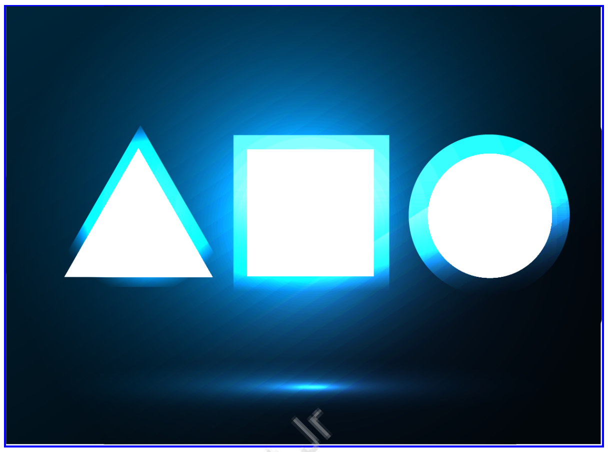
INTRODUCTION TO OLED



What is our GOAL for this CLASS?

In this class, we learned about **OLED (Organic Light-Emitting device) and its working. We also learned how OLED can be used to display text, shapes.**

What did we ACHIEVE in the class TODAY?

- We learned about the OLED
- Draw shapes on OLED
- Draw text on OLED

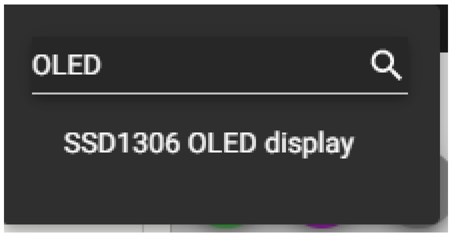
Which CONCEPTS/ CODING BLOCKS did we cover today?

- OLED:
    - An OLED stands for an organic light-emitting diode. An OLED display is made up of pixels that glow when electricity is applied to them. It's like the heating elements in a toaster, but with less heat and a better resolution. This effect is called **electroluminescence**
    - It is called organic because it is made up of organic substances, such as carbon.

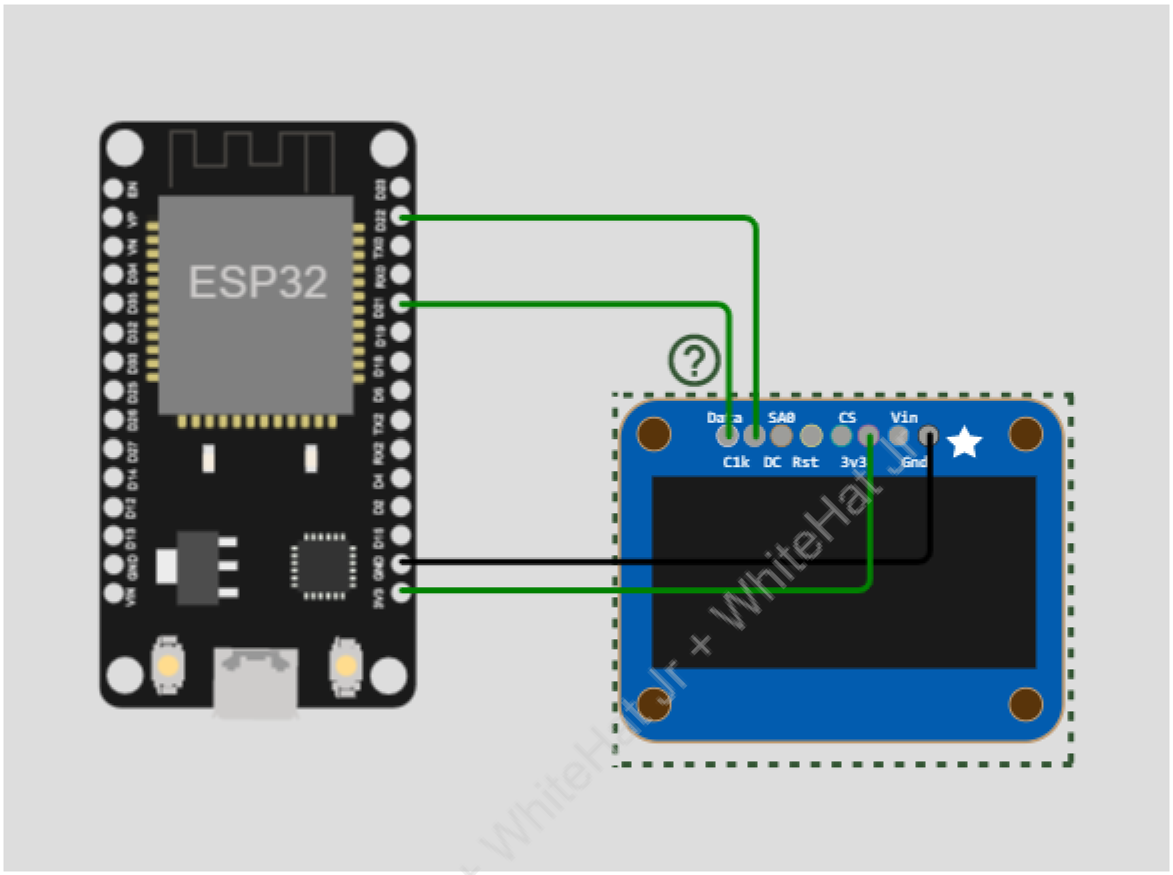
How did we DO the activities?

1. Display **WHITEHATJR** on the OLED.
    - **Collect the material**
        - 1 x ESP32

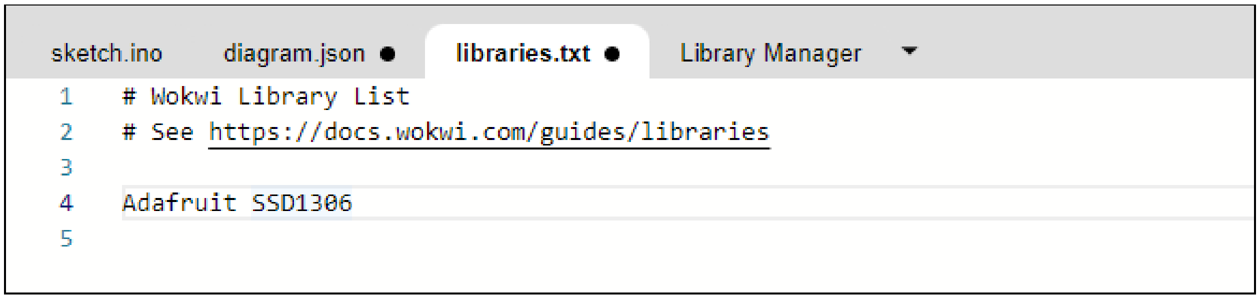
- **1 x OLED**



- **Connections:**
  - Insert OLED into the breadboard
  - Take four jumper wires.
  - OLED VCC to ESP32 PIN VCC
  - OLED GND to ESP32 PIN GND
  - OLED Clk to ESP32 PIN GPIO22
  - OLED Data to ESP32 PIN GPIO21



2. To control the **OLED** display, install libraries
   - Click on the small triangle icon ▾ next to Library Manager
   - Select New File
   - Name the file libraries.txt
   - Write down **Adafruit SSD1306**



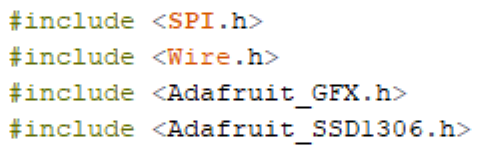
```
# Wokwi Library List
# See https://docs.wokwi.com/guides/libraries

Adafruit SSD1306

```

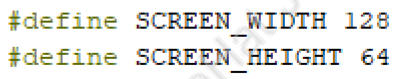
3. **Import Libraries:**

- **SPI.h Serial Peripheral Interface (SPI)** is a synchronous serial communication protocol used by microcontrollers for communicating with one or more peripheral devices quickly over short distances.When using SPI, there is always one master device (usually a microcontroller) that controls all peripheral devices.
- **Wire.h** This **library** allows you to communicate with I2C / devices. I2C is **a serial communication protocol**, so data is transferred bit by bit along a single wire.
- **Adafruit_GFX.h:** This library offers a common graphical syntax and set of functions for all LCD displays, OLED displays, and LED matrices.
- **Adafruit_SSD1306** : This library takes care of low-level communication with the hardware.



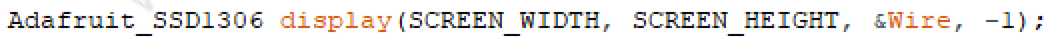
```
#include <SPI.h>
#include <Wire.h>
#include <Adafruit_GFX.h>
#include <Adafruit_SSD1306.h>
```

4. Define **SCREEN_WIDTH & SCREEN_HEIGHT** for OLED
   - **OLED** size is a 1**28×64**



```
#define SCREEN_WIDTH 128
#define SCREEN_HEIGHT 64
```

5. Declare **SSD1306** display that connects to **I2C** communication using **Wire** Library
   - Initialize a **display** object with the **SCREEN_WIDTH & SCREEN_HEIGHT** defined earlier with I2C communication protocol.
   - A value of **(-1)** indicates that our OLED display does not have a **RESET** pin. Sometimes OLED displays have a RESET pin on the OLED, in that case we should connect it to a GPIO and should include the GPIO number as a parameter.



```
Adafruit_SSD1306 display(SCREEN_WIDTH, SCREEN_HEIGHT, &Wire, -1);
```

6. Initialize using **void setup()** function
   - Serial.begin(115200): Sets the **data rate** in bits per second (baud) for **serial** data transmission.
   - Initialize the OLED display with the begin() method.
   - If the OLED displays nothing, check the OLED address at **0x3C**. In our case, the address is 0x3C.
   - If we are not able to connect to the display, it prints a message on the Serial Monitor.

```
void setup() {
  Serial.begin(115200);

  if(!display.begin(SSD1306_SWITCHCAPVCC, 0x3C)) {
    Serial.println(F("SSD1306 allocation failed"));
    for(;;);
  }
```

7. Print data on OLED
   - to initialize, add a **two second delay** before writing text
   - Clear the display buffer with the **clearDisplay()** method after initializing the display
   - To **write** text set the font size, color, and location where the text will be displayed in the OLED and data which need to be printed.
   - Set the font size using the **setTextSize()** method
   - Set the font color using the **setTextColor()** method. **WHITE** sets white font and black background.
   - Using the **setCursor(x,y)** method, specify the starting point of the text. In this case, the text will be started at **(0,10).**
   - send the text to the display using the **println()** method
   - Call the **display()** method to isplay the text on the screen.

```
  delay(2000);
  display.clearDisplay();

  display.setTextSize(2);
  display.setTextColor(WHITE);
  display.setCursor(10, 20);
  display.println("WHTEHATJR");
  display.display();
}
```

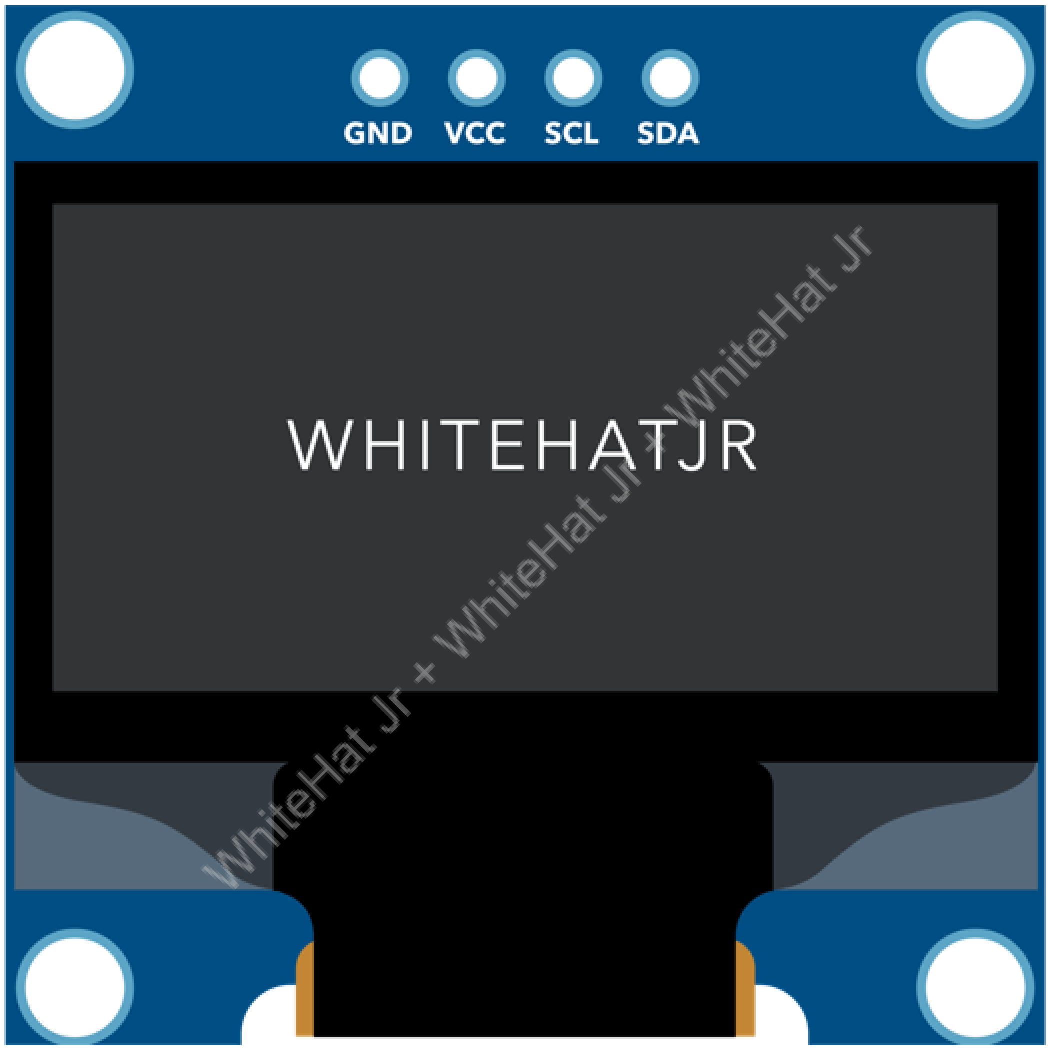
   - Call the main function using **void loop()**

```
void loop() {

}
```

8. **Output:**
   - **Compile and upload** the program to the ESP32 board using Arduino IDE
   - **Verify the program** by clicking the Tick option.
   - **Upload the program** by clicking the arrow option.
   - If the port is not selected, insert the USB cable in Computer's port and select the port

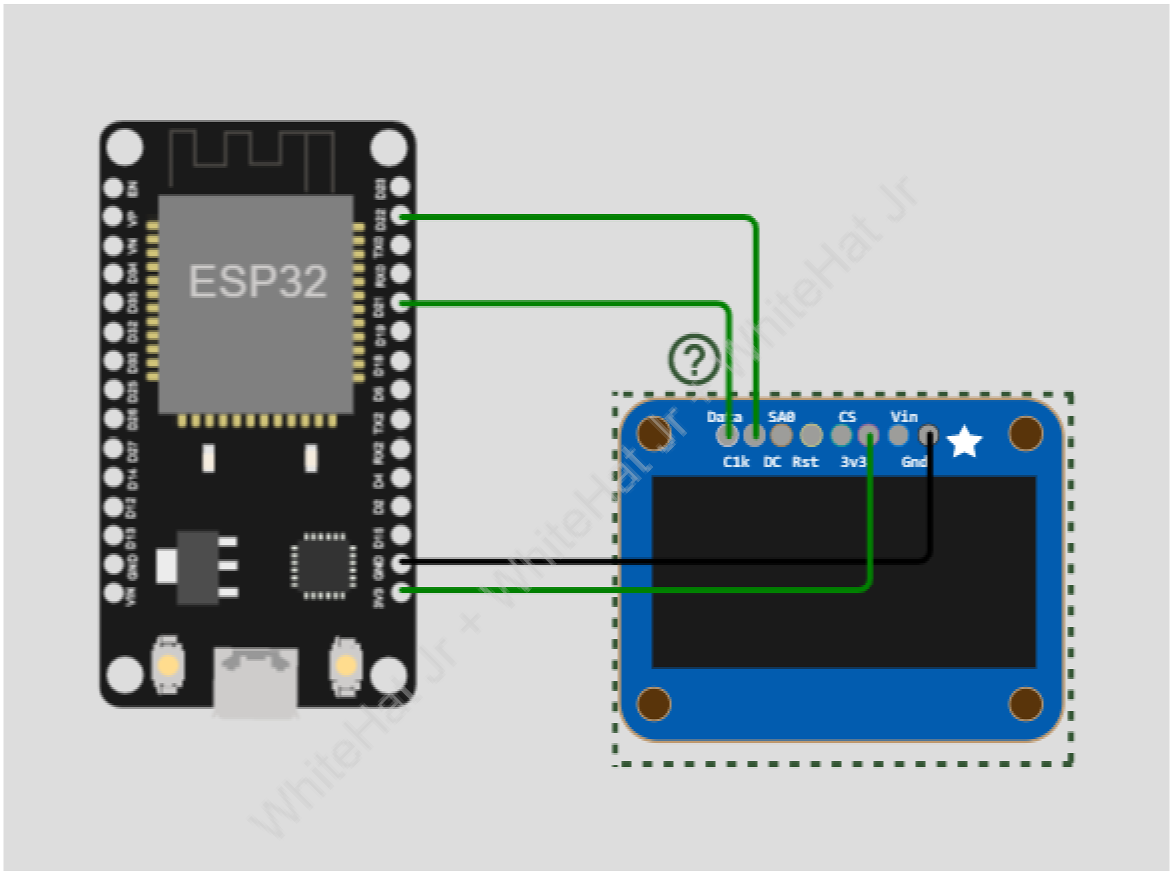
- If your OLED display is not showing anything:
- Check that the OLED display is properly wired



9. To print shapes on **OLED.**
   - **Collect the material**
     - **1 x ESP32**
     - **1 x OLED**

10. Let's do connections:
   - Insert OLED into the breadboard
   - Take four jumper wires.

- Connect OLED **PIN VCC** to **ESP32 PIN 3.3V**
- Connect OLED **PIN GND** to **ESP32 PIN GND**
- Connect OLED **PIN CLK** to **ESP32 PIN GPIO22**
- Connect OLED **PIN DATA** to **ESP32 PIN GPIO21**



11. Import Libraries:

- **SPI.h Serial Peripheral Interface (SPI)** is a synchronous serial communication protocol used by microcontrollers for communicating with one or more peripheral devices quickly over short distances.When using SPI, there is always one master device (usually a microcontroller) that controls all peripheral devices.
- **Wire.h** This **library** allows you to communicate with I2C / devices. I2C is **a serial communication protocol**, so data is transferred bit by bit along a single wire.
- **Adafruit_GFX.h:** This library offers a common graphical syntax and set of functions for all LCD displays, OLED displays, and LED matrices.
- **Adafruit_SSD1306**: This library takes care of low-level communication with the hardware.

```
#include <SPI.h>
#include <Wire.h>
#include <Adafruit_GFX.h>
#include <Adafruit_SSD1306.h>
```

12. Define **SCREEN_WIDTH & SCREEN_HEIGHT** for OLED
    - Our **OLED** size is a 128×**64**

```
#define SCREEN_WIDTH 128
#define SCREEN_HEIGHT 64
```

13. Declaration of an **SSD1306** display that connects to **I2C** communication using **Wire** Library
    - Initialize a **display** object with the **SCREEN_WIDTH & SCREEN_HEIGHT** defined earlier with I2C communication protocol.
    - A value of **(-1)** indicates that our OLED display does not have a **RESET** pin. Sometimes OLED displays have a RESET pin on the OLED, in that case connect it to a GPIO and include the GPIO number as a parameter.

```
Adafruit_SSD1306 display(SCREEN_WIDTH, SCREEN_HEIGHT, &Wire, -1);
```

14. Initialize using **void setup()** function
    - Serial.begin(115200): Sets the **data rate** in bits per second (baud) for **serial** data transmission.
    - Initialize the OLED display with the begin() method
    - If the OLED displays nothing, check the OLED address at **0x3C**. In our case, the address is 0x3C.
    - If we are not able to connect to the display, it prints a message on the Serial Monitor.
    - If something fails, don't proceed further, try to repeat the process using **for()** **l**oop
    - Using the **setCursor(x,y)** method, specify the starting point of the text. In this case, the text will be started at **(0,0).**

```
void setup() {
  Serial.begin(9600);

  // initialize OLED display with I2C address 0x3C
  if (!oled.begin(SSD1306_SWITCHCAPVCC, 0x3C)) {
    Serial.println(F("failed to start SSD1306 OLED"));
    while (1);
  }

  delay(2000); // wait two seconds for initializing
  oled.setCursor(0, 0);
}
```

15. Write code for shapes that need to display under the main function i.e **void loop()** function.
    - Circle:
        - Clear the display buffer with the **clearDisplay()** method after initializing the display
        - **drawCircle** method is used to draw circle shape on the OLED**.** drawCircle will use **X** and Y coordinates along with Radius (CenterX, CenterY, Radius in Pixels, WHITE);
        - **display.display()** is used to apply the changes.
        - Set a **delay** of 1s
        - **fillCircle** method is used to fill color in the circle shape on the OLED**. fillCircle** will use **X** and Y coordinates along with Radius (CenterX, CenterY, Radius in Pixels, WHITE);

```
void loop() {
  // draw a circle
  display.clearDisplay();
  display.drawCircle(50, 30, 30, WHITE);
  display.display();
  delay(1000);

  // fill a circle
  display.clearDisplay();
  display.fillCircle(50, 30, 30, WHITE);
  display.display();
  delay(1000);
```

    - Triangle:
        - Clear the display buffer with the **clearDisplay()** method after initializing the display.
        - **drawTriangle()** method is used to draw a triangle shape on the OLED**. drawTraiangle()** will use **X** and Y coordinates for three sides of a triangle

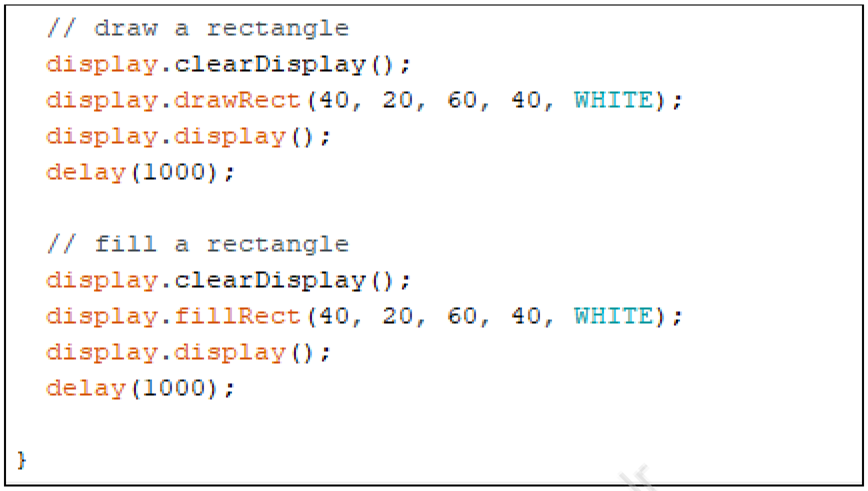
along with color.

- **display.drawTriangle (FirstX , FirstY, SecondX, SecondY, ThirdX, ThirdY, WHITE).**
- **display.display()** is used to apply the changes.
- Set a **delay** of 1s.
- **fillTriangle()** method is used to fill color in a triangle shape on the OLED**. drawtriangle()** method will use **X** and Y coordinates for three sides of a triangle along with color.

```
// draw a triangle
display.clearDisplay();
display.drawTriangle(50, 10, 0, 60, 60, 60, WHITE);
display.display();
delay(1000);

// fill a triangle
display.clearDisplay();
display.fillTriangle(50, 10, 0, 60, 60, 60, WHITE);
display.display();
delay(1000);
```

- **Rectangle**
  - Clear the display buffer with the **clearDisplay()** method after initializing the display
  - **drawRectangle()** method is used to draw a rectangle shape on the OLED**. drawRectangle** will use **X** and Y coordinates, Width & Height in Pixels along with the color
  - **display.drawRect(**StartX**, StartY, Width in Pixels, Height in Pixels, WHITE);**
  - **isplay.display()** is used to apply the changes.
  - Set a **delay** of 1s
  - **fillRectangle()** method is used to fill color in a rectangle shape on the OLED**. drawRectangle** will use **X** and Y coordinates, Width & Height in Pixels along with the color

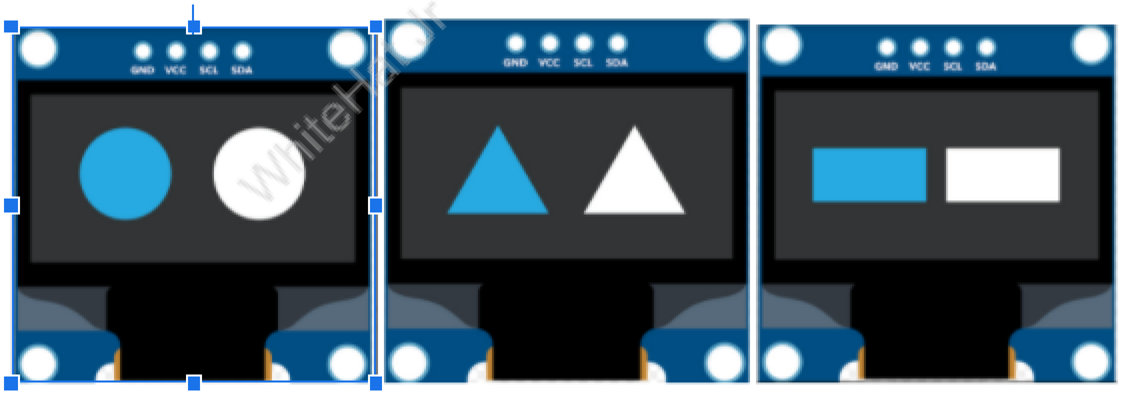


```
  // draw a rectangle
  display.clearDisplay();
  display.drawRect(40, 20, 60, 40, WHITE);
  display.display();
  delay(1000);

  // fill a rectangle
  display.clearDisplay();
  display.fillRect(40, 20, 60, 40, WHITE);
  display.display();
  delay(1000);

}
```

16. **Output:**
    - Compile and upload the program to ESP32 board using Arduino IDE
    - Verify the program by clicking the Tick option.
    - Upload the program by clicking the arrow option.
    - **If the port is not selected, insert the USB cable in Computer's port and select the port**
    - **If OLED display is not showing anything: Check that the OLED display is properly wired**
    - **We learned about OLED and how to display text and pattern on OLED.**



What's NEXT?

In the next class, we will learn about BIT ARRAYS

Expand Your Knowledge

To know more about **OLED** click here.