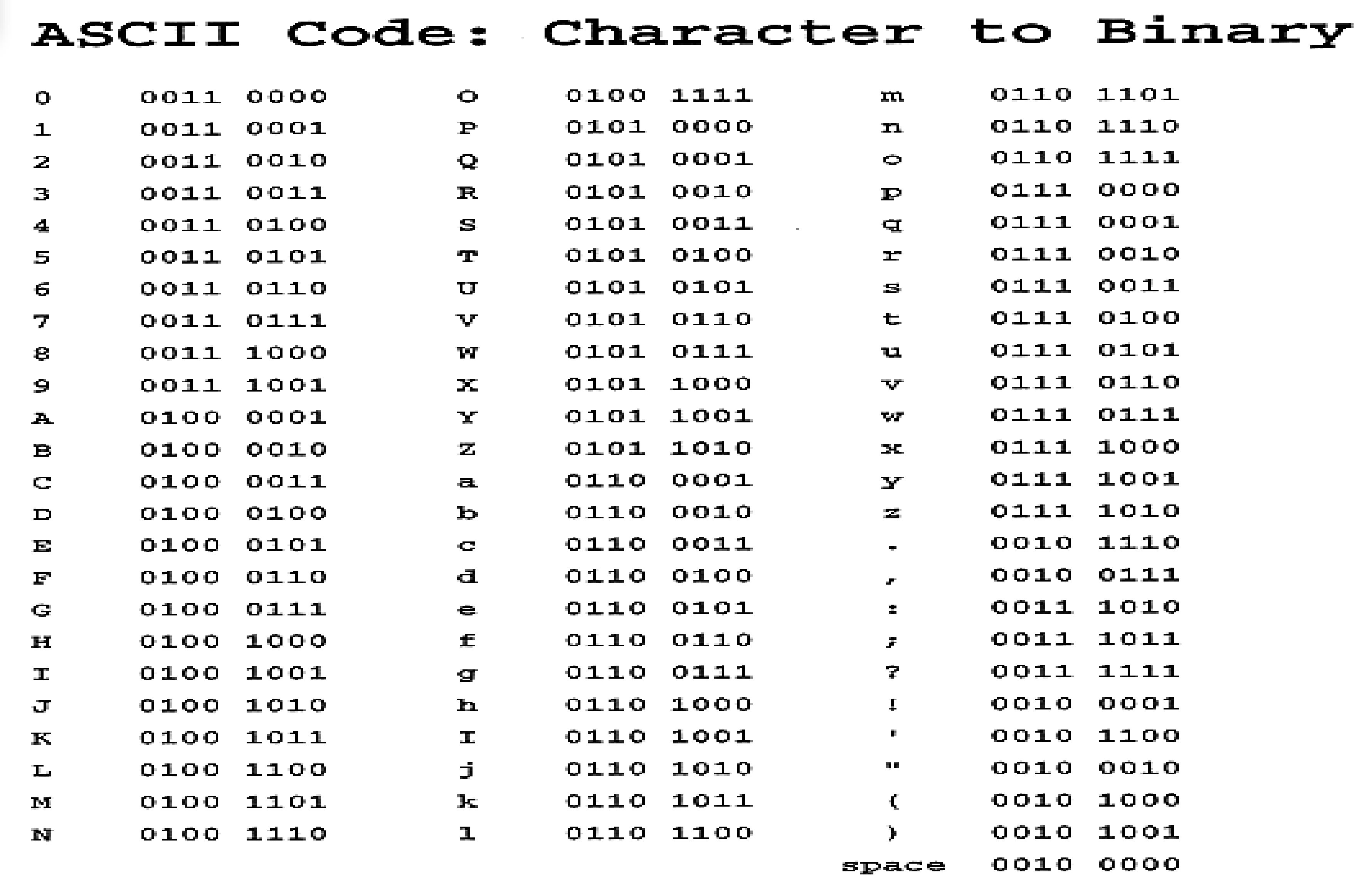


Binary Code

- Binary Code is used in the computer world to represent number and computer processor instructions.
- The Binary system consists of 2 digits or bits: “1” and “0”
- A Binary string of 8 bits {ex. 0000 0000, 0000 0001} can represent 256 possible values corresponding to symbols, letters, and instructions.
- When dealing with logic gates, the “1” and “0”, can represent true or false, logic high or logic low respectively.

ASCII Table



ASCII Code: Character to Binary

0	0011 0000	O	0100 1111	m	0110 1101
1	0011 0001	P	0101 0000	n	0110 1110
2	0011 0010	Q	0101 0001	o	0110 1111
3	0011 0011	R	0101 0010	p	0111 0000
4	0011 0100	S	0101 0011	q	0111 0001
5	0011 0101	T	0101 0100	r	0111 0010
6	0011 0110	U	0101 0101	s	0111 0011
7	0011 0111	V	0101 0110	t	0111 0100
8	0011 1000	W	0101 0111	u	0111 0101
9	0011 1001	X	0101 1000	v	0111 0110
A	0100 0001	Y	0101 1001	w	0111 0111
B	0100 0010	Z	0101 1010	x	0111 1000
C	0100 0011	a	0110 0001	y	0111 1001
D	0100 0100	b	0110 0010	z	0111 1010
E	0100 0101	c	0110 0011	.	0010 1110
F	0100 0110	d	0110 0100	,	0010 0111
G	0100 0111	e	0110 0101	:	0011 1010
H	0100 1000	f	0110 0110	;	0011 1011
I	0100 1001	g	0110 0111	?	0011 1111
J	0100 1010	h	0110 1000	!	0010 0001
K	0100 1011	I	0110 1001	'	0010 1100
L	0100 1100	j	0110 1010	"	0010 0010
M	0100 1101	k	0110 1011	(	0010 1000
N	0100 1110	1	0110 1100	)	0010 1001
				space	0010 0000

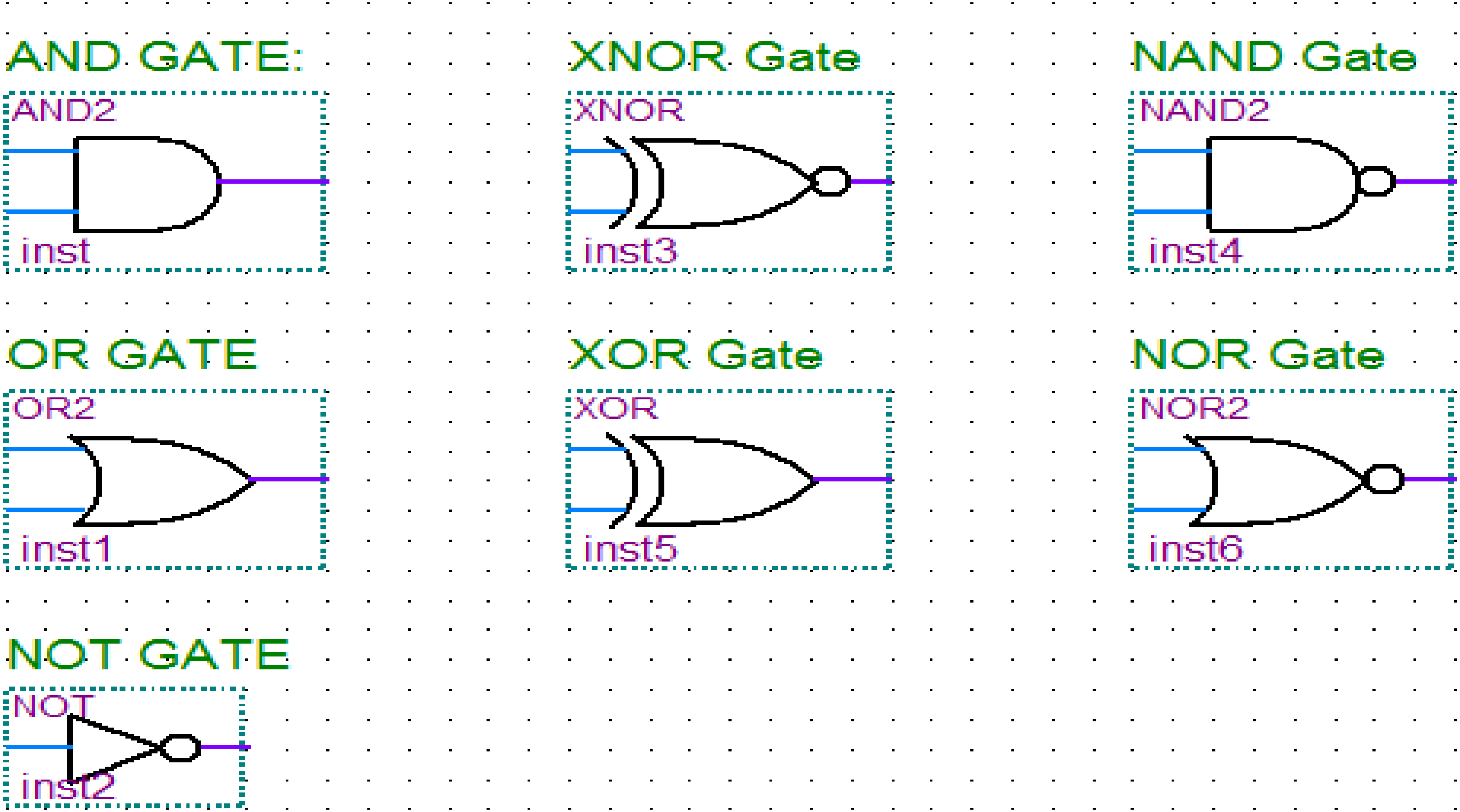
Truth Tables

- A truth table is a breakdown of a logic function by listing all possible values the function can attain
- It can be used to tell whether the proposed expression is true for all legitimate input values and is logically valid.
- Truth tables for classical logic are limited to Boolean logical systems in which only two logical values are possible, **false** and **true**, usually written **F** and **T**, or sometimes **0** or **1**, respectively.

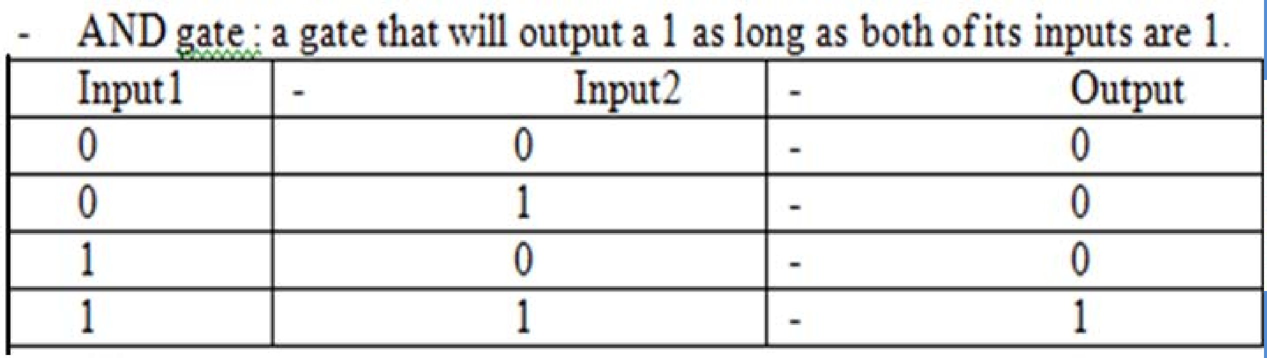
What is a Logic Gate:

- A key component of a digital circuit
- The typical logic gate operates on two inputs, and their outputs are determined by their specific function in a digital circuit.
- They accept and output one of two binary conditions, 0 and 1, which represent the voltage level going through a circuit

Types of Logic Gates

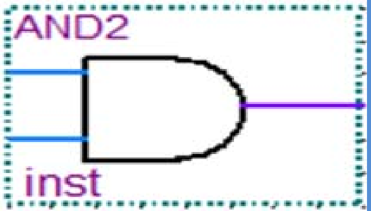


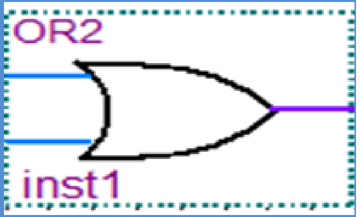
Main Gates

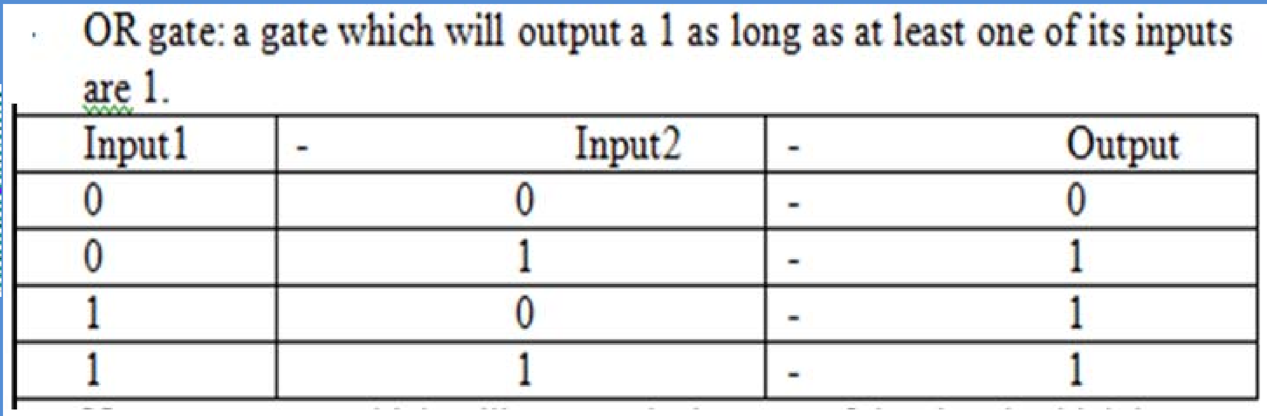


- AND gate : a gate that will output a 1 as long as both of its inputs are 1.

Input1	-	Input2	-	Output
0		0	-	0
0		1	-	0
1		0	-	0
1		1	-	1

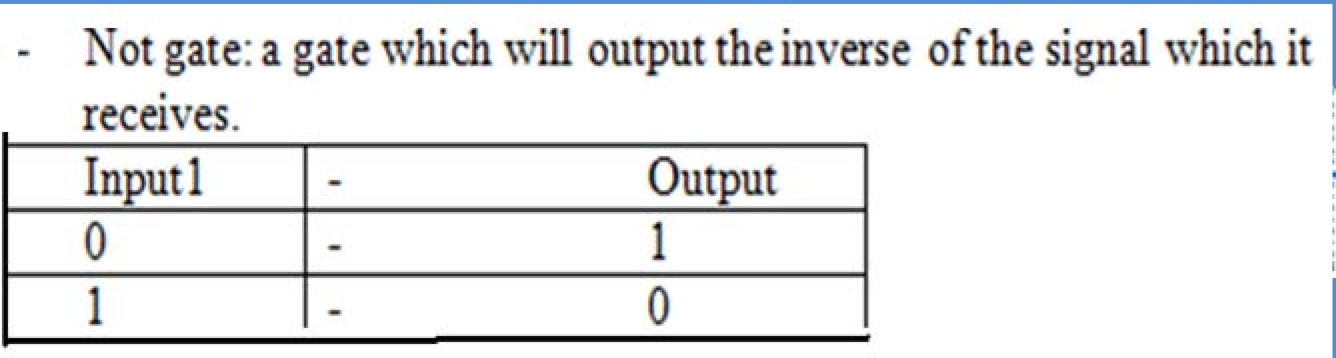






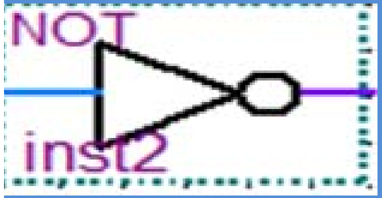
- OR gate: a gate which will output a 1 as long as at least one of its inputs are 1.

Input1	-	Input2	-	Output
0		0	-	0
0		1	-	1
1		0	-	1
1		1	-	1

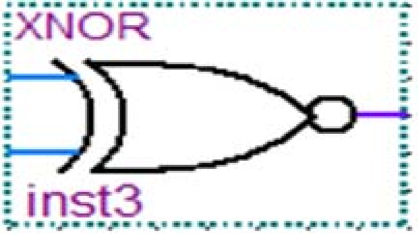


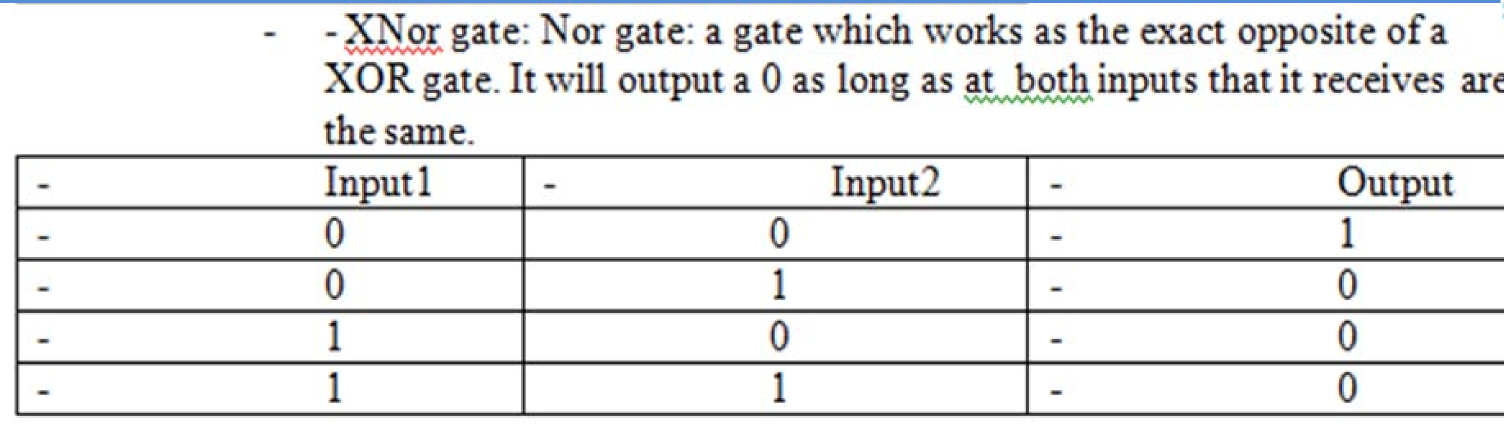
- Not gate: a gate which will output the inverse of the signal which it receives.

Input1	-	Output
0	-	1
1	-	0

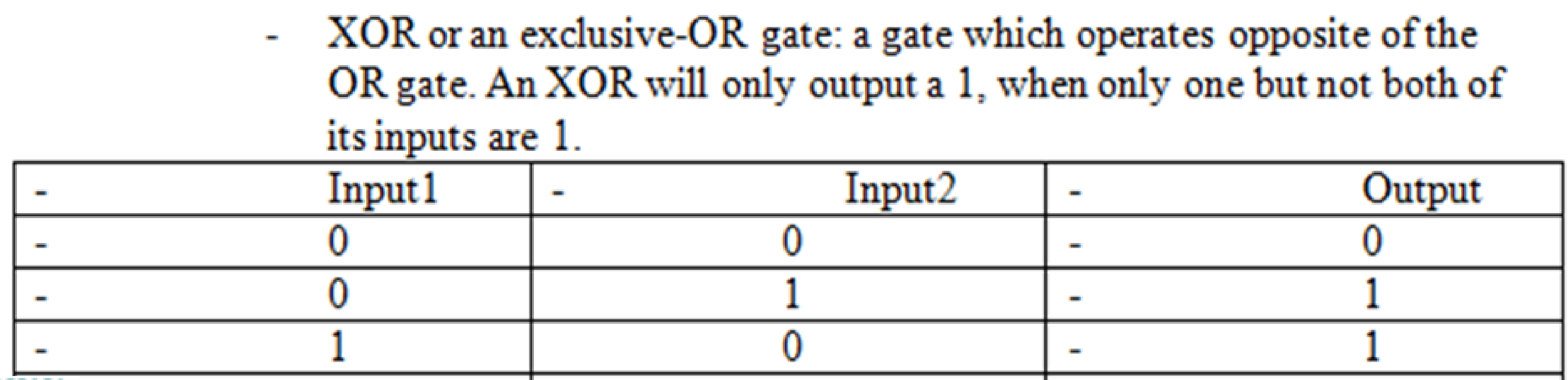


X-Gates

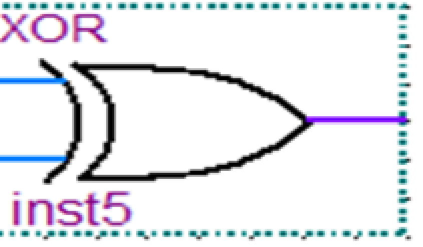



- -XNor gate: Nor gate: a gate which works as the exact opposite of a XOR gate. It will output a 0 as long as at both inputs that it receives are the same.

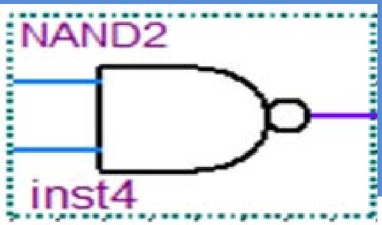
- Input1	- Input2	- Output
- 0	0	- 1
- 0	1	- 0
- 1	0	- 0
- 1	1	- 0

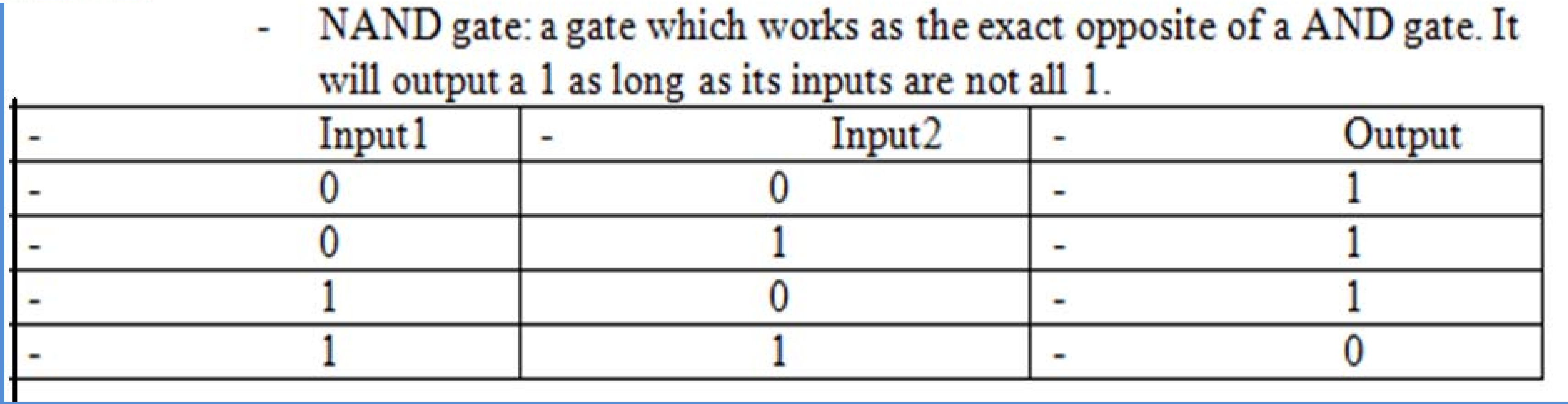

- XOR or an exclusive-OR gate: a gate which operates opposite of the OR gate. An XOR will only output a 1, when only one but not both of its inputs are 1.

- Input1	- Input2	- Output
- 0	0	- 0
- 0	1	- 1
- 1	0	- 1
1	1	- 0



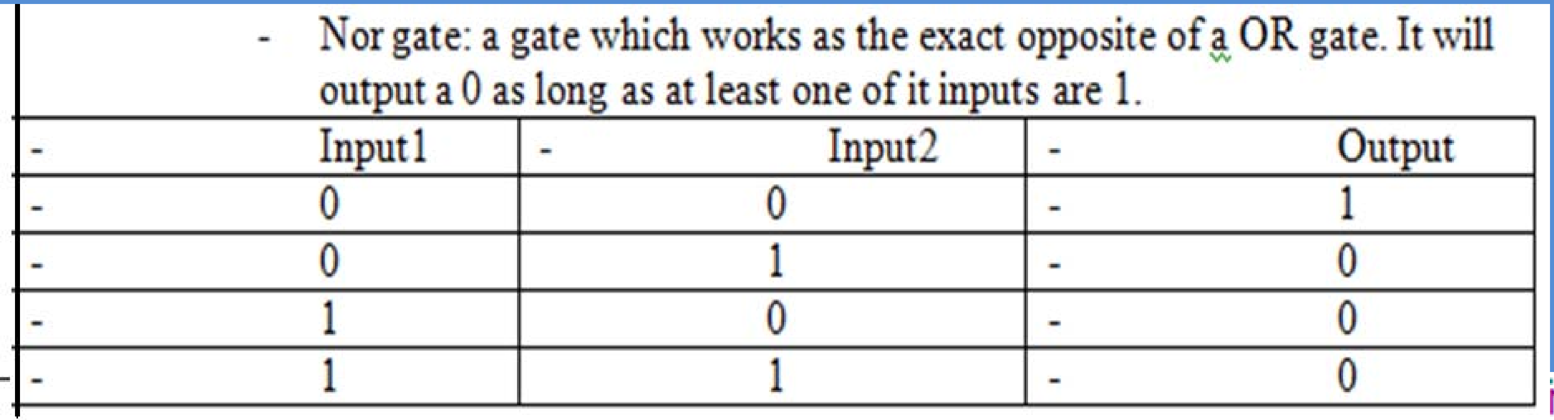
N-Gates





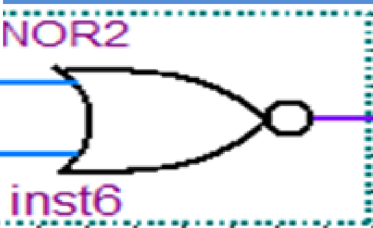
- NAND gate: a gate which works as the exact opposite of a AND gate. It will output a 1 as long as its inputs are not all 1.

- Input1	- Input2	- Output
- 0	0	- 1
- 0	1	- 1
- 1	0	- 1
- 1	1	- 0



- Nor gate: a gate which works as the exact opposite of a OR gate. It will output a 0 as long as at least one of it inputs are 1.

- Input1	- Input2	- Output
- 0	0	- 1
- 0	1	- 0
- 1	0	- 0
- 1	1	- 0



Requirements

- Requirement #1 –

  There should be 2 Smoke Detectors, One Sprinkler and One Automatic Telephone Dialer

- Requirement #2 –

  If at **least** one of the Smoke Detectors active-low output is asserted then the Sprinklers active-low input should be asserted also.

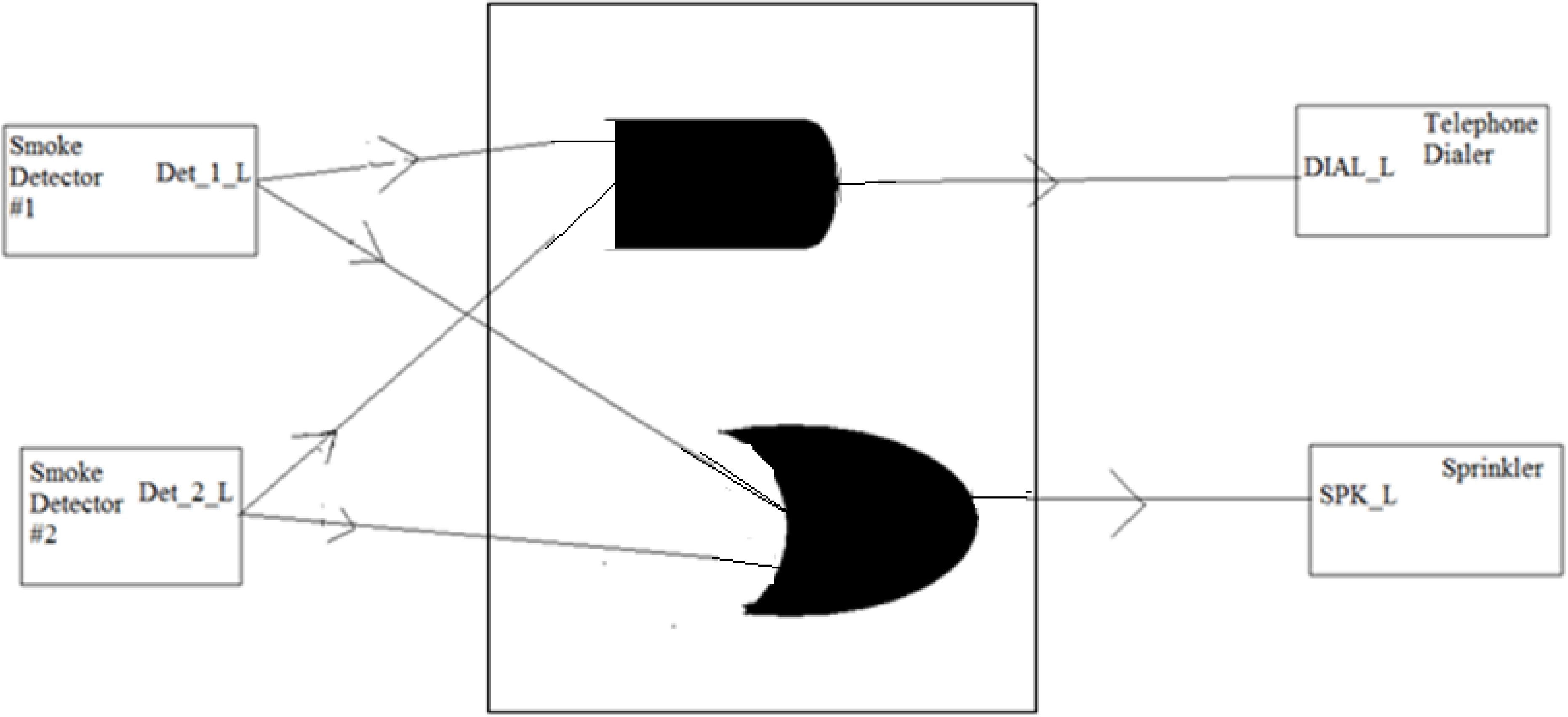
- Requirement #3 –

  If **both** of the Smoke Detectors are active-low outputs are asserted then both the sprinkler and the telephone dialer's active-low inputs should be asserted also. The telephone dialer should be placing a call to the fire department.

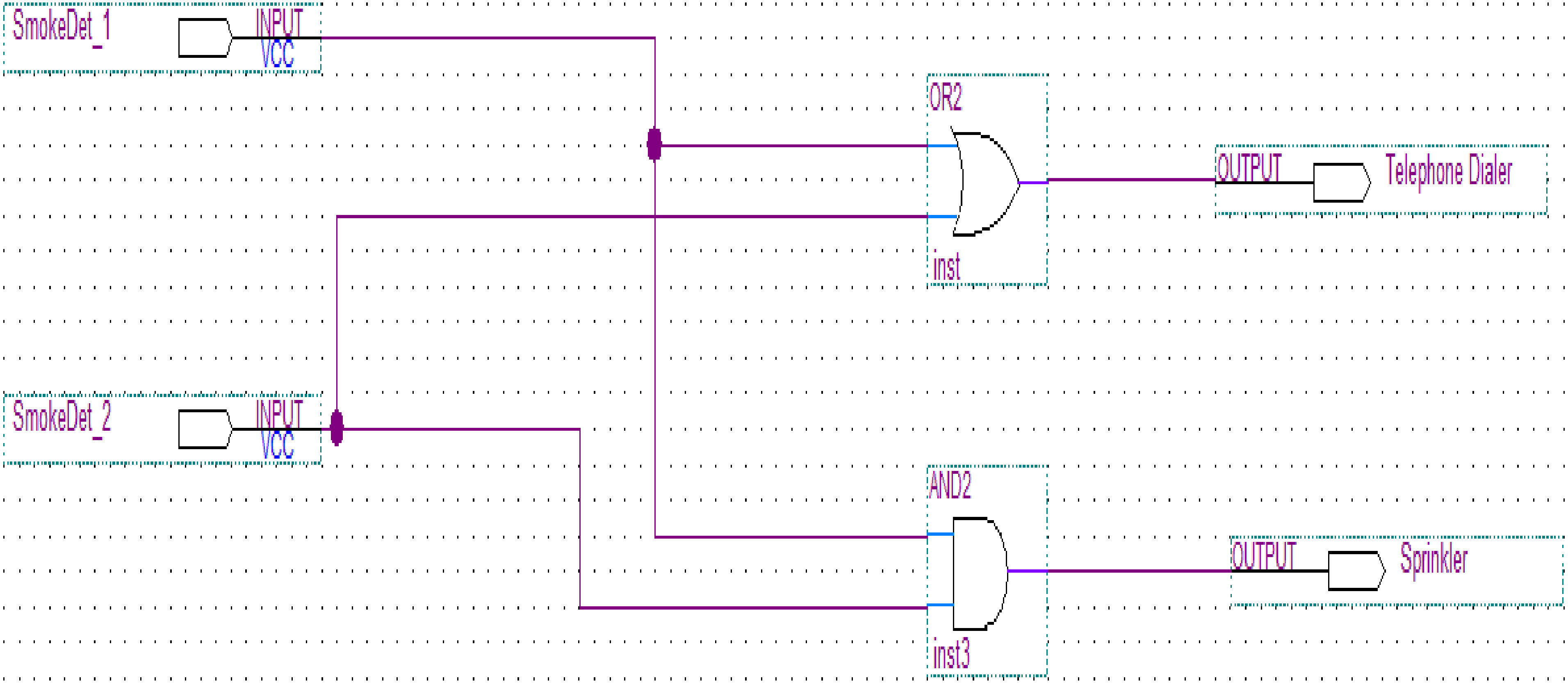
Active-Low Inputs and Outputs of Smoke Alarm System

SMOKE DETECTOR 1	SMOKE DETECTOR 2	SPRINKLER	TELEPHONE DIALER
1	1	1	1
0	1	0	1
1	0	0	1
0	0	0	0

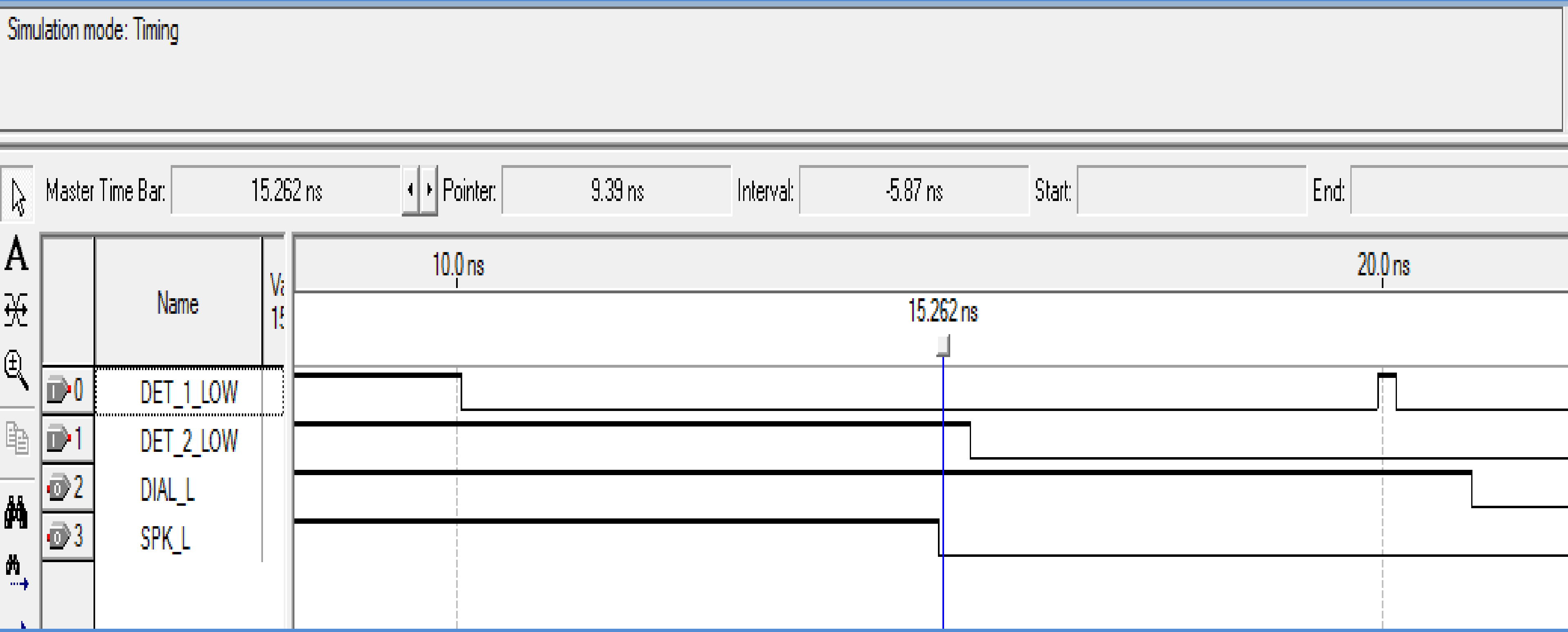
Block Design of Smoke Alarm System



Design Schematic



Simulation of Design



Simulation mode: Timing

Master Time Bar: 15.262 ns

Pointer: 9.39 ns

Interval: -5.87 ns

Start:

End: