

# Basic Logical Operations (Fascinating)



In this section you will learn what are the basic logical operations and how to evaluate different logical expressions

Image from Star Trek © Paramount

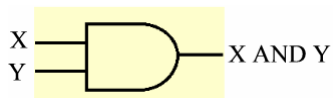
James Tam

## Logical AND

Truth table		
X	Y	X AND Y
False	False	False
False	True	False
True	False	False
True	True	True

Truth table		
X	Y	X AND Y
0	0	0
0	1	0
1	0	0
1	1	1

Logic gate



James Tam

## Logical AND: An Example

	T	T	F	F	T	F
AND	F	T	F	T	T	F
<hr/>						
	F	T	F	F	T	F

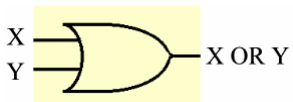
James Tam

## Logical OR

Truth table		
X	Y	X OR Y
False	False	False
False	True	True
True	False	True
True	True	True

Truth table		
X	Y	X OR Y
0	0	0
0	1	1
1	0	1
1	1	1

Logic gate



James Tam

## Logical OR: An Example

	T	T	F	F	T	F
OR	F	T	F	T	T	F
<hr/>						
	T	T	F	T	T	F

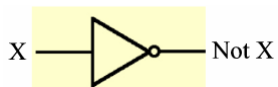
James Tam

## Logical NOT

Truth table	
X	Not X
False	True
True	False

Truth table	
X	Not X
0	1
1	0

Logic gate



James Tam

## Logical NOT: An Example

	T	T	F	F	T	F
NOT	F	F	T	T	F	T

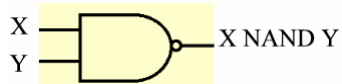
James Tam

## Logical NAND

Truth table			
X	Y	X AND Y	X NAND Y
False	False	False	True
False	True	False	True
True	False	False	True
True	True	True	False

Truth table			
X	Y	X AND Y	X NAND Y
0	0	0	1
0	1	0	1
1	0	0	1
1	1	1	0

Logic gate



James Tam

## Logical NAND: An Example

	T	T	F	F	T	F
AND	F	T	F	T	T	F
<hr/>						
	F	T	F	F	T	F
NAND	T	F	T	T	F	T

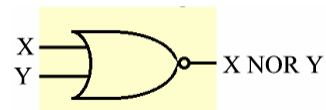
James Tam

## Logical NOR

Truth table			
X	Y	X OR Y	X NOR Y
False	False	False	True
False	True	True	False
True	False	True	False
True	True	True	False

Truth table			
X	Y	X OR Y	X NOR Y
0	0	0	1
0	1	1	0
1	0	1	0
1	1	1	0

Logic gate



James Tam

## Logical NOR: An Example

	T	T	F	F	T	F
OR	F	T	F	T	T	F
<hr/>						
	T	T	F	T	T	F
NOR	F	F	T	F	F	T

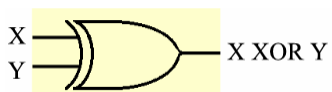
James Tam

## Logical Exclusive OR (XOR)

Truth table		
X	Y	X XOR Y
False	False	False
False	True	True
True	False	True
True	True	False

Truth table		
X	Y	X XOR Y
0	0	0
0	1	1
1	0	1
1	1	0

Logic gate



James Tam

### Logical XOR: An Example

	T	T	F	F	T	F
XOR	F	T	F	T	T	F
<hr/>						
	T	F	F	T	F	F

James Tam

### Logic: Greater Than Two Inputs

X	Y	Z	X OR Y OR Z
?	?	?	?

X	Y	Z	X AND Y AND Z
?	?	?	?

James Tam

## Example Boolean Expressions To Evaluate

True **AND** True **AND** False **AND** True

True **OR** True **OR** False **OR** True

(True **OR** False) **AND** (False **OR** False)

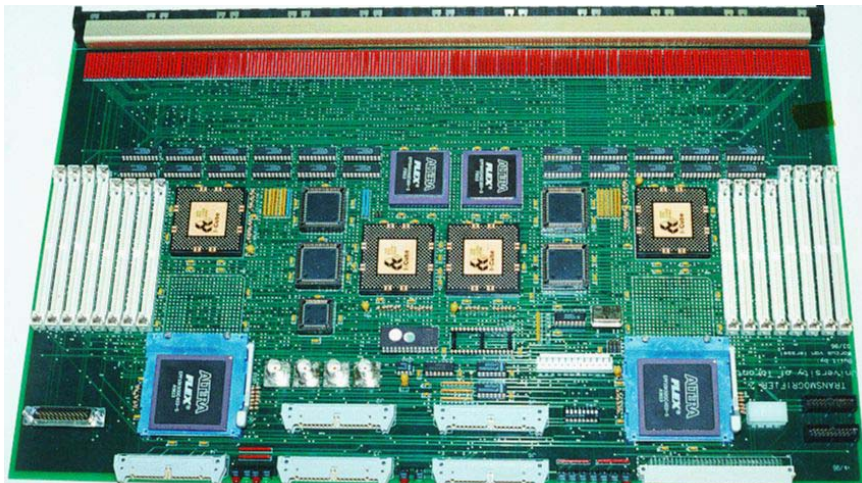
**NOT** (True **OR** False)

**NOT** (True **AND** True)

James Tam

## Reasons For Learning Logic: Hardware

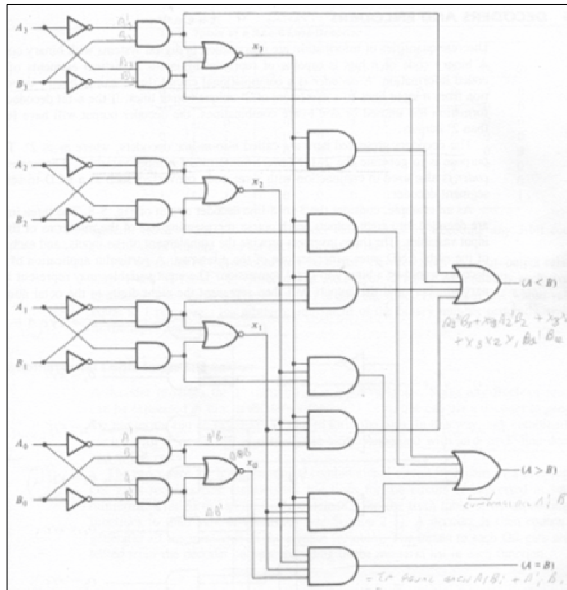
The computer is built using logic circuits



James Tam



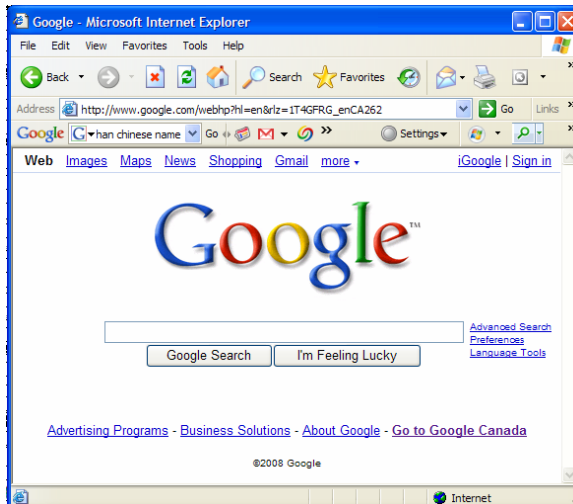
## A 4 Bit Comparator Circuit



James Tam

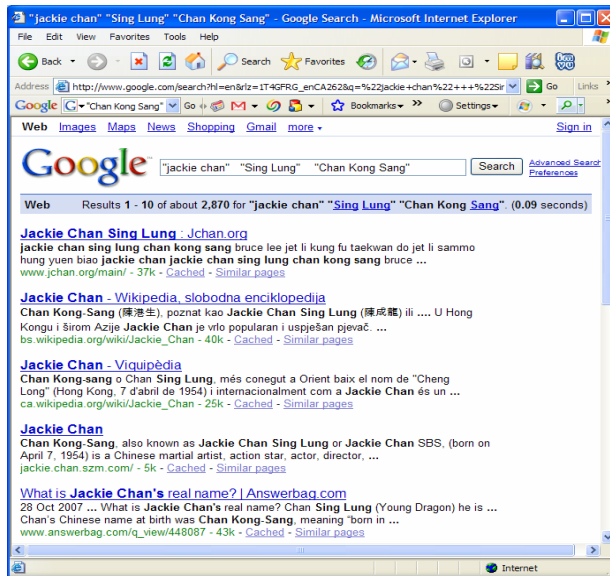
## Reasons For Learning About Logic: Software

Logic is common-place in computer programs e.g., database searches.



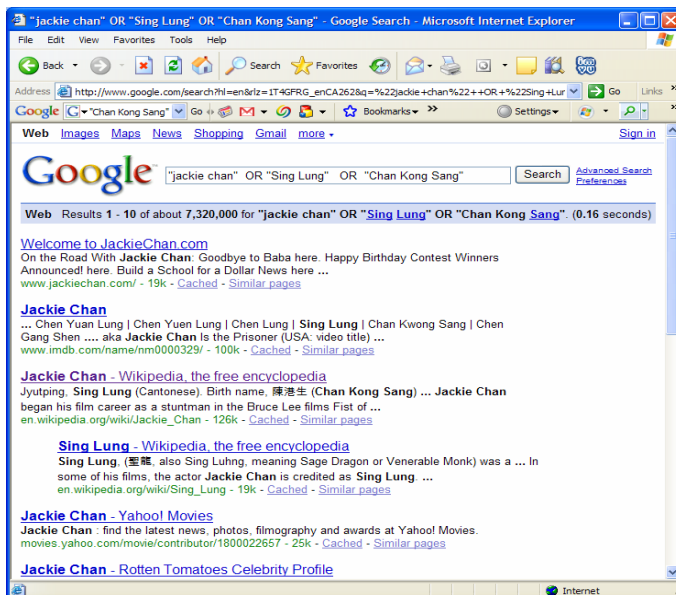
James Tam

## Reasons For Learning About Logic: Software (2)



James Tam

## Reasons For Learning About Logic: Software (3)



James Tam

## **You Should Now Know**

The different types of logical operations that a computer may perform

- AND
- OR
- NOT
- NAND
- NOR
- XOR

How to evaluate complex Boolean expressions formed with combinations of AND, OR, NOT

How logic gates form an important part of computers