Embedded System Workshops

03. Liquid Crystal Displays (LCDs)
CCA Girls Who Code

Project Overview

- Purpose
  - Introduce the LCD Screen display and use it to print text
- Projects
  - LCD “Hello World!”
- Grab your kit, and let’s get started!

What are we making?

- LCD Project
  - Use an LCD to display a message
  - Then, display the number of seconds since it wrote the message.

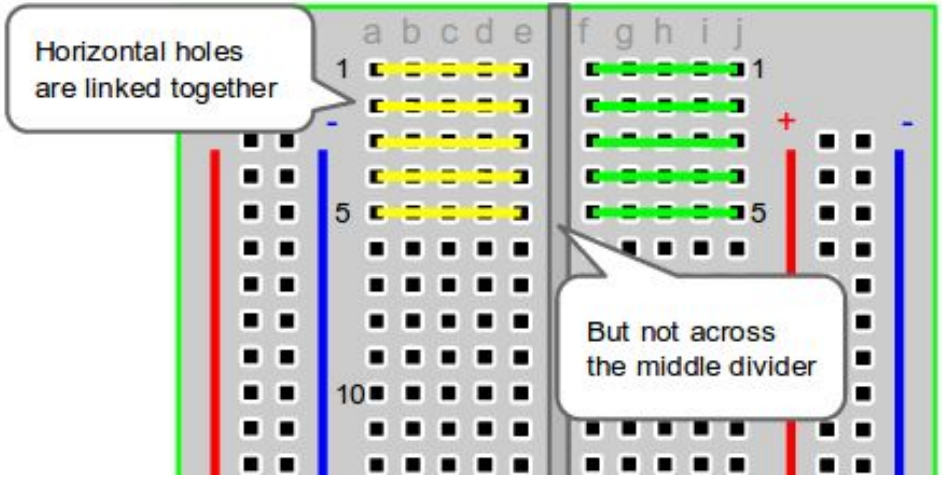
Parts List

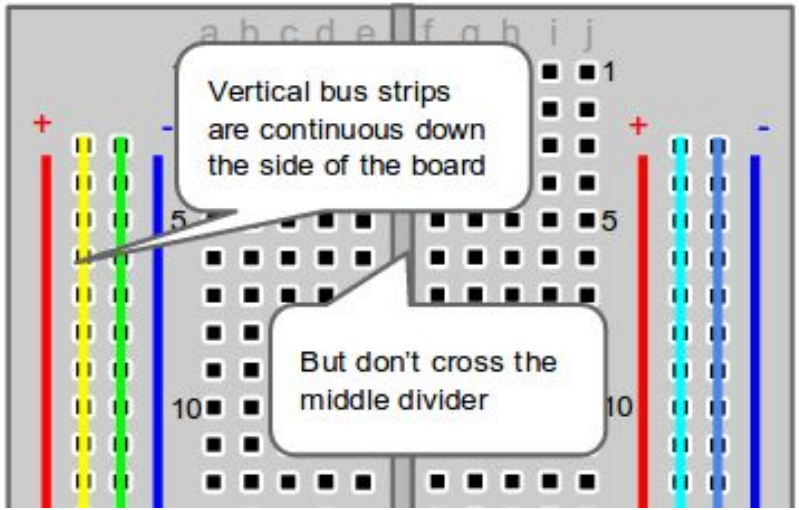
Below is the list of parts we'll be using during this lesson

- Arduino UNO R3 Controller Board
- USB Cable
- Breadboard
- LCD Display
- 330Ω Resistor
- Potentiometer
- Male-male jumper wires
  - (you will need a lot of them)

Review

Review: Breadboards Explained

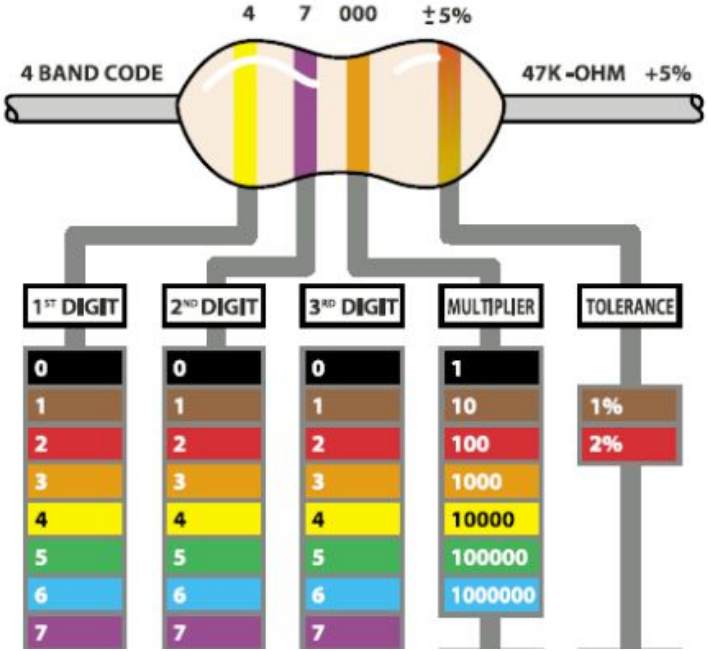




Tip: It is good practice to have your power input connected to the red/positive rail and your ground pin connected to the blue/negative rail.

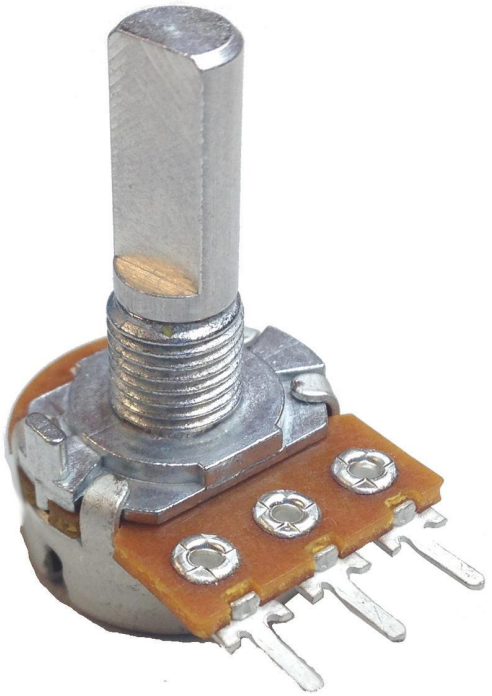
Review: Resistors

- Resistors slow the electric current, and control where and how fast the current flows
- Resistance value is measured in ohms Ω, which is represented by colored stripes on the body of the resistor
- Each stripe has a different value depending on the color and location as shown in the reference chart
- A potentiometer is a variable resistor



Review: What is a Potentiometer?

- A potentiometer is essentially a variable resistor: you can change how much resistance is applied by twisting the knob
- This is useful for adjusting brightness, power, etc.
- For our purposes, this will be used to adjust the brightness of the LCD screen

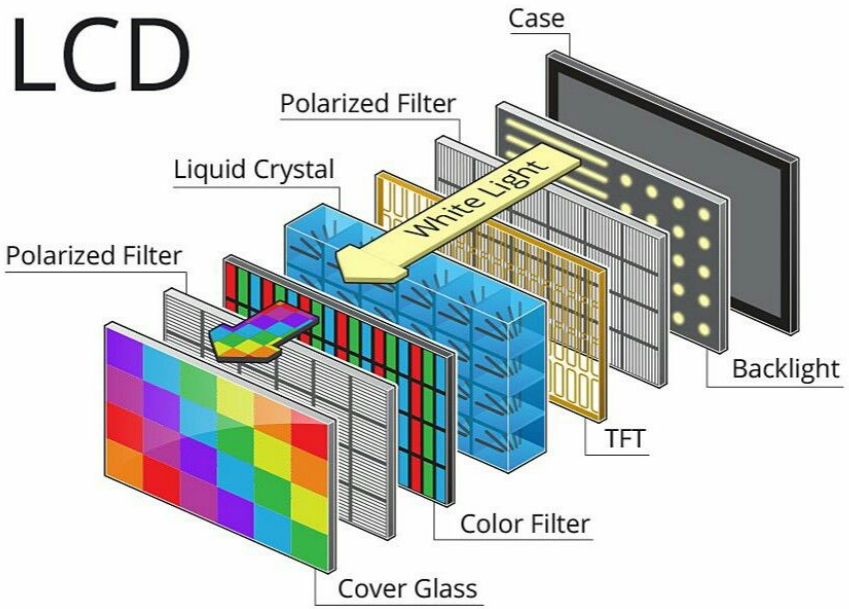


Project

Introduction to LCD Screens

An LCD, or Liquid Crystal Display, is a type of screen that can display images by varying the brightness and color of the light shining from its backlight using a set of filters.

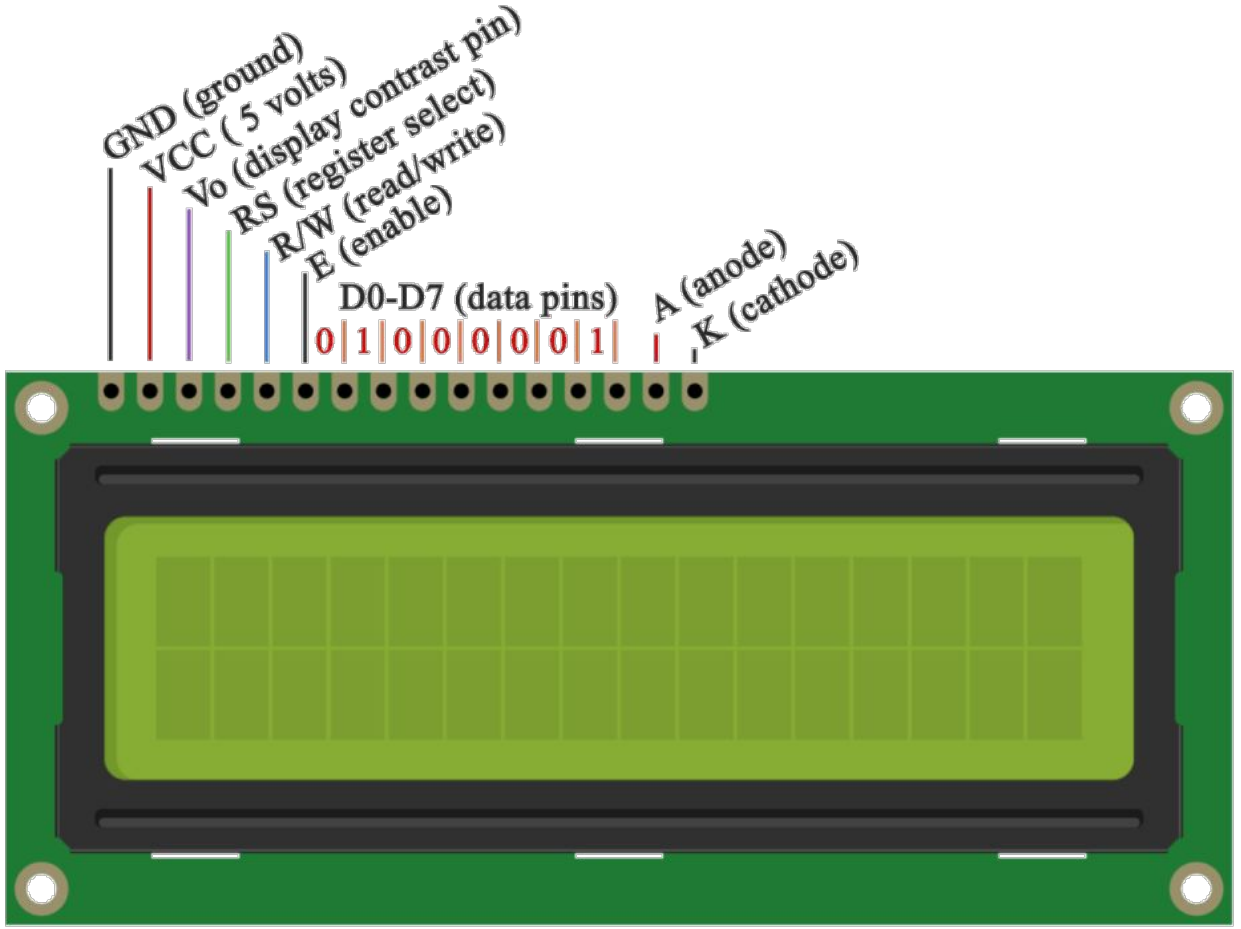
These screens are extremely widespread on TV's, computer monitors, phone and tablet screens, basically anything that requires a screen.



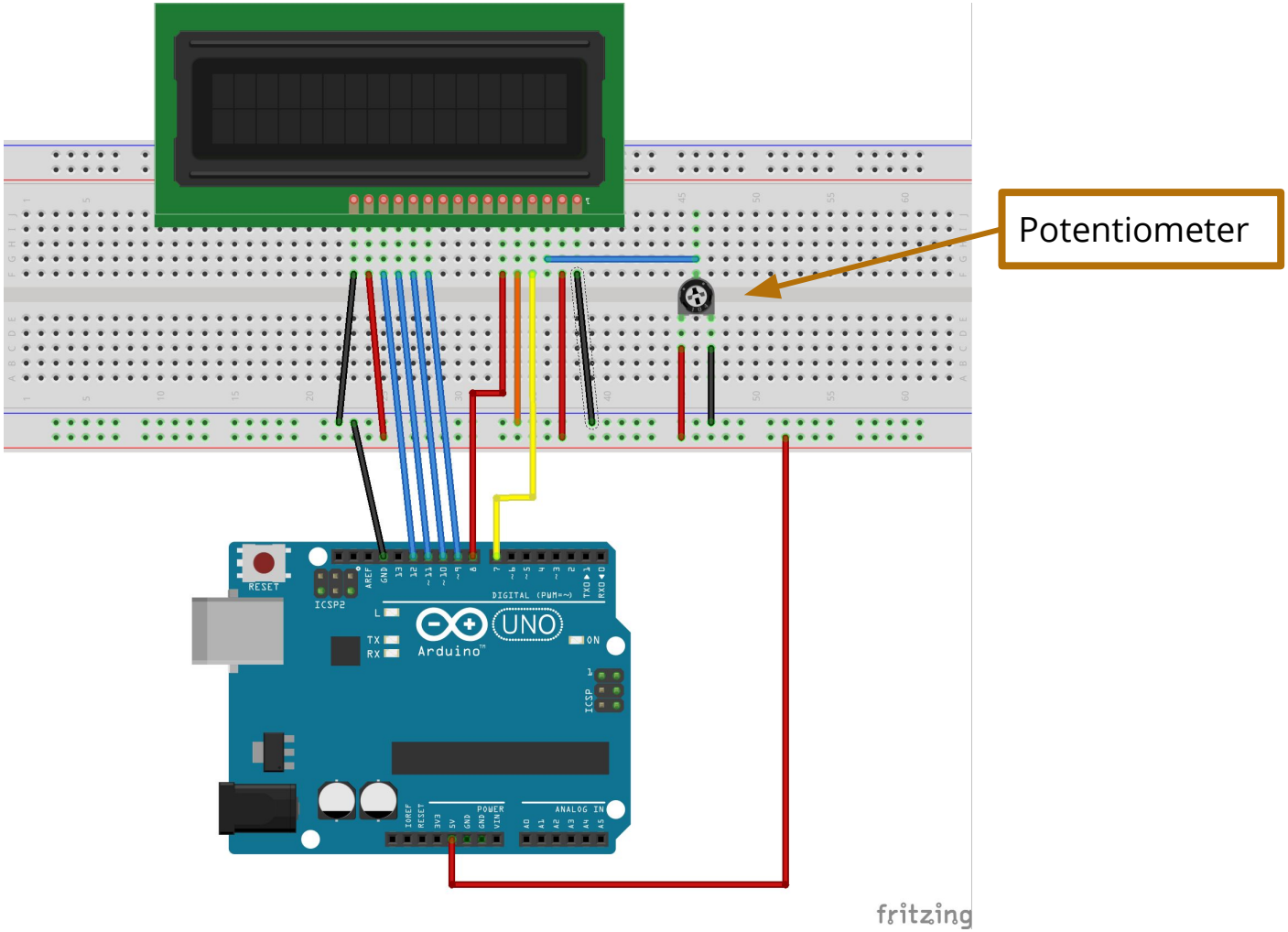
Arduino LCD

The LCD we will be using can display letters and numbers on a 16x2 grid for a total of 32 characters.

We will show you how to wire it, then how to display messages and other information on it.



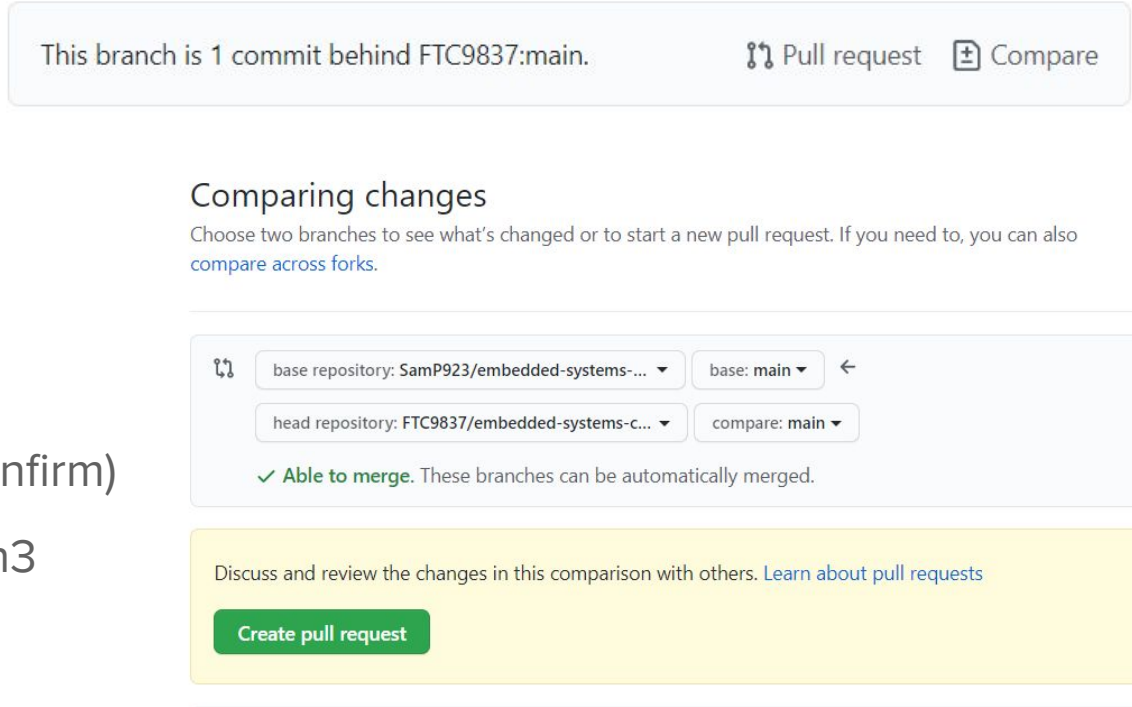
LCD Diagram



Grab the Starter Code from GitHub

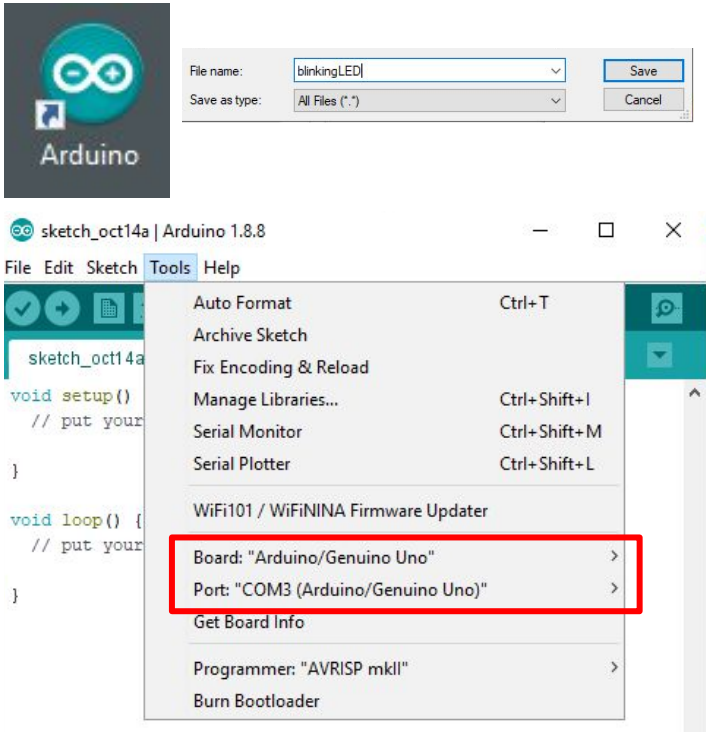
If you haven't made the repository yet, check these slides

- Go to your repository (username/embedded-systems-course)
- Click "Compare"
- Switch the repos so yours is the base repository and FTC9837 is the head
- Create pull request (x2)
- Merge pull request (and confirm)
- You should have the lesson3 folder in your repository



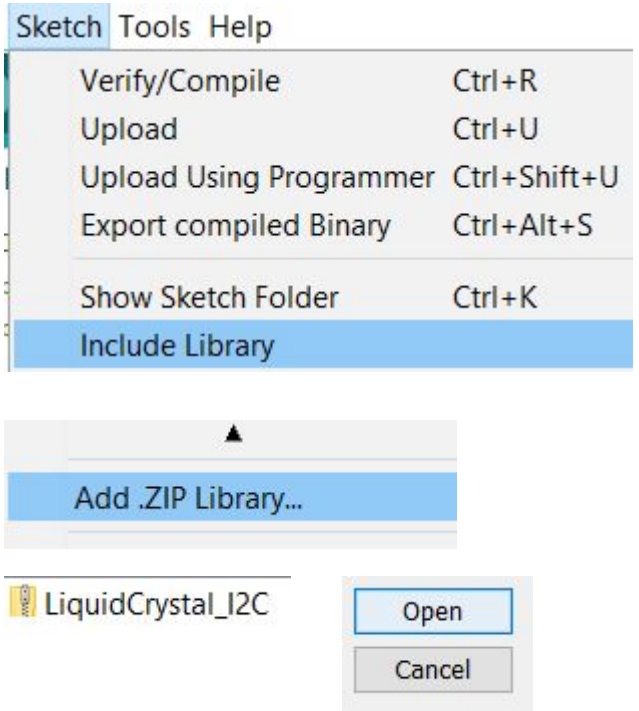
Review: Setting up Arduino

- Find and open Arduino on your desktop
- Click “File” in the top left corner and click save
- Save this tab as “LCDtest”
- Connect the USB cord in your kit to the Arduino and the computer (USB port is on the left side of the monitor)
- Open the “Tools” Window and make sure the board has been recognized and the port is “COM#(Arduino/Genuino Uno)”



Downloading a Library

- We need to download a library in order to used the Liquid Crystal Displays (LCDs)
- Download the LiquidCrystal_I2C library here
  - Save it to your downloads folder
- Go to the Sketch Tab ⇒ Include Library ⇒ Add .Zip Library.
- Navigate to your downloads folder and select and open the LiquidCrystal_I2C library.



I2C LCD - Print Code

LiquidCrystal_I2C is a type of **Object**.

The numbers that we pass it correspond to the screen size of the LCD.

To test your code, click the checkmark then the arrow!

LCDsunfounderdemo §

```
// include the library code
#include <Wire.h>
#include <LiquidCrystal_I2C.h>

// initialize the library with the numbers of the interface pins
LiquidCrystal_I2C lcd(0x27,16,2);

void setup()
{
  lcd.init(); //initialize the lcd
  lcd.backlight(); //open the backlight
  lcd.setCursor(0,0); // set the cursor to column 1, line 0
  lcd.print("hello, world!"); // Print a message to the LCD.
}

void loop()
{
  // set the cursor to column 0, line 1
  // (note: line 1 is the second row, since counting begins with 0):
  lcd.setCursor(0, 1);
  // print the number of seconds since reset:
  lcd.print(millis() / 1000);
}
```

init, backlight, setCursor, and print are **functions**. setCursor sets where characters will start to appear on the screen. print takes one parameter, the String you want to print.

****EXERCISE****

Change your LCD code so it says “girls who code!”

I2C LCD - Scroll Print Code

LCDsunfounderdemo §

```
// include the library code
#include <Wire.h>
#include <LiquidCrystal_I2C.h>

char array2[]="hello, world!             "; //the string to print on the LCD
int tim = 500; //the value of delay time

// initialize the library with the numbers of the interface pins
LiquidCrystal_I2C lcd(0x27,16,2); // set the LCD address to 0x27 for a 16 chars and 2 line display

void setup()
{
  lcd.init(); //initialize the lcd
  lcd.backlight(); //open the backlight
}

void loop()
{
  lcd.clear(); //Clears the LCD screen and positions the cursor in the upper-left  corner.
  lcd.setCursor(15,0); // set the cursor to column 15, line 1
  for (int positionCounter = 0; positionCounter < 26; positionCounter++)
  {
    lcd.scrollDisplayLeft(); //Scrolls the contents of the display one space to the left.
    lcd.print(array2[positionCounter]); // Print a message to the LCD.
    delay(tim); //wait for 250 microseconds
  }
  lcd.clear(); //Clears the LCD screen and positions the cursor in the upper-left corner.
}
```

Click here for the repl.it file!

LCD - Print Code

LiquidCrystal is a type of **Object**.

The numbers that we pass it correspond to the **pin numbers** on the Arduino.

To test your code, click the checkmark then the arrow!

LCDdemo

```
// include the library code:
#include <LiquidCrystal.h>

// initialize the library with the numbers of the interface pins
LiquidCrystal lcd(12, 11, 5, 4, 3, 2);

void setup() {
  // set up the LCD's number of columns and rows:
  lcd.begin(16, 2);
  // Print a message to the LCD.
  lcd.print("hello, world!");
}

void loop() {
  // set the cursor to column 0, line 1
  // (note: line 1 is the second row, since counting begins with 0):
  lcd.setCursor(0, 1);
  // print the number of seconds since reset:
  lcd.print(millis() / 1000);
}
```

begin and print are **functions**. begin takes two parameters, the numbers of columns and rows of the LCD. print takes one parameter, the String you want to print.

****EXERCISE****

Change your LCD code so it says “girls who code!”

LCD Variation 1

gwcLEDdemo §

```
// include the library code:
#include <LiquidCrystal.h>
String string = "girls who code";
String string2 = "wuz here";

// initialize the library with the numbers of the interface pins
LiquidCrystal lcd(12, 11, 5, 4, 3, 2);

void setup() {
  // set up the LCD's number of columns and rows:
  lcd.begin(16, 2);

}
```

LCD
Variation 1

```
void loop() {
  // set the cursor to column 0, line 1
  // (note: line 1 is the second row, since counting begins with 0):
  for(int x = 1; x <= string.length(); x++){
    delay(250);
    lcd.setCursor(0, 0);
    lcd.print(string.substring(0,x));
  }
  lcd.setCursor(0, 1);
  for(int x = 1; x <= string2.length(); x++){
    delay(250);
    lcd.setCursor(0, 1);
    lcd.print(string2.substring(0,x));
  }
  for(int x = 0; x < 3; x++){
    lcd.setCursor(8, 1);
    lcd.print("    ");
    delay(250);
    lcd.setCursor(8, 1);
    lcd.print(".");;
    delay(250);
    lcd.print(".");
    delay(250);
    lcd.print(".");
    delay(250);
  }
  lcd.clear();
}
```

Thank you!

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