ECE216:
DIGITAL ELECTRONICS LABORATORY

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Practical 1 : Analysis and Synthesis of Boolean Expressions using Basic Logic Gates

- Understanding the combinational logic by implementing the boolean function using basic logic gates.

How do we describe the behavior of gates and circuits?

Boolean expressions

Uses Boolean algebra, a logical statement whether it is true or false.

Logic diagrams

A graphical representation of a circuit; each gate has its own symbol.

Truth tables

A table showing all possible input value and the associated output values.

Circuits

Combinational circuit

The input values explicitly determine the output.

Sequential circuit

The output is a function of the input values and the existing state of the circuit.

We describe the circuit operations using

- Boolean expressions
- Truth tables

Gates

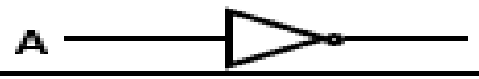
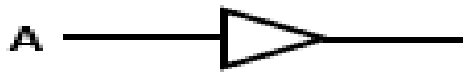
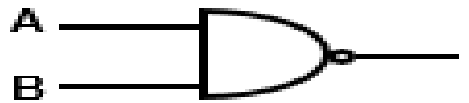
Six types of gates

- NOT 7404
- AND 7408
- OR 7432
- XOR 7486
- NAND 7400
- NOR 7402

MCQ

An OR gate produces 0 if both input values are 0

True or False

Name	Symbol	Function	Truth Table
AND		X = A • B or X = AB	A B X 0 0 0 0 1 0 1 0 0 1 1 1
OR		X = A + B	A B X 0 0 0 0 1 1 1 0 1 1 1 1
I		X = A'	A X 0 1 1 0
Buffer		X = A	A X 0 0 1 1
NAND		X = (AB)'	A B X 0 0 1 0 1 1 1 0 1 1 1 0
NOR		X = (A + B)'	A B X 0 0 1 0 1 0 1 0 0 1 1 0
XOR Exclusive OR		X = A ⊕ B or X = A'B + AB'	A B X 0 0 0 0 1 1 1 0 1 1 1 0
XNOR Exclusive NOR or Equivalence		X = (A ⊕ B)' or X = A'B'+ AB	A B X 0 0 1 0 1 0 1 0 0 1 1 1

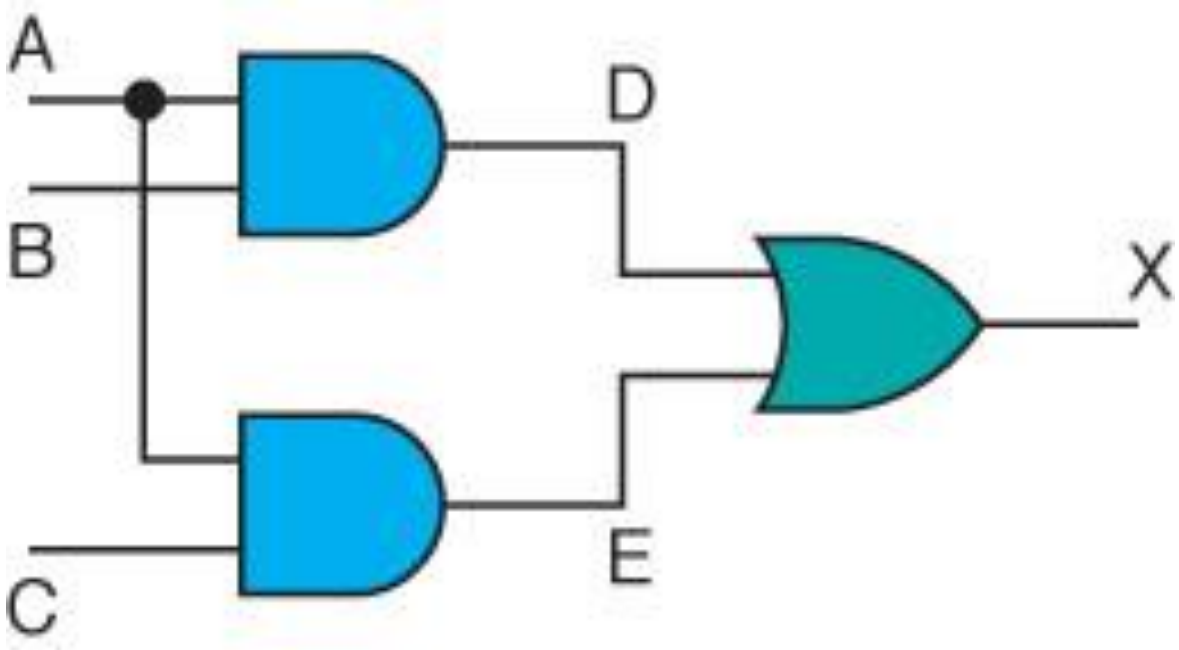
MCQ

An XOR gate produces 1 if input values are the same

True or False

Combinational Circuits

Gates are combined into circuits by using the output of one gate as the input for another



A	B	C	D	E	X
0	0	0	0	0	0
0	0	1	0	0	0
0	1	0	0	0	0
0	1	1	0	0	0
1	0	0	0	0	0
1	0	1	0	1	1
1	1	0	1	0	1
1	1	1	1	1	1

This same circuit using a Boolean expression is $(AB + AC)$

MCQ

An AND gate produces 1 if both input values are 1

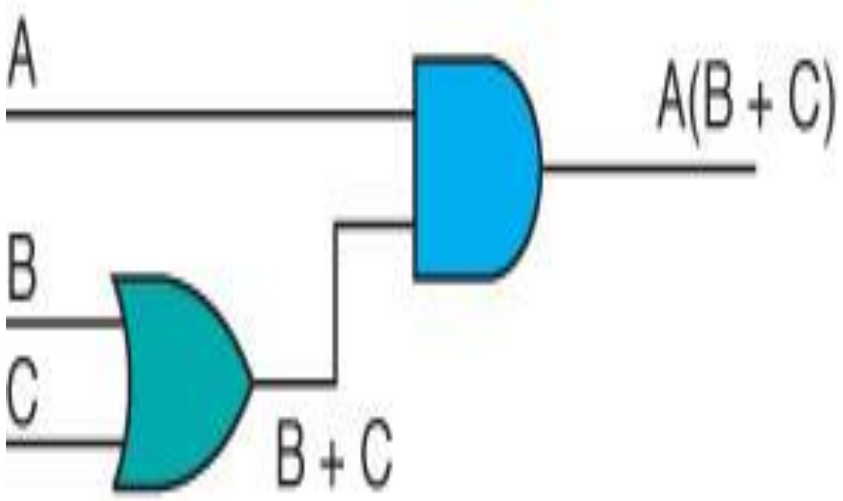
- True

  or

- False

Combinational Circuits

Consider the following Boolean expression $A(B + C)$



A	B	C	B + C	A(B + C)
0	0	0	0	0
0	0	1	1	0
0	1	0	1	0
0	1	1	1	0
1	0	0	0	0
1	0	1	1	1
1	1	0	1	1
1	1	1	1	1

Combinational Circuits

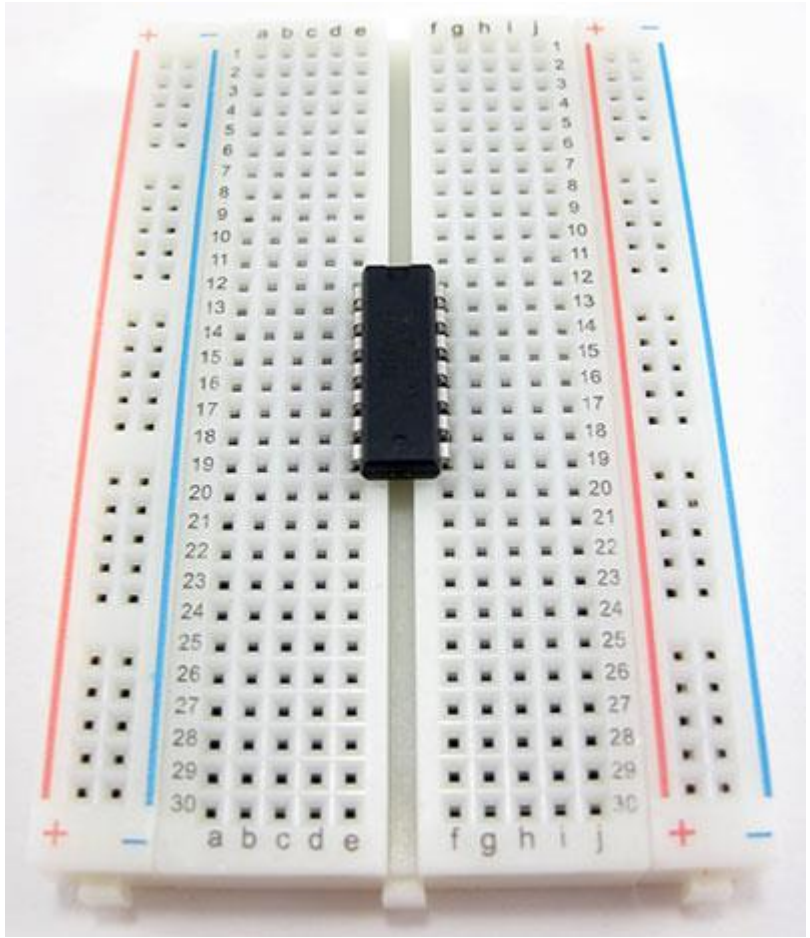
Circuit equivalence

Two circuits that produce the same output for identical input

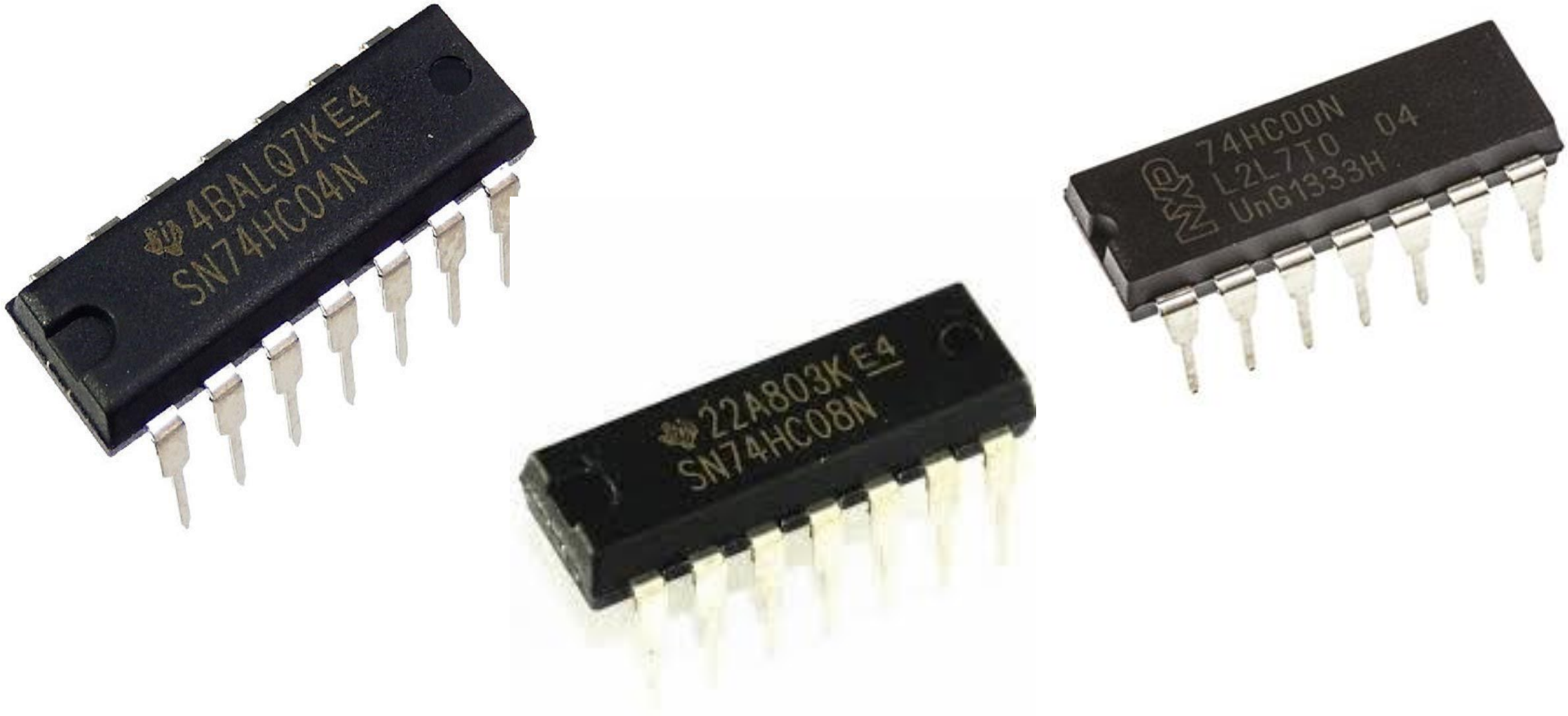
Boolean algebra allows us to apply provable mathematical principles to help design circuits

A(B + C) = AB + BC (distributive law) so circuits must be equivalent

Bread Board Connection

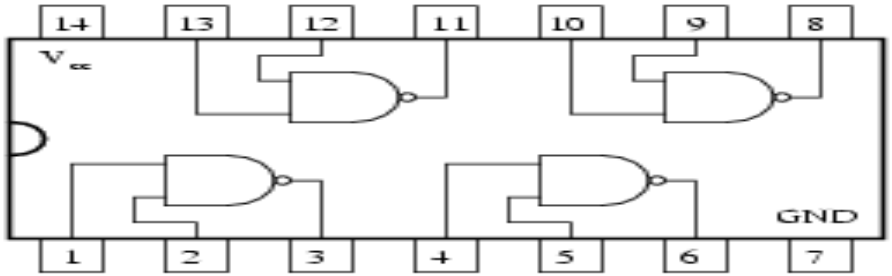


Integrated Circuits

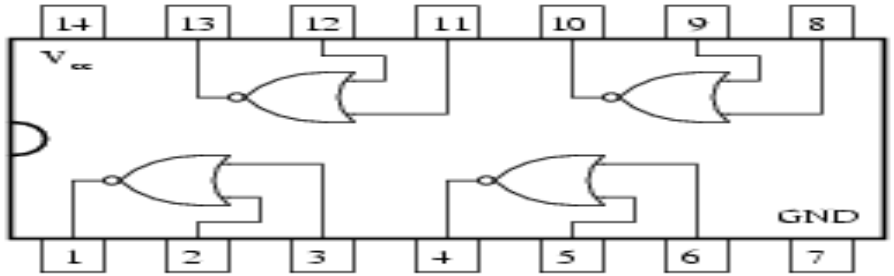


Various logic gate IC's

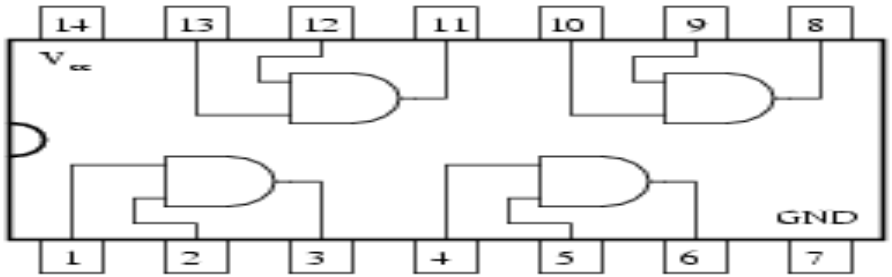
5400/7400
Quad NAND gate



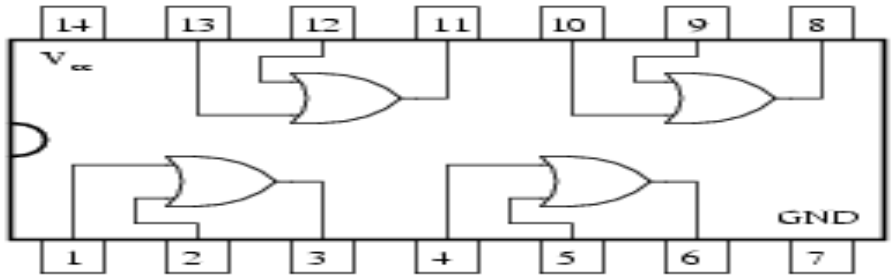
5402/7402
Quad NOR gate



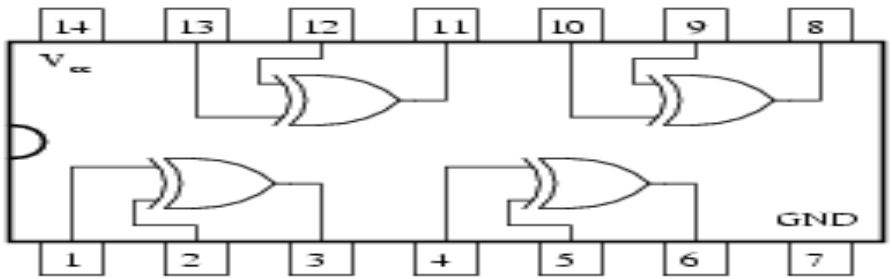
5408/7408
Quad AND gate



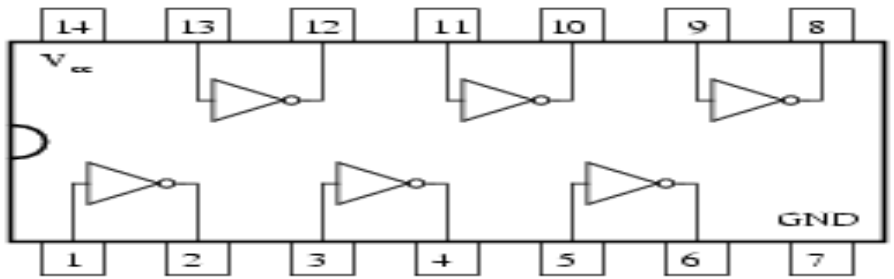
5432/7432
Quad OR gate



5486/7486
Quad XOR gate



5404/7404
Hex inverter



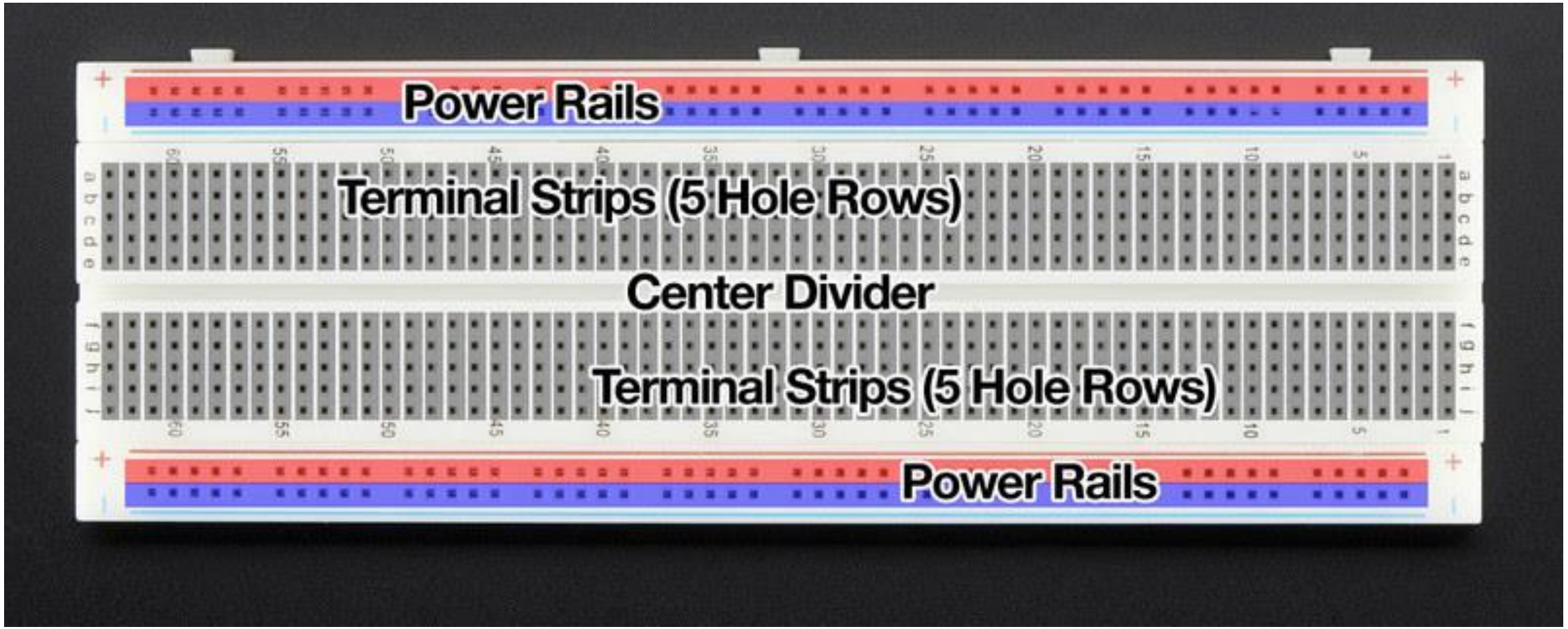
IC number of OR gate ?

(a) 7400
(b) 7408
(c) 7432
(d) 7486

How many number of pins in logic gate IC?

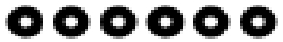
(a) 7
(b) 10
(c) 14
(d) 20

Breadboard diagram

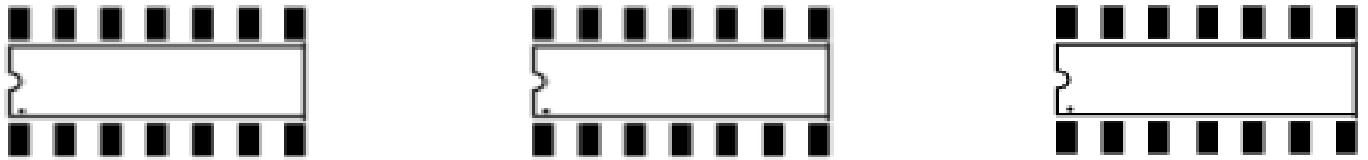


Draw Bread Board Connection diagram:

VCC

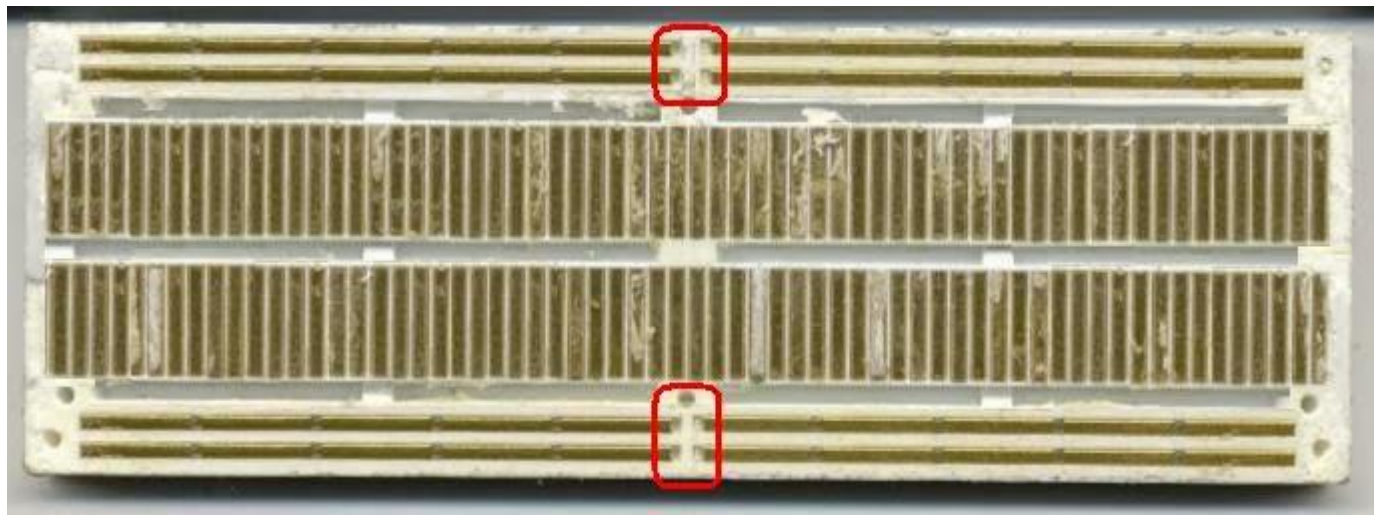


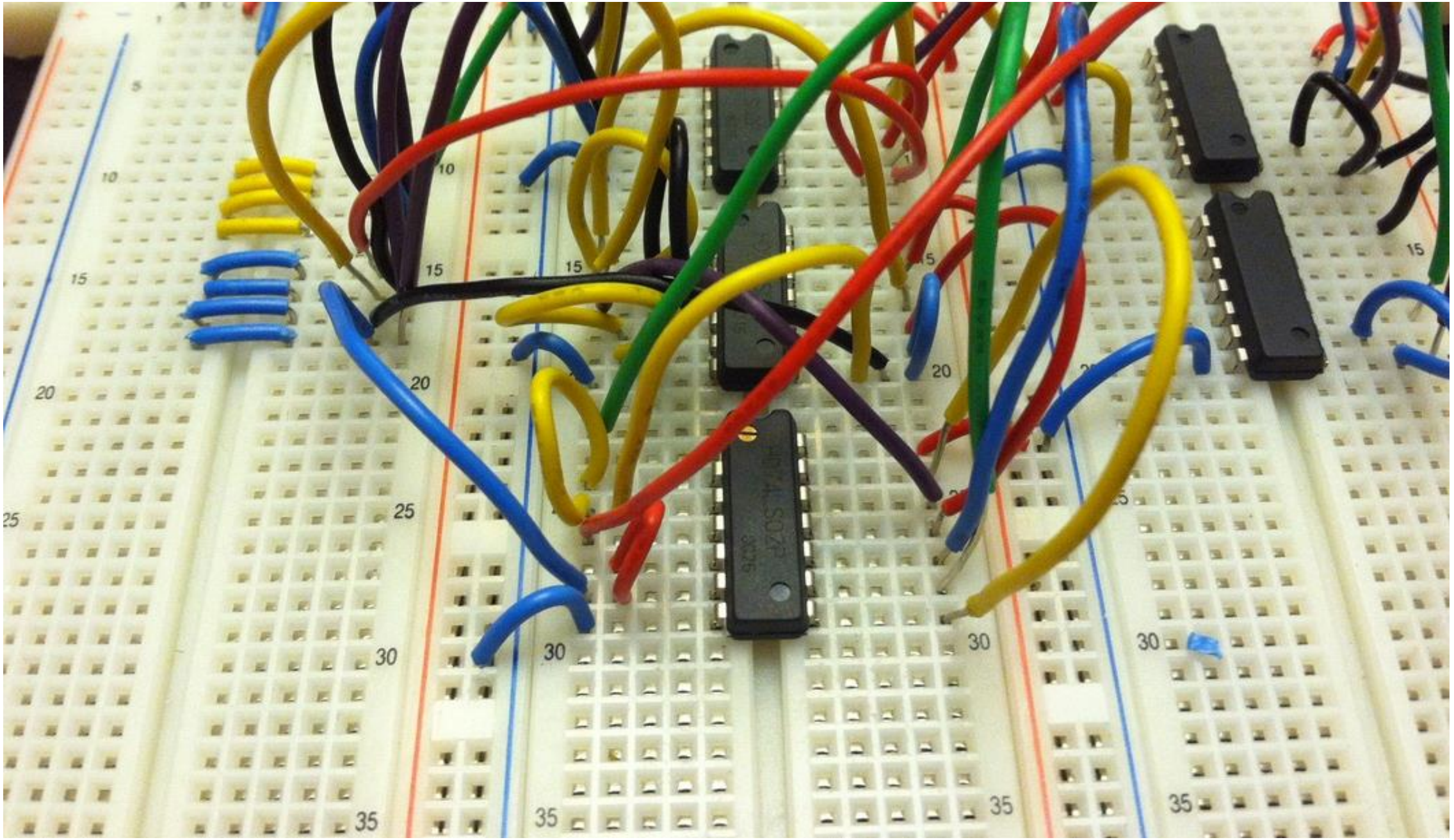
Outputs

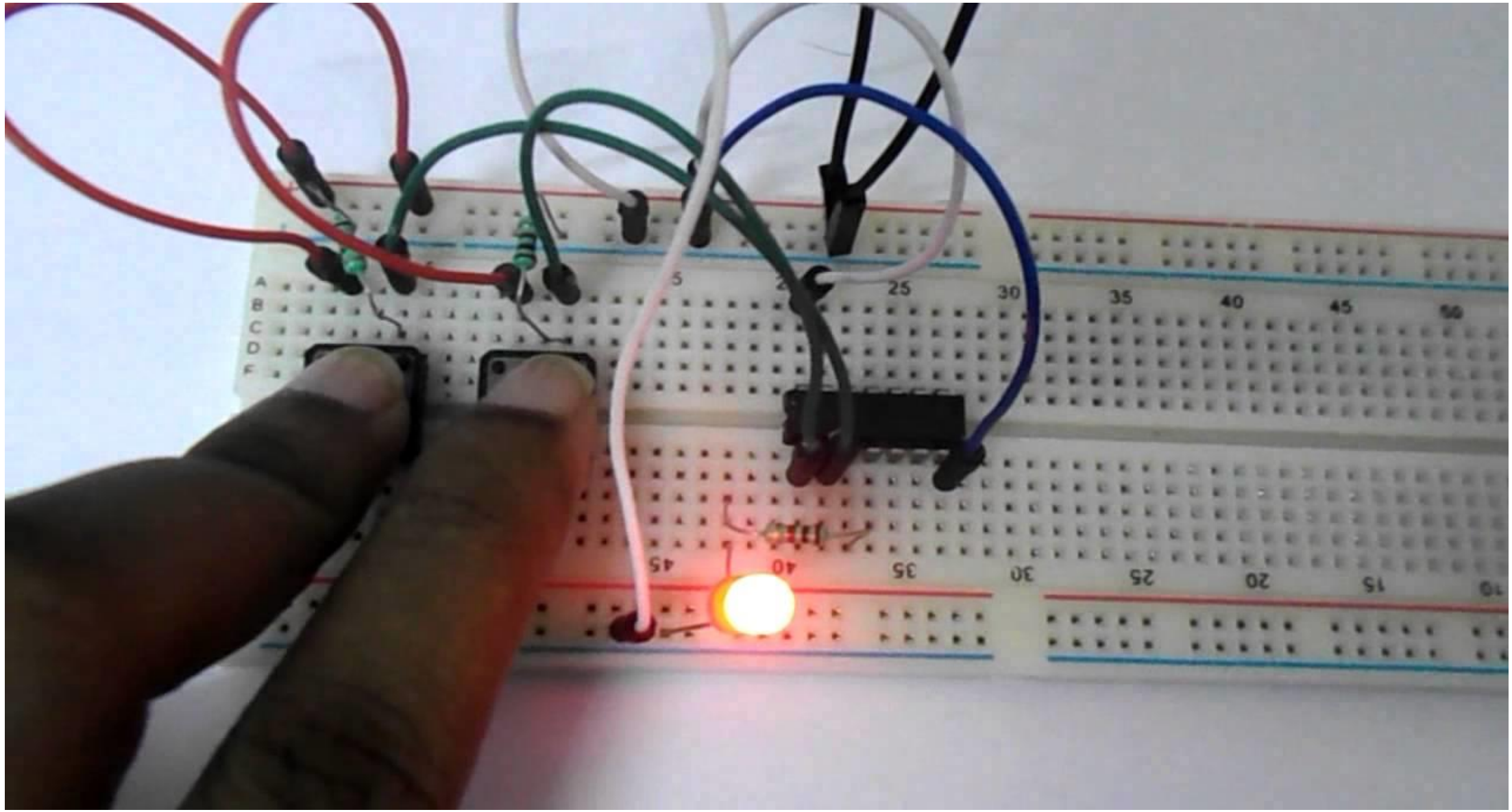


GND

Inputs




10
15
20
25
30
35
SN74LS02P


A
B
C
D
F
25
30
35
40
45
50

Implement the given Boolean equation

$$X = A\bar{B} + B\bar{C}$$

https://docs.google.com/forms/d/1SfUYN_Lxo2c7Bu53sCpskdVqp4CKPkJJmYK8sA_iaTY/edit