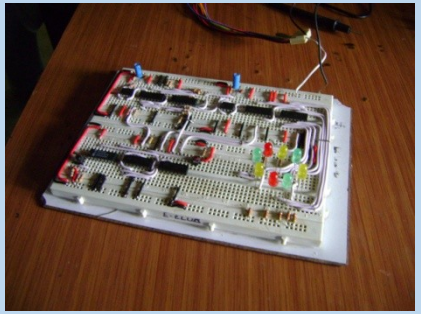
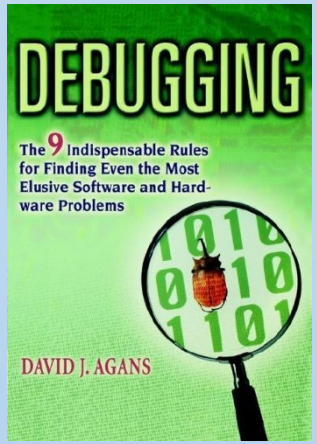
Electromania
Problem statement discussion

A Competition



Basic Circuiting

What is Electromania?



Debuggin g

Innovation

Let’s recall the previous lecture..!!

Electronics

- Digital
- Analog

Analog

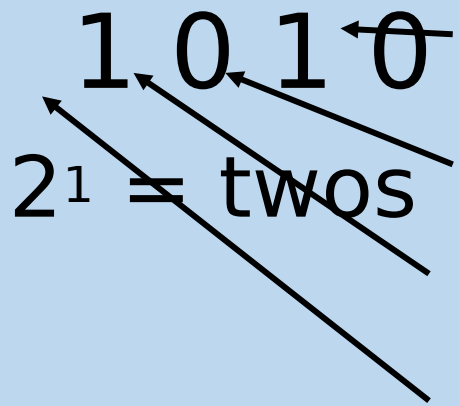
Digital

Digital Electronics

- Consists of discrete states
- High corresponds to 5V(Logic 1)
- Low corresponds to 0V(Logic 0)

Binary number System

- Another method of number representation
- Binary consists of two digits 0 and 1.



2^0 = ones

2^2 = fours

2^3 = eights

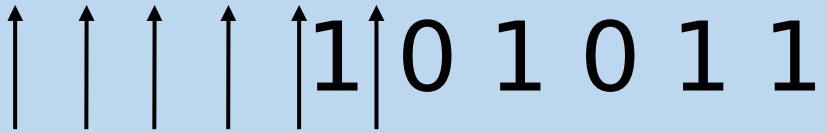
1*8 + 0*4 + 1*2 + 0*1 = 10(base-10)

1010(base-2) = 10(base-10)

Binary to Decimal Conversion

Find the decimal representation of 101011.

Step 1) Put a number subscript to every digit from right to left



Step 2) Two raised to the power of number written in the

transcript gives the face value of the number

Binary to Decimal Conversion

$101011_{(base\text{-}2)} = 1*2^5 + 0*2^4 + 1*2^3 + 0*2^2 + 1*2^1 + 1*2^0$

$= 1*32 + 0*16 + 1*8 + 0*4 + 1*2 + 1$

$= 43$

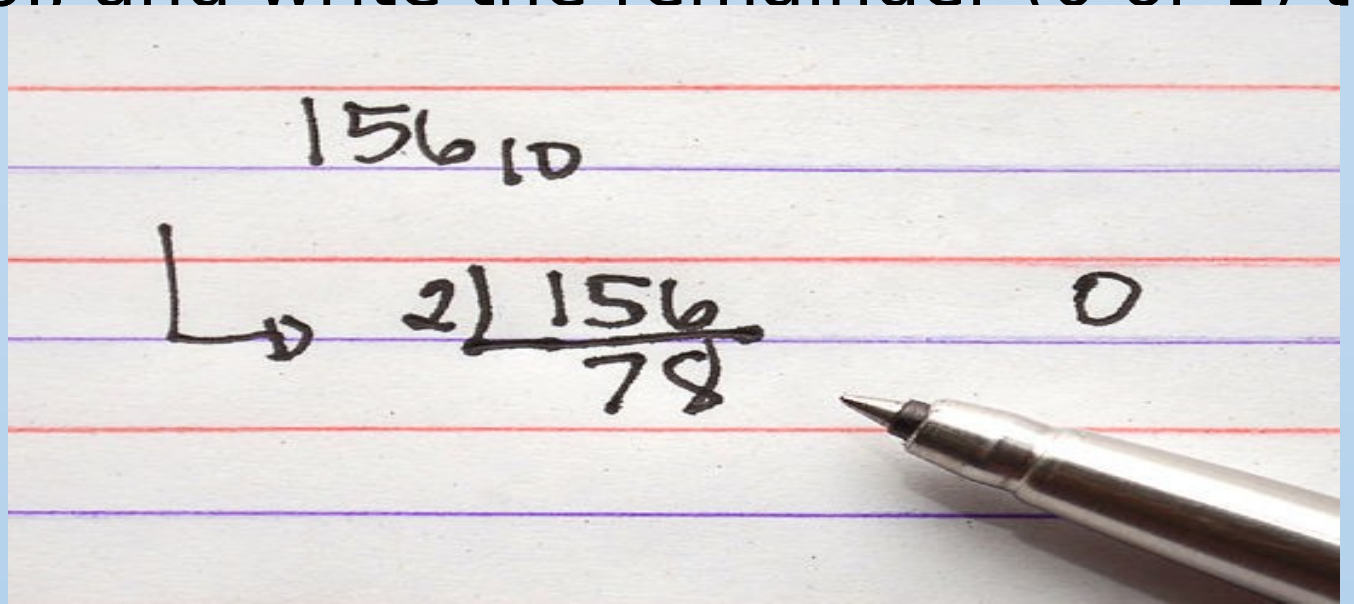
Decimal to binary conversion

Convert 156(base-10) to binary(base-2)

Step1) Write the integer answer (quotient) under the long division

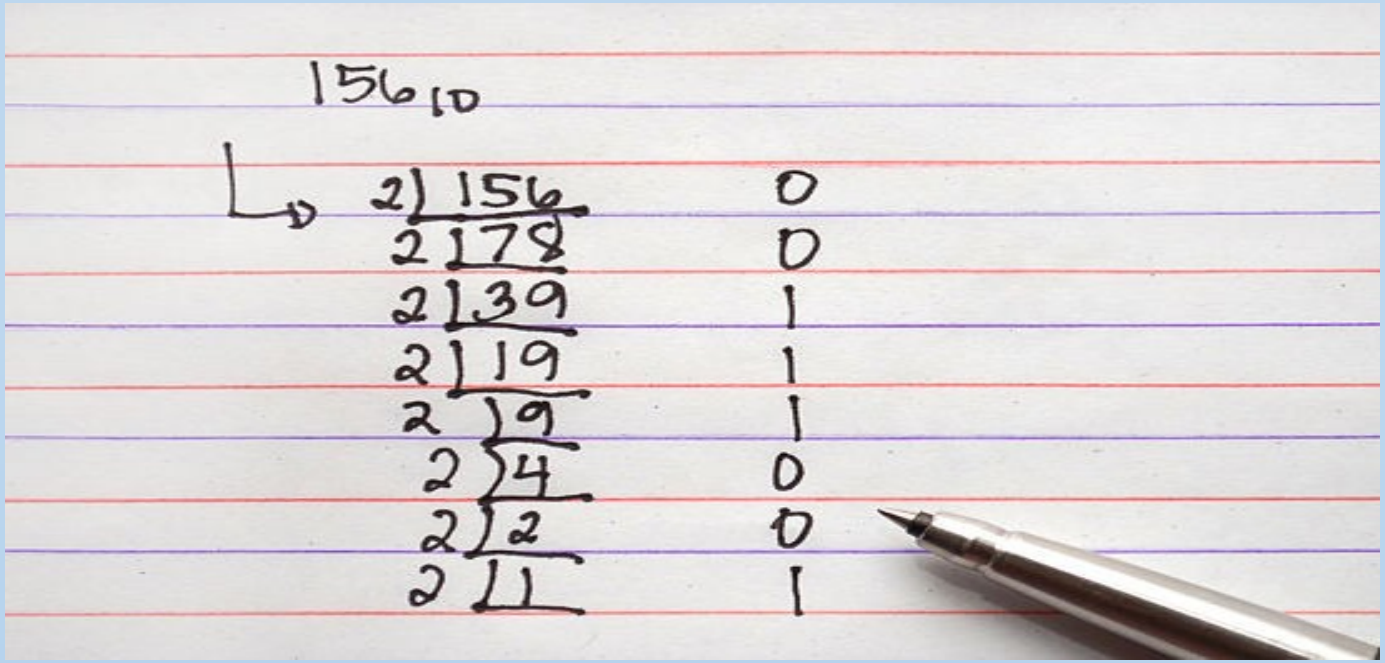
symbol. and write the remainder (0 or 1) to the right of the

divide



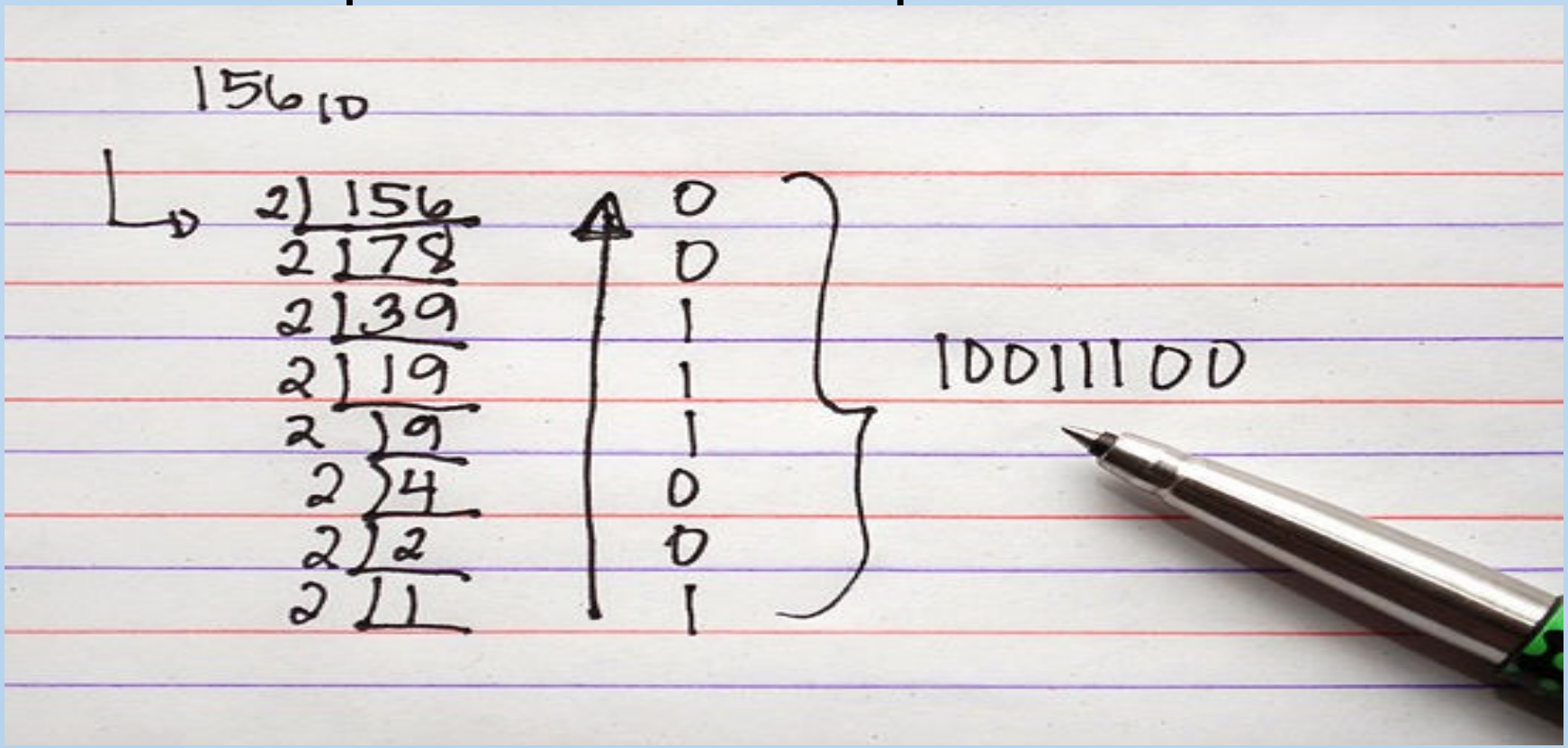
Decimal to binary conversion

- Continue downwards, dividing each new quotient by two and writing the remainders to the right of each dividend. Stop when the quotient is 0 or 1.



Decimal to binary conversion

- Starting with the bottom remainder, read the sequence of remainders upwards to the top



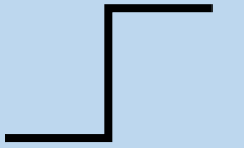
Decimal to binary conversion

The binary equivalent of 156_{10} is 10011100_2

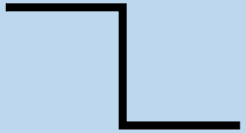
Clock Pulse

Clock has 2 components :-

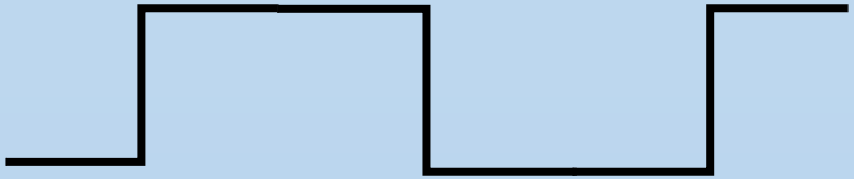
- Rising Edge



- Falling Edge



CLK



Generate a clock

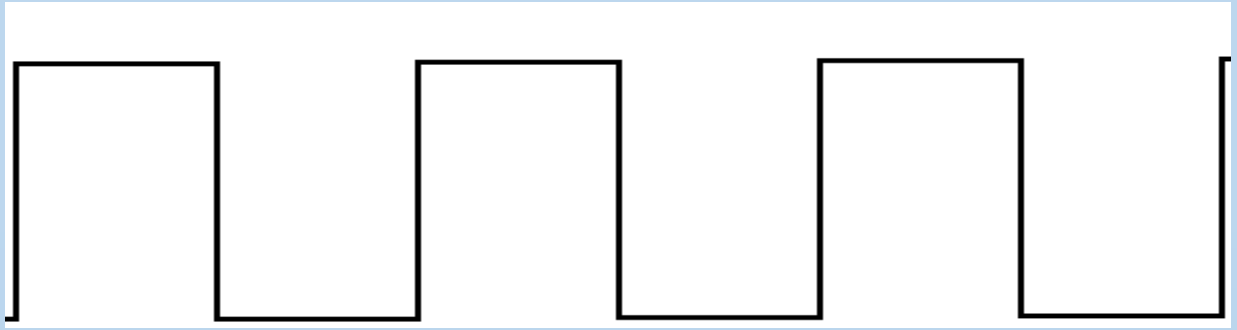
555 Timer

- Can generate clock pulses of the given time period
- It is used in 2 modes :
- Monostable and Astable

555 : Astable Mode

- Generates Clock pulses continuously

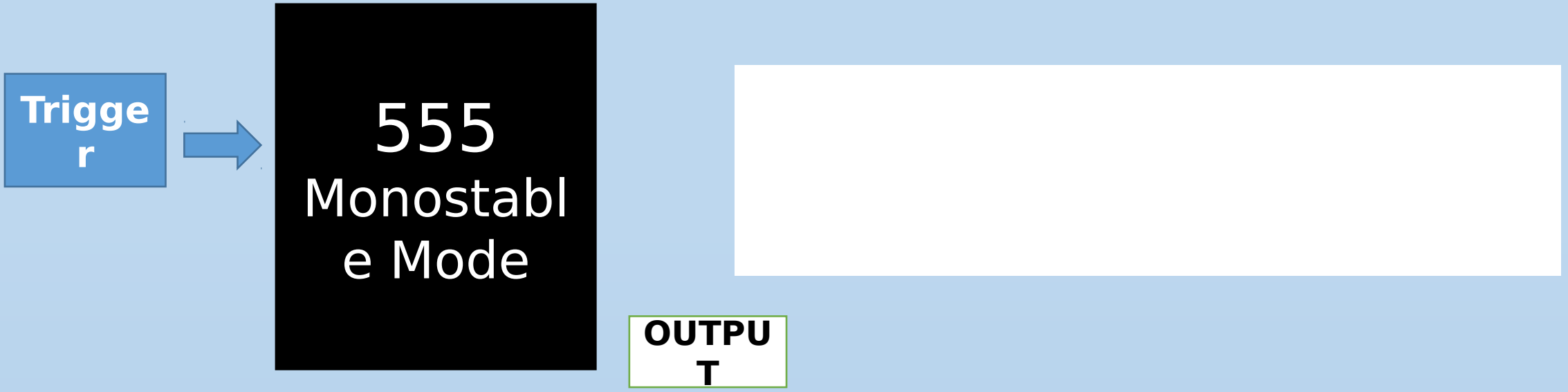
555
Astable
Mode



OUTPUT

555 : Monostable Mode

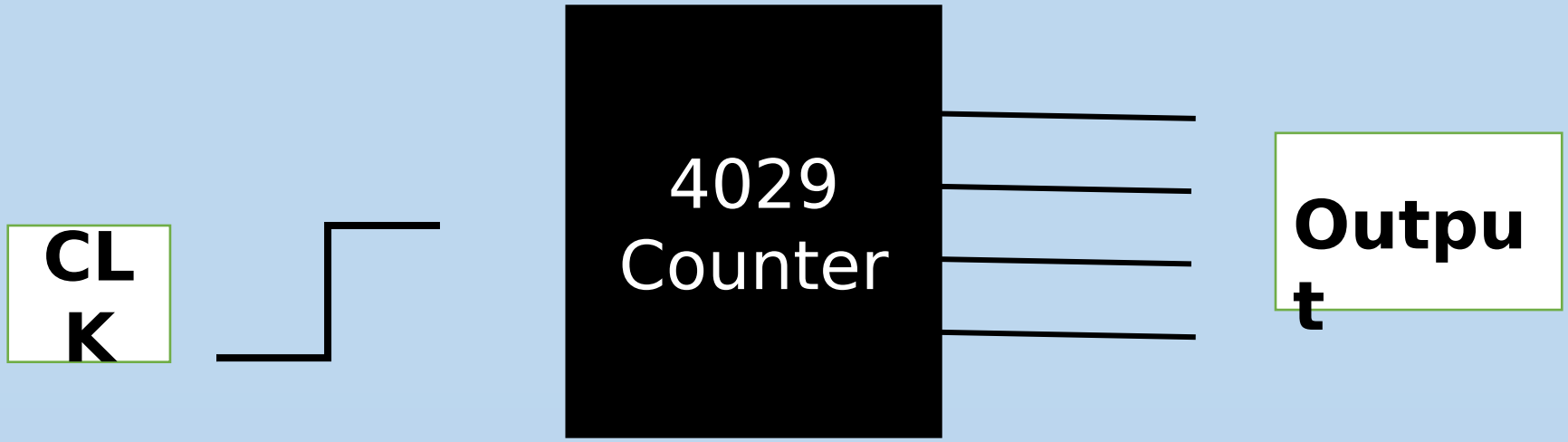
- Generates Clock pulse when triggered



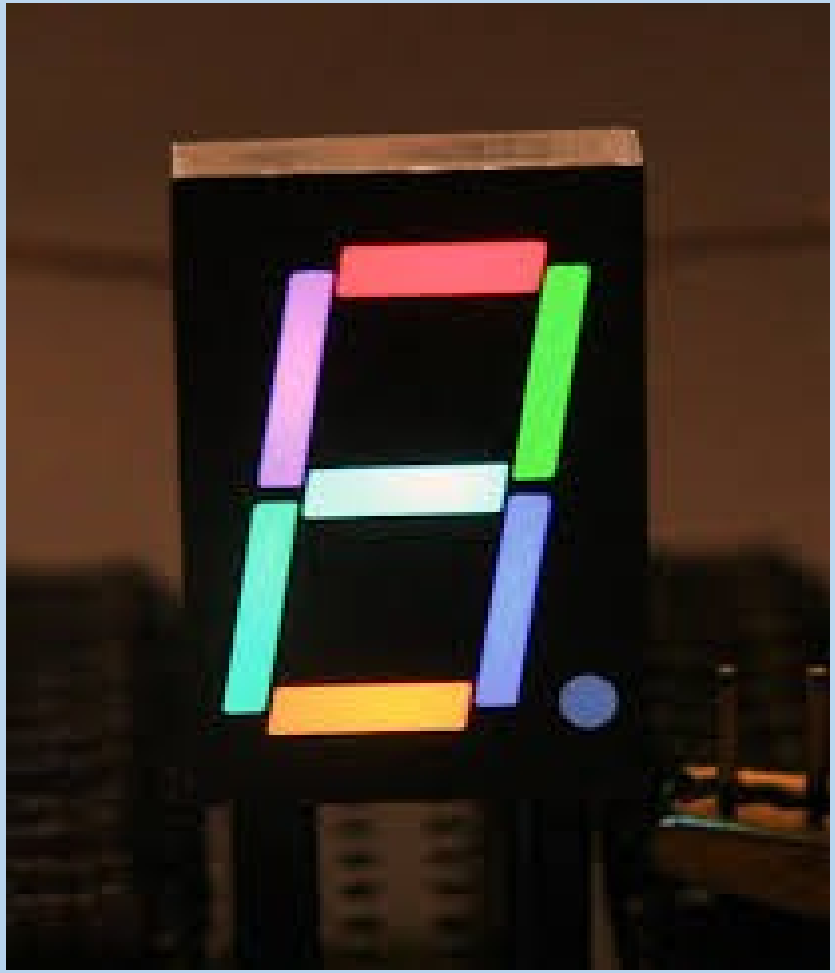
4029 counter

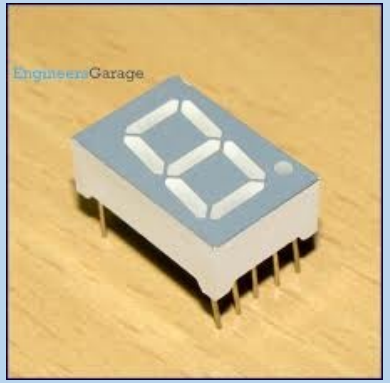
- Has 4 binary output pins
- Counter changes its output by 1 every time it receives a clock pulse

4029 counter

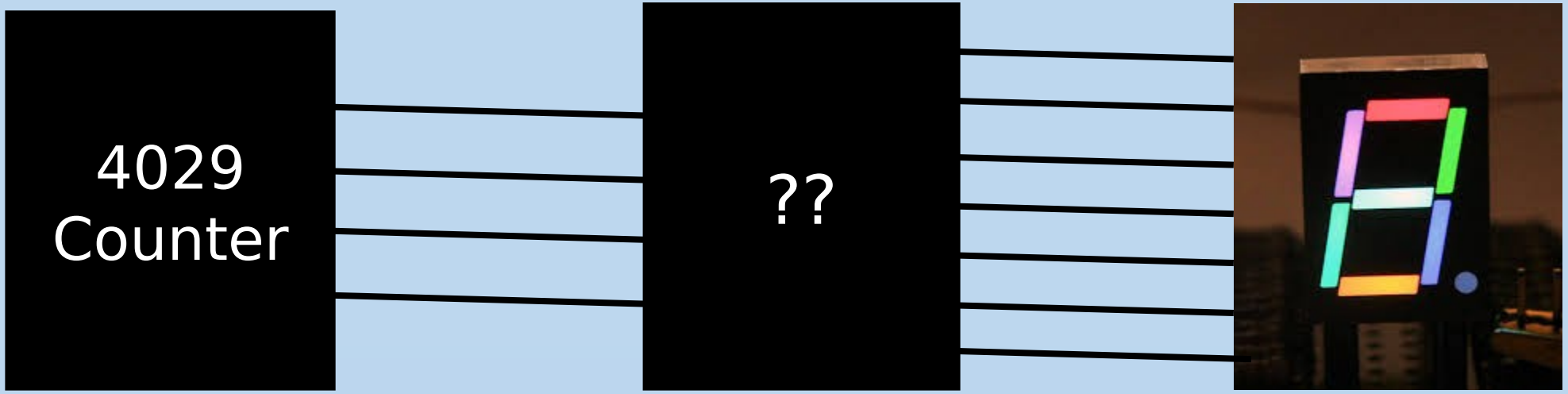


Display Time

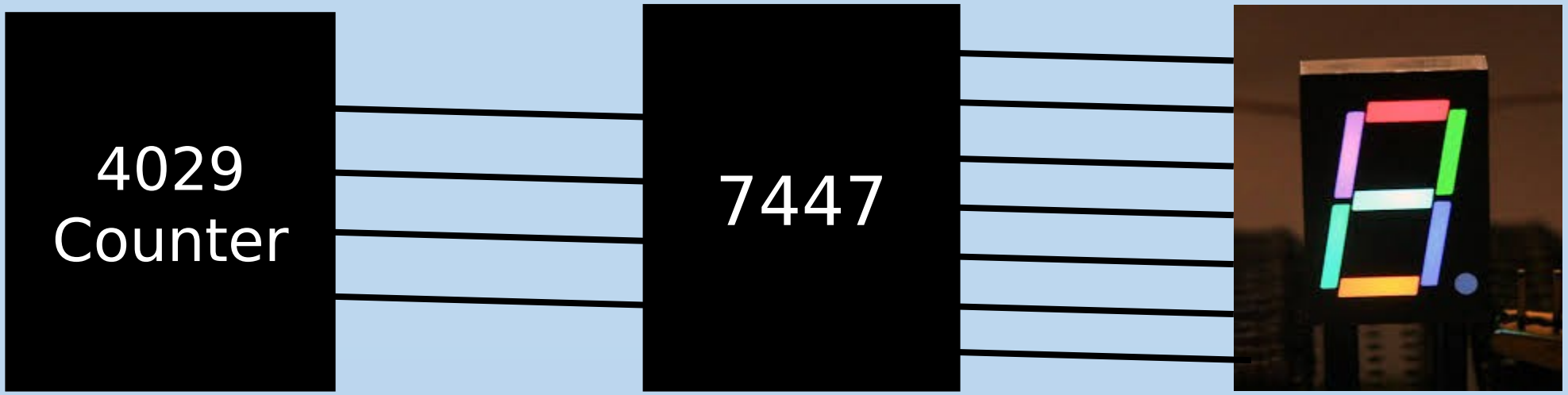




Display Time

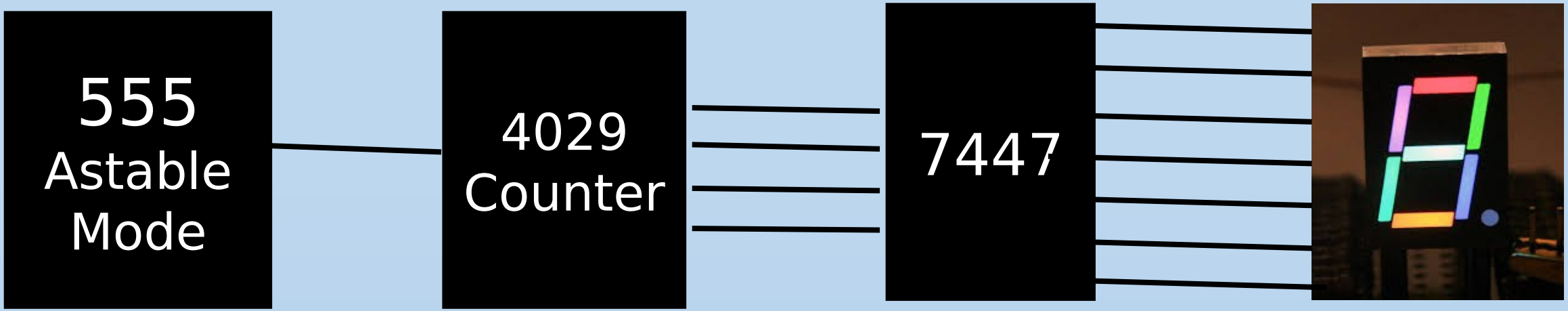


Display Time

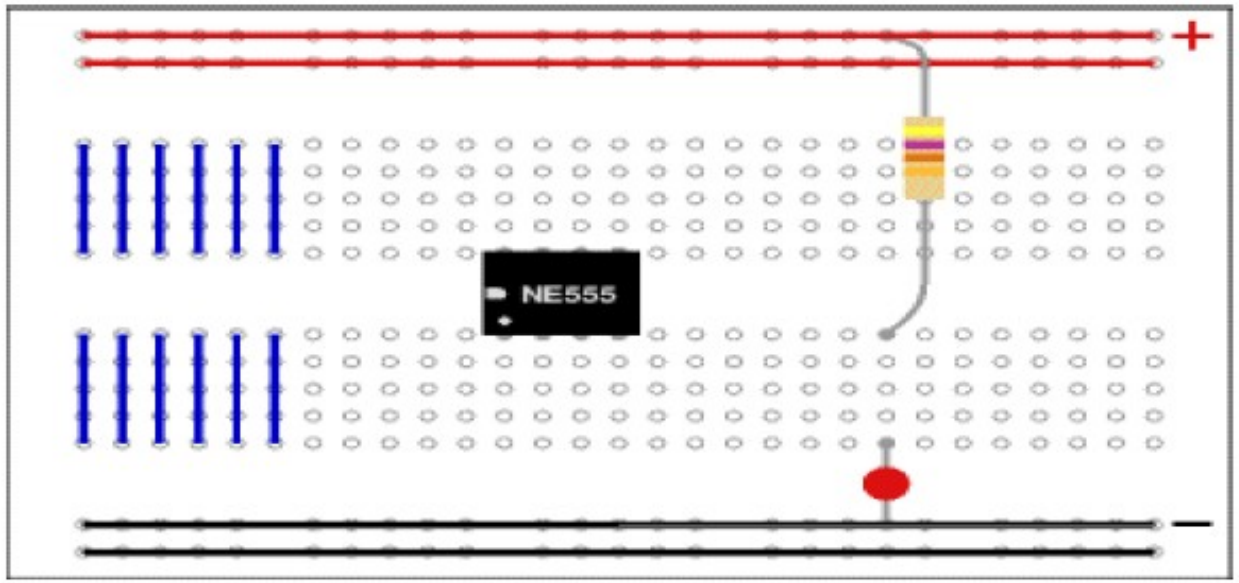


The final circuit

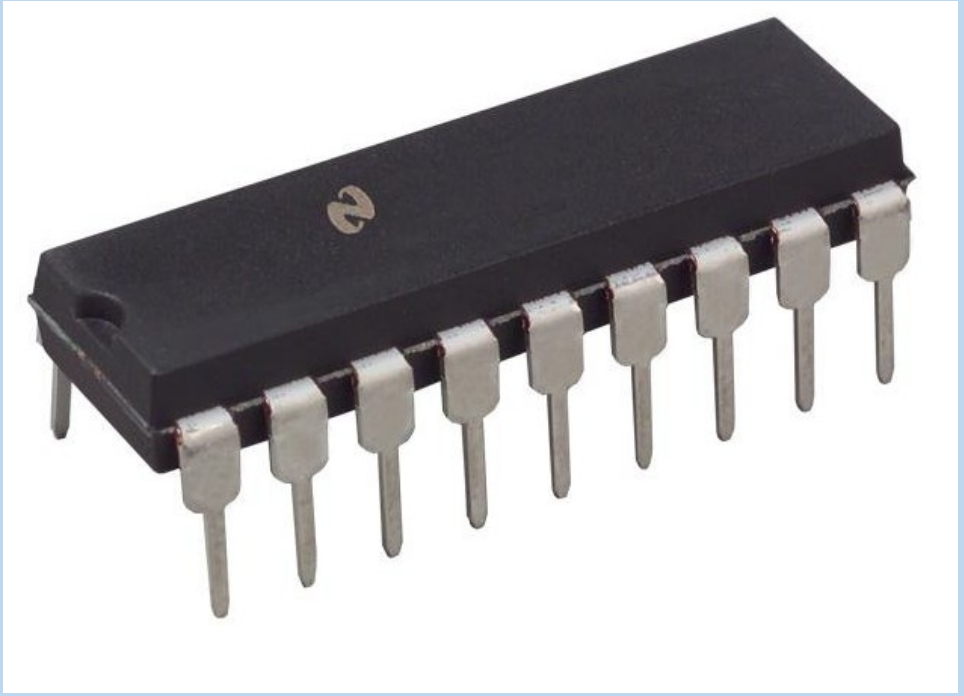
- Timer
- Counter
- Display



Tools...



Breadboard



Integrated Circuits

ogic design??

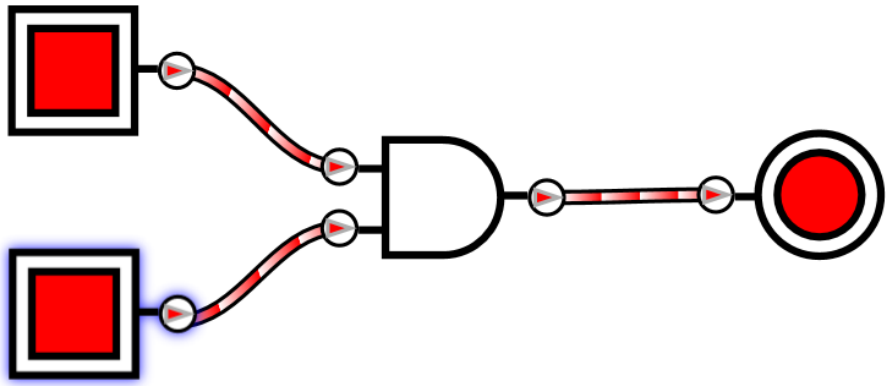
All prebuilt modules..!!
Where’s logic ?
How to implement

Logic Gates

- Used to implement logic in your circuits.

  i.e. to get the desired output from a set of inputs

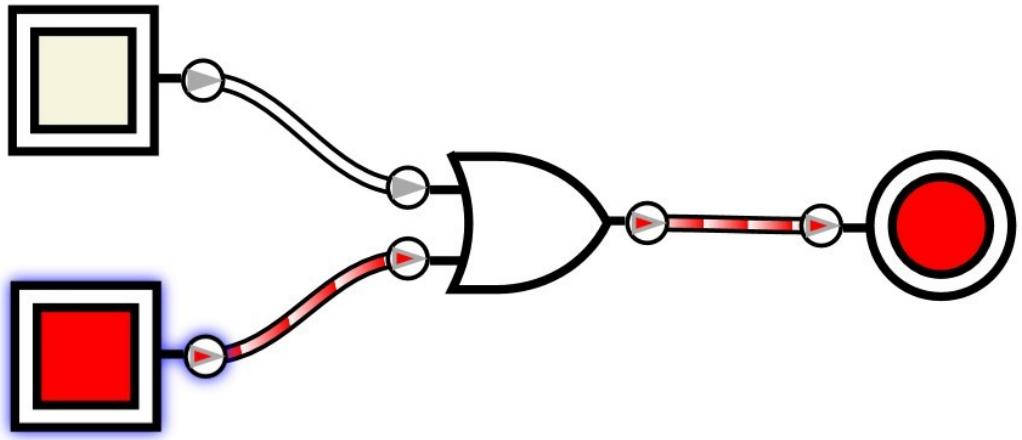
AND Gate (4081)



Truth Table(A.B)

INPUT		OUTPUT
A	B	A AND B
0	0	0
0	1	0
1	0	0
1	1	1

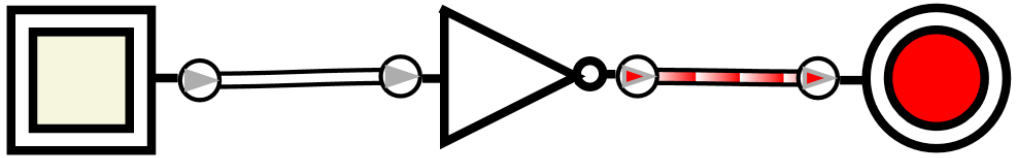
OR Gate(4071)



Truth Table(A+B)

INPUT		OUTPUT
A	B	A AND B
0	0	0
0	1	1
1	0	1
1	1	1

NOT Gate(4069)

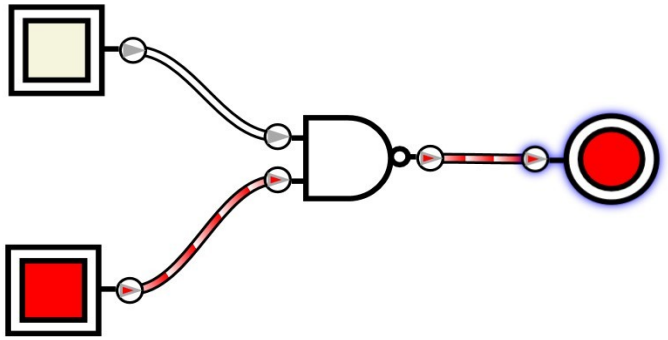


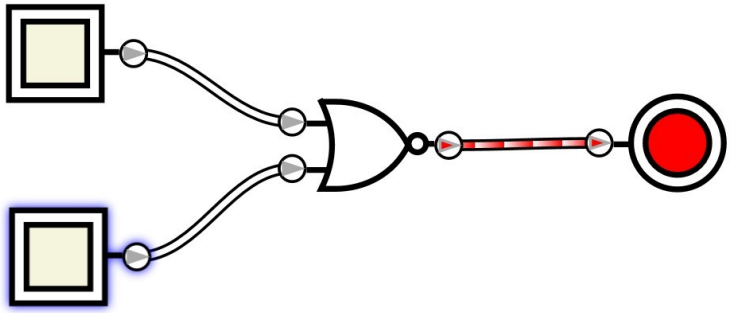
Truth Table(~A)

INPUT	OUTPUT
A	NOT A
0	1
1	0

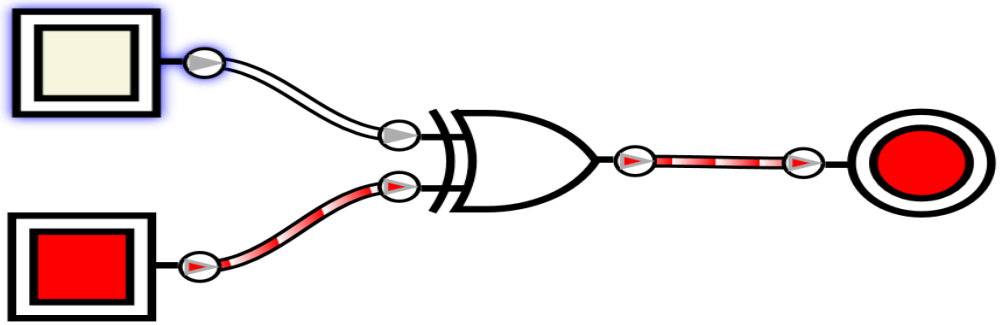
Other Gates

- NAND gate- not of a AND
- NOR gate- nor of a OR





XOR Gate(4070)



Truth Table(A ⊕ B)

INPUT		OUTPUT
A	B	A AND B
0	0	0
0	1	1
1	0	1
1	1	0

Multiplexer(MUX)
And Demultiplexer(DeMux)

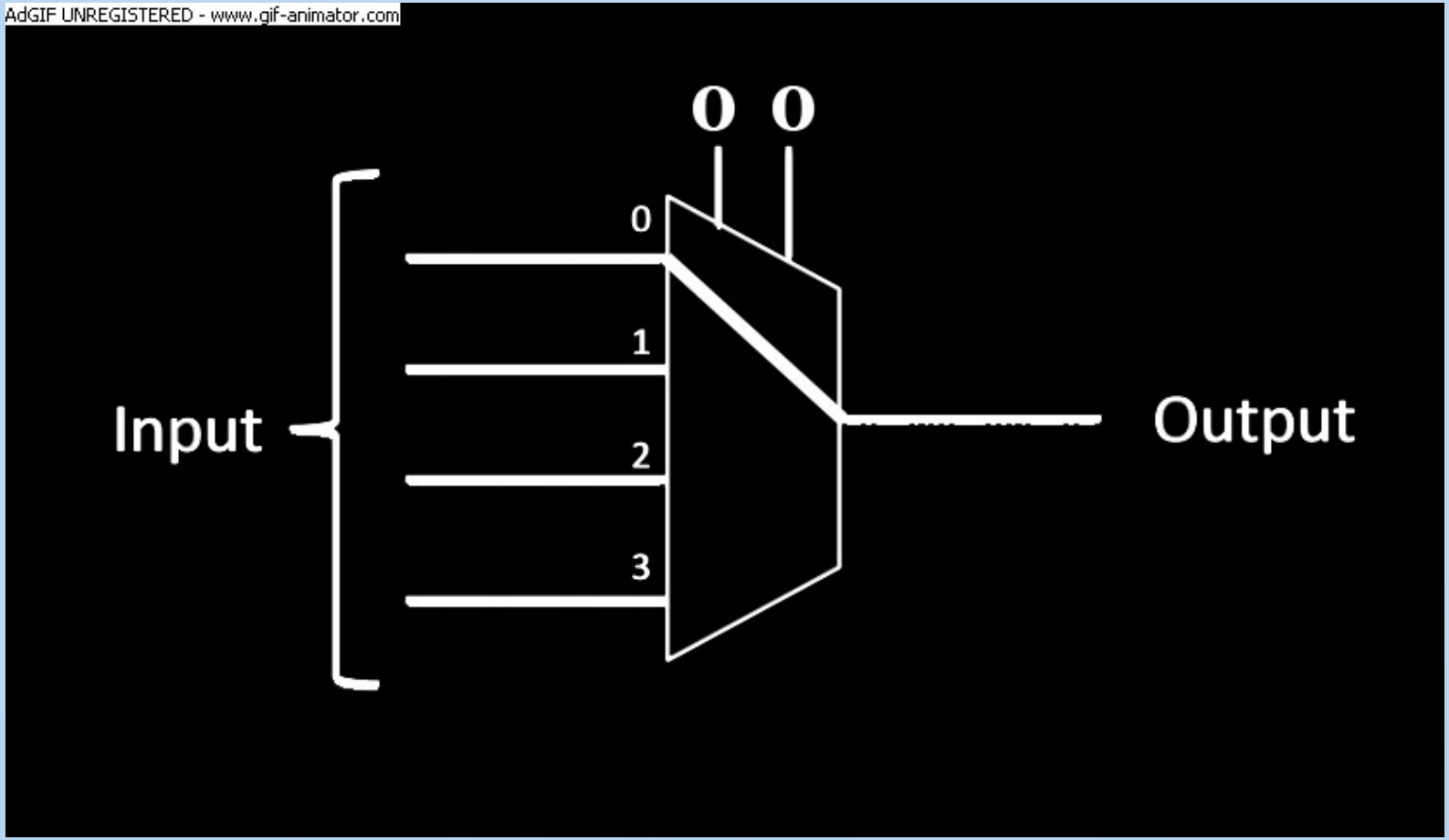
Multiplexer

- Multiple input, one output
- A single input line is connected electrically to

  the output
- The selection of the input line is done via

  separate input

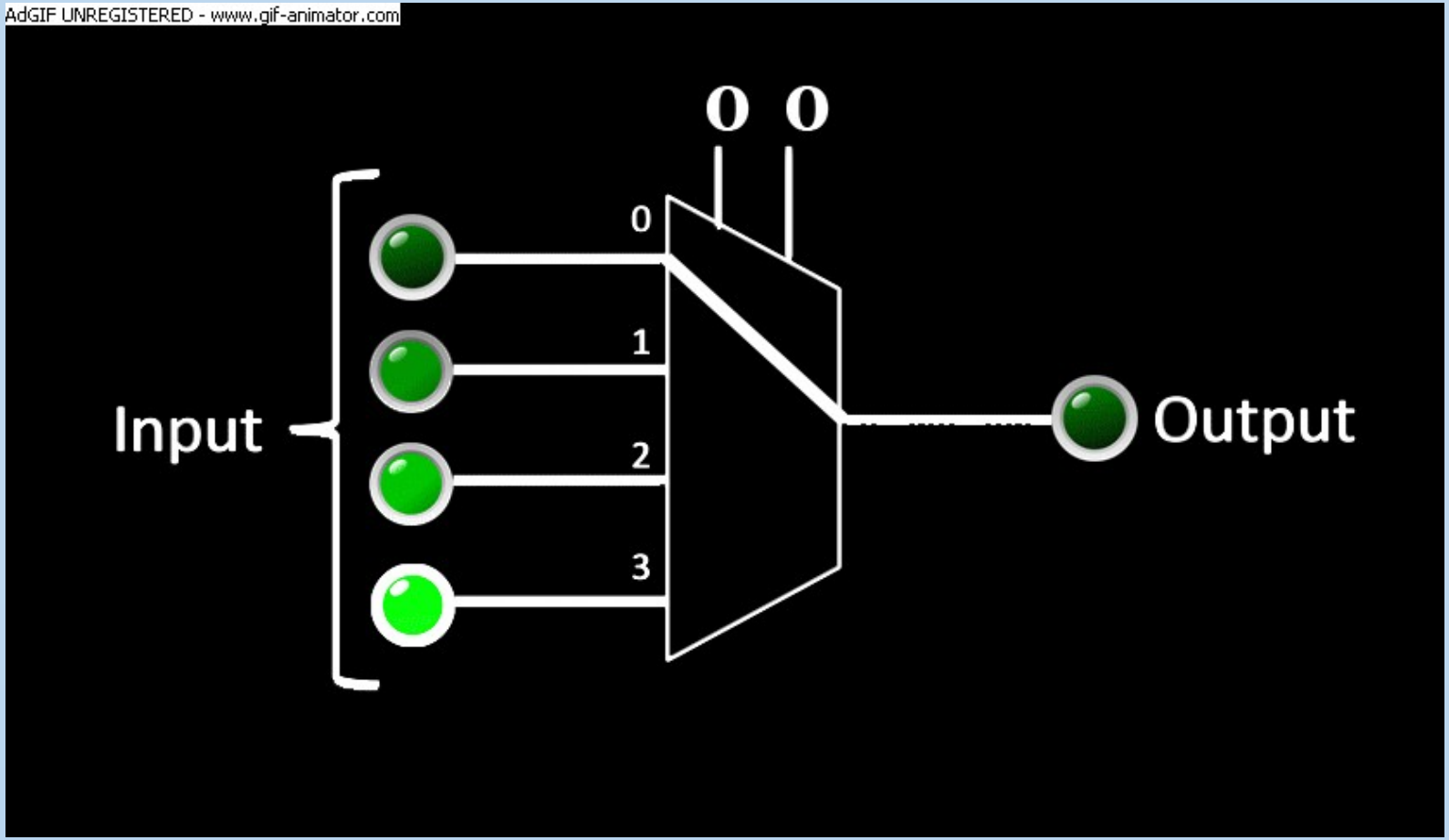
Multiplexer



What do we mean by “Electrical”?

- Connection is analog, not digital
- Any value of voltage is copied to output, and any input current is transmitted to the output
- It is as if the input and output have been shorted by a wire

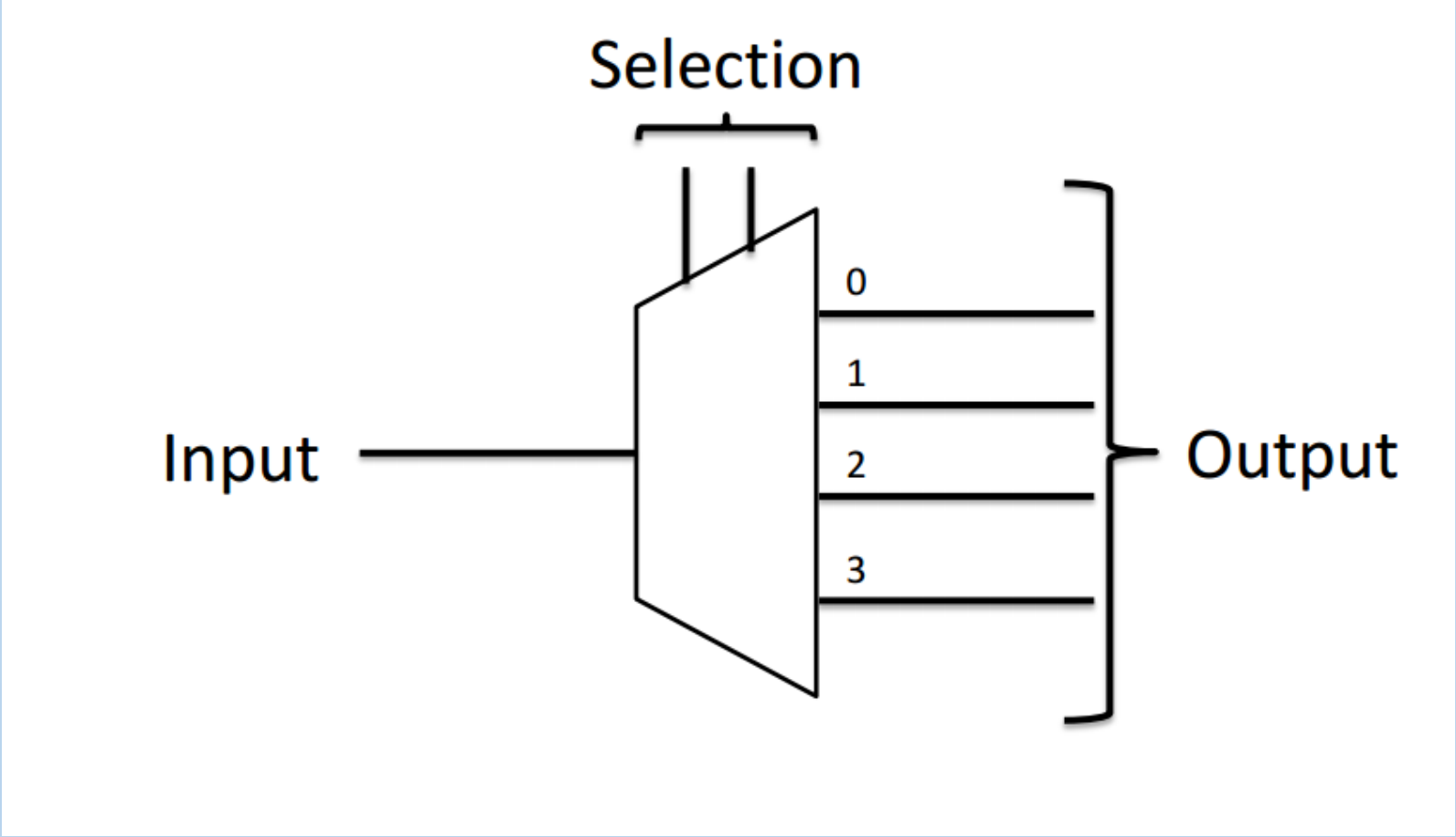
What do we mean by “Electrical”?



Demultiplexer

- Opposite of multiplexing
- Multiple output, single input
- Input is electrically connected to one of the output lines
- Selection of output line is done via separate input

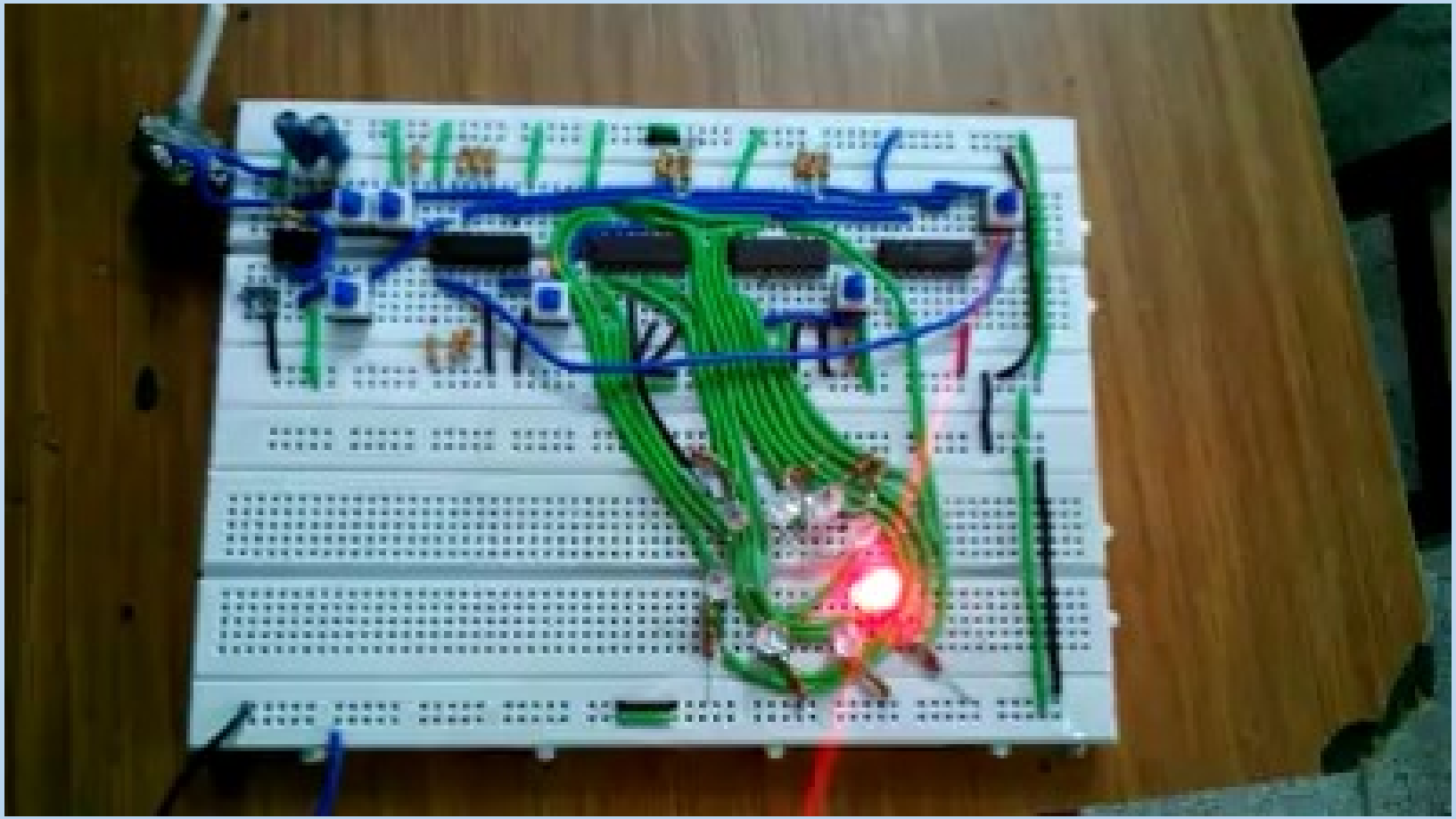
Demultiplexer



What’s the difference?

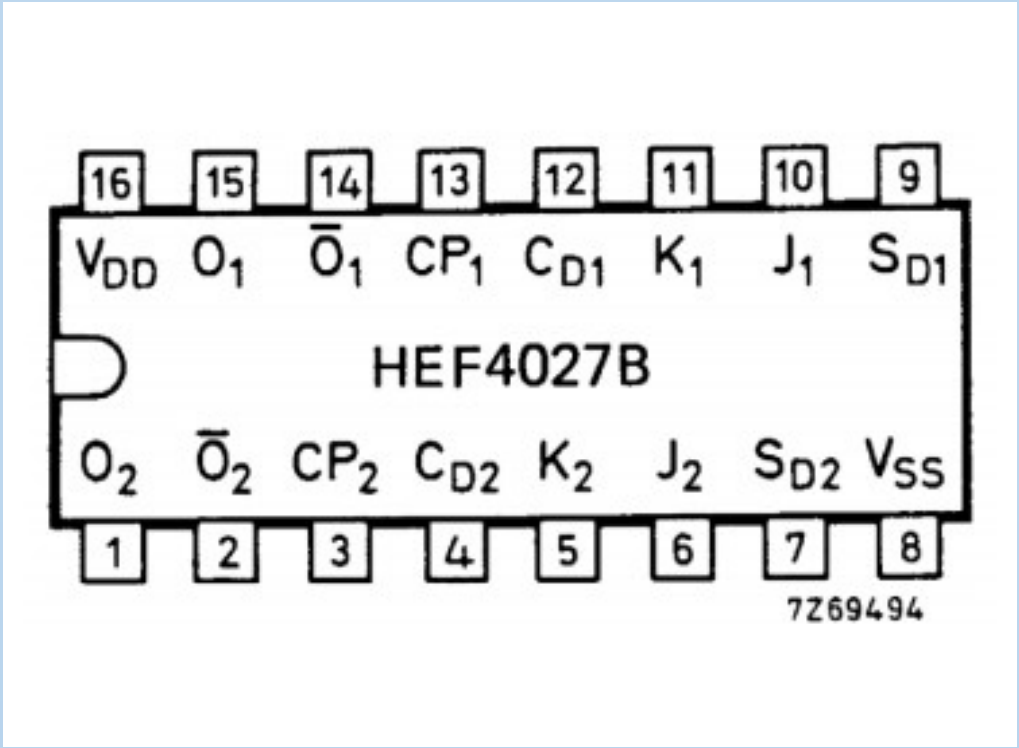
- Since the connection is electrical, same IC can act as multiplexer as well as demultiplexer
- We call this Mux-Demux
- In particular, the above IC is 4052 – a 4 * 1 Mux-Demux
- 4051- 8 * 1 Mux-Demux

Roulette



Designing a Toggle Switch

Flip-Flop



Flip Flops : Truth Table

Inputs					Outputs	
S_d	C_d	CP	J	K	O_{n+1}	$\overline{O}_{n+1}$
H	L	X	X	X	H	L
L	H	X	X	X	L	H
H	H	X	X	X	H	H

In these configurations of S and D , the output of the Flip Flop does not depend on Clock or J, K and is fixed

Inputs					Outputs	
S_d	C_d	CP	J	K	O_{n+1}	$\overline{O}_{n+1}$
L	L	⎍	L	L	O_n	$\overline{O}_n$
L	L	⎍	H	L	H	L
L	L	⎍	L	H	L	H
L	L	⎍	H	H	$\overline{O}_n$	O_n

S and D are kept low to for most of our applications.
Looking at the truth Table , ca you design a toggle switch??

Decimal to binary conversion

- **Encoder (74148)**

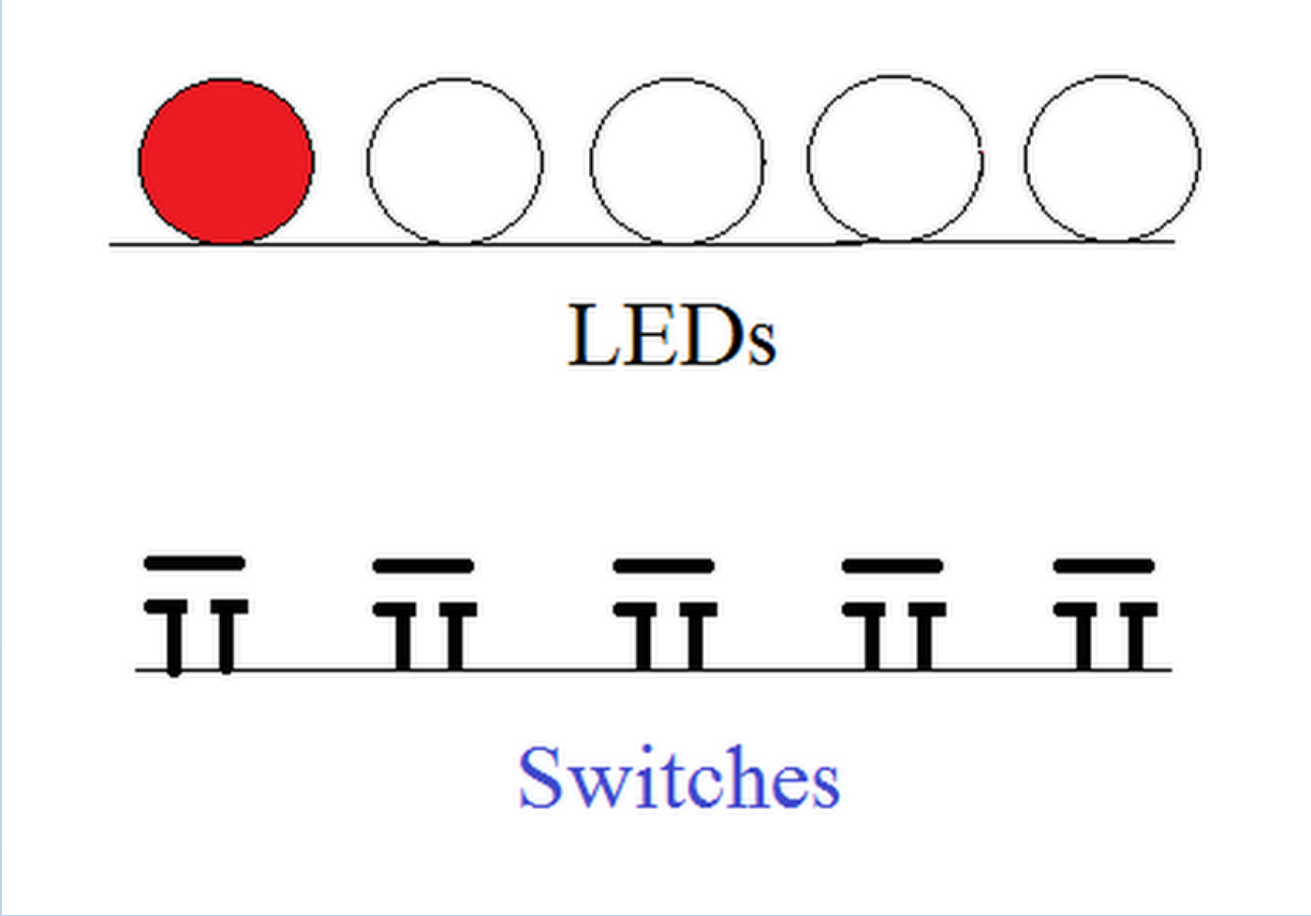
- Converts decimal to 3-bit binary

- High/low voltage on any of the 7 input pins gives corresponding binary representation of the number on output pins.

So far…

- Electronics – Digital and Analog
- Digital Electronics and Binary Number system
- Inter-conversion between Decimal and Binary Number system.
- Clock pulse and 555 timer IC
- 4029 counter IC
- 7447 and BCD
- Logic Gates – AND, OR, NOT, NAND, NOR and XOR
- Multiplexer/Demultiplexer
- Flip-Flop
- Encoder

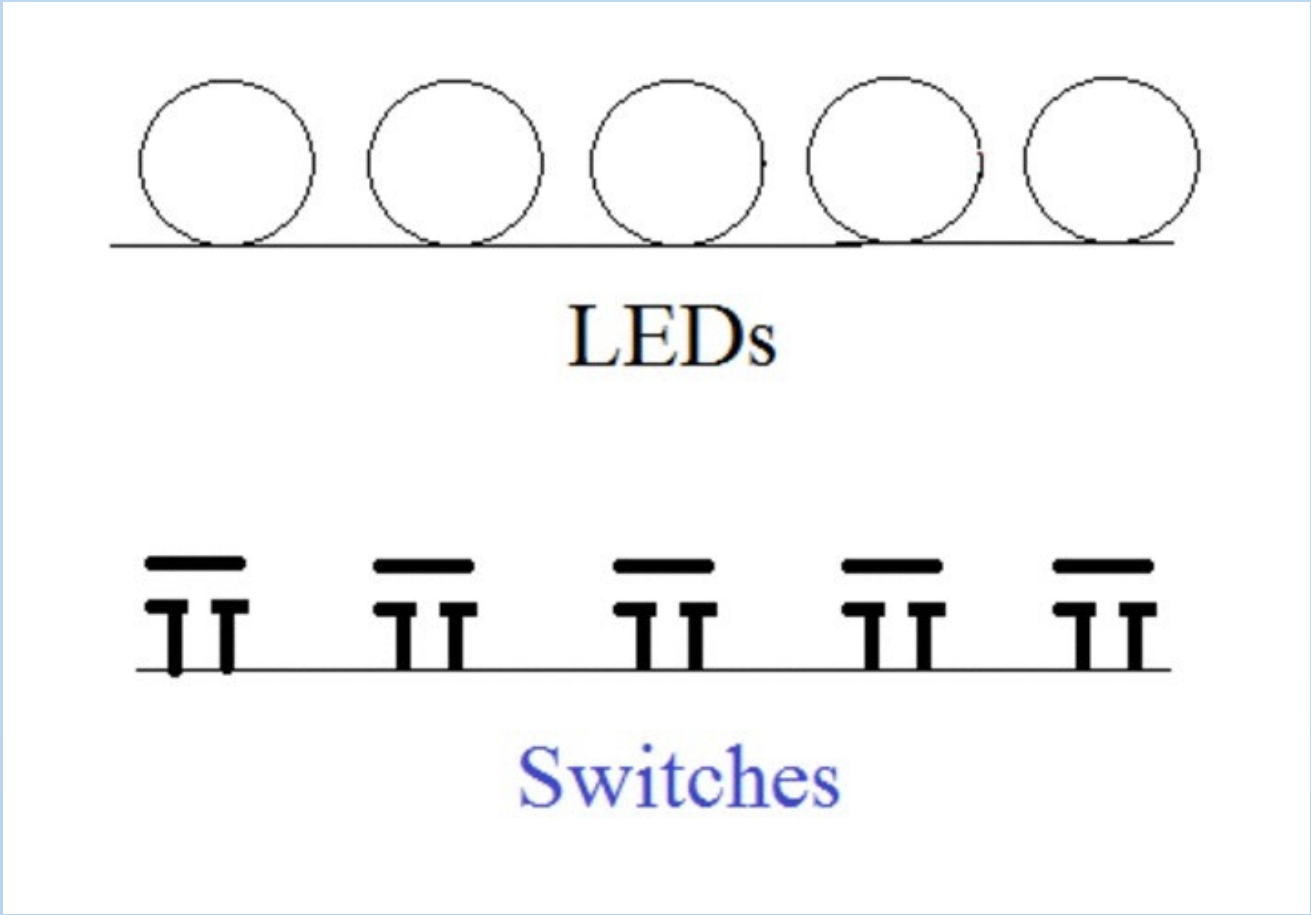
Electromania



Problem Statement

The aim of the competition is to design the game “**Simon Says**” using LED’s to represent the sequence. In this game, a sequence of LED glows randomly and the player has to memorize the sequence. The LED is turned off and now the player has to enter the sequence, which was shown. The game continues in case of a correct sequence guessed and ends otherwise.

Problem Statement



COMPULSARY FEATURES

- **LED array**: Minimum of five LEDs to display the sequence.
- **Sequence Input**: Five switches corresponding to each LED.
- **Minimum sequence length**: Your circuit must work for sequence length of at least one LED i.e. you should display any one LED randomly out of the 5 LEDs and then player needs to press the corresponding switch to win the game.

ADDITIONAL FEATURES

- **Sequence length** to be memorized can be increased up to 5.
- **Scoring mechanism** to count the number of correct sequence entered.
- These are just some of the additional features. Apart from these, any other innovative additional features can be implemented.

Eligibility & Team structure

- Students belonging to **Y13 batch of any program** (B.Tech , M.Tech etc.) are eligible.

- Team strength should be **minimum 3 and maximum 4**.

- No restrictions on number of teams from a pool. Though all members of a single team should belong to the same pool.

For other rules and further details visit :-

http://students.iitk.ac.in/takneek/2013/events/ps/Electromania.pdf

Why participate in Electromania ??

Circuit design process…

Deciding the logic and

preparing a block diagra

Circuit design process...

Making hardware connection
and actual implementat

Circuit design process…

Learn from mistakes..

Circuit design process...

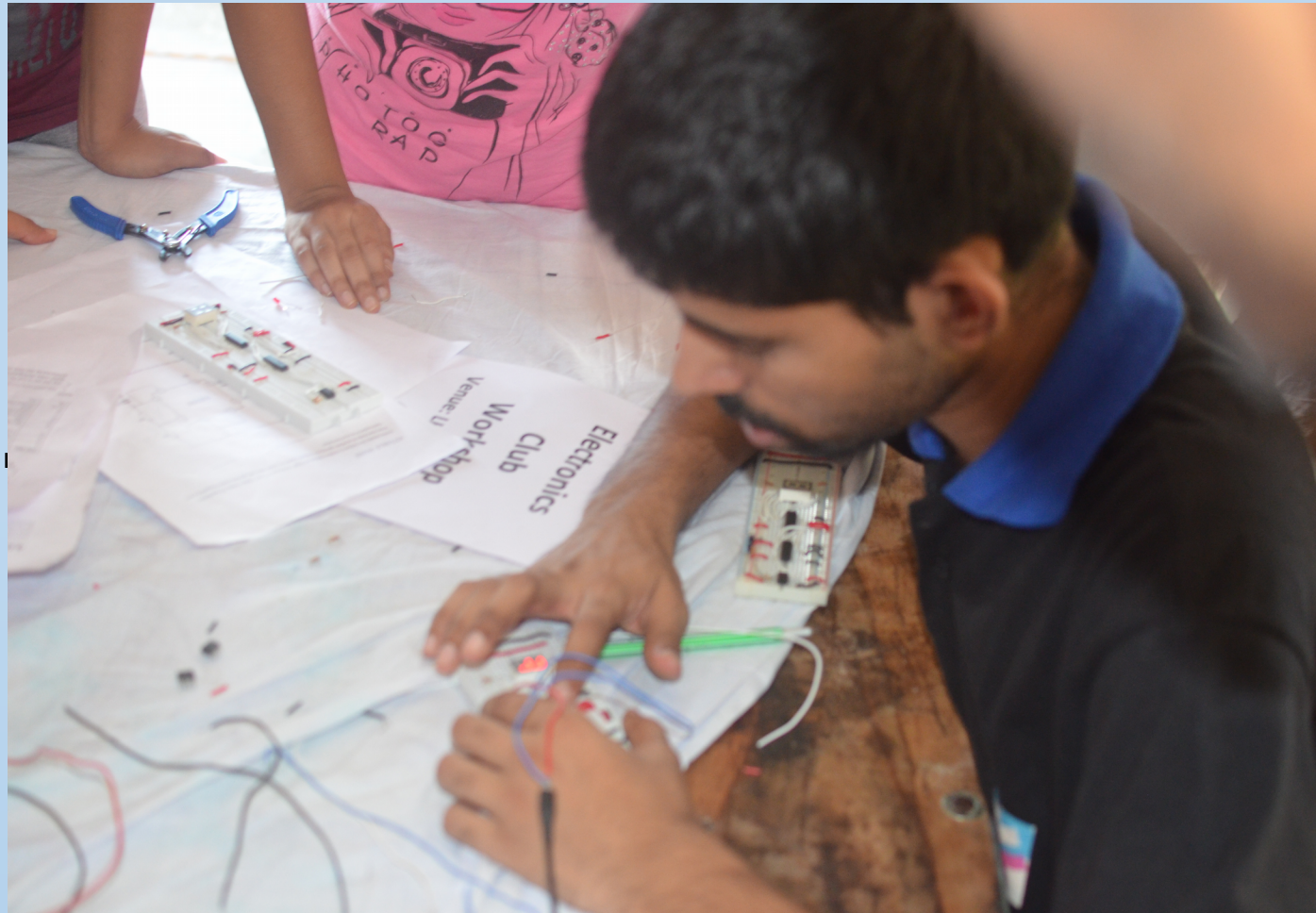
All it requires is...

A bit of patience..!!

Circuit design process...

Challenge of

Debugging...



Circuit design process...

and then the

The final Deli

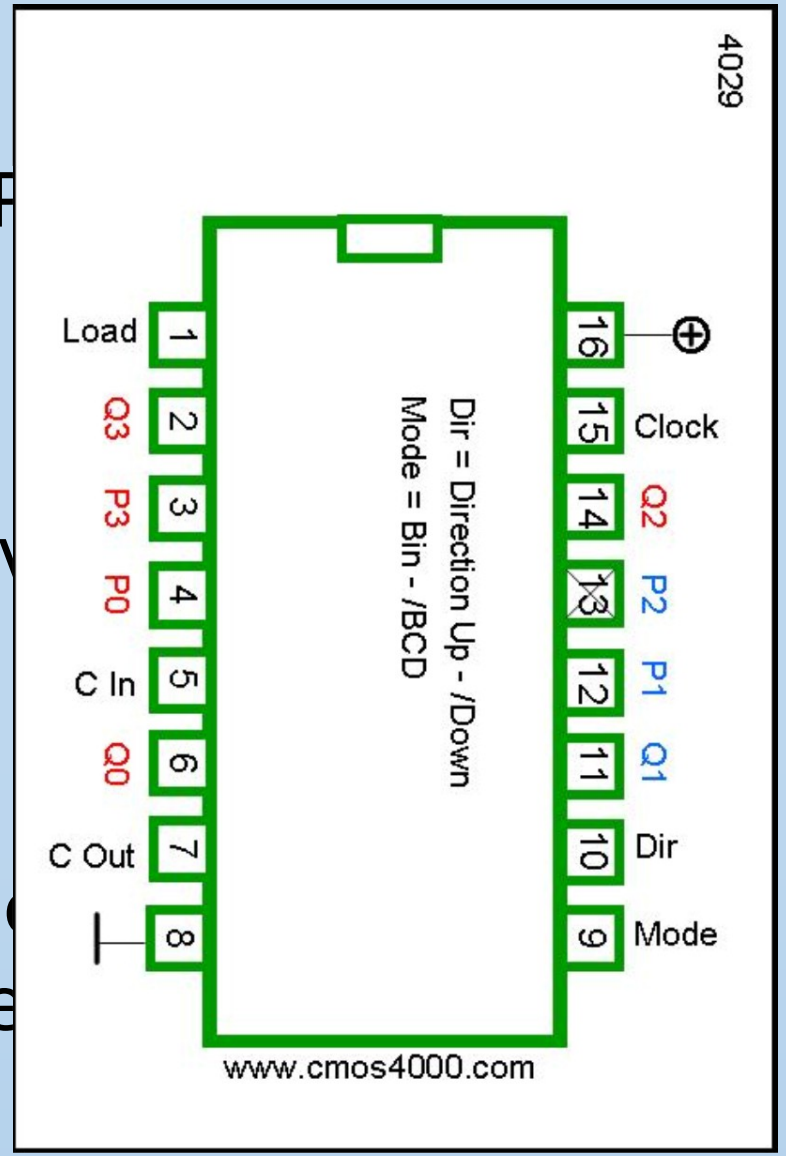
A few things yet to cover....

4029 revisited

- **Parallel load** - Loads the value of P
  Input bit into the output bits.

- **TC bar –** Generates a clock pulse at ev
  Counter overflow

- **Up/Down mode** – Can be used to in
  decrement at every clock pulse



Using a switch

- Never leave a input pin unconnected.

- Pull Up/Pull Down.

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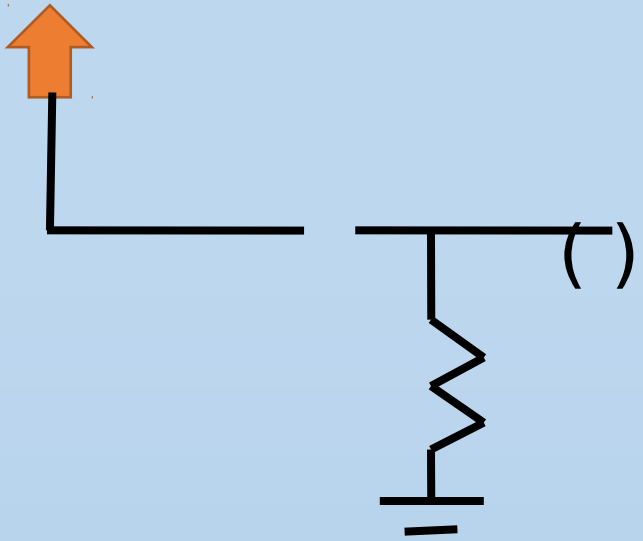

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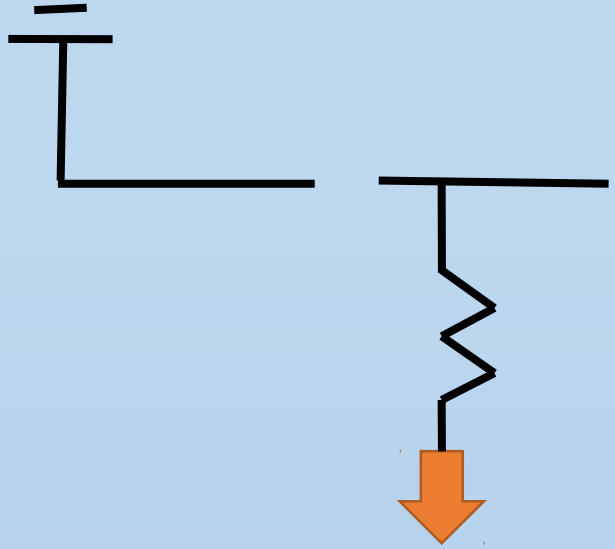

DOs DON’Ts

- Make tight connections. *Don’t leave input pins unconnected
- Use proper wire convention. *Never control power pin of IC
- Use gates to combine outputs. *Never connect outputs directly
- Test the circuit regularly before making major changes.

- Keep in contact with Hall Secys(http:// students.iitk.ac.in/eclub/contact.php)


SO ... DO YOU HAVE ANY
QUESTIONS FOR ME?

Thanks ❞

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