

Familiarisation with Breadboard, Logic Gates & Online software tools

This lab session will be devoted to (i) getting conversant with the breadboard, logic gate ICs and TinkerCAD/Circuitverse software to be used for this course, and (ii) using this to understand the implications of binary logic levels.

Breadboard

All circuits we will study in this course will need a 5V d-c power supply. ([video](#))

The circuit to be studied will have to be assembled on the breadboard (on TinkerCAD).

Fig. 1.1 shows the schematic of the breadboard. It has 128 vertical strips, 64 on each side of the horizontal divider in the middle, each strip consisting of 5 spring-loaded tie-points internally connected to one another. The breadboard also has 8 horizontal strips, four on the top side and 4 on the bottom side, each having 25 tie-points. These strips are generally used for making power supply connections.

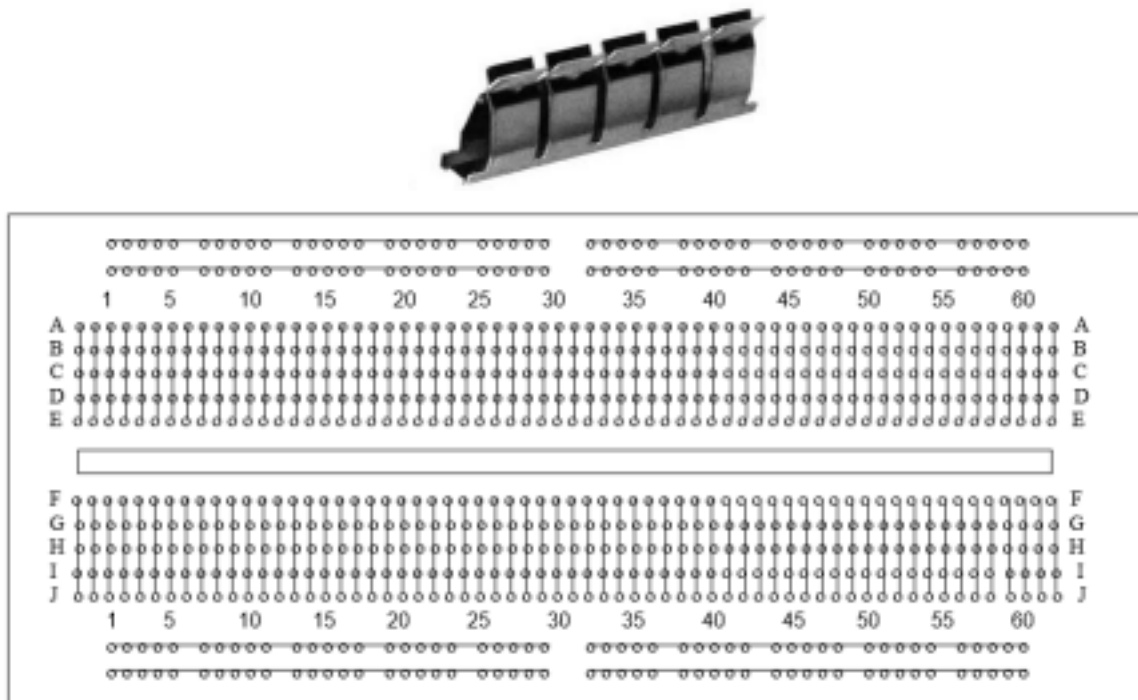


Fig. 1.1 Breadboard Schematic

Basic Logic Gates

Two families of digital ICs are commonly used: the TTL 74LSxx series and the CMOS CD 40xx series. Many of these ICs have 14 pins, and some have 16 or more. Two pins are used for power supply connections. Thus 12 pins are available in a 14-pin IC for gate inputs and outputs. A 2-input gate requires three pins per gate (two for inputs and one output), and so ICs that implement 2-input logic functions generally have 4 gates per IC.

TTL ICs require a fixed d-c power supply voltage V_{CC} having the nominal value of 5V and a tolerance of 5%, i.e. $4.75V \sim V_{CC} \sim 5.25V$; a voltage outside this range can damage the IC. Most CMOS ICs can work with $3V \sim V_{CC} \sim 15V$.

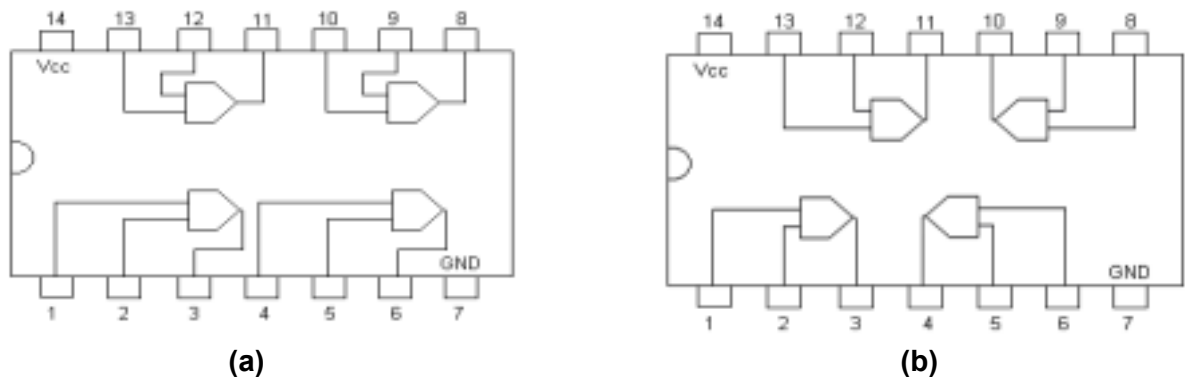


Fig. 1.2 Two types of Pin Connections of Quad 2-input Gates

TinkerCAD

Link to Simulator: [TinkerCAD](https://www.tinkercad.com/)

Part A. Familiarisation with breadboard

1. Get familiar with the usage of the breadboard
2. A quick hands-on on TinkerCAD by adding a LED on a breadboard and controlling it with a slide switch (use 3v power supply).

Part B. Gate Identification

Outputs of different ICs, AND / OR / NOT/ XOR/ NAND / NOR gates will be tested in this part on TinkerCAD. The ICs available on TinkerCAD belong to the TTL 74xx family and have the pin connections shown in **Fig. 1.2(a)**.

Find out the logic function of each of the ICs on Tinkercad by proceeding step by step as follows:

1. Connect the V_{CC} and GND pins of one of the given IC to the positive and negative terminals of the power supply. Connect the input pins of any one of the four gates in the IC to two input switches respectively and the output pin of the same gate to a LED in series with a 1 kohm resistor.
2. Apply the four possible combinations of (binary) values to the gate inputs one by one by means of the input switches and tabulate the corresponding values of the gate output as observed on the LED to obtain the truth table of the gate.
3. Identify the given ICs by repeating steps 1, 2, and 3 for each IC one by one.

Circuitverse

Link to Simulator: <https://circuitverse.org/simulator>

1. Familiarization with logic gates, Inputs, Outputs
2. Make the circuit of NAND gate using AND/NOT ICs