

Logic Design Laboratory

Lab: Week 2
March 25th, 2020

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Architecture and Code Optimization (ARC) Lab.
Seoul National University

TA: Seonghoon Seo, Sam Son
Sangwoo Kwon, Sunhong Min

Tinkercad Login Info

- **Student ID : ~ 2018-xxxxxx**
 - Class code : SBXK-CD54-TFFD

- **Student ID : 2019-xxxxxx ~**
 - Class code : QX58-HICE-IR2I

- **Your nickname is**
[Your student ID without hyphen(-)]+[Random number]
 - example) ID : 2019-12345 Random number : 9876
=> Nickname : 2019123459876

- **TAs have sent you your nickname via eTL message.**
 - If you didn't receive a message, please tell the TA!

Recap: Signing in to Tinkercad

Start Tinkering

How will you use Tinkercad?

In school?

Educators start here

Students, join a Class

On your own

Create a personal account

Already have an account?

[Sign In](#)

Join Class

Your teacher will give you a code

Type your class code.

Go to my class

Not Joining a class?

[Go Back](#)

Welcome to

**Logic Design Lab Class 01 (Spring, 2020,
M1522.000700_002)**

Enter your nickname provided by your teacher.

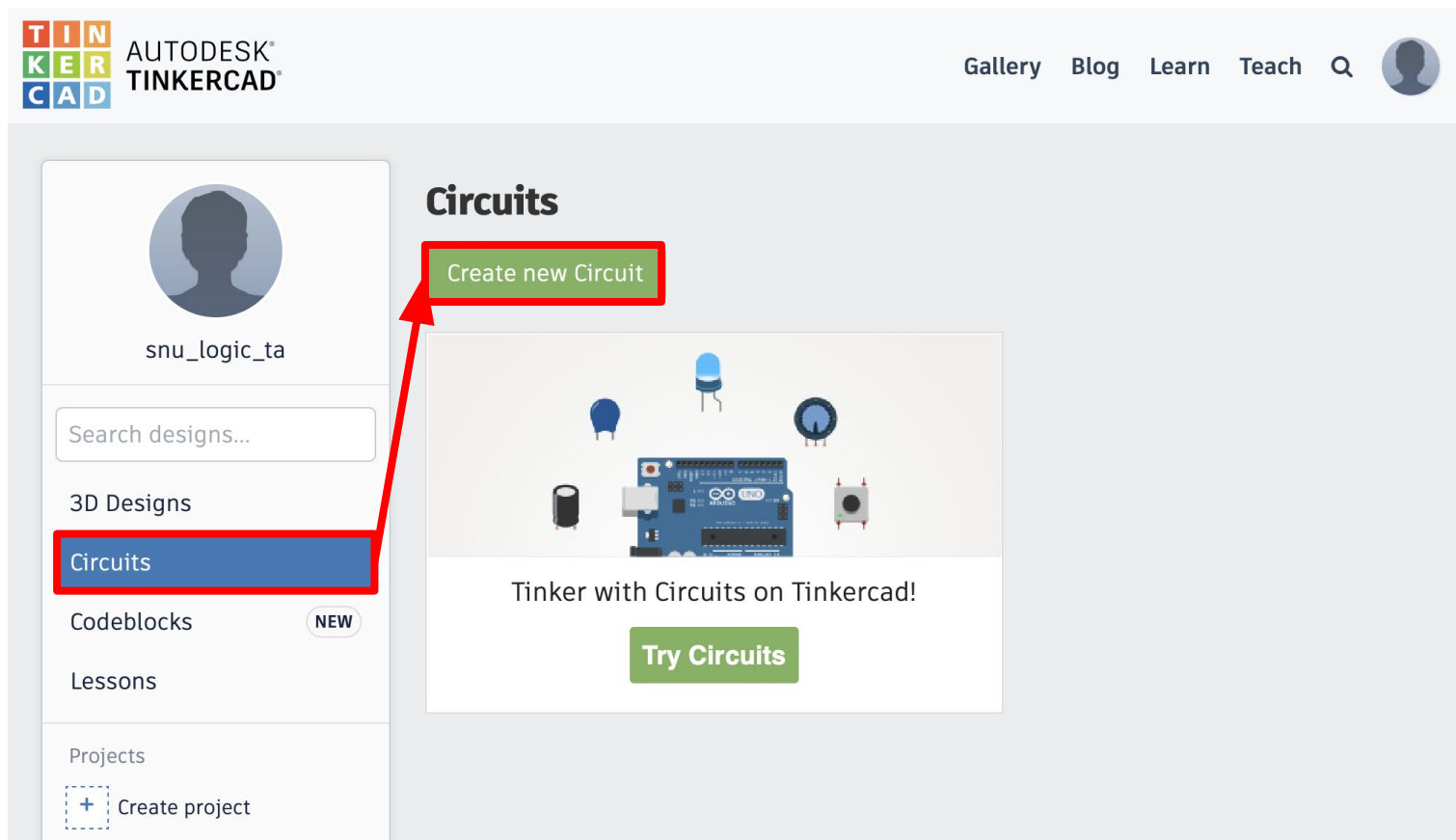
Type your Nickname

That's me!

Not Joining a class?

[Go Back](#)

Recap: Creating a new circuit



Contents

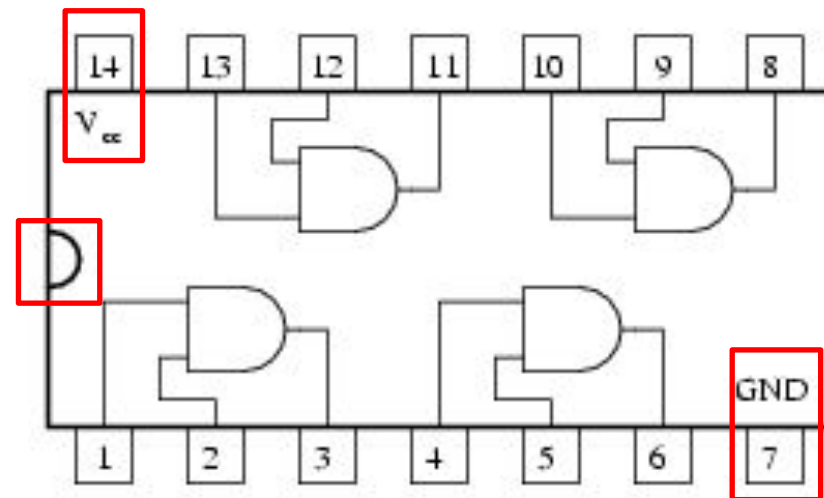
- Background
- Tool usage guide
- Useful Tinkercad shortcuts
- Combinational logic practice
- Homework

Background

■ Transistor-transistor logic (TTL) gates



Vcc: Connect to 5 volts



GND: Connect to Ground

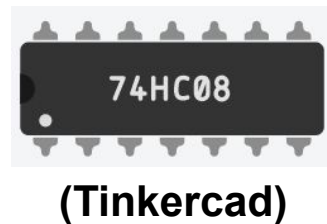
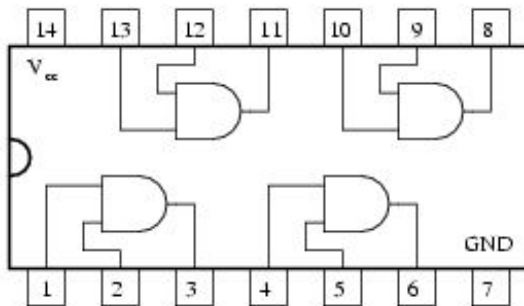
Dual in-line package containing 4 AND gates (7408)

Background

■ Transistor-transistor logic gates (TTL gates)

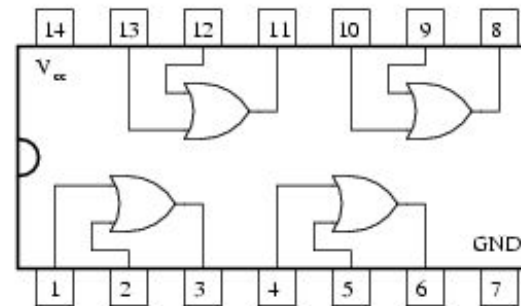
- Refer to this slide for wiring of your logic gates

5408/7408
Quad AND gate



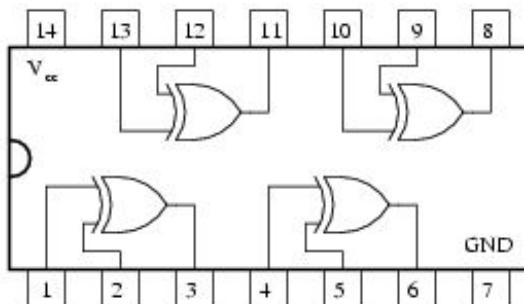
(Tinkercad)

5432/7432
Quad OR gate



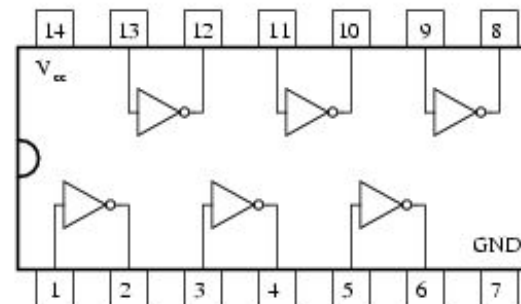
(Tinkercad)

5486/7486
Quad XOR gate



(Tinkercad)

5404/7404
Hex inverter



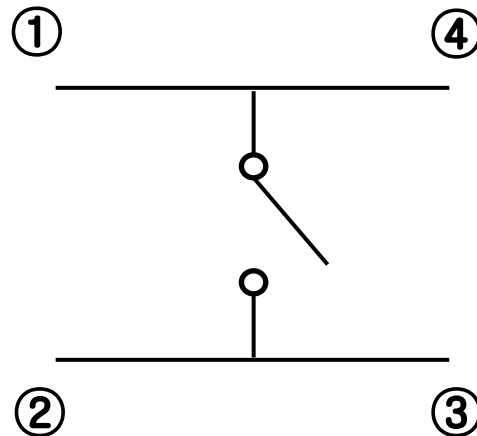
(Tinkercad)

Background

■ Tactile switch



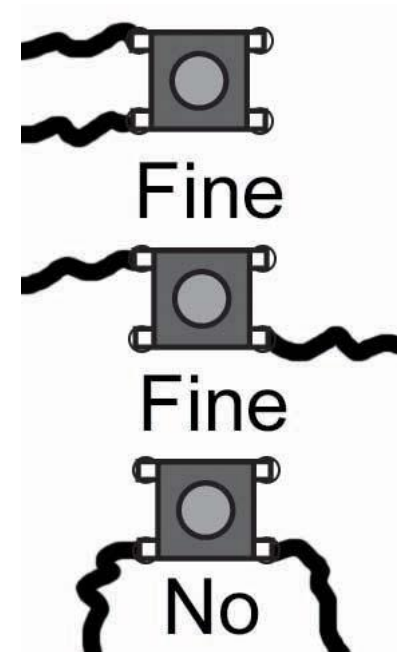
Tactile Switch



Circuit Diagram



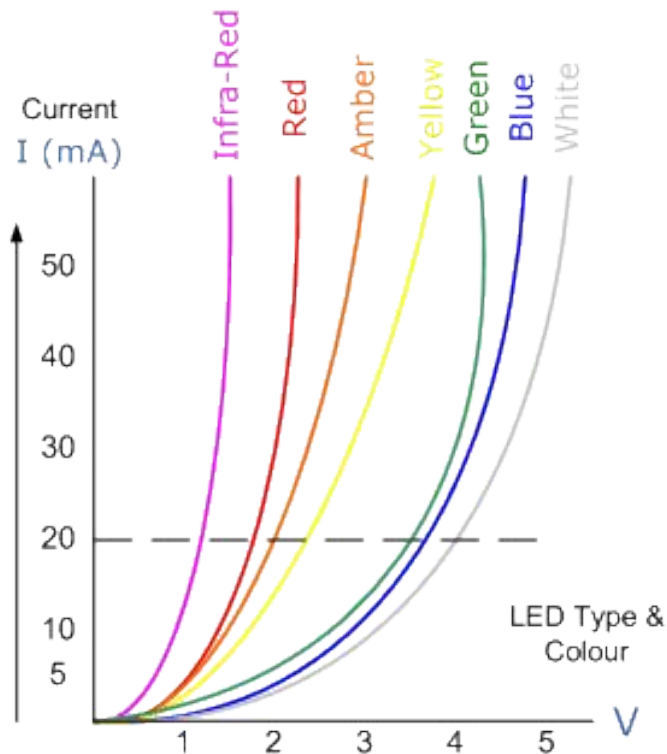
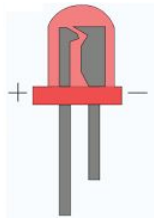
Tinkercad



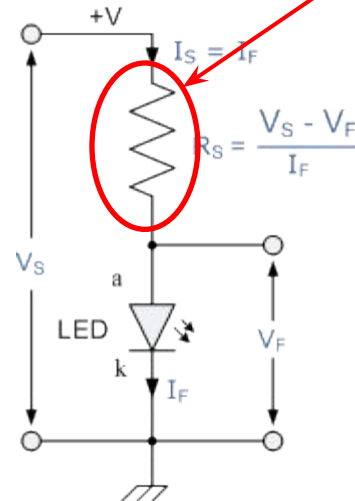
Usage

Background

■ LED



- LEDs emit colored light when passed through by forward current
- To protect LED from excessive current flow, **using an appropriate resistor (around 3~400Ω) is necessary**



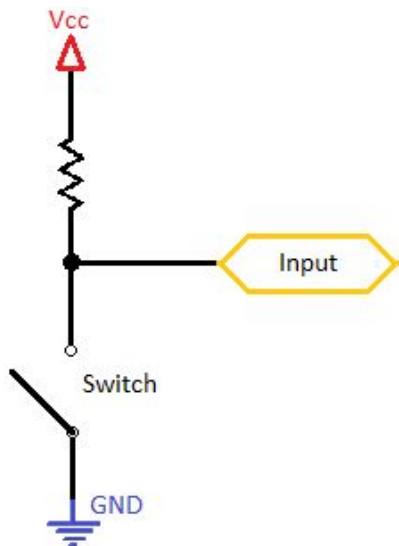
LED with proper current



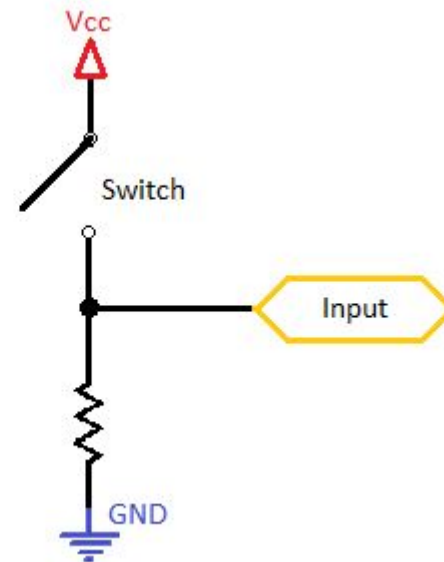
LED with overcurrent

Background

- **Pull-up & Pull-down resistors**
 - Prevent floating input when switch is open (off)!



Pull-up Resistor



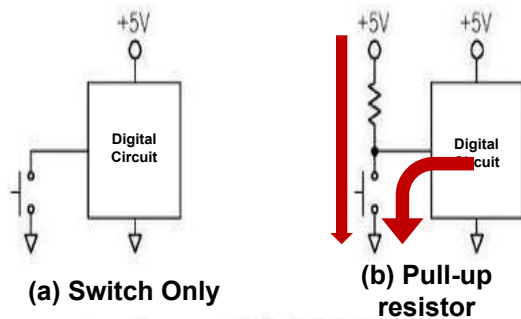
Pull-down Resistor

Source: <https://www.edaboard.com/showthread.php?274628-Pull-up-and-pull-down-resistors>

Background

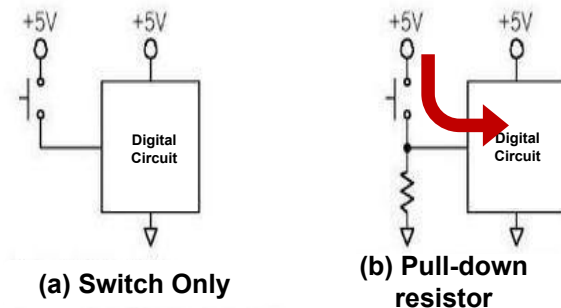
■ Pull-up & Pull-down resistors

- Behavior is identical regardless of pull resistor when switch is closed (On).



<Pic 1> L switch & Pull-up resistor

switch	ON	OFF
(a)그림	0V(Low)	Floating
(b)그림	0V(Low)	+5V(High)



<Pic 2> H switch & Pull-down resistor

switch	ON	OFF
(a)그림	+5V(High)	Floating
(b)그림	+5V(High)	0V(Low)

Pull-up Resistor

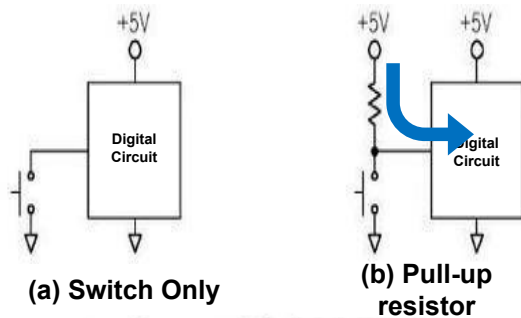
Pull-down Resistor

■ Switch on ■ Switch off

Background

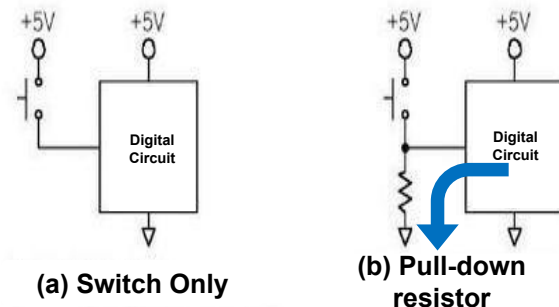
■ Pull-up & Pull-down resistors

- Pulling resistors prevent input values from floating!



<Pic 1> L switch & Pull-up resistor

switch	ON	OFF
(a)그림	0V(Low)	Floating
(b)그림	0V(Low)	+5V(High)



<Pic 2> H switch & Pull-down resistor

switch	ON	OFF
(a)그림	+5V(High)	Floating
(b)그림	+5V(High)	0V(Low)

Pull-up Resistor

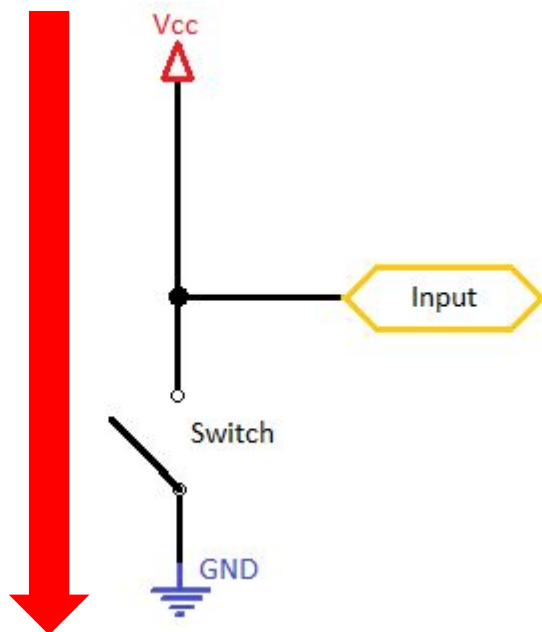
Pull-down Resistor

■ Switch on ■ Switch off

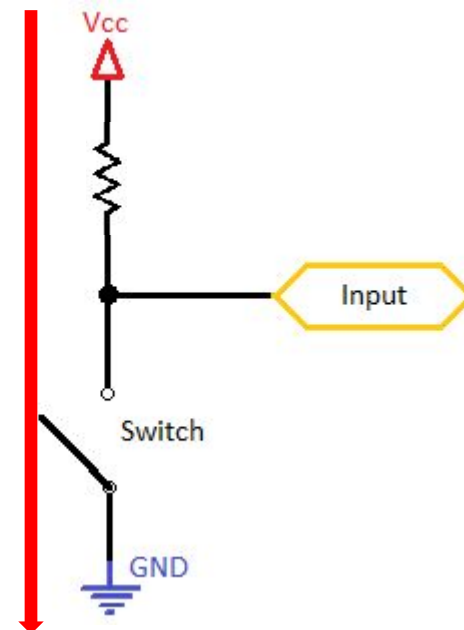
Background

■ Pull-up & Pull-down resistors

- We need resistors to prevent **direct short** between Vcc and GND.



Overcurrent!



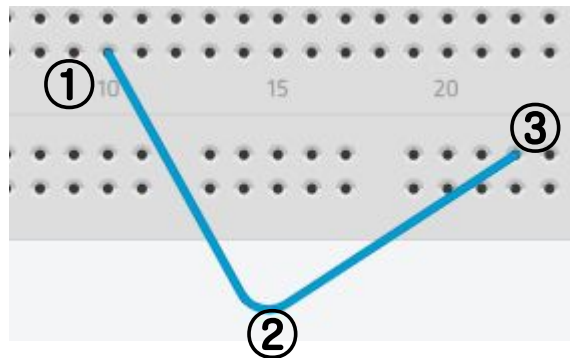
Appropriate Current

Source: <https://www.edaboard.com/showthread.php?274628-Pull-up-and-pull-down-resistors>

Tool usage

■ Wiring in Tinkercad

- ① Click a port to start wiring.
- ② (If necessary) Click empty place to give the wire a polygonal shape.
- ③ Click another port to end the wiring.
- Changing the color of the wire can be done at the upper right menu.
- Press ESC to cancel the current wiring.

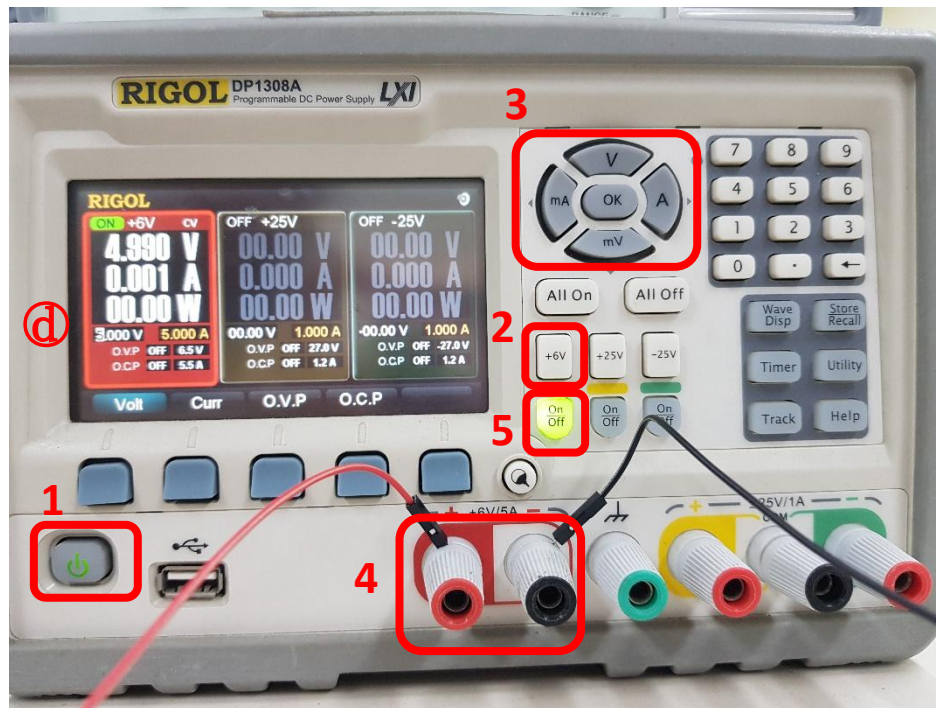


Tool usage

■ Power supply



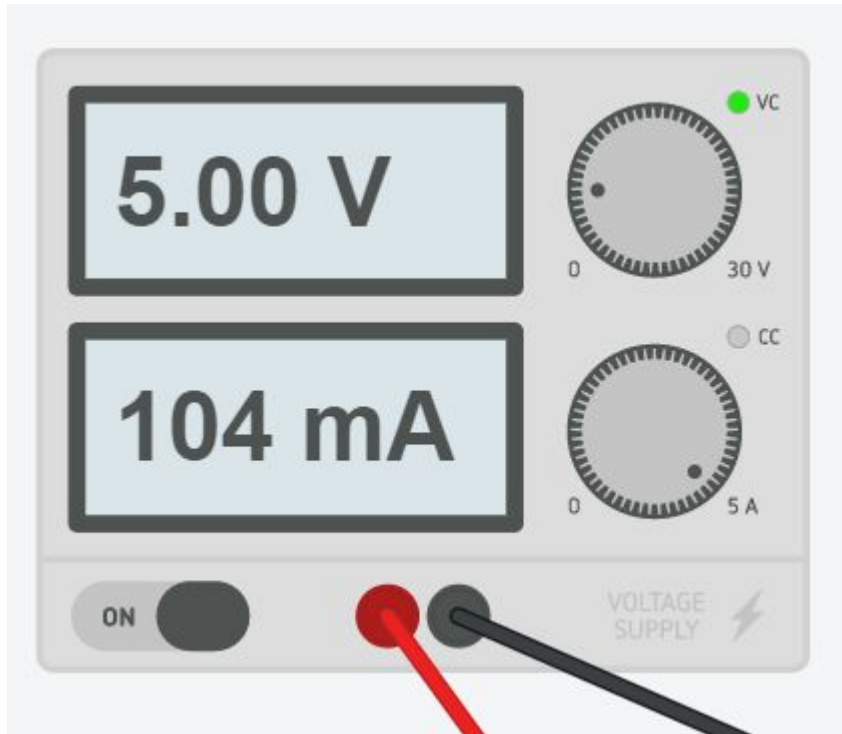
Tool usage



■ Power supply usage

- 1. Turn it on.
- 2. Select 6V output.
- 3. Set voltage to 5V.
 - Use D-pad to control voltage
 - Target voltage is displayed in ①
- 4. Connect circuit.
- 5. Turn the output on.

Tool usage

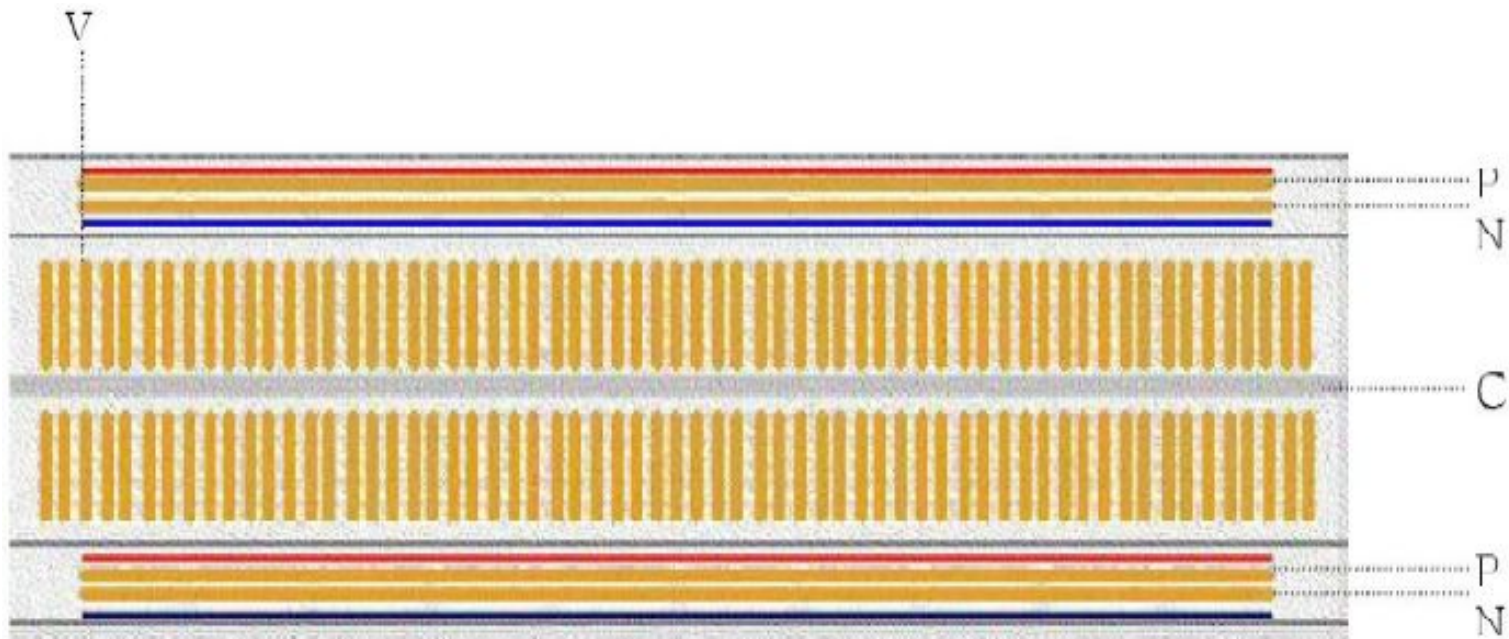


- **Power supply usage in Tinkercad**
 - Set voltage(or current) level on the upper right menu which appears when clicked.
 - When simulating, setting voltage (or current) level is also available by rotating the dials.

Tool usage

■ Breadboard

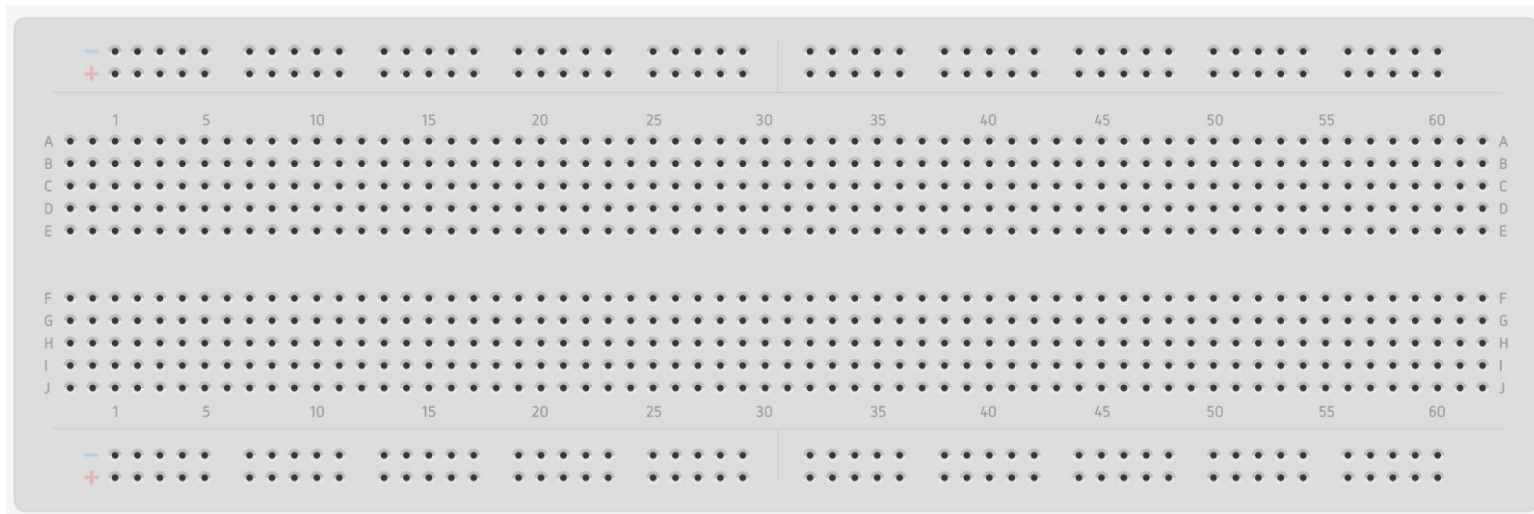
- Internal wiring



✓ Internal wiring of Bread board

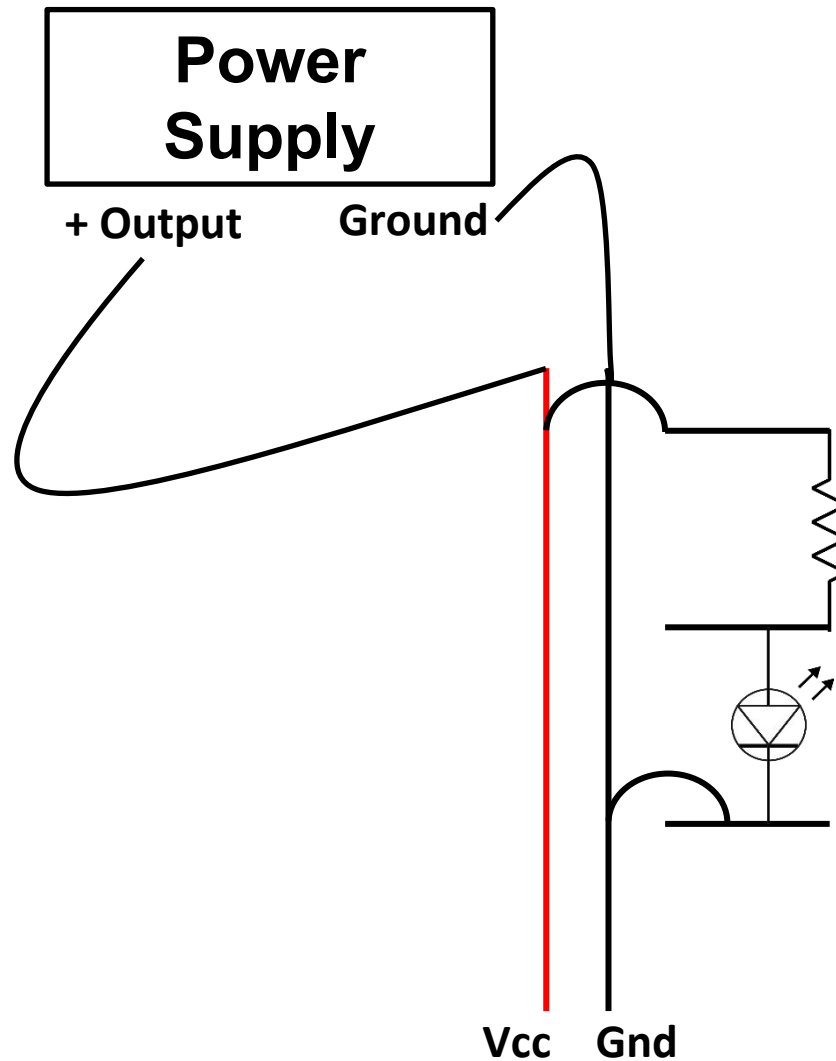
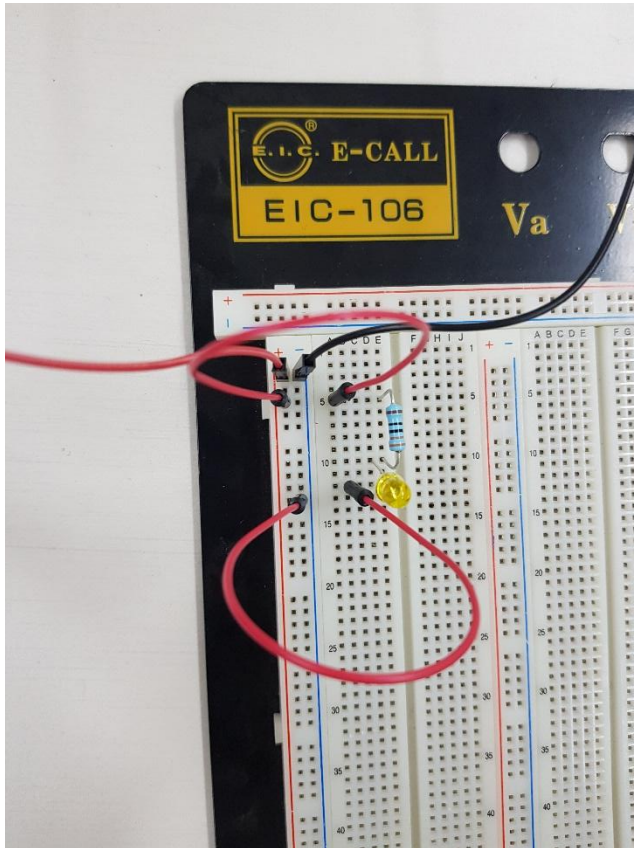
Tool usage

- **Breadboard in Tinkercad**
 - Same as a real breadboard!



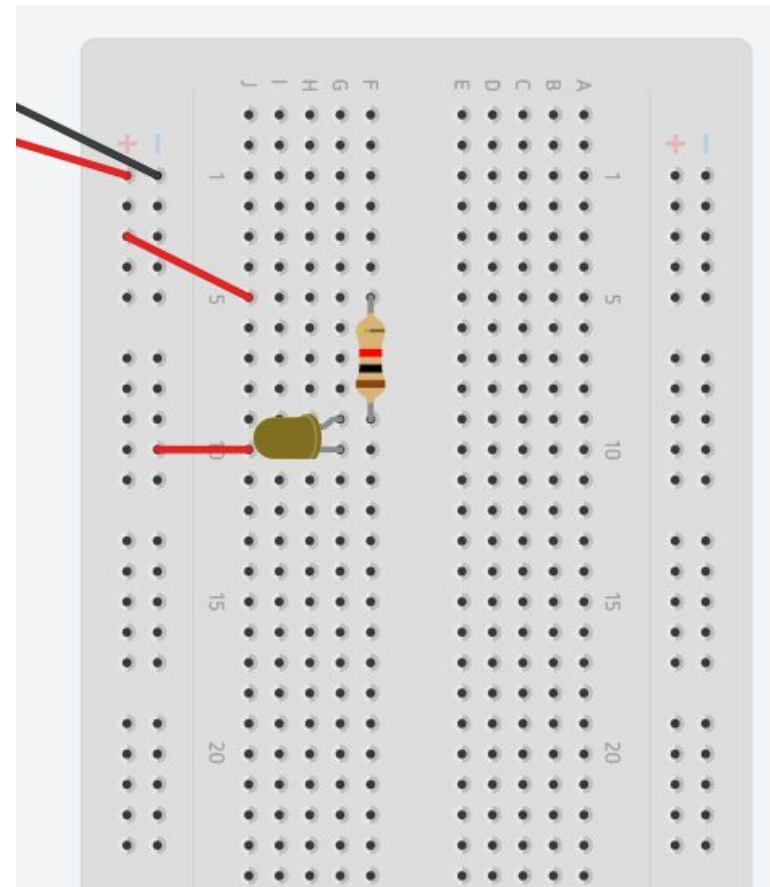
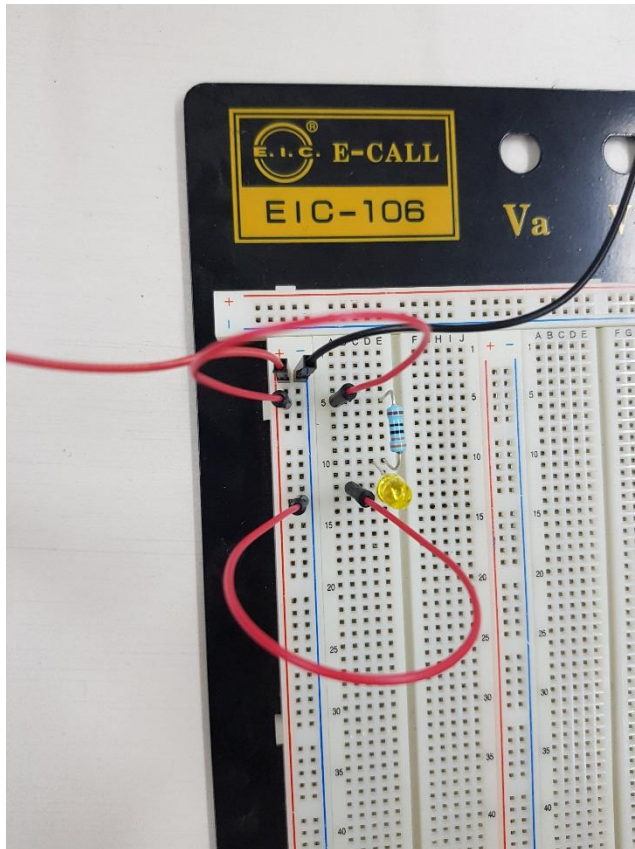
Tool usage

- Breadboard
 - Sample wiring








Tool usage

- Breadboard in Tinkercad
 - Sample wiring



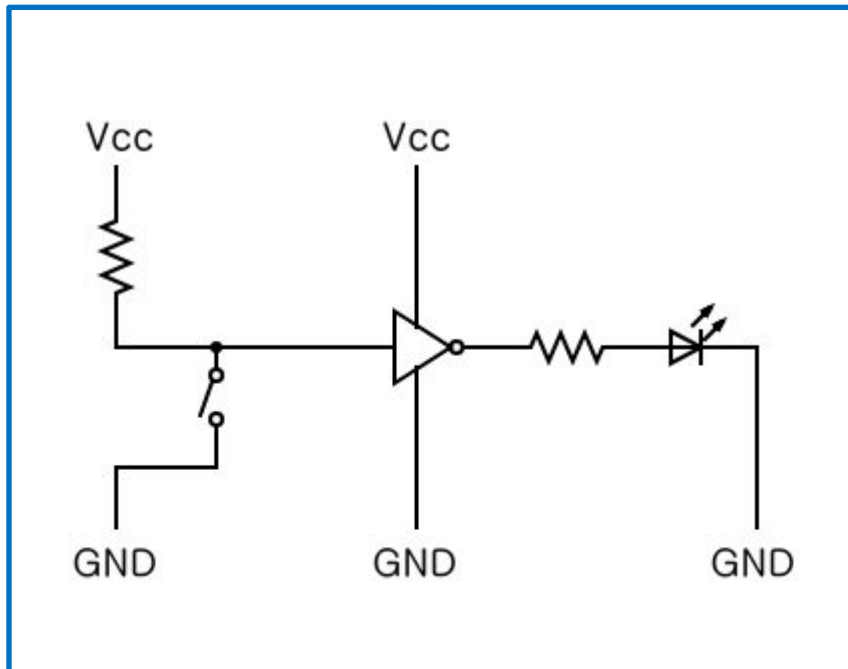
Useful Tinkercad Shortcuts

- R (or ) : Rotate Object (CW)
 - Shift+R (or Shift+ ): Rotate Object (CCW)
 - Del (or ) : Delete Object
 - Ctrl+Z (or ) : Undo
 - Ctrl+Y (or ) : Redo
 - Z : Set view to center of project
 - Ctrl+X/C/V : Cut/Copy/Paste
 - Ctrl+I : Select inverse
 - Shift : Hold to select multiple Objects
- Hold and click tactile switch to keep it pressed

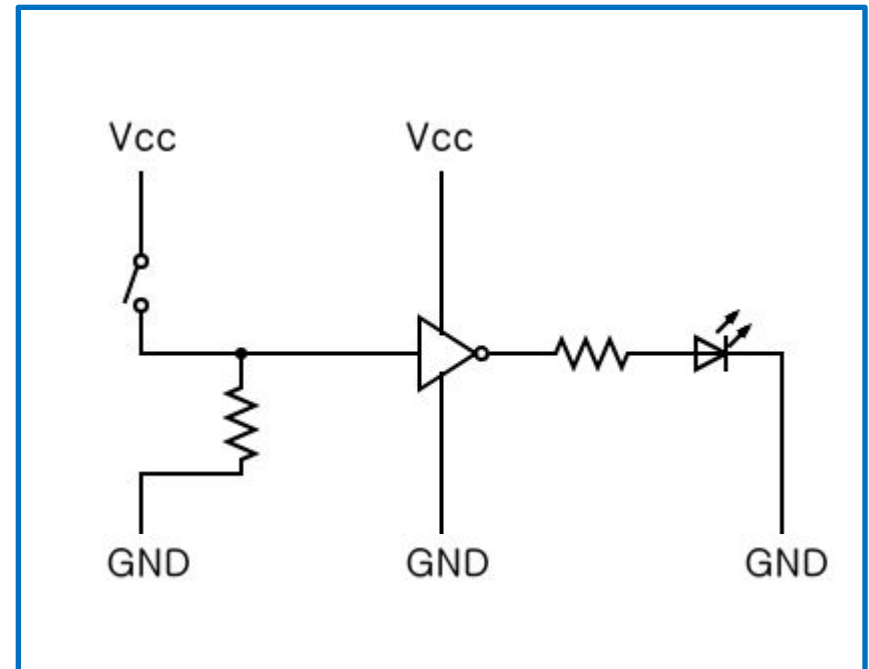
Practice (1)

■ Implement pull-up and pull-down resistor on breadboard

- Using 330 Ohm resistors is recommended.
- Test it with an inverter and a LED.
- Use multimeter to check that the input voltage




Pull-Up Resistor

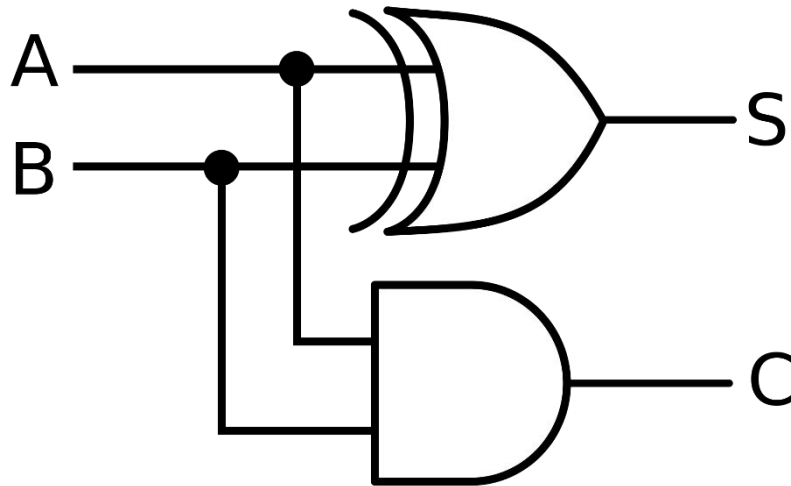


Pull-Down Resistor

Practice (2)

■ Implement half adder on breadboard

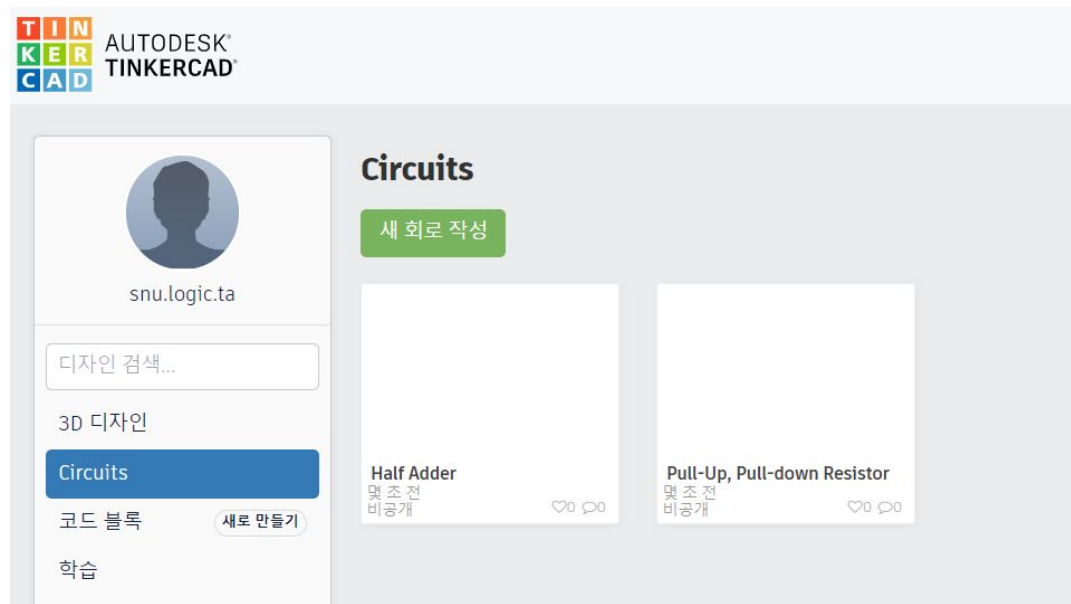
- Use LED to prove its operation.
- Use comment () to indicate each input and output.





Input		Output	
A	B	Sum	Carry
0	0	0	0
0	1	1	0
1	0	1	0
1	1	0	1

Practice

- Create new circuit for each practice.
- You can leave as soon as you finish both practices.
- When done, give TAs a chat in Zoom.
 - Using private chat is recommended.
 - ex) “[CHECK REQUEST] Classroom 1, Hong-gil Dong”

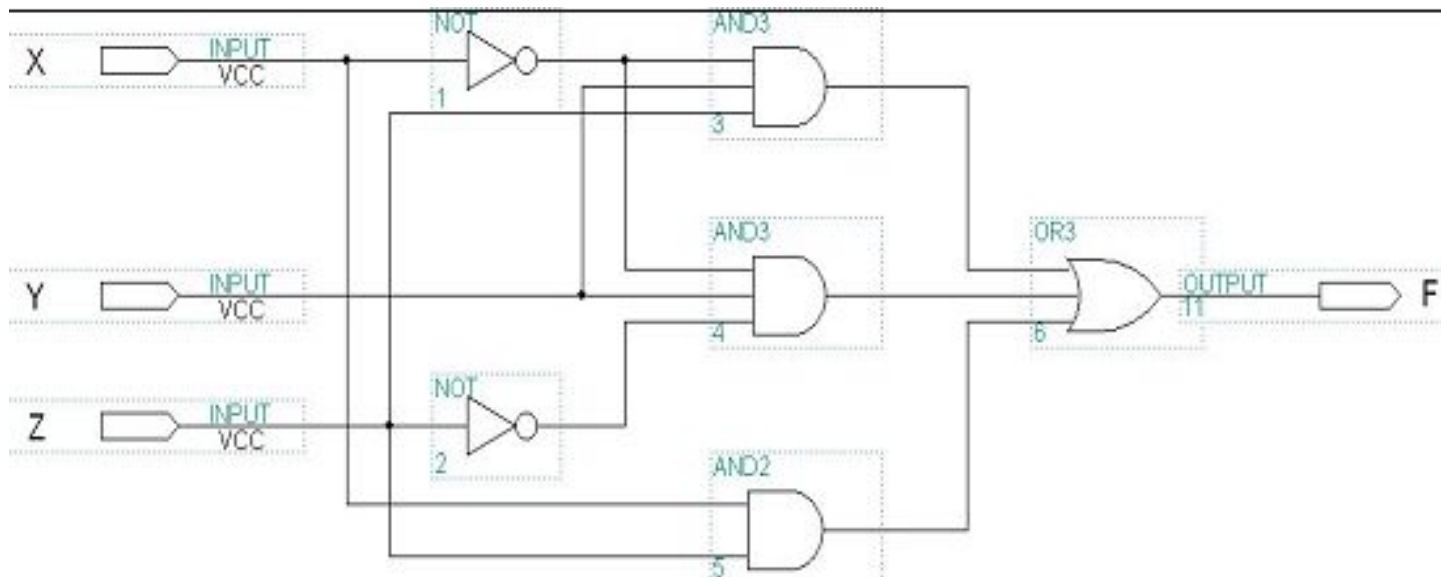


Homework

- **1. Implement a 1-bit full adder on breadboard (Tinkercad)**
 - Use LED to prove it's working.
 - Use comment () to indicate each input and output.
- **2. Implement a 2-bit full adder on breadboard (Tinkercad)**
 - Use LED to prove it's working.
 - Use comment () to indicate each input and output.
 - It can be implemented with two 1-bit full adders (Utilize copy-and-paste feature in Tinkercad!)

Homework

- 3. Build a truth table for following circuit diagram.
- 4. After that, Draw the circuit diagram of it with 1 NOT gate, 2 AND gates and 1 OR gate.



Homework

■ Submission guide

- Take a screenshot and attach to document for homework 1, 2.
- For 3 and 4, You may scan and attach your hand-drawn answer.
- Or you can use drawing program like [logisim](#).
- This is an individual assignment.
- **Due: 2020. 04. 01 (Wed) 19:00**
- Refer to general guideline in lab intro slides for other details.

■ Please submit single ZIP file on eTL.

- Compress your report(.pdf) into a **single ZIP file**.
- Your score may be deducted if you submit in wrong format.
- Both the report and zip file should be in the following format :

LDLAB_YYMMDD_team#_NAME_StudentID

- Example: LDLAB_200325_team02_손샘_2020-10101.zip