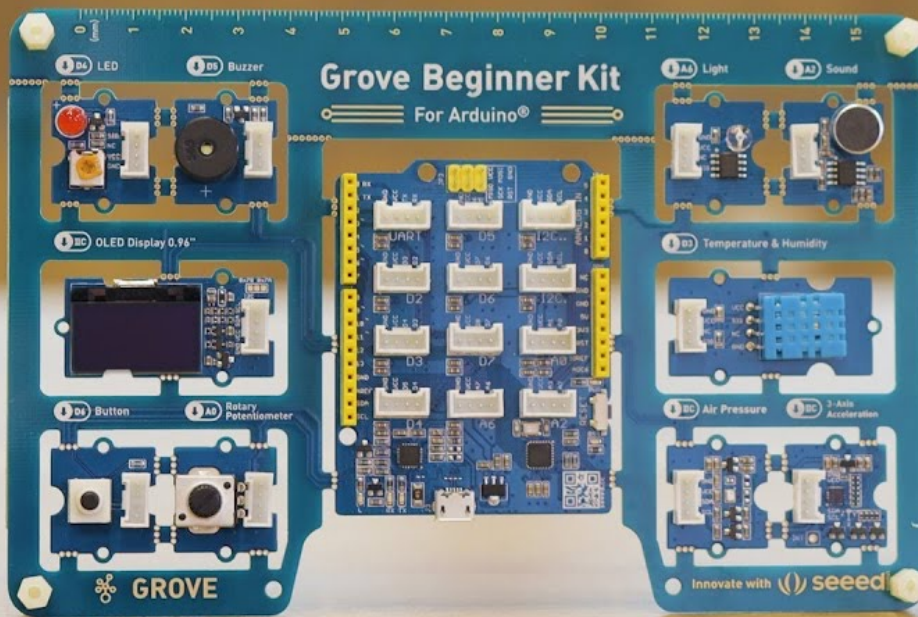


Grove Arduino Prototyping

ELECTRONICS

PHYSICAL COMPUTING

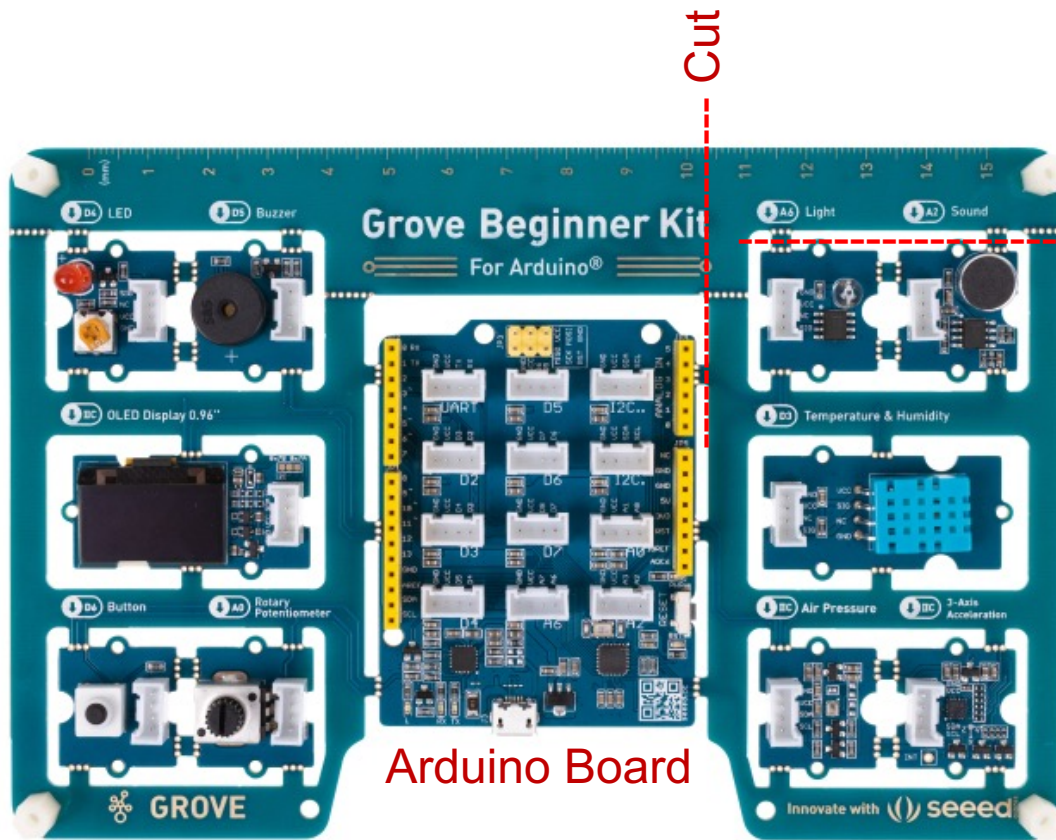


ARDUINO UNO COMPATIBLE

10 PRE-WIRED GROVE MODULES

STEP-BY-STEP TUTORIALS

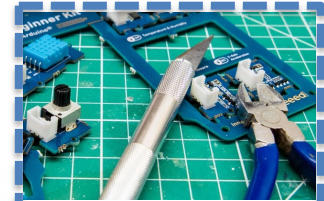
Grove Beginner for Arduino



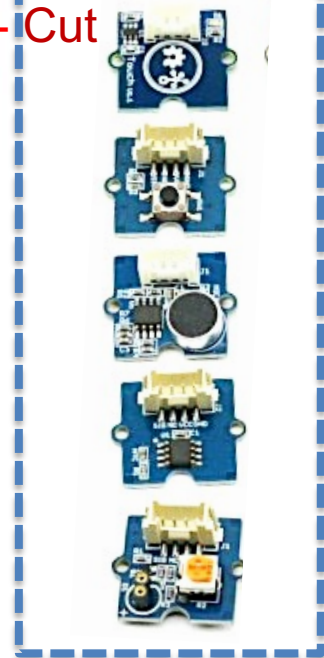
Modules

Arduino Board

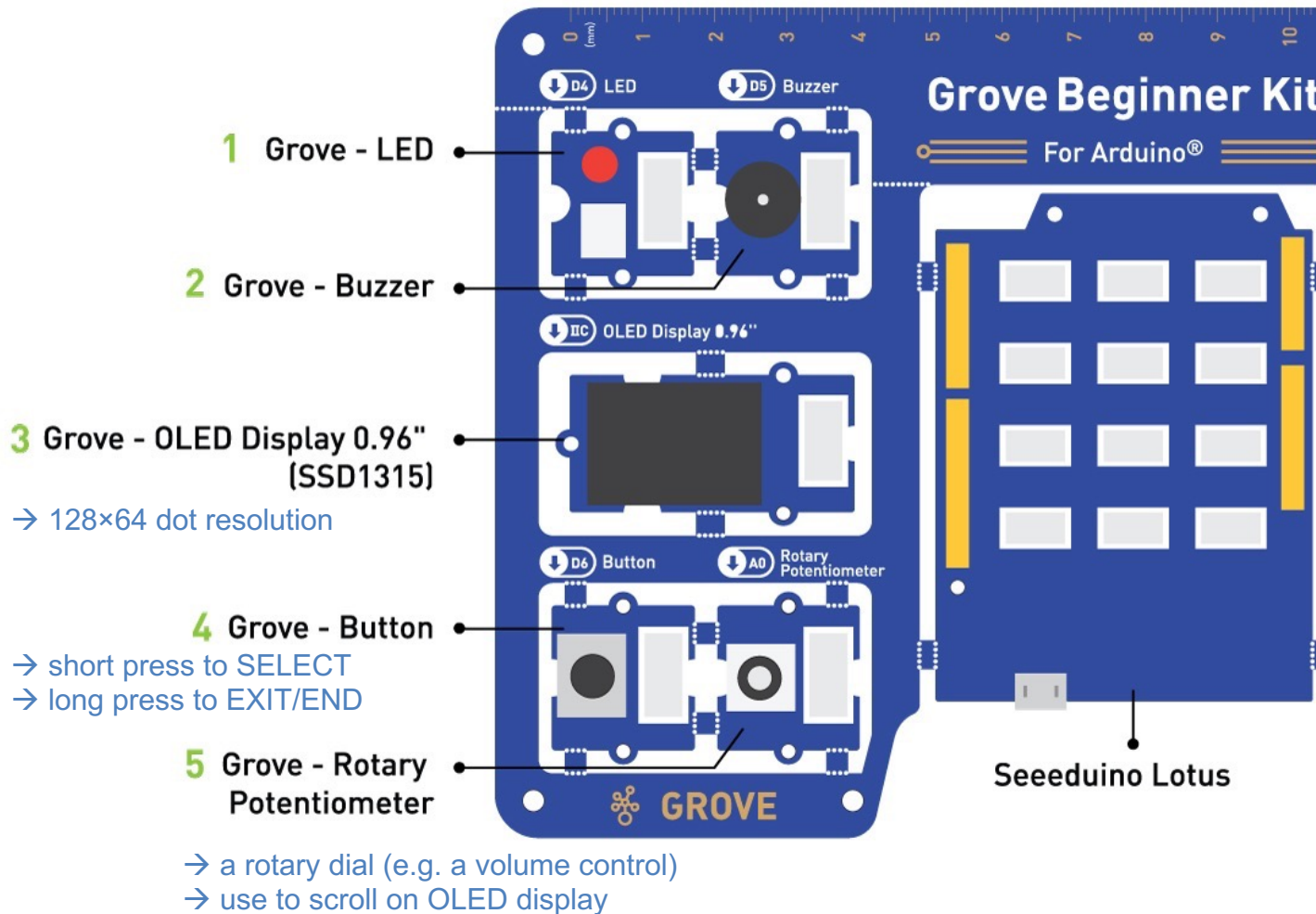
Modules



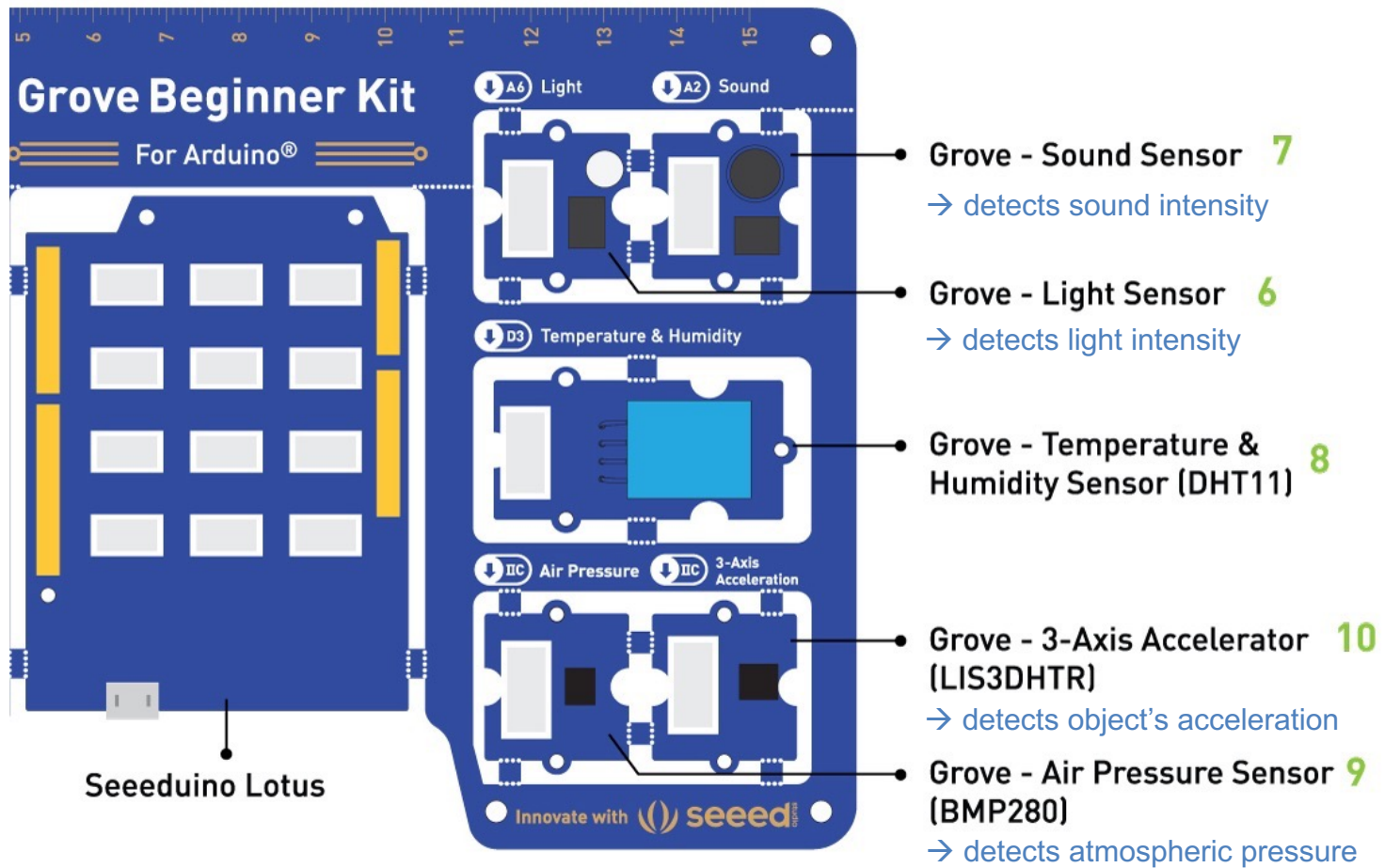
Cut



Grove Kit: What's Here?



Grove Kit: What's Here?



Grove Beginner for Arduino

USING GROVE & ARDUINO CODE-----

GETTING STARTED

Follow [my slides](#) to install [Arduino](#) and the [USB Driver](#) on your computer, to begin working with Grove and Arduino coding, to fix common errors, and to use ChatGPT for solving coding and hardware issues and modifying and generating Arduino code.

- View videos [1](#) & [2](#) on Grove and review the [Grove Beginners Kit for Arduino Wiki](#).
- More in [an article](#) and [a video](#) on how to use [ChatGPT](#) to code Arduino for you!
- *If you want to know:* [my notes](#) on what Arduino code means, line-by-line.

ARDUINO CODE YOU CAN COPY & PASTE

Paste these codes in Arduino! Change values in the code! Modify with ChatGPT!

- A Sound Sensor controls a single LED [[code](#)].
- A Button controls a single LED and a Buzzer [[code](#)].
- A Potentiometer (i.e., Rotary Angle Sensor) controls a Servo Motor [[code](#)].
- An Ultrasonic Sensor controls a Servo Motor and an RGB LED Stick [[code](#)].
- A Gesture Sensor controls a Servo Motor and a single LED [[code](#)].
- A Light Sensor controls a Servo Motor and an RGB LED Stick; a Switch turns the whole system on/off [[code](#)].

BEFORE our next class:



Prototype with Grove!

Show us that you can make work, using Grove, [any example code](#) that I provided on our course webpage (or any other one).

What to upload: [a link to a video](#) (Vimeo or YouTube) of the working Grove system. **Pass or Fail [5 pts]** uploaded to our shared folder by the due date on our course webpage.

• **5 points** | **GROVE DEMO** | **Example 1**

Show us that you can make work, using Grove, any example code that I provided on this course webpage under the heading, "Arduino Code You Can Copy & Paste."

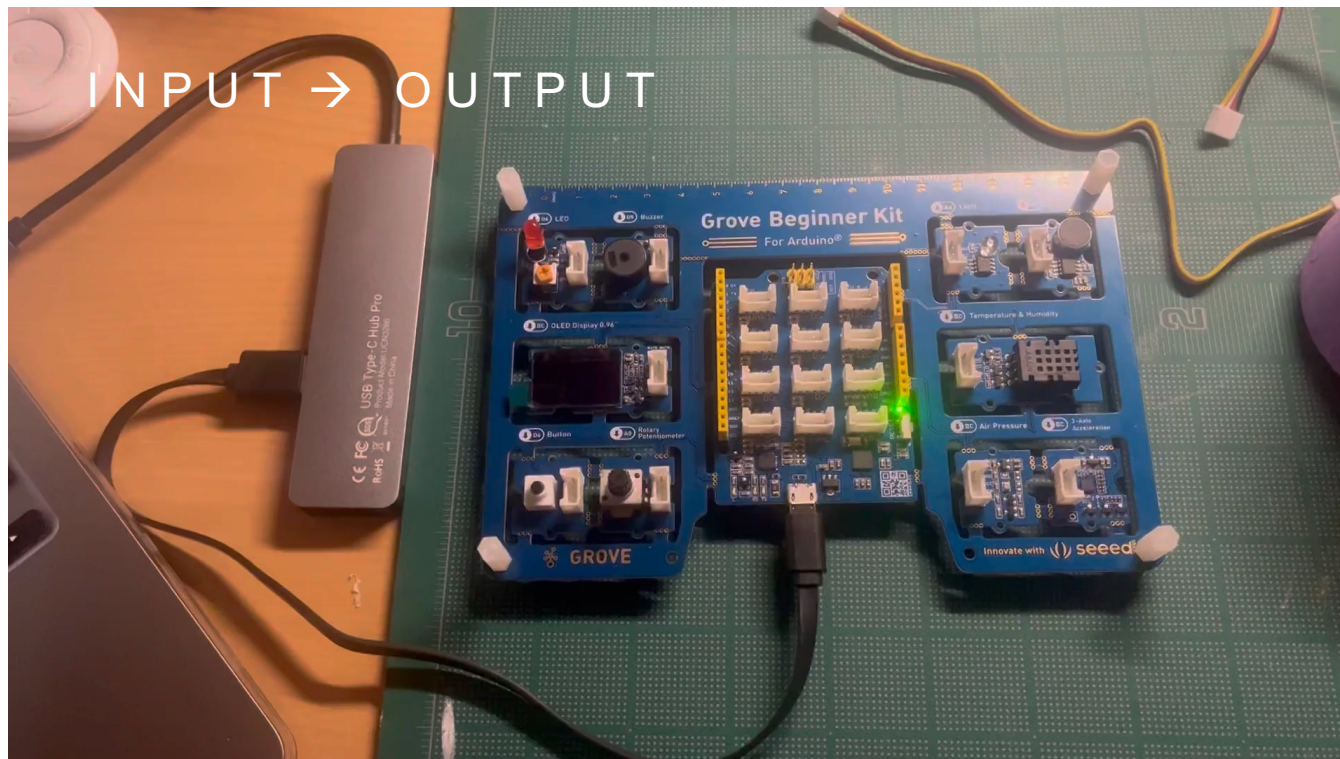
What to upload: a Word .doc with a link to a video (Vimeo or YouTube) of the working system, uploaded to our shared folder by the due date shown on this webpage. Name your Word .doc *[My Name]-Grove-Demo.doc*. Here is an example video: 1. This is Pass or Fail [5 pts]: you receive 5 pts if: [a] we can access your video from the link you provided, [b] your video shows a working system, [c] you named your file correctly, and [d] you submitted your .doc by the deadline. If you fail to meet any of these criteria, you receive a zero.

* **Example 1**



REMEMBER: we are designing an interactive device: your design will have at least one input and one output using the Grove Kit!

Example 1 from our course webpage



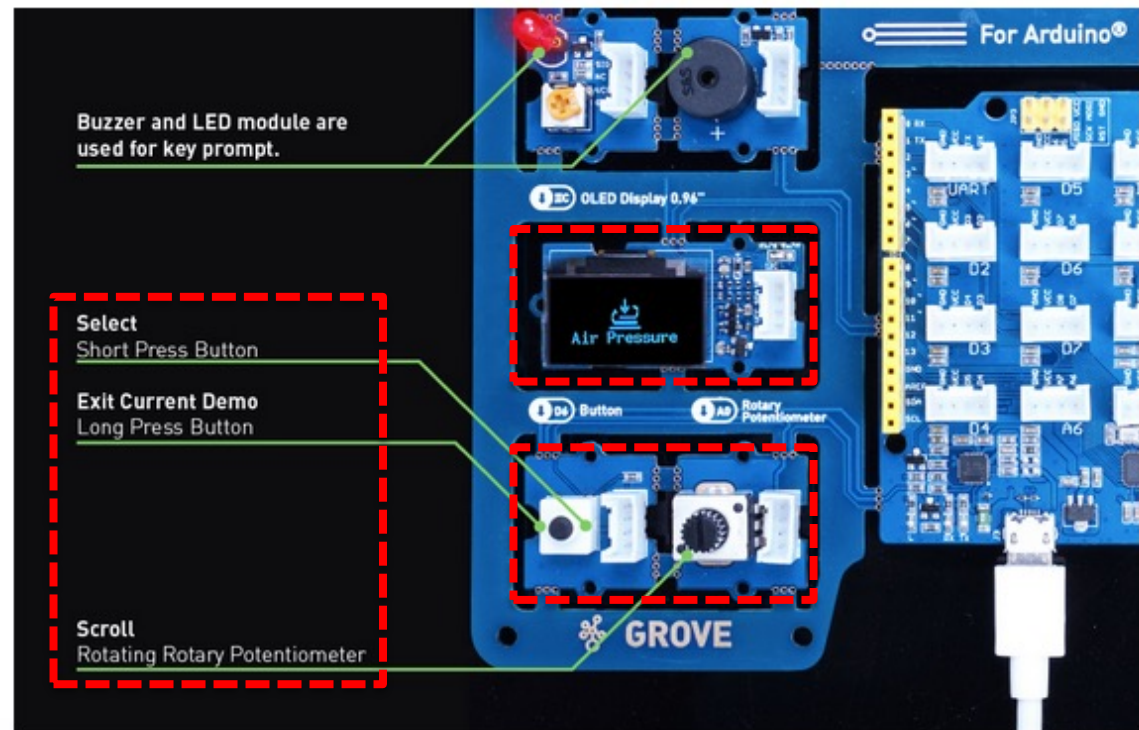
<https://arl.human.cornell.edu/images/Input-Output.mp4>

EXPERIENCE ALL THE MODULES

Grove Kit: The Unboxing Demo

1. Connect your new Grove Kit into your computer using the provided USB cord.
2. Use the potentiometer (twist dial) to scroll to the different modules; press the button to select one you want to explore.
3. Interact with the module and see what happens.
4. Press the button longer to exit (with a “beep”); then scroll to the next module to explore.

The Grove Beginner Kit has a plug and plays unboxing demo, where you first plug in the power to the board, you get the chance to **experience all the sensors** in one go! Use the button and rotary potentiometer to experience each sensor demo!



Download Arduino and the Driver

Download Arduino IDE

Install Arduino and the required USB Driver for your OS.

Software Downloads

Software (10)

Software · 10

- *Click on the one for your OS and you're done.*
- *It will download for you.*

CP210x Universal Windows Driver	v11.3.0 6/24/2023
CP210x VCP Mac OSX Driver	v6.0.2 10/26/2021
CP210x Windows Drivers	v6.7.6 9/3/2020
CP210x Windows Drivers with Serial Enumerator	v6.7.6 9/3/2020
CP210x_5x_AppNote_Archive	9/3/2020

Show 5 more Software

Select your Board & Port

* See next slide if your window doesn't look like the one below.

“USB serial”

The screenshot shows the Arduino IDE interface with the 'Select Board' dropdown menu open. The 'Unknown /dev/cu.usbserial-0001' option is selected. A red arrow points from the text '“USB serial”' to this option. The 'Select Other Board and Port' dialog box is open, showing the 'Arduino Uno' board selected in the 'BOARDS' list and the '/dev/cu.usbserial-0001 Serial Port (USB)' selected in the 'PORTS' list. A red arrow points from the text '“Uno”' to the 'Arduino Uno' board. Another red arrow points from the text '“USB”' to the selected port. A dashed blue box highlights the 'OK' button in the dialog box. A red asterisk is in the top left corner of the IDE window. The IDE title bar reads 'sketch_aug15a | Arduino IDE 2.1.1'. The IDE code editor shows the following code:

```
0. h>
LED. h>
N 7
DS 10
ensor A0
LEDS];

ch(5);
eds<W52812,
14 pinMode(7, OUTPUT);
15 }
16
17 void loop()
18 {
19   int value = analogRead(
20   if (value < 150) {
21
22     leds[0] = CRGB ( 250,
23     leds[1] = CRGB ( 250,
24     leds[2] = CRGB ( 250,
25     leds[3] = CRGB ( 250,
```

The Output window shows the following error message:

```
Missing FQBN (Fully Qualified Board Name)
Compilation error: Missing FQBN
```

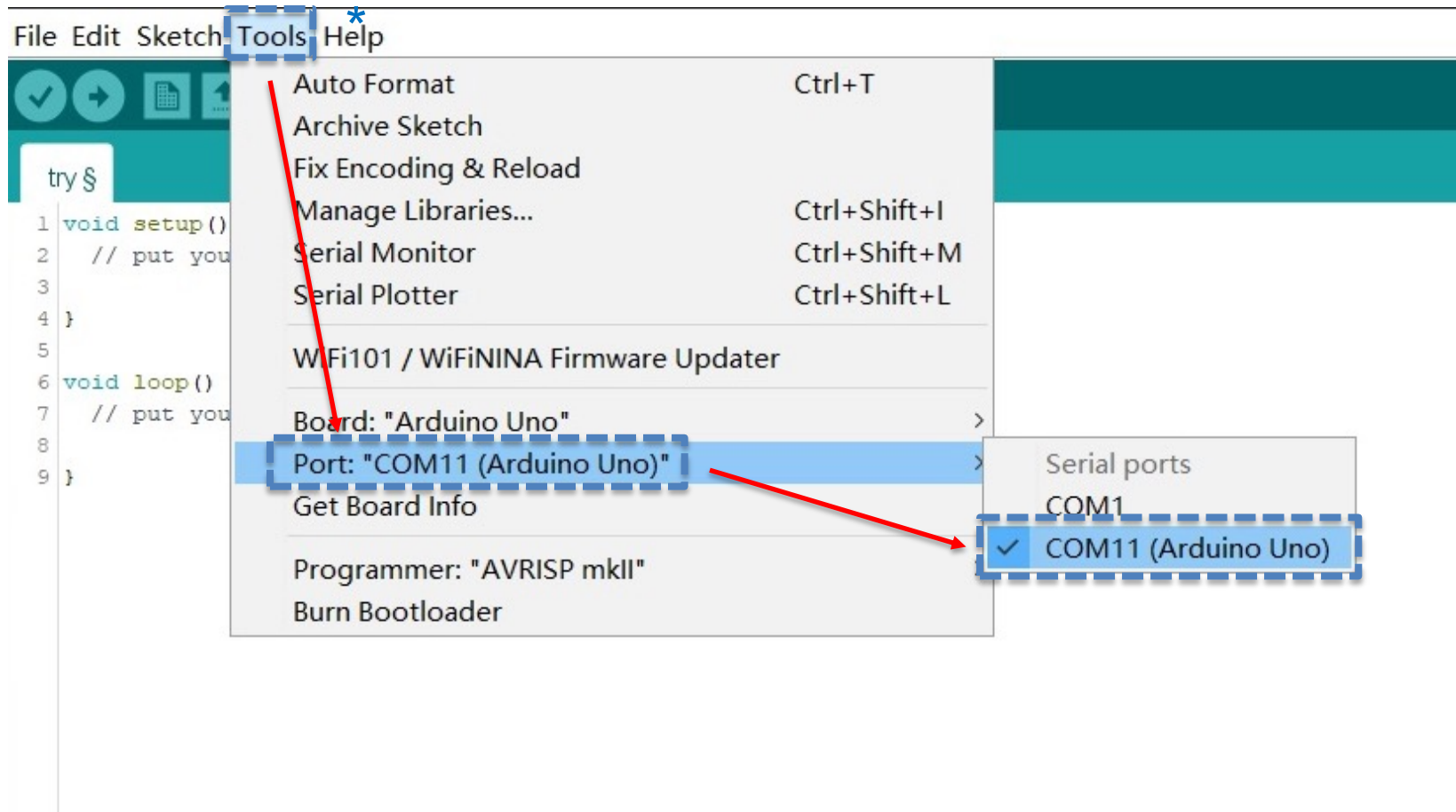
The status bar at the bottom of the IDE shows 'Ln 54, Col 1' and 'No board selected'.

Select your Board

1. Open the **Arduino IDE** on your PC. 2. Click on **Tools** -> **Board**-> **Arduino AVR Boards**-> **Arduino Uno** to select the correct Development Board Model. Select **Arduino Uno** as Board.

The screenshot shows the Arduino IDE interface with the 'Tools' menu open. The 'Board' submenu is selected, showing 'Arduino AVR Boards' and 'Arduino Uno' highlighted. Red arrows indicate the navigation path from 'Tools' to 'Board' to 'Arduino AVR Boards' to 'Arduino Uno'. The text 'AVR' and 'Uno' are written in blue above the respective menu items. The IDE title bar shows 'sketch_jun02a | Arduino 1.8.14 Hourly Build 2021/04/09 02:33'. The menu items are: Auto Format (Ctrl+T), Archive Sketch, Fix Encoding & Reload, Manage Libraries... (Ctrl+Shift+I), Serial Monitor (Ctrl+Shift+M), Serial Plotter (Ctrl+Shift+L), WiFi 101 / WiFiNINA Firmware Updater, Board: "Arduino Uno", Port, Get Board Info, Programmer: "AVRISP mkII", and Burn Bootloader. The 'Board' submenu includes: Boards Manager..., Arduino AVR Boards, Arduino Mbed OS Boards, Arduino Mbed OS Nano Boards, Arduino Mbed OS RP2040 Boards, Arduino SAMD (32-bits ARM Cortex-M0+) Boards, and Seeed SAMD (32-bits ARM Cortex-M0+ and Cortex-M4) Boards. The 'Arduino AVR Boards' submenu includes: Arduino Yun, Arduino Uno, Arduino Duemilanove or Diecimila, Arduino Nano, Arduino Mega or Mega 2560, Arduino Mega ADK, Arduino Leonardo, Arduino Leonardo ETH, Arduino Micro, Arduino Esplora, Arduino Mini, Arduino Ethernet, Arduino Fio, Arduino BT, LilyPad Arduino USB, LilyPad Arduino, Arduino Pro or Pro Mini, Arduino NG or older, Arduino Robot Control, and Arduino Robot Motor.

Select your Port



Try our first example code on your own.

ARDUINO CODE YOU CAN COPY & PASTE

Paste these codes in Arduino! Change values in the code! Modify with ChatGPT!

- A Sound Sensor controls a single LED [code].
- A Button controls a single LED and a Buzzer [code].
- A Potentiometer (i.e., Rotary Angle Sensor) controls a Servo Motor [code].
- An Ultrasonic Sensor controls a Servo Motor and an RGB LED Stick [code].
- A Gesture Sensor controls a Servo Motor and a single LED [code].
- A Light Sensor controls a Servo Motor and an RGB LED Stick; a Switch turns the whole system on/off [code].

• A Sound Sensor controls a single LED [code].

Try our first example code on your own.

Sound Sensor to LED

URL to video demo:

<https://drive.google.com/file/d/19xwRG4q0Y06yv3syiYYozPFNYY1yet2b/view?usp=sharing>

Code:

COPY THIS:

```
//The sound sensor detects sounds and lights up an LED

int soundPin = A2; //connect sound sensor to A2
int ledPin = 4; //connect LED to D4
void setup() {
  pinMode(ledPin, OUTPUT);
  Serial.begin(9600);
}
void loop(){
  int soundState = analogRead(soundPin); //read sound sensor's value
  Serial.println(soundState);
  if (soundState > 200) {
    digitalWrite(ledPin, HIGH); //when a sufficiently loud sound is detected,
    LED turns on
    delay(10);
    ~~~~~
    digitalWrite(ledPin, LOW); //when it's quiet (sound ends), LED turns off
  }
}
```

Try our first example code on your own.

Sound Sensor to LED

URL to video demo:

<https://drive.google.com/file/d/19xwRG4g0Y06yv3syiYYozPFNYY1yet2b/view?usp=sharing>

Code:

COPY THIS:

```
//The sound sensor detects sounds and lights up an LED
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  pinMode(ledPin, OUTPUT);
  Serial.begin(9600);
}
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  int soundState = analogRead(soundPin); //read sound sensor's value
  Serial.println(soundState);
  if (soundState > 200) {
    digitalWrite(ledPin, HIGH); //when a sufficiently loud sound is detected,
    LED turns on
    delay(10);
  }
  digitalWrite(ledPin, LOW); //when it's quiet (sound ends), LED turns off
}
```

Tells me which module is connected to which pin.

Paste my code in Arduino window.

Serial Monitor



Verify (code)



Upload (code)



New (code)



Open (code)



Save (code)

```
sketch_feb07a | Arduino 1.6.5  
sketch_feb07a §  
void setup() {  
  // put your setup code here, to run once:  
}  
PASTE HERE  
(in place of what's here;  
nothing in yellow  
highlighting should remain).  
void loop() {  
  // put your main code here, to run repeatedly:  
}  
Save Canceled.  
9 - 1  
Arduino Uno on /dev/cu.usbmodem1411
```

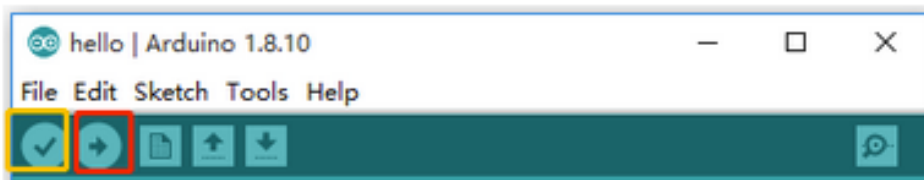

Verify code by Clicking on



Upload code by Clicking on



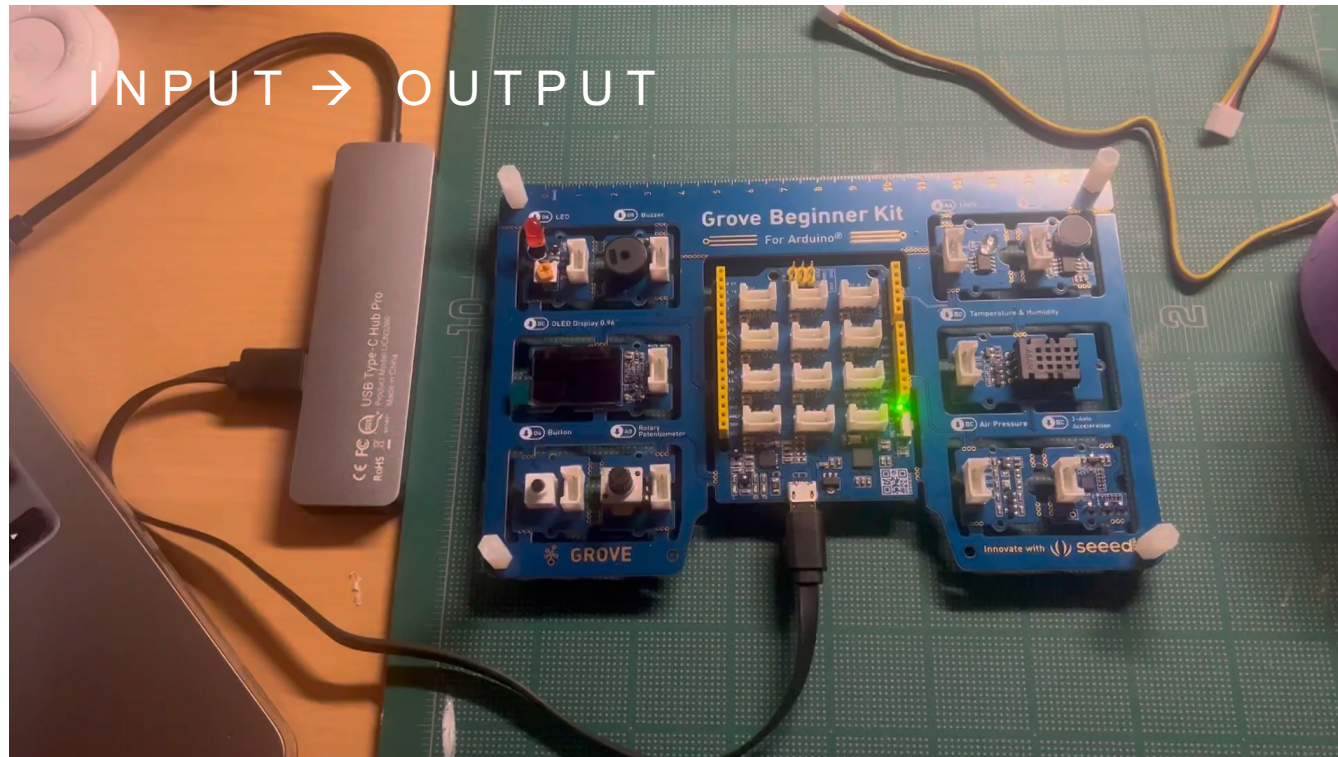
5. In the upper left corner of the Arduino IDE, there are two buttons, **Verify and Upload**. First, press the Verify button(✓) to compile. After the compilation is successful, press the upload button(→).



Verify:
Upload:

You should be able to light up the red LED by making noise...

Example 1 from our course webpage



<https://arl.human.cornell.edu/images/Input-Output.mp4>

ERRORS

... or not!

sketch_oct12a | Arduino IDE 2.0.0

Select Board

```
sketch_oct12a.ino
1 //LED Blink
2 //The LED will turn on for one second and then turn off for one second
3 int ledPin = 4;
4 void setup() {
5   pinMode(ledPin, OUTPUT);
6 }
7 void loop() {
8   digitalWrite(ledPin, HIGH);
9   delay(1000);
10  digitalWrite(ledPin, LOW);
11  delay(1000);
12 }
13
```

ERROR!

Output

Missing FQBN (Fully Qualified Board Name)

Compilation error: Missing FQBN (Fully Qualified Board Name)

⊗ No board selected. Please select your Arduino board from the Tools > Board menu. ×

COPY ERROR MESSAGES

Ln 12, Col 2 UTF-8 × No board selected 1

ERRORS

Error: "No board selected."

sketch_oct12a.ino

```
1 //LED Blink
2 //The LED will turn on for one second
3 int ledPin = 4;
4 void setup() {
5   pinMode(ledPin, OUTPUT);
6 }
7 void loop() {
8   digitalWrite(ledPin, HIGH);
9   delay(1000);
10  digitalWrite(ledPin, LOW);
11  delay(1000);
12 }
13
```

sketch_oct12a

Select Board

- Unknown /dev/cu.Bluetooth-Incoming-Port
- Unknown /dev/cu.JabraElite45h
- Unknown /dev/cu.usbserial-0001
- Select other board and port...

Output

Missing FQBN (Fully Qualified Board Name)

Compilation error: Missing FQBN (Fully Qualified Board Name)

X: No board selected

No board selected. Please select your Arduino board from the Tools > Board menu.

COPY ERROR MESSAGES

ERRORS

Select your board!

sketch_oct12a | Arduino IDE 2.0.0

Select Board

```
sketch_oct12a.ino
1 //LED Blink
2 //The LED will turn on for one second and then turn off for one second
3 int ledPin = 4;
4 void setup() {
5   pinMode(ledPin, OUTPUT);
6 }
7 void loop() {
8   digitalWrite(ledPin, HIGH);
9   delay(1000);
10  digitalWrite(ledPin, LOW);
11  delay(1000);
12 }
13
```

Select Other Board and Port

Select both a Board and a Port if you want to upload a sketch.
If you only select a Board you will be able to compile, but not to upload your sketch.

BOARDS	PORTS
Search board	
Arduino Robot Control	/dev/cu.Bluetooth-Incoming-Port Serial Port
Arduino Robot Motor	/dev/cu.JabraElite45h Serial Port
Arduino Tian	/dev/cu.usbserial-0001 Serial Port (USB) ✓
Arduino Uno	<input type="checkbox"/> Show all ports
Arduino Uno Mini	
Arduino Uno WiFi	

Please pick a board connected to the port you have selected.

CANCEL OK

Output

```
Missing FQBN
Compilation
```

Other Common Errors

You didn't copy & paste the entire code!

You didn't connect the right components to the right pins!

You didn't download the driver!

You have a misplaced or extra { or } in your code!

ERRORS

I can't figure out what the error is!

(ChatGPT may be your answer!)

Default (GPT-3.5)



I unplugged the display and plugged it back in. Nothing displays on the screen with this code. In the previous version of the code, text was displayed.



I apologize for the confusion. It seems like there might be some issues with the communication or initialization of the display. Before proceeding, please ensure the following:

1. Double-check your connections between the display and the Arduino SEEED Lotus board. Make sure the I2C connections (SCL and SDA) are correctly wired.
2. Confirm that you're using the correct I2C address for your specific OLED display module. If you're not sure about the I2C address, refer to the documentation provided by Seeed for the Grove OLED Display 0.96" (SSD1315).
3. Ensure that the display module is working correctly. Sometimes, displays might have manufacturing defects or loose connections.

Once you've confirmed the above points, let's try a simpler code snippet to display the eye pattern:

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

#define SCREEN_WIDTH 128
#define SCREEN_HEIGHT 64

// Replace with your display's I2C address
#define OLED_ADDRESS 0x3D

Adafruit_SSD1306 display(SCREEN_WIDTH, SCREEN_HEIGHT, &Wire, OLED_ADDRESS);
```

Copy code

→ Arduino

ERRORS

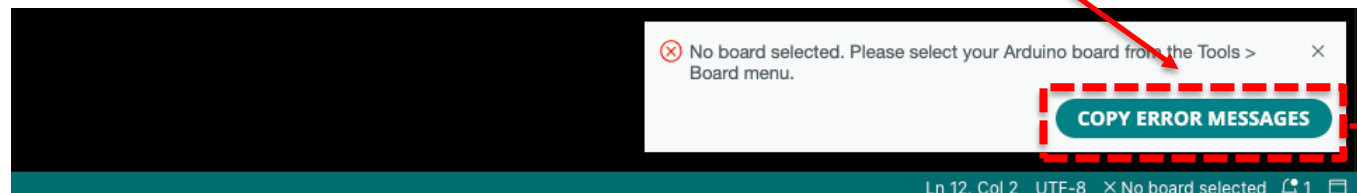
I can't figure out what the error is!

Example prompts for correcting Arduino code using ChatGPT:

Correct the following code: [paste the entire code to be corrected here].

(Correct the following code: **shift > return** // allows you to move to line below in ChatGPT [paste the entire code to be corrected here].)

(You can also past your code into ChatGPT, copy & paste the error code from Arduino, and ask ChatGPT to correct the error.)



Chat
GPT

It works! / Now try changing values...

Sound Sensor to LED

Code:

```
//The sound sensor detects sounds and lights up an LED

int soundPin = A2; //connect sound sensor to A2
int ledPin = 4; //connect LED to D4
void setup() {
  pinMode(ledPin, OUTPUT);
  Serial.begin(9600);
}
void loop(){
  int soundState = analogRead(soundPin); //read sound sensor's value
  Serial.println(soundState);
  if (soundState > 200) { HIGH = "On!" (i.e., lit up!)
    digitalWrite(ledPin, HIGH); //when a sufficiently loud sound is detected,
    LED turns on
    delay(10); ← Try changing 10 to 100 and then to 1000 Notice anything different?
  }
  digitalWrite(ledPin, LOW); //when it's quiet (sound ends), LED turns off
  LOW = "Off!" (i.e., no light!)
}
```

ADDING LIBRARIES

Try our 5th example code on your own.

ARDUINO CODE YOU CAN COPY & PASTE

Paste these codes in Arduino! Change values in the code! Modify with ChatGPT!

- A Sound Sensor controls a single LED [\[code\]](#).
- A Button controls a single LED and a Buzzer [\[code\]](#).
- A Potentiometer (i.e., Rotary Angle Sensor) controls a Servo Motor [\[code\]](#).
- An Ultrasonic Sensor controls a Servo Motor and an RGB LED Stick [\[code\]](#).
- A Gesture Sensor controls a Servo Motor and a single LED [\[code\]](#).
- A Light Sensor controls a Servo Motor and an RGB LED Stick; a Switch turns the whole system on/off [\[code\]](#).

• A Gesture Sensor controls a single LED [\[code\]](#).


```
/* The Gesture Sensor controls a servo and a singular LED.
```

ADDING LIBRARIES

The Gesture Sensor module provides simple motion-based gesture recognition and object tracking.

Try our 5th example code on your own.

In gesture mode it can recognize 9 hand moving gestures:

```
move up
move down
move left [USED IN THIS CODE: turns LED on and rotates servo -120 degrees]
move right [USED IN THIS CODE: turns LED off and rotates servo +120 degrees]
circle clockwise
circle anti-clockwise (counter-clockwise / widdershins)
forwards / towards
backwards / away
wave
```

The device also counts the quantity of hand waves.

```
*/
```

```
#include <Wire.h> // This library is for I2C communication.
#include "paj7620.h" // This is the library for the Gesture Sensor.
```

```
#include <Servo.h> // This is the library for the Servo.
```

[There's more code in between here on the word doc. Don't copy code from this slide!]

```
    case GES_RIGHT_FLAG:
        digitalWrite(LED_pin, LOW); // Turn LED off
        servo_1.write(0);           // Return servo to 0 degrees
        break;
    default:
        break;
}
}
delay(100);
}
```

COPY CODE FROM WORD DOC

ADDING LIBRARIES

Paste my code in Arduino window.



Verify (code)



Upload (code)



New (code)



Open (code)



Save (code)

Serial Monitor



```
sketch_feb07a | Arduino 1.6.5  
sketch_feb07a §  
void setup() {  
  // put your setup code here, to run once:  
}  
void loop() {  
  // put your main code here, to run repeatedly:  
}
```

PASTE HERE
(in place of what's here;
nothing in yellow
highlighting should remain).

Save Canceled.

Info and errors shown here

9 - 1 Arduino Uno on /dev/cu.usbmodem1411

ADDING LIBRARIES

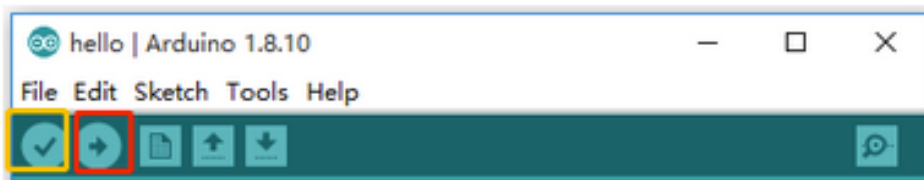
Verify code by Clicking on



Upload code by Clicking on



5. In the upper left corner of the Arduino IDE, there are two buttons, **Verify and Upload**. First, press the Verify button(✓) to compile. After the compilation is successful, press the upload button(→).



Verify:
Upload:

ERRORS

Adding Libraries

sketch_oct12a | Arduino IDE 2.0.0

Select Board

sketch_oct12a.ino

1
2
3
4
5
6
7
8
9
10
11
12
13

ERROR!

Output

Missing libraries!
E.g., "No [Servo.h] : No such file or directory."

COPY ERROR MESSAGES

Ln 12, Col 2 UTF-8 × No board selected 1

```
/* The Gesture Sensor controls a servo and a singular LED.
```

ADDING LIBRARIES

The Gesture Sensor module provides simple motion-based gesture recognition and object tracking.

Try our 5th example code on your own.

In gesture mode it can recognize 9 hand moving gestures:

```
move up
move down
move left [USED IN THIS CODE: turns LED on and rotates servo -120 degrees]
move right [USED IN THIS CODE: turns LED off and rotates servo +120 degrees]
circle clockwise
circle anti-clockwise (counter-clockwise / widdershins)
forwards / towards
backwards / away
wave
```

The device also counts the quantity of hand waves.

```
*/
```

```
#include <Wire.h> // This library is for I2C communication.
#include "paj7620.h" // This is the library for the Gesture Sensor.

#include <Servo.h> // This is the library for the Servo.
[...]
```

```
    case GES_RIGHT_FLAG:
        digitalWrite(LED_pin, LOW); // Turn LED off
        servo_1.write(0);           // Return servo to 0 degrees
        break;
    default:
        break;
}
}
delay(100);
}
```

You need to add these “libraries” to make your code work, or you will get an ERROR.

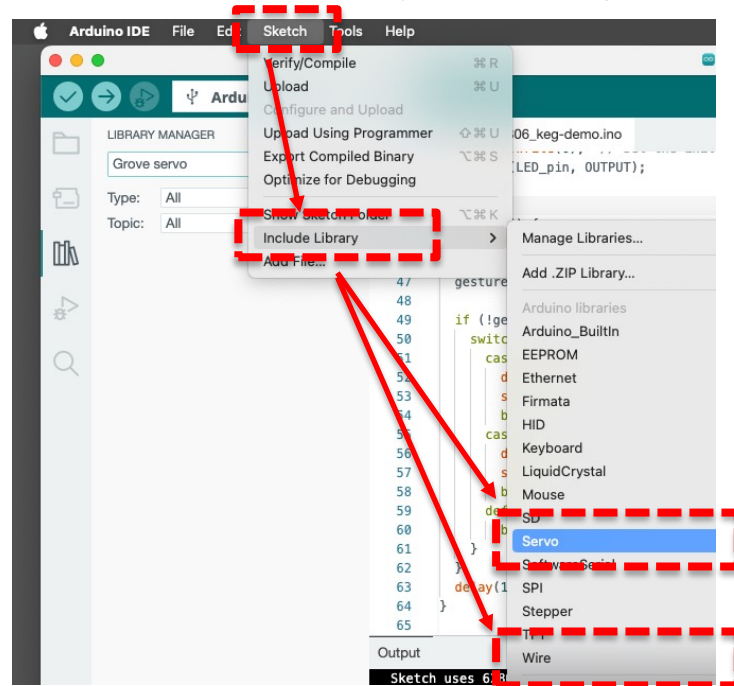
Adding Libraries

To correct this ERROR, you need to add the libraries identified in your code (and again in your ERROR message below it) to your Arduino libraries folder.

For this 5th example, we need the 3 libraries indicated after `#include:`
`<Wire.h>`, `"paj7620.h"`, and `<Servo.h>`.

The `Wire` and `Servo` libraries can be added by simply following the path shown on the screen shot here:

(The `Servo` library is added by just clicking on "Servo"; repeat the same by clicking "Wire".



Adding Libraries

The "paj7620" library is not on this list -- it's a less common Arduino module. `paj7620` can be added by simply following the path shown on the screen shot here:

The screenshot shows the Arduino IDE interface with the Library Manager open. The 'Tools' menu is open, and 'Manage Libraries...' is selected. The Library Manager search bar contains 'paj7620'. The search results show two libraries: 'DFRobot_PAJ7620U2' and 'Gesture PAJ7620'. The 'Gesture PAJ7620' library is highlighted, and the 'INSTALL' button is clicked.

Type `paj7620` in search

Click

```
...
41
42
43
44
45
46 void loop() {
47   gesture_data = gesture_read();
48   gesture_error = gesture_error();
49
50   if (!gesture_error) {
51     switch (gesture_data) {
52       case G_GESTURE_NONE:
53         digitalWrite(servo_1_pin, LOW);
54         break;
55       case G_GESTURE_FORWARD:
56         digitalWrite(servo_1_pin, HIGH);
57         break;
58       case G_GESTURE_BACKWARD:
59         digitalWrite(servo_1_pin, LOW);
60         break;
61       default:
62         break;
63     }
64   }
65   delay(100);
}
```

Adding Libraries

Once you've added a library for a [Servo], you will always have it loaded for the future. (You only need to add the [Servo] library once.)

ChatGPT

More fun with ChatGPT:

add modules, change colors, change speeds, ...

If ChatGPT generated a code for you (or if you pasted one of my example codes into ChatGPT) but now you wanted, in your project, [an OLED display], you (in the same “Chat”) add a prompt such as:

Write code to display the temperature and humidity readings from a DHT22 sensor on a SSD1306 OLED display. DHT is connected to pin D3 of an Arduino Uno. SSD1305 uses I2C.

You could likewise ask ChatGPT to add a pushbutton to your code:

Add a pushbutton connected to pin D4 to the above circuit. Code the pushbutton to toggle the temperature display from Celsius to Fahrenheit.

You could likewise ask ChatGPT to substitute the LED stick for the single [red] LED:

Replace the single LED with a Grove RGB LED Stick 15-WS2813 Mini. If the soundState of the sound sensor is > 200, the LED Stick lights up blue.

This is the way to build-up a complex Arduino code: working from a simple code to a more complex code, step-by-step, by asking for modifications like the above.

Generate code with ChatGPT:

[Generating Arduino code using ChatGPT](#) | Example prompts you type into ChatGPT:

Notes [1]: When ChatGPT has generated the code for you, you can copy the code by simply clicking **Copy code** in the upper-right of the ChatGPT window.

Note [2]: Note ChatGPT's "Note" found beneath the window containing the code. This note tells you which pins are used to connect your hardware (e.g., a push button, a light sensor, a servo motor) to your Arduino board, which Arduino libraries need to be installed to run your code, and where to find this library.

Prompt Example 1:

Write code to flash the onboard LED on an Arduino Uno once per second.

Prompt Example 2:

Control the brightness of an LED attached to pin 9 on an Arduino Uno with a potentiometer connected to analog pin A0, using PWM.

PWM (Pulse-width modulation) is a method of controlling the average power delivered by an electrical signal. The average value of voltage (and current) fed to the load is controlled by switching the supply between 0 and 100% at a rate faster than it takes the load to change significantly. The longer the switch is on, the higher the total power supplied to the load.

Prompt Example 3:

Write code to display the temperature and humidity readings from a DHT22 sensor on the serial monitor. DHT is connected to pin D3 of an Arduino Uno.

What do the pins mean?

D is Digital, **A** is Analog, **I2C** is Inter-Integrated Circuit, **UART** is universal asynchronous receiver /transmitter

D for Digital: 0 or 1 values: e.g., the button

A for Analog: 0 to 1023 values (10 bit); e.g., the potentiometer (aka = rotary angle sensor); the light sensor

I2C for Inter-Integrated Circuit: e.g., the LCD display. NOTE: Unlike with D and A pins, with I2C pins, in your code, you do not have to designate a particular I2C pin for your [LCD display], as in “I2C 3”; simply plug the LCD display into any one of the three I2C pins and the code will find it.

UART for Universal Asynchronous Receiver-Transmitter (i.e., a serial port for connecting the given Arduino board to other Arduino boards or a computer or other computing devices. For more information, see <https://docs.arduino.cc/tutorials/nano-every/run-4-uar>

What does the code mean?

```
sketch_oct15f
//LED Blink ← // is the start of a comment (not part of the code; for you!)
//The LED will turn on for one second and then turn off for one second
int ledPin = 4; ← the pin # on Arduino board connected to the LED
void setup() { ← {} setup begins the program
  pinMode(ledPin, OUTPUT); ← ; ends the line
}
void loop() { ← loop loops (repeats) the function
  digitalWrite(ledPin, HIGH); ← ledPIN "HIGH" means 3.3v delivered: "on"
  delay(1000);
  digitalWrite(ledPin, LOW); ← ledPIN "LOW" means 0v delivered: "off"
  delay(1000); ← delay: how long on or off in ms (milliseconds)
}
```