



IIT KANPUR



ELECTRONICS CLUB

Electromania Problem Statement Discussion

An Competition

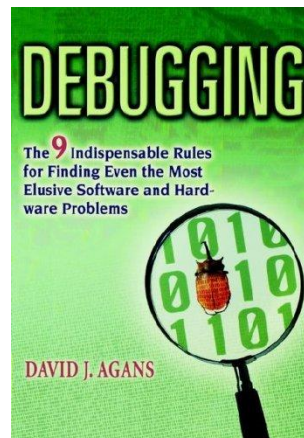


Basic Circuiting

What is Electromania?



Innovation



Debugging



Lets Revise the Basics...

Electronics

- Digital



- Analog



Digital Electronics

- Similar to switches
- Consists of only two states
- Low corresponds to 0V
- High corresponds to 5V



Binary Number System

1 0 1 1
↑ ↑ ↑ ↑
Eights Fours Twos Ones

2^0 = ones
 2^1 = twos
 2^2 = fours
 2^3 = eights

$$1*8 + 0*4 + 1*2 + 1*1 =$$
$$1*8 + 1*2 + 1*1 = 11 \text{ (base-10)}$$

$$11 \text{ (base-10)} = 1011 \text{ (base-2)}$$

Clock Pulse

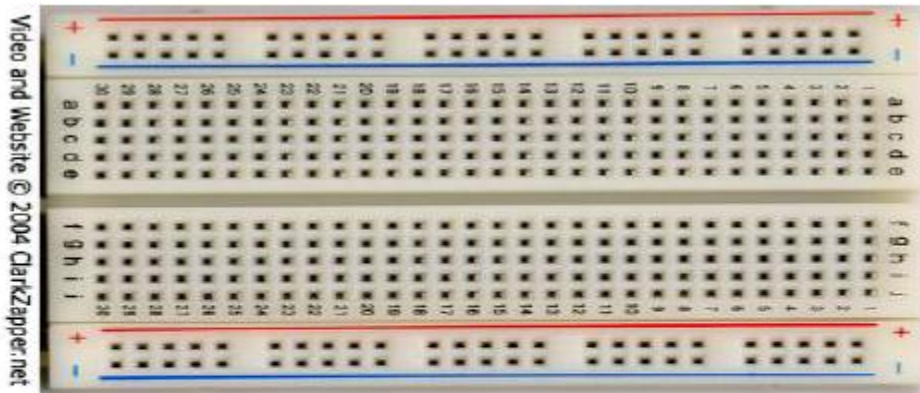
- Clock has 2 components :-

- Rising Edge 

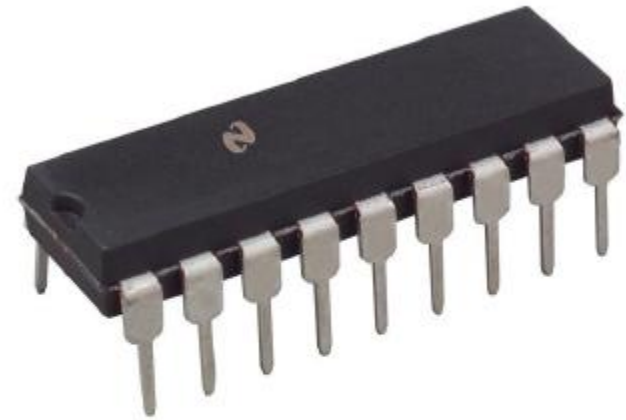
- Falling Edge 

- CLK 

Basic Tools In Circuit



BreadBoards



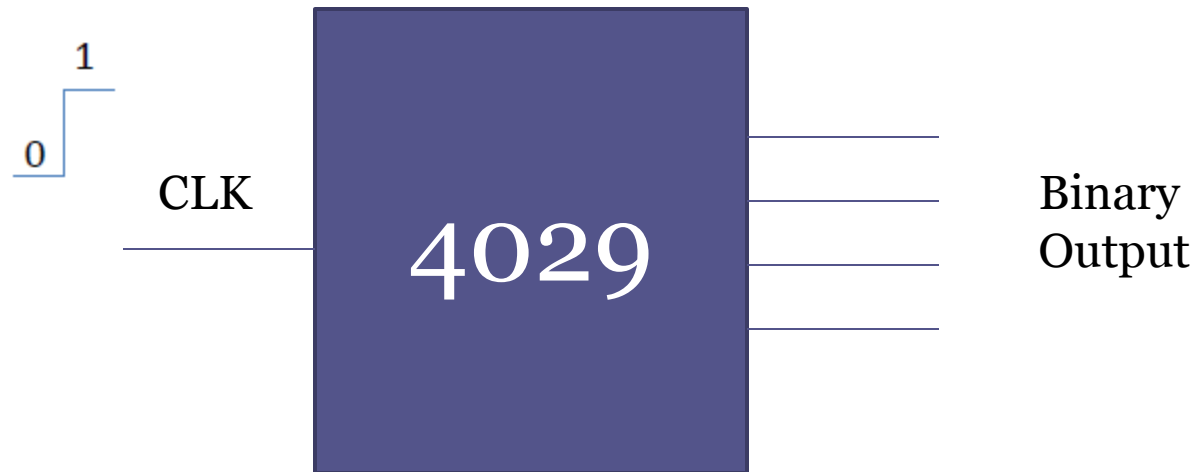
Integrated Circuits

How do we Count?

4029 counter

- Has one input pin, 4 output pins
- Output is always a binary number x
- When a rising edge (transition from LOW to HIGH) is detected on the input pin (CLK), output is incremented by 1 to $(x + 1)$
- After reaching maximum value, on detecting a rising edge on input, output reverts to 0

4029 counter

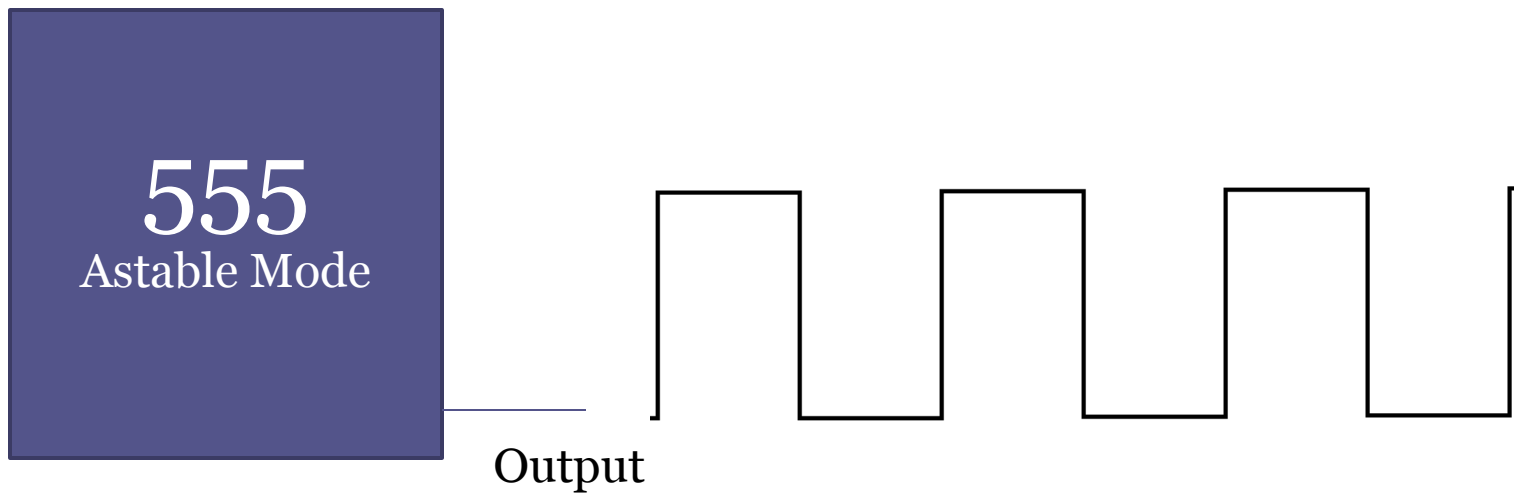




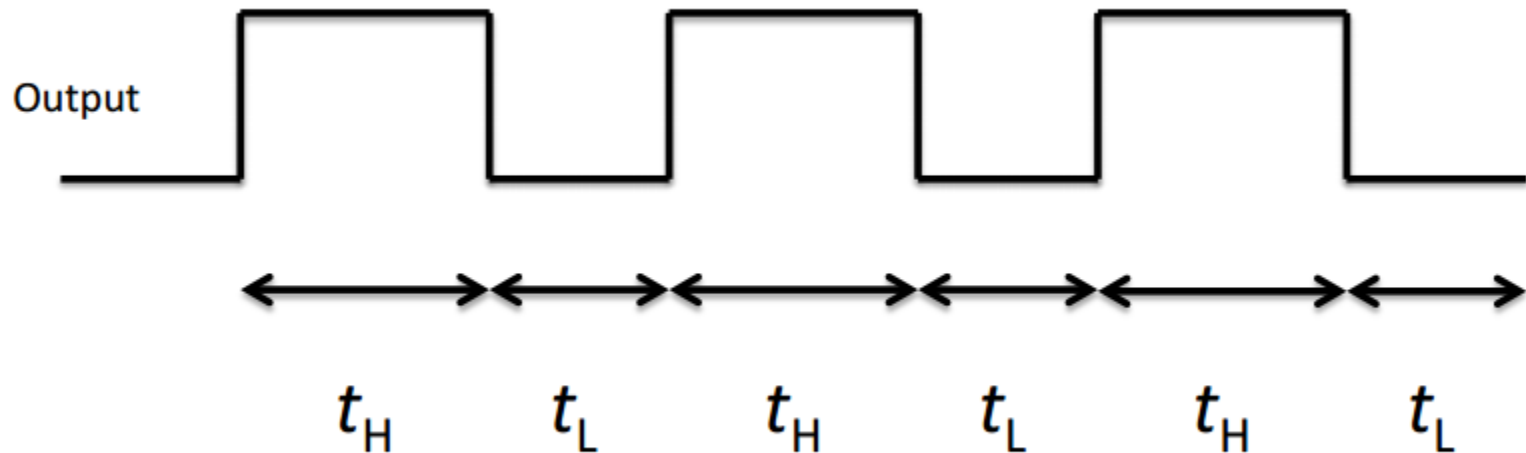
How to generate Clock ?

555 : Astable Mode

Generates Clock pulses continuously



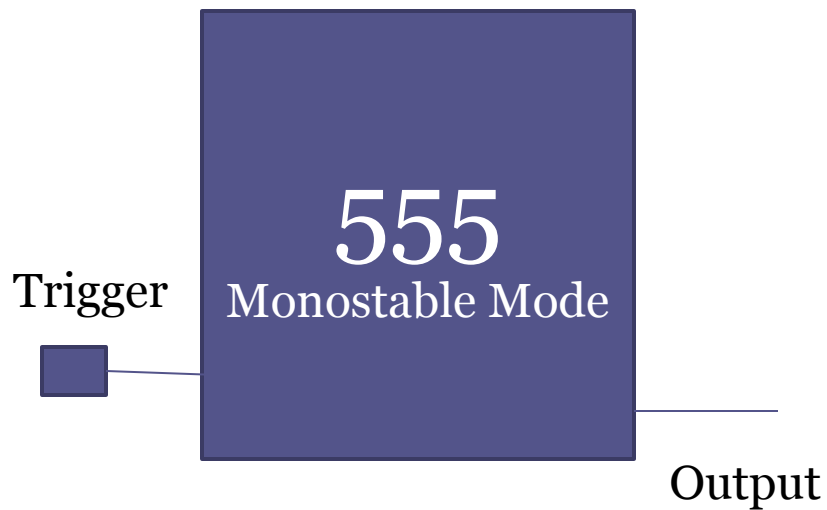
555 : Astable Mode



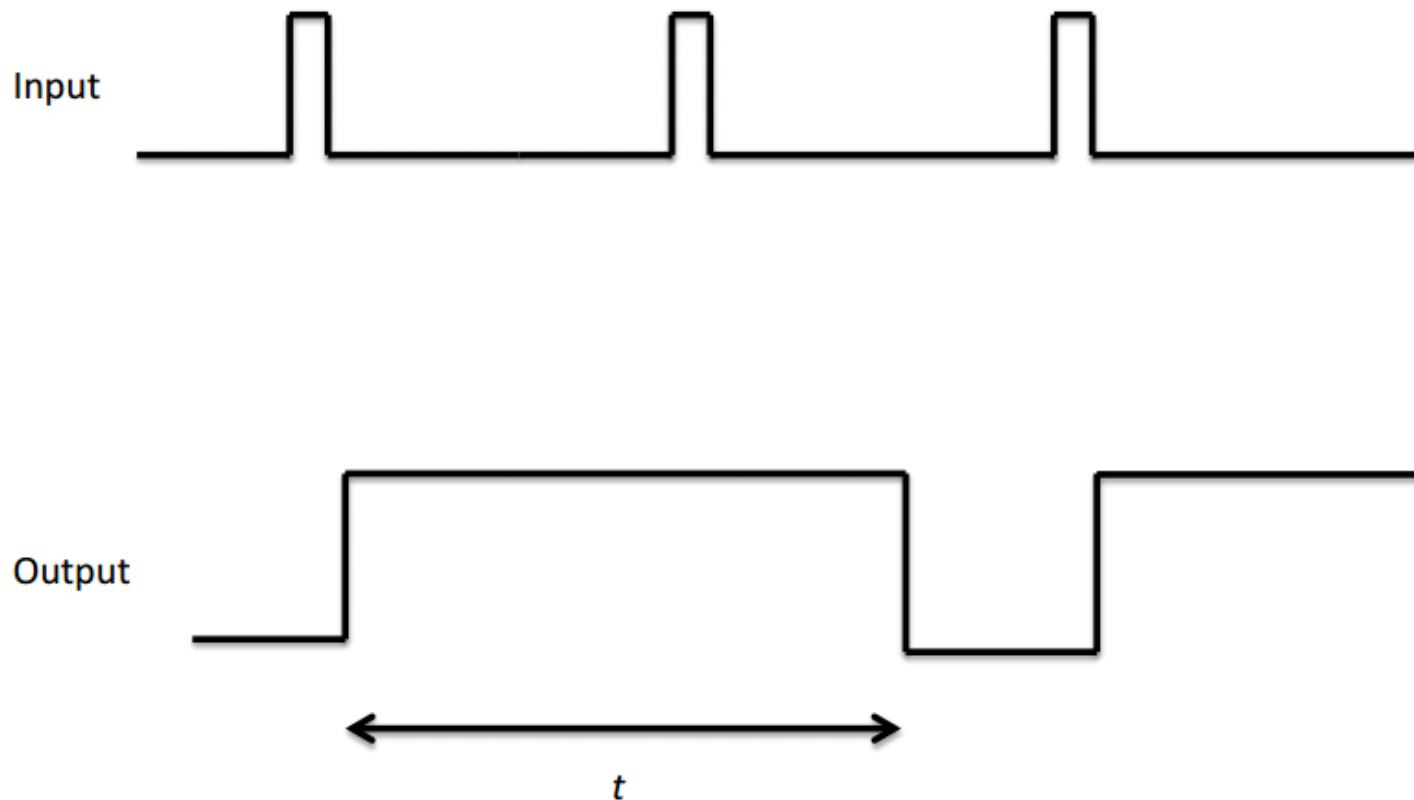
The high time t_H and low time t_L can be set according to the resistors and capacitors connected to 555

555 : Monostable Mode

Generates Clock pulse when triggered

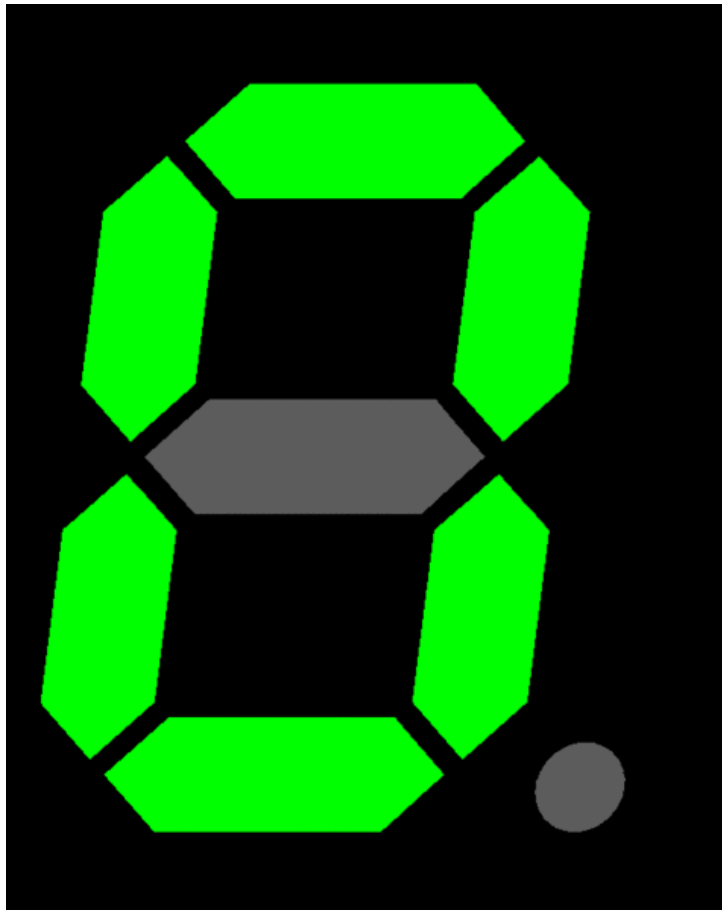


555 : Monostable Mode



The time t can be set according to the resistors and capacitors connected to 555

Display



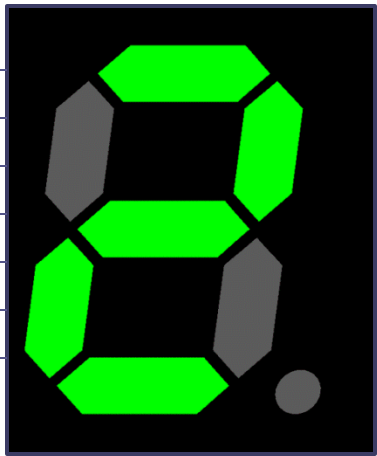
7 Segment Display

4029

4 bits

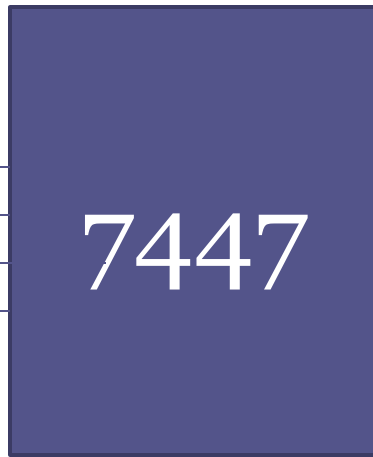
??

7 LEDs

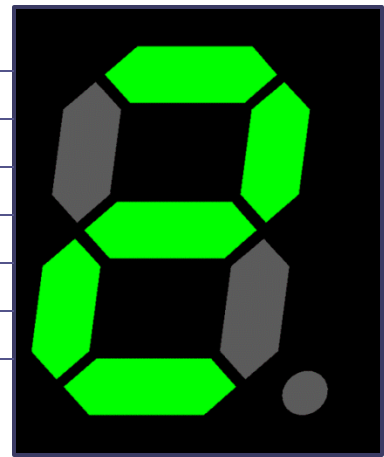




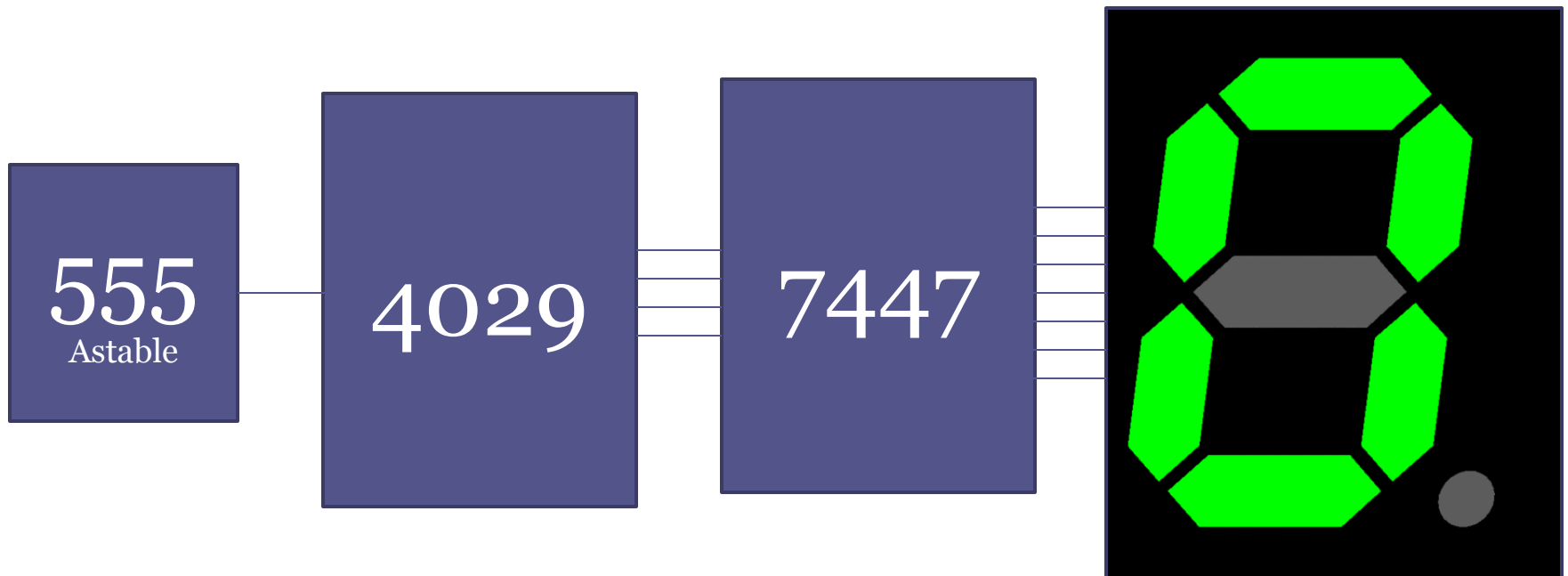
4 bits



7 LEDs



Final Circuit



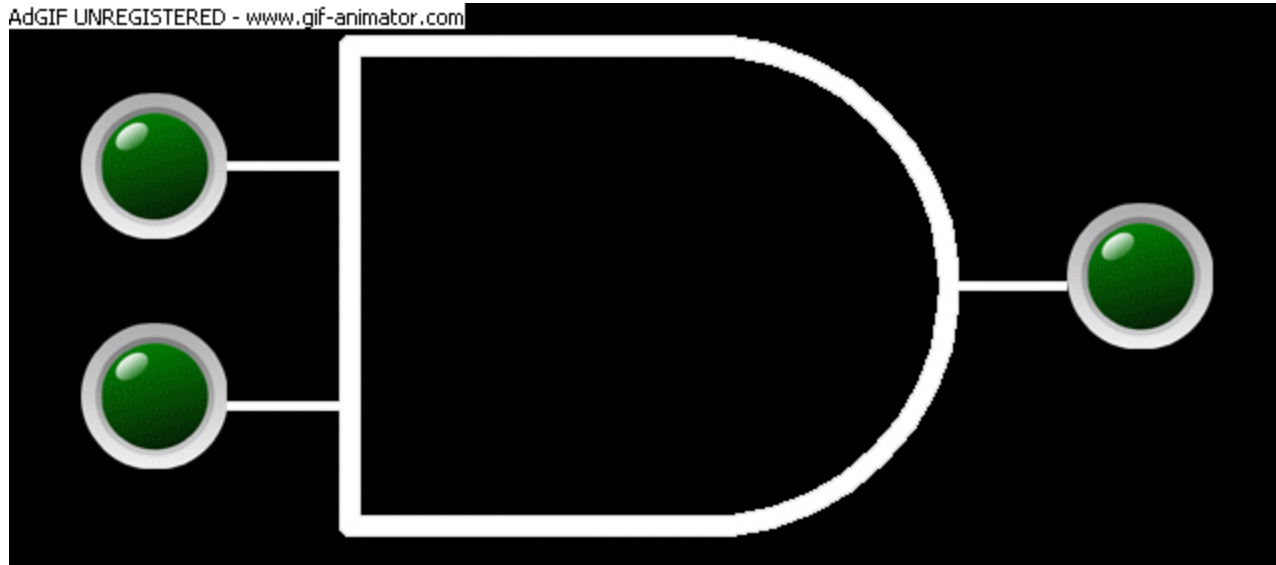
Logic Gates

Logic Gates

- Used to implement logic in your circuits.
i.e. to get the desired output from a set of inputs

And Gate(4081)

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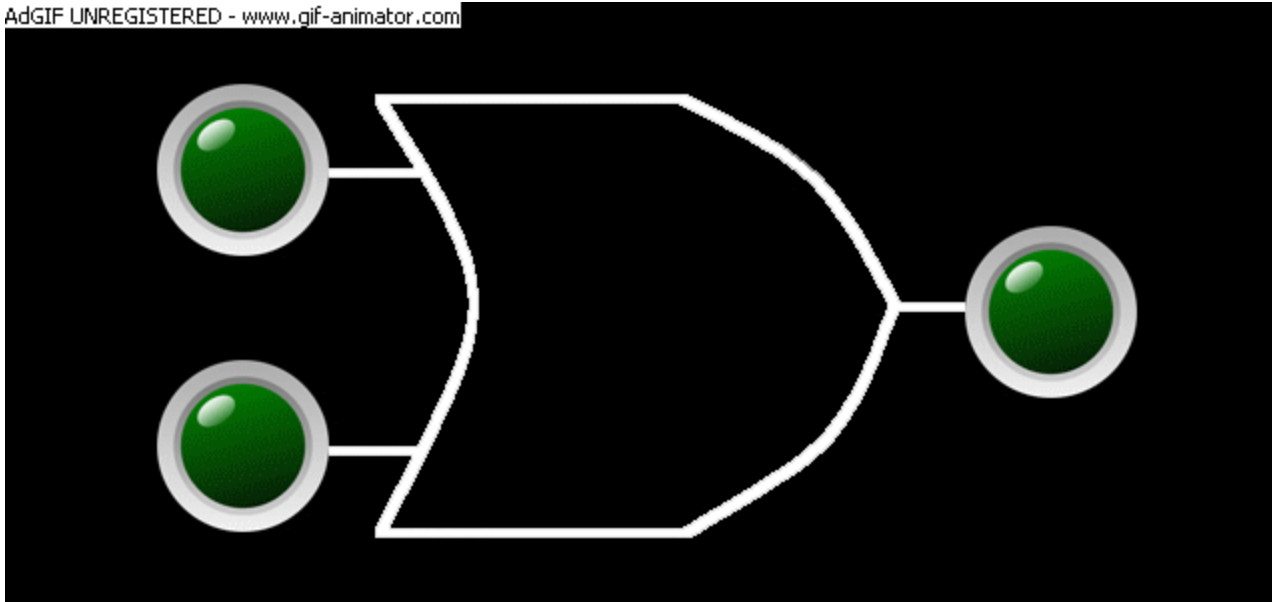


Truth Table(A.B)

INPUT		OUTPUT
A	B	A . B
0	0	0
0	1	0
1	0	0
1	1	1

OR Gate(4071)

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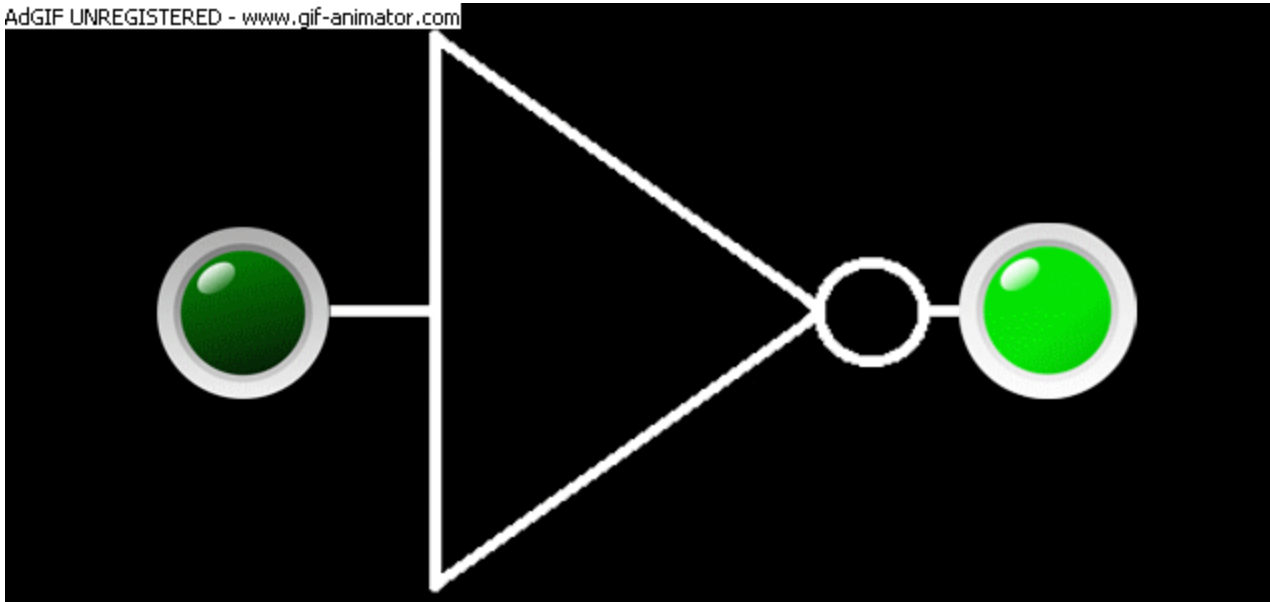


Truth Table(A+B)

INPUT		OUTPUT
A	B	A + B
0	0	0
0	1	1
1	0	1
1	1	1

NOT Gate(4069)

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Truth Table(\bar{A})

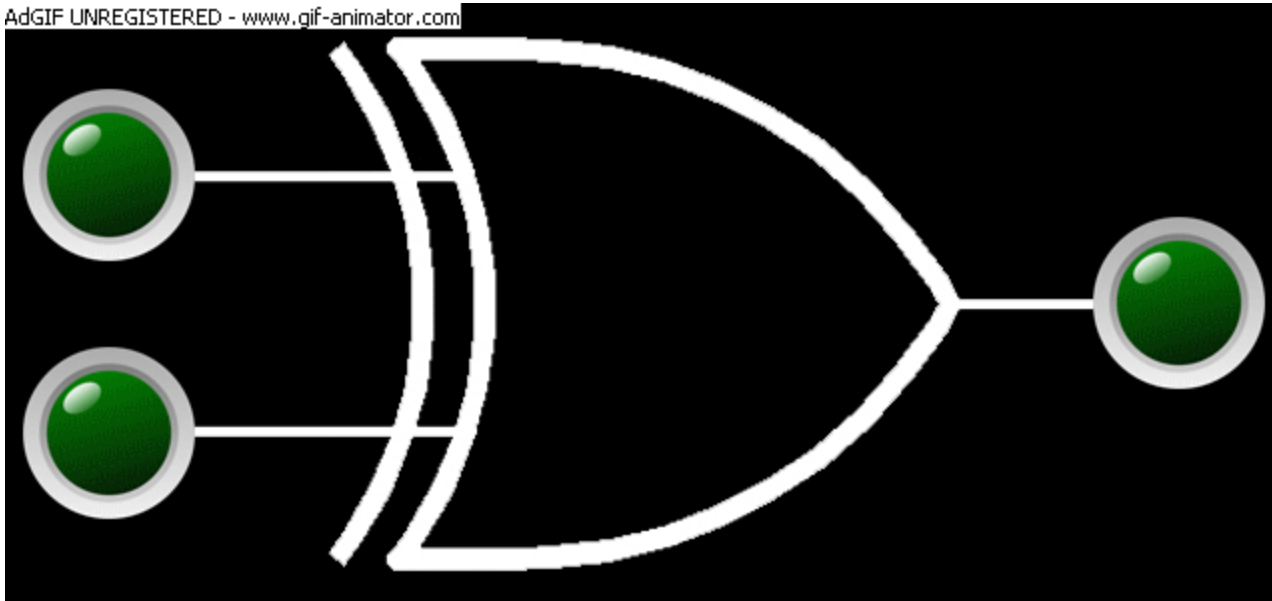
INPUT	OUTPUT
A	\bar{A}
0	1
1	0

Other gates

- NAND – Not of AND
- NOR – Not of OR
- XOR – Exclusive OR

XOR Gate(4070)

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Truth Table ($A \oplus B$)

INPUT		OUTPUT
A	B	A XOR B
0	0	0
0	1	1
1	0	1
1	1	0

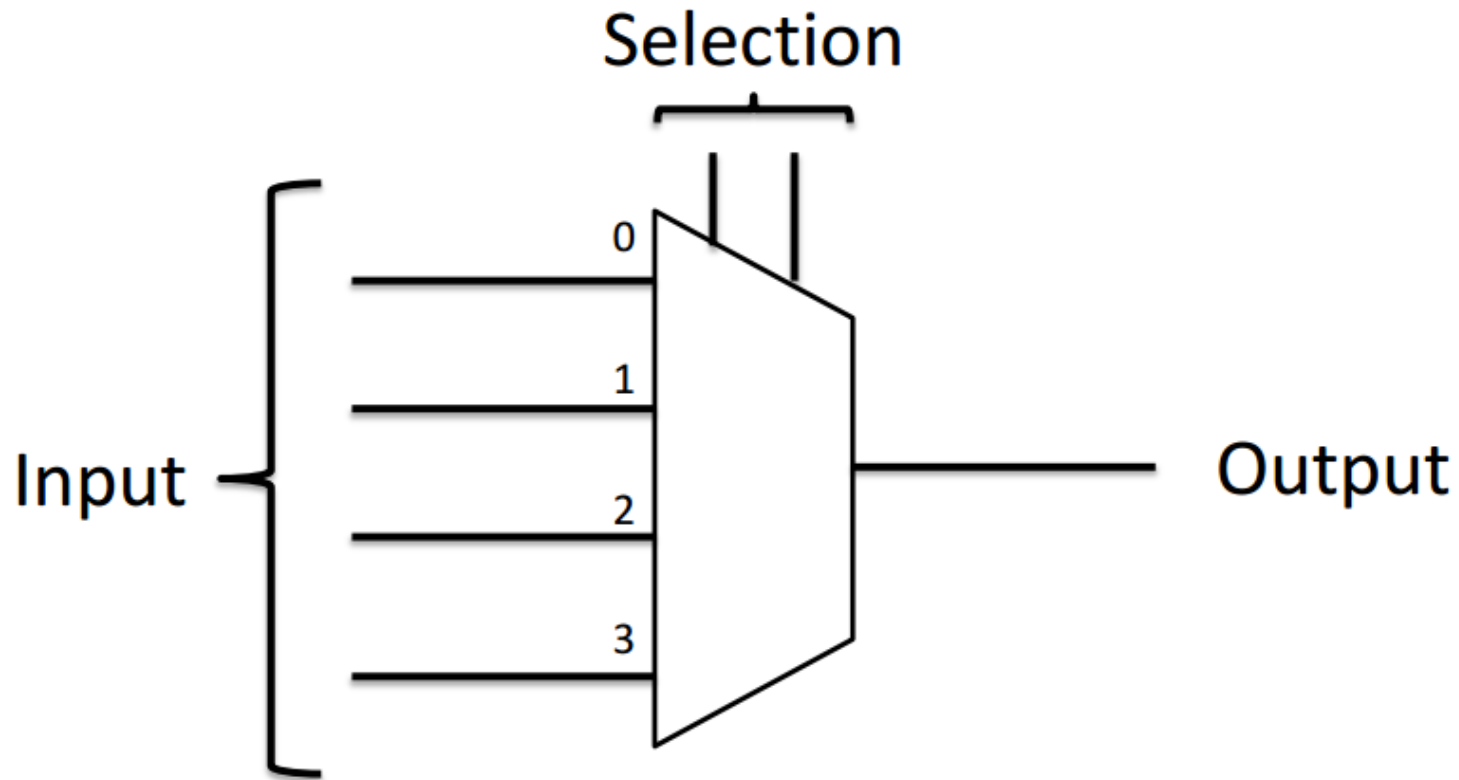


Multiplexer(MUX) And Demultiplexer(DeMux)

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

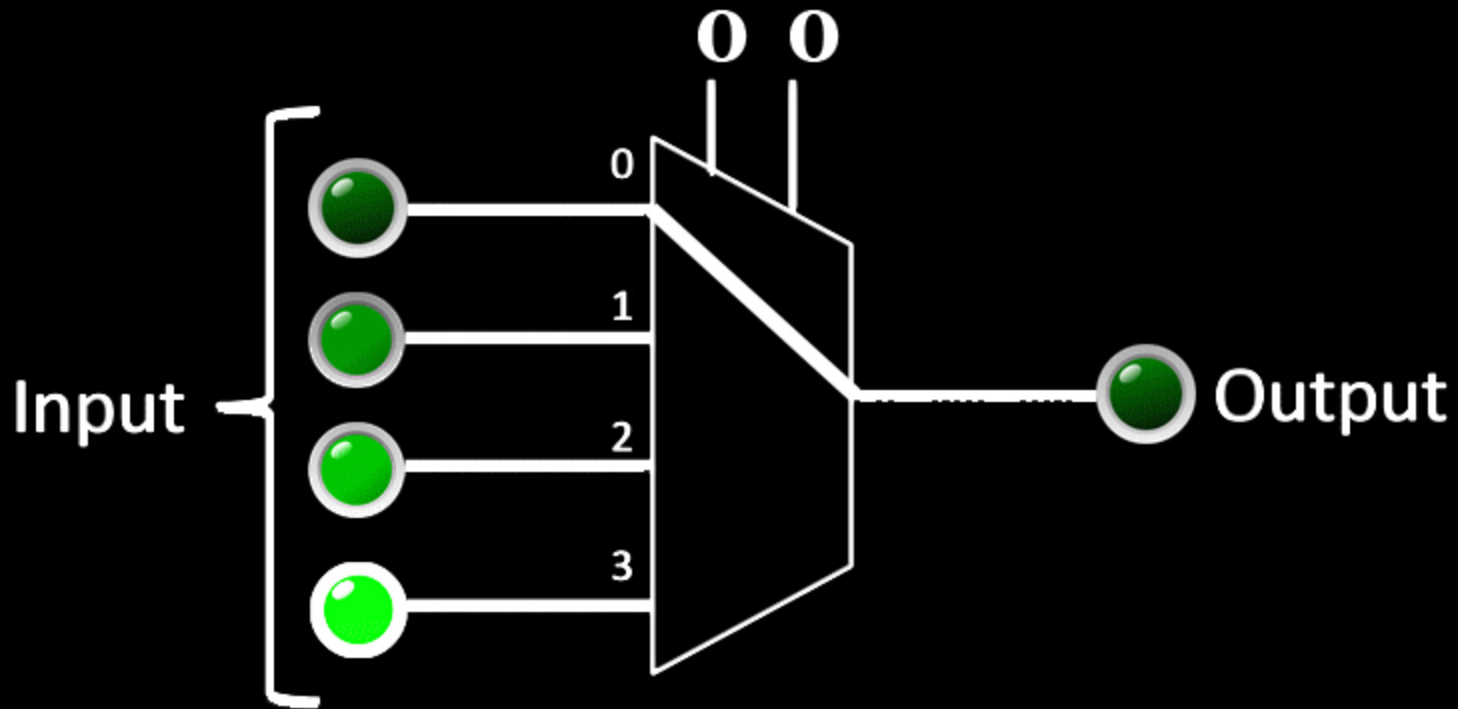


What do we mean by “Electrical”?

- 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”?

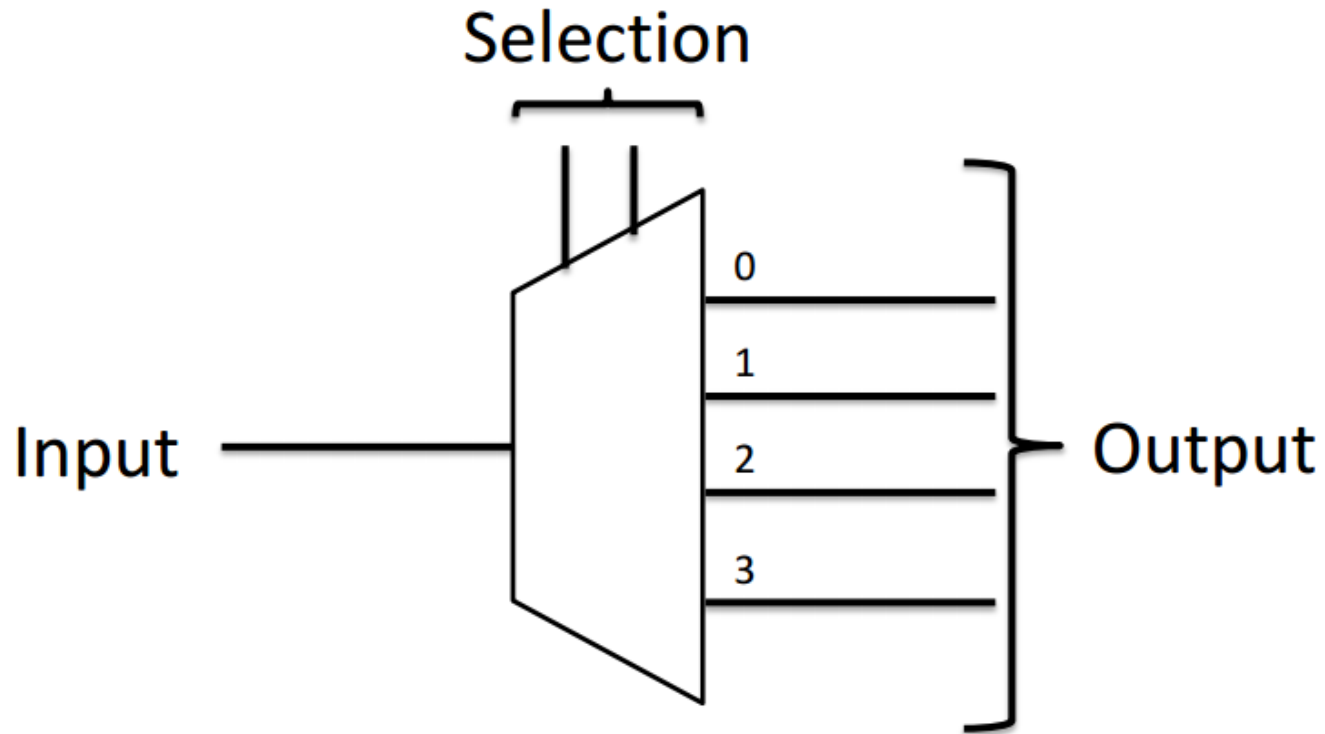
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Demultiplexer

- 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

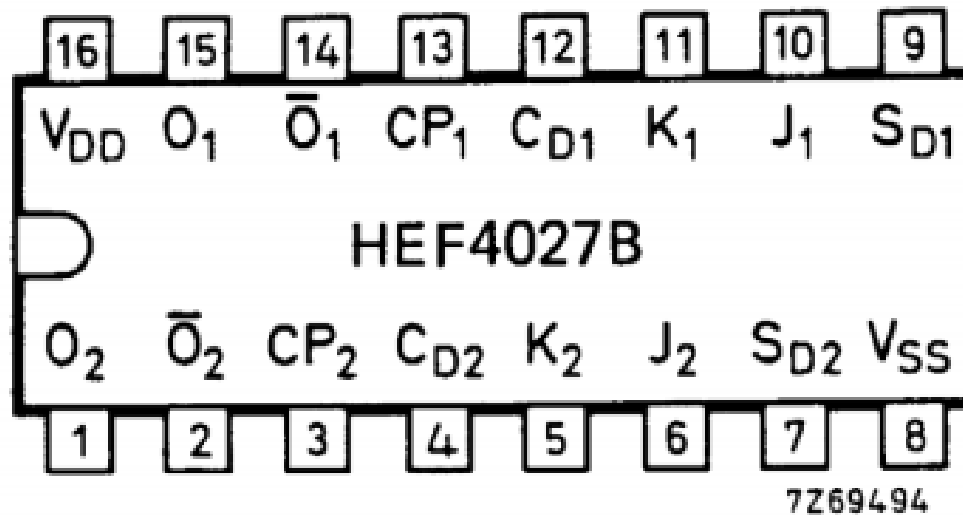
Electrovate Results

Flip Flops

Flip Flops

- Can be used as toggle switches
- One clock input, one output
- On receiving pulse on input, output “toggles”

Flip Flops : Pin Diagram



Flip Flops : Truth Table

Inputs					Outputs	
S_d	C_d	CP	J	K	O_{n+1}	\bar{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

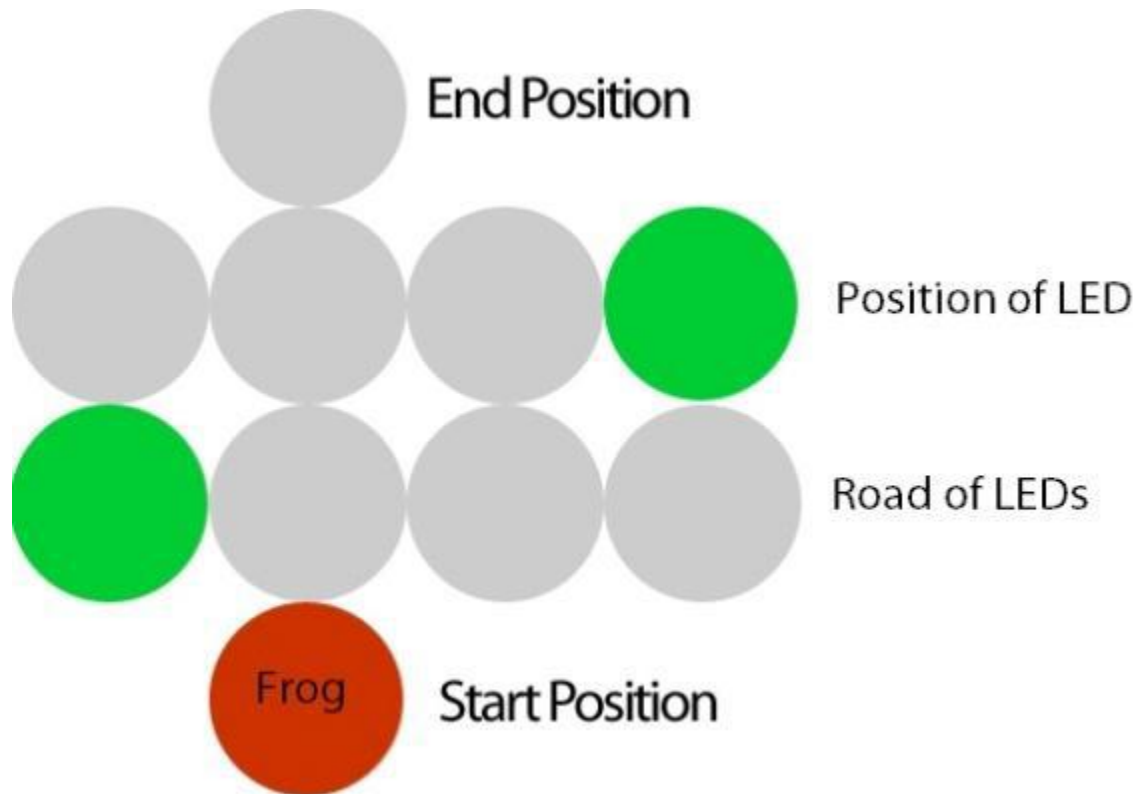
Flip Flops : Truth Table

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

S and D are kept low to for most of our applications.

Looking at the truth Table , can you design a toggle switch??

Problem Statement

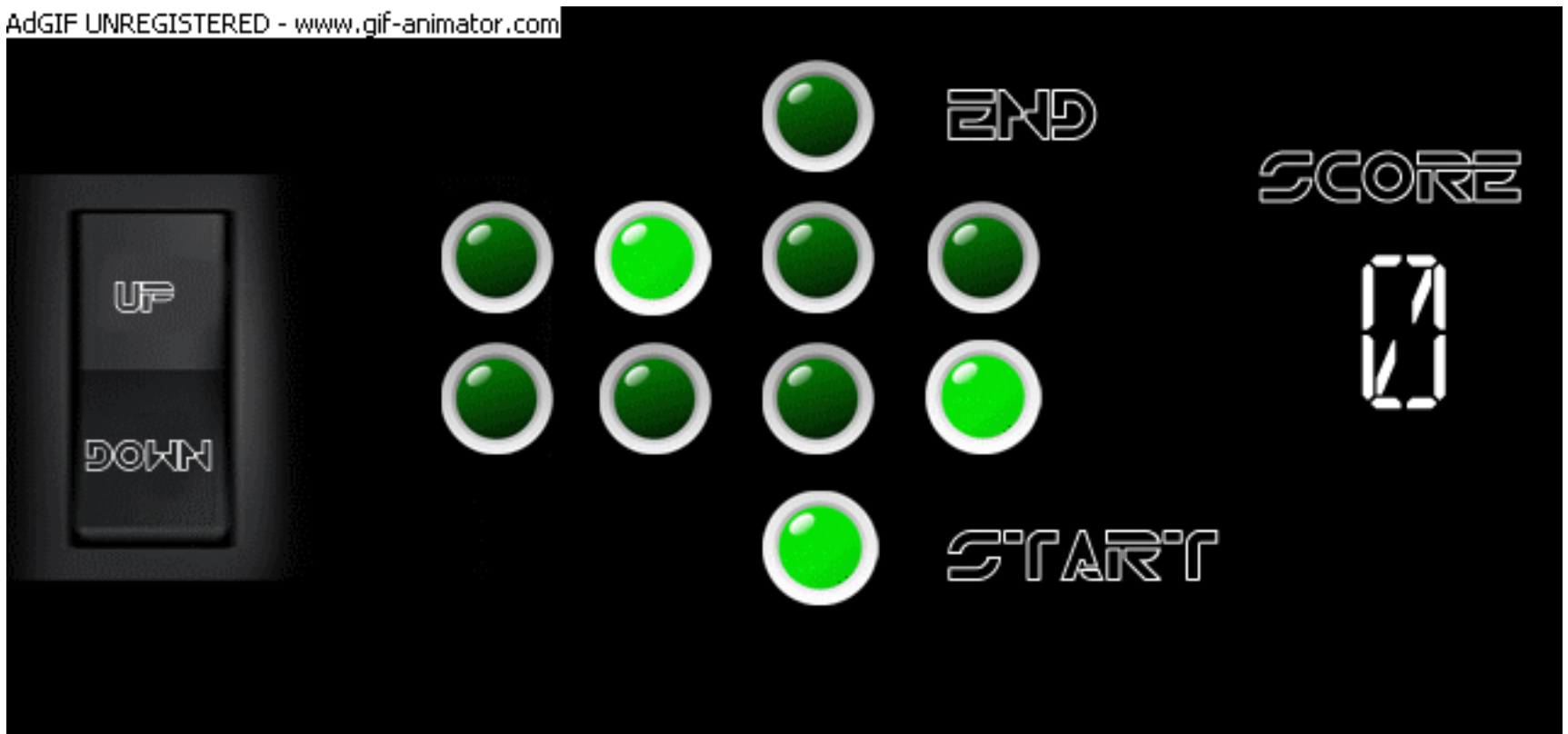


Problem Statement

- The aim of the competition is to design and build a frogger game using LEDs for display. The object of the game is to direct frogs to their homes one by one. To do this, each frog must avoid cars while crossing a busy road.

Problem Statement

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Compulsory Feature #1

- **Road of LED:** There must be at least 2 roads (rows) of LED with a minimum of 4 LEDs in each rows. A car depicted by a glowing LED must move continuously in each of the rows.

Compulsory Feature #2

- **Pathway for Frog and Navigation Keys:** Up and Down navigation keys must be present to move the frog in the vertical direction.

Compulsory Feature #3

- **Collision Detection:** In case of collision of the frog with the car, it must be detected by the circuit and a signal must be generated (either by glowing a LED or any other way possible).

Extra Features

- 2 Cars on the same road instead of 1
- Different levels of game with different speed of cars
- Full fledged Scoring Mechanism

Some rules

- Students belonging to Y12 batch of any program (UG and PG) are eligible.
- Team strength should be minimum 3 and maximum 4.

Some Tips and Advices

- 4029 : Parallel Load Inputs
- Never leave input pins unconnected
- Pull Up / Pull Down
- Never connect two outputs directly , always use a gate
- Never control the power pin of an IC

Final Words

- Keep in contact with the secretaries – details are available at club website
- In case of any problem regarding your circuit, contact a secretary
- If the secretary can't help you, or any other issue, contact the coordinators



QUESTIONS

Thank You



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