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Installing and Navigating the Arduino IDE

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What is an IDE

- An **integrated development environment** (IDE) is software designed to increase productivity by integrating useful tools into one application
- These tools vary between different IDEs, but commonly include a source code editor, compiler, and debugger

Source Code Versus Machine Code

- **Source code** is designed for human readability and uses textual syntax that is translated into machine code
- **Machine code** is low-level binary data written for a computer that does not need additional translation

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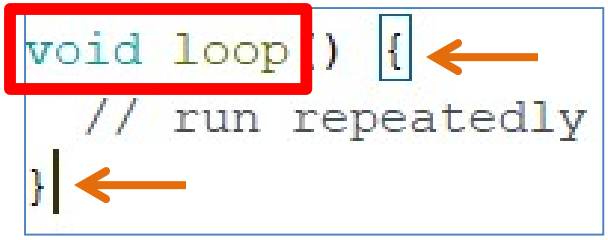
Source Code Editor

- A text editor designed specifically for editing code
- Features:
  - Syntax highlighting and brace matching
  - Automatic indentation
  - Auto-complete word prediction that fills in common words or phrases as the programmer is typing



• Brace matching: Clicking beside a brace puts a box around its counterpart (orange arrows)

• Syntax highlighting groups elements by color; void is a data type and loop is a function (red box)

Compiler

- Used to convert one language into another language
- Converts the source code into machine code for the computer to read

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Debugger

- Software designed for testing the source code
- Oftentimes, the debugger will offer suggestions based on expectations to help the programmer identify and resolve issues

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Common IDEs

- Arduino
- Visual Studio
- Eclipse
- Komodo
- Android Studio
- NetBeans
- Atom
- BlueJ

The Arduino IDE

- Arduino software is open source and can be downloaded for free at https://www.arduino.cc/en/Main/Software
- Compatible with Windows, Mac OS X and Linux systems



Choosing the Correct Package

- Select download link for the appropriate operating system

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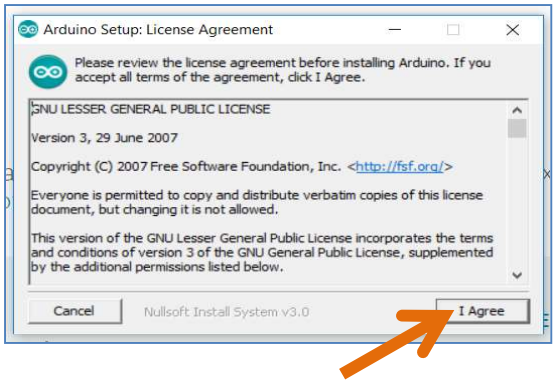
Installation

- Follow on-screen instructions to run the installation software (example is for Windows)

1.



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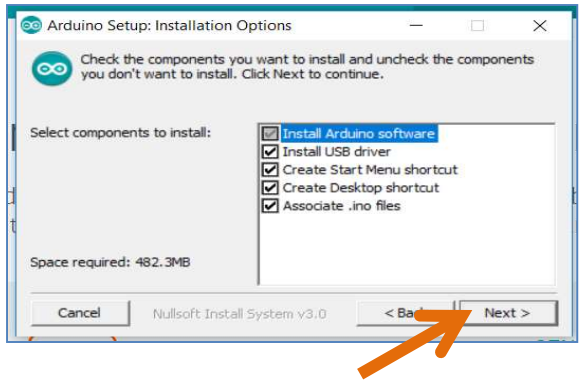

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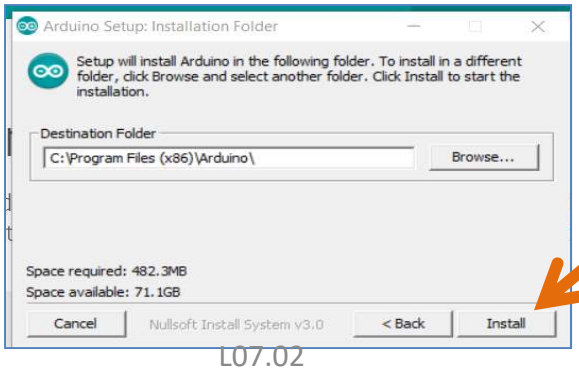

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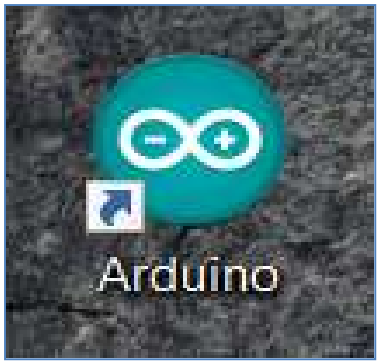
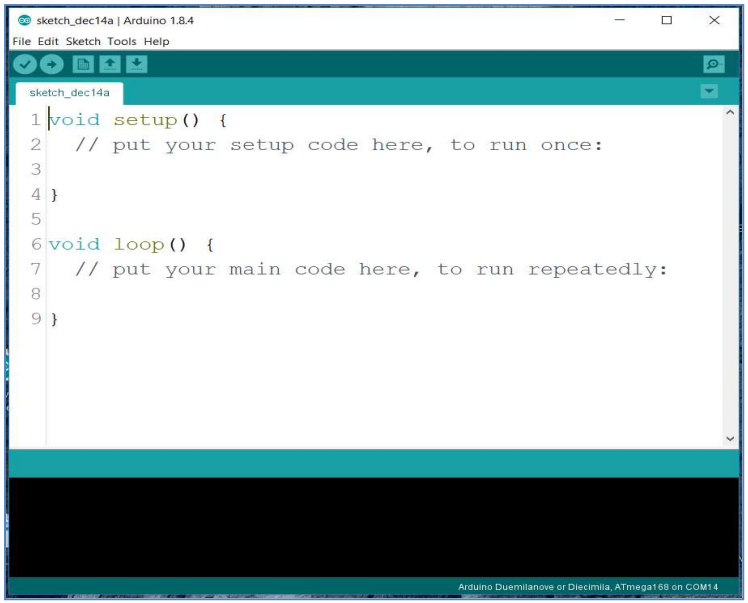
Opening the IDE

- Locate the Arduino icon on your desktop and double click to open the program



Clicking this



Should give you this

Navigation

- The toolbar at the top of the IDE contains functions for file, edit, sketch, tools, and help
- The next line gives shortcuts for verify, upload, new, open, and save
- The tab at the bottom shows the name of the current sketch

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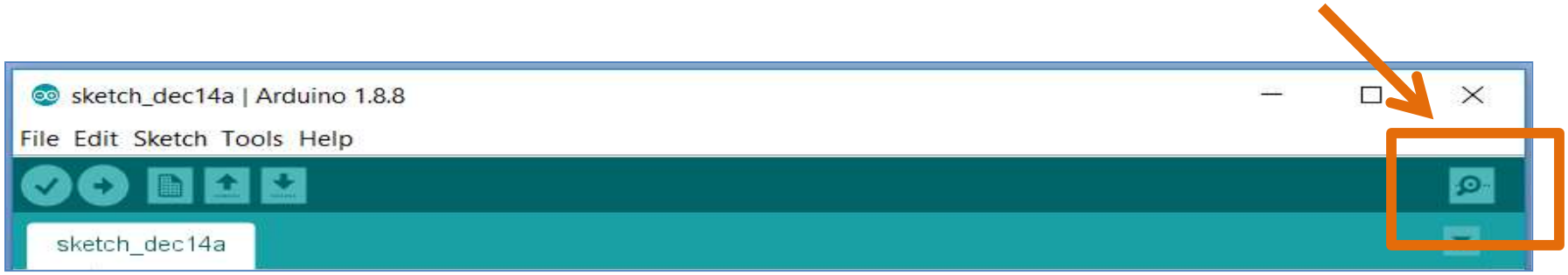
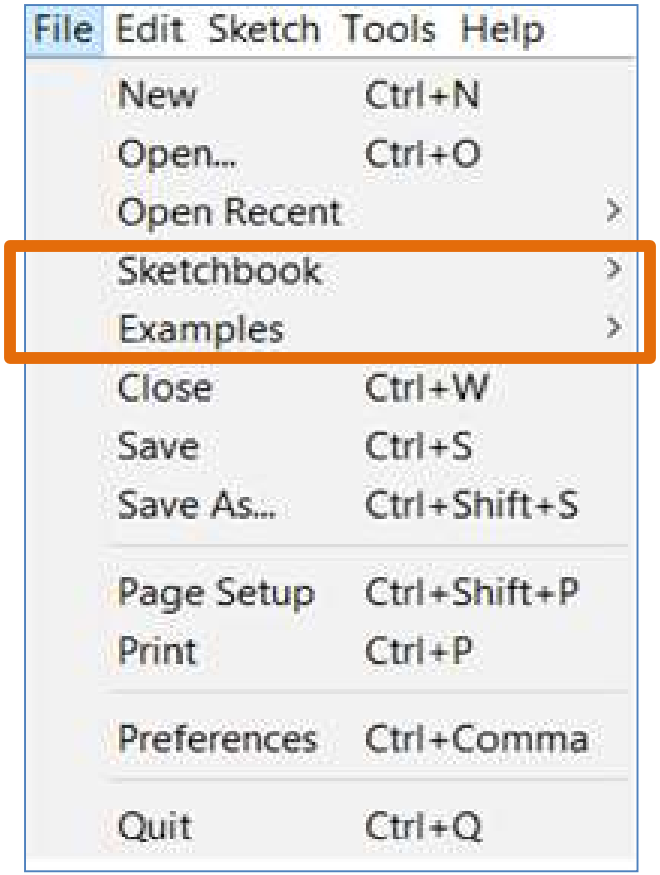
The Serial Monitor

- The icon of the magnifying glass in the top right-hand corner opens the **serial monitor**
- This is a pop-up window that allows the programmer to see interactions as the code runs



File

- The **file** folder contains features such as new, open, save, and print
- The **sketchbook** subfolder contains a collection of code written by the programmer
- The **examples** subfolder contains fully functional code written for the programmer to assist with common tasks



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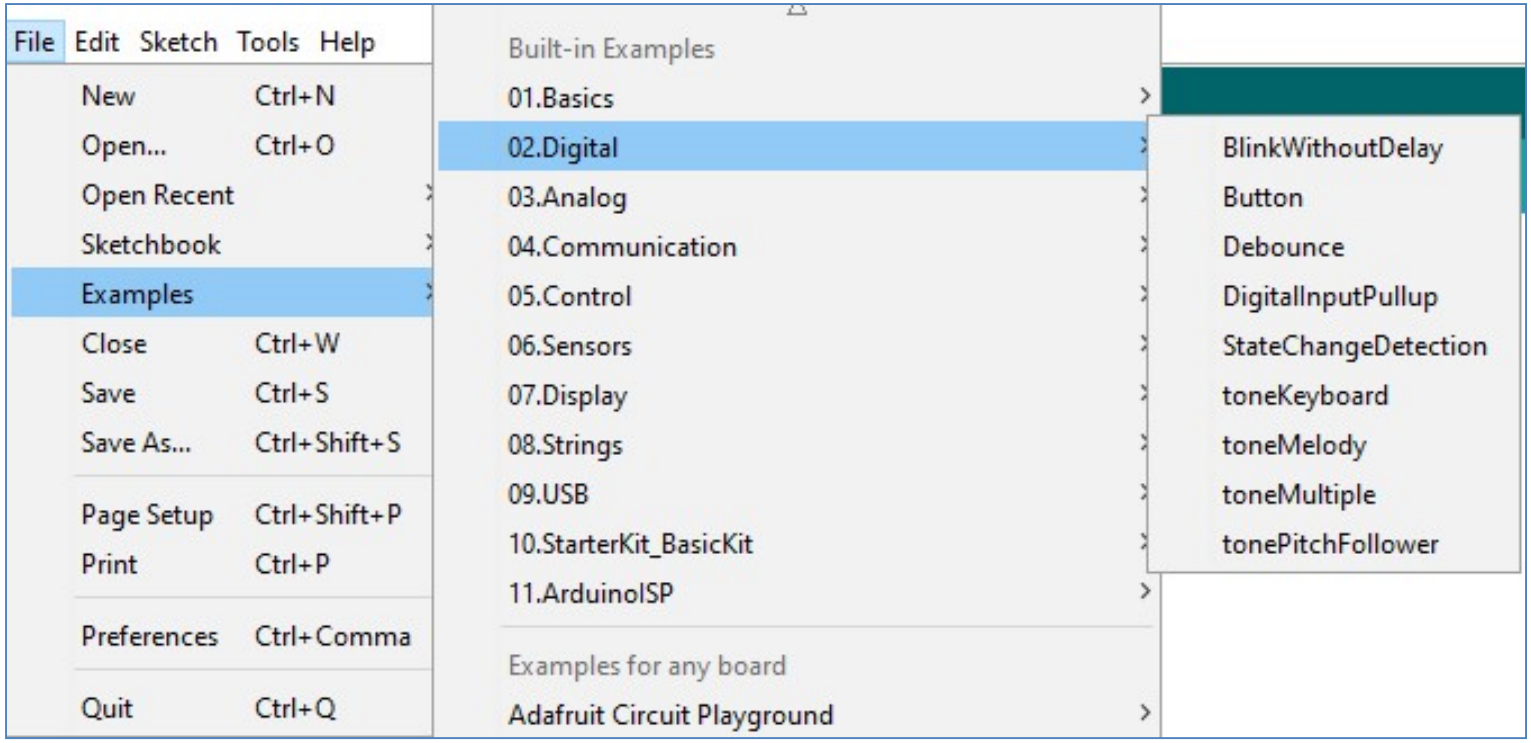
File: Examples

- The **examples** subfolder covers a wide range of processes



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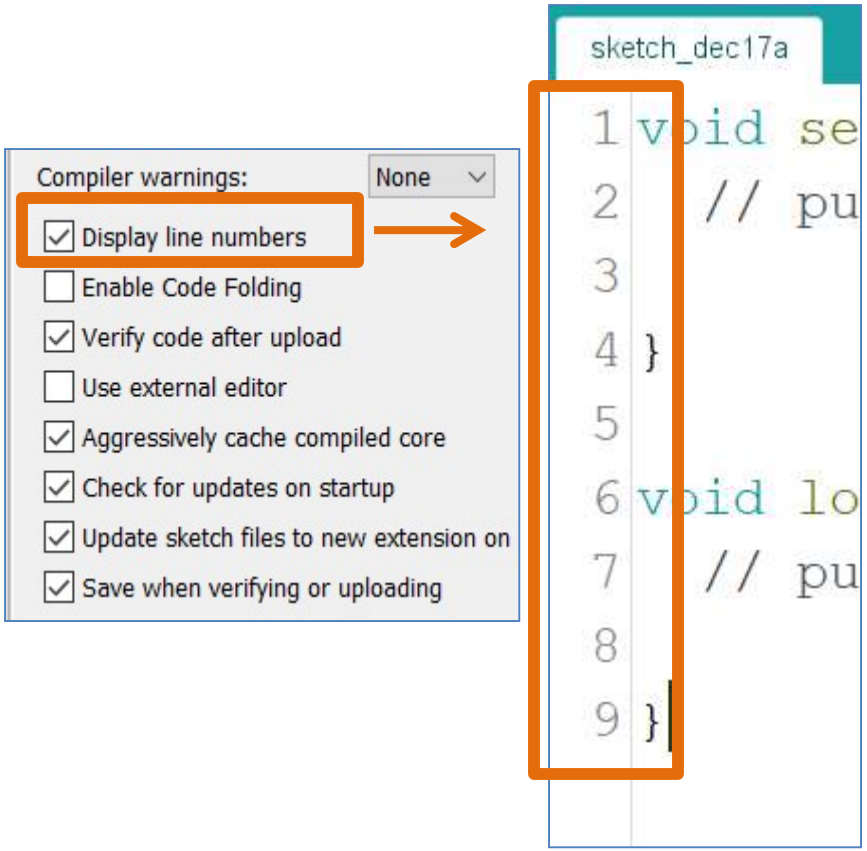
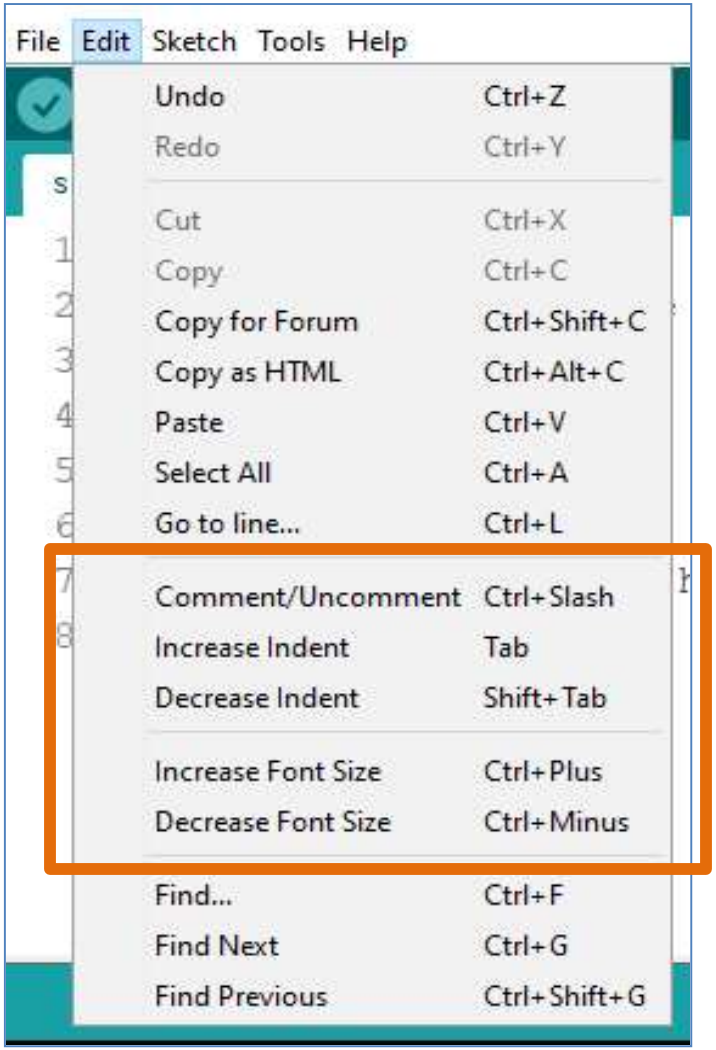
File: Preferences

- The **preferences** subfolder allows you to customize the IDE
- **Display line numbers** is a popular feature that adds or removes line numbers from the source code



Edit

- **Edit** provides shortcuts for useful features such as undo, redo, cut, copy, and paste
- You can increase or decrease indentions as well as font size
- A simple shortcut lets you comment or uncomment an entire section of highlighted code



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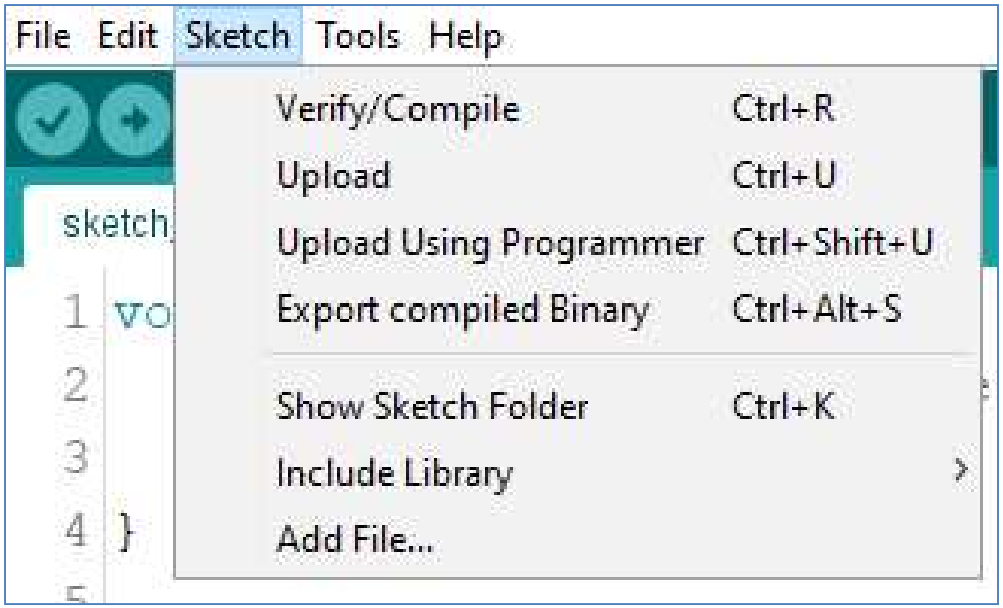
Sketch

- **Sketch** provides shortcuts for verifying, compiling, and uploading code
- It allows you to include libraries or incorporate files into the code as needed



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Verifying and Uploading Code

- **Verifying** checks for problems
- **Uploading** verifies and sends the code to a microcontroller
- It is recommended to verify often as it is easier to locate mistakes from a short line of code as opposed to an entire script

Libraries

- **Libraries** are a collection of precompiled modules that use keywords to activate functions
- The example below uses a library named pitches.h for its preset melody, duration, and notes without the need for additional code

```
#include "pitches.h"

int melody[] = {NOTE_C4, NOTE_G3, NOTE_G3, NOTE_A3, NOTE_G3, 0, NOTE_B3, NOTE_C4};

int noteDurations[] = {4, 8, 8, 4, 4, 4, 4, 4};

tone(8, melody[thisNote], noteDuration);
```

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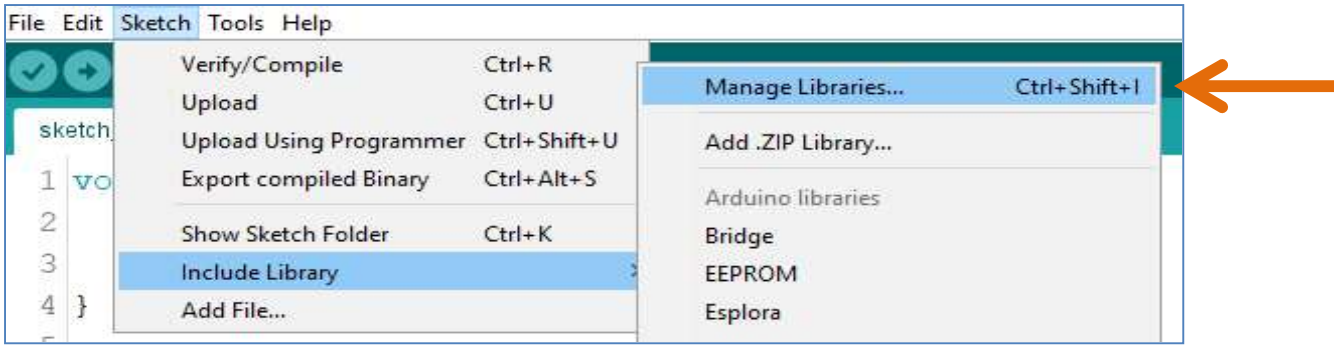
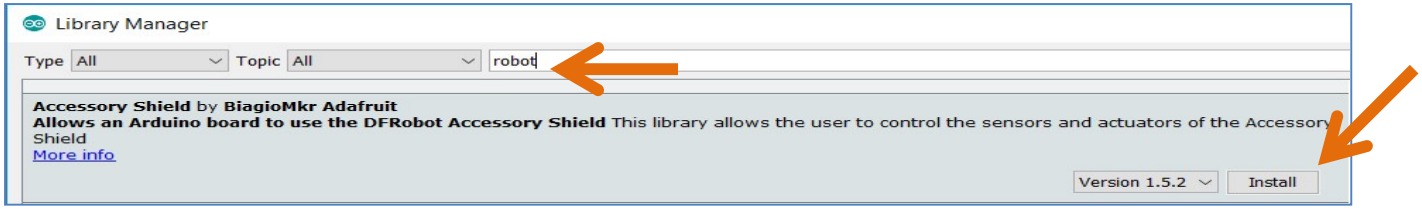
How to Add a Library

- Select **Manage Libraries** subfolder



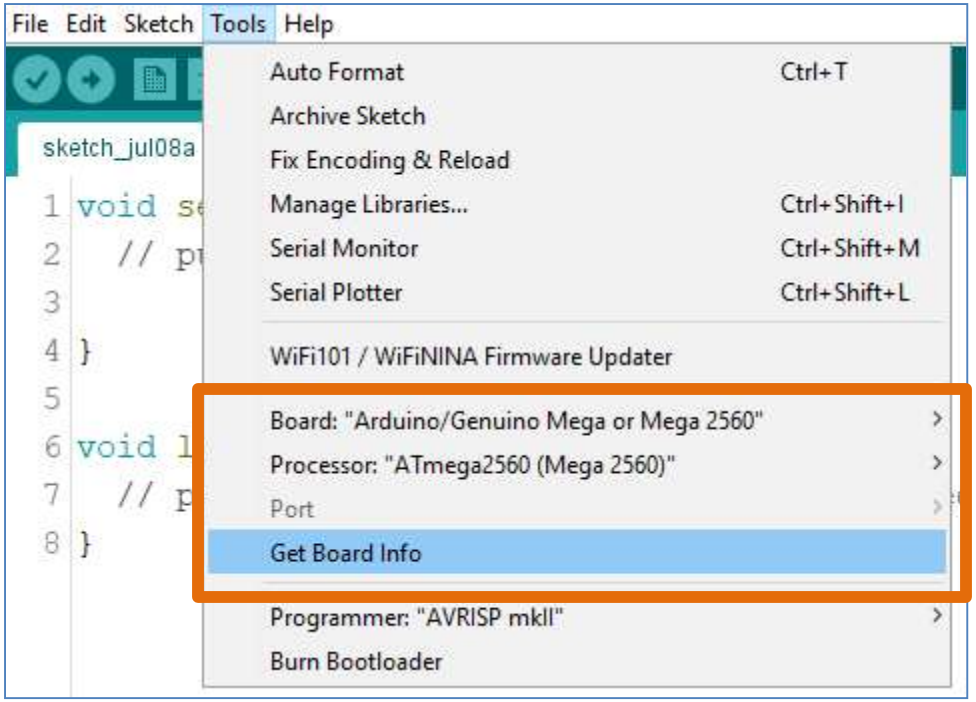
- Type **keyword** to locate a library and select install to download



- Locate and select new library in **include library** subfolder

Tools

- **Tools** is where the board and processor are selected
  - Code will not run properly if this does not match your equipment
- Use '**Get Board Info**' if you are unsure about the microcontroller being used



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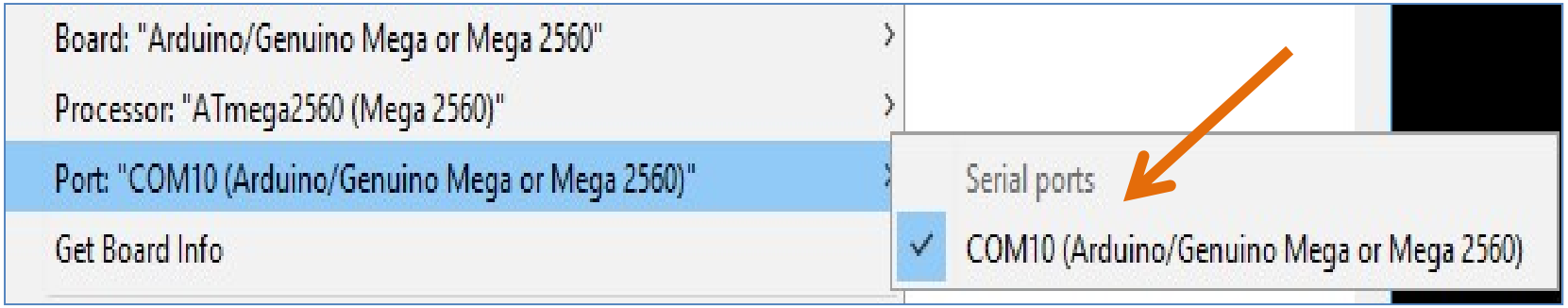
Tools: Port

- The serial port number is determined by the microprocessor
- The following link contains instructions for determining the correct port for Windows, Mac, and Linux:

  http://www.me.umn.edu/courses/me2011/arduino/technotes/debug/arduinodebug.html



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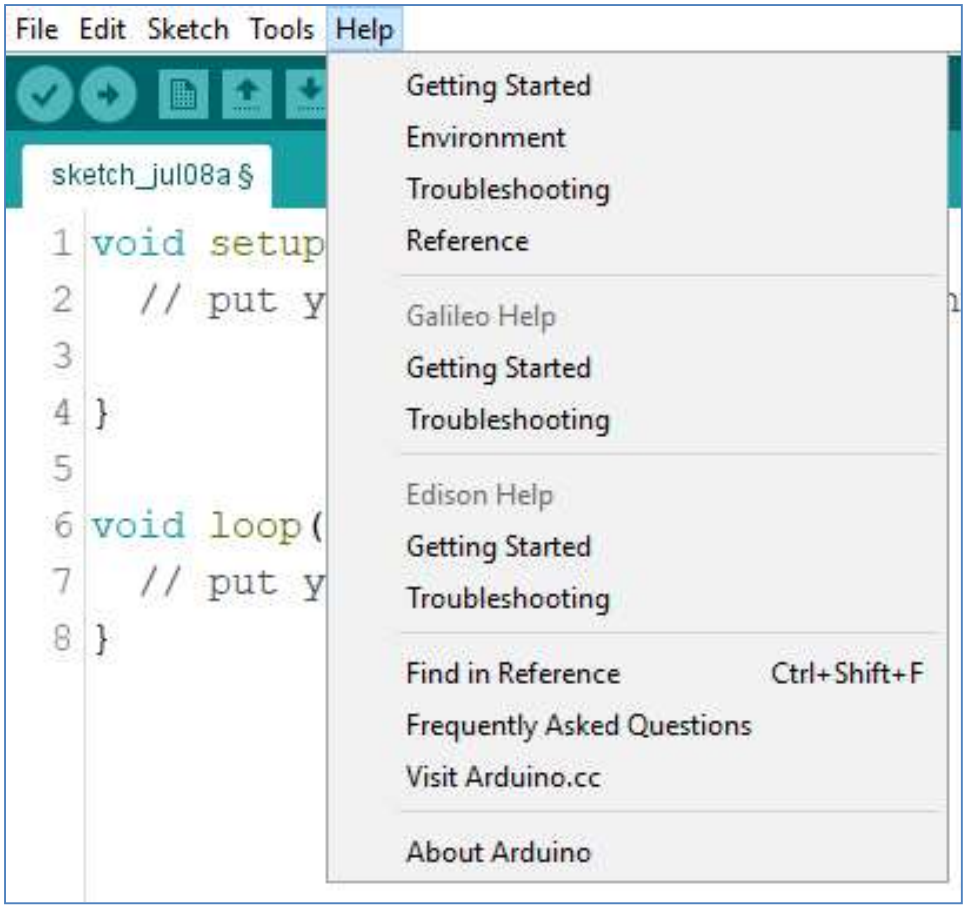
Help

- If ever stuck, **help** offers links for getting started, frequently asked questions, and troubleshooting



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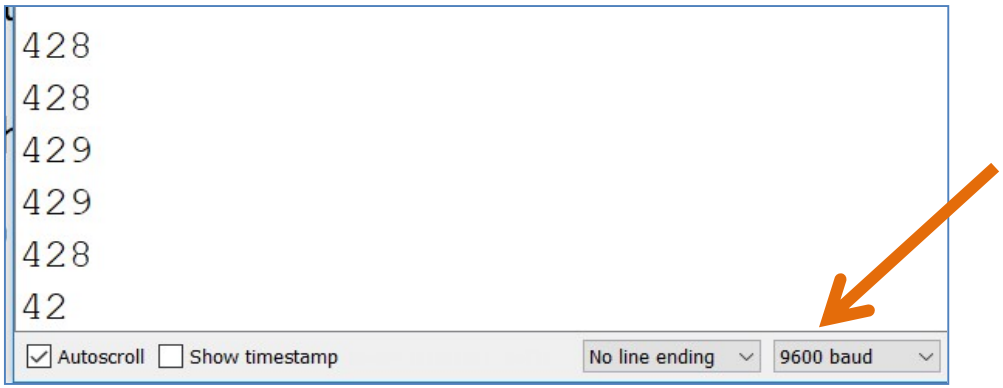
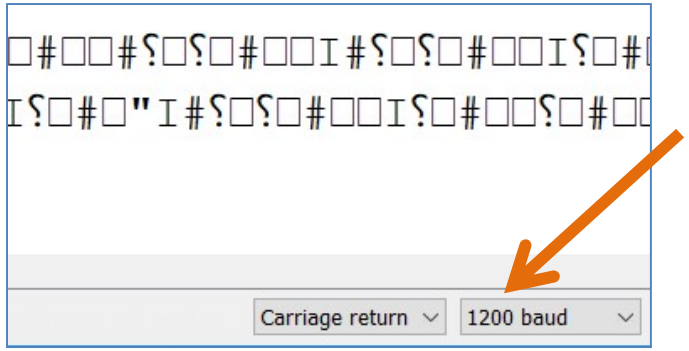
Baud Rates

- The **baud rate** is the rate by which information is transferred
- The serial monitor will display unintended caricature if the baud rate on the monitor is not set to match what is dictated in the code

```
Serial.begin(9600);
```





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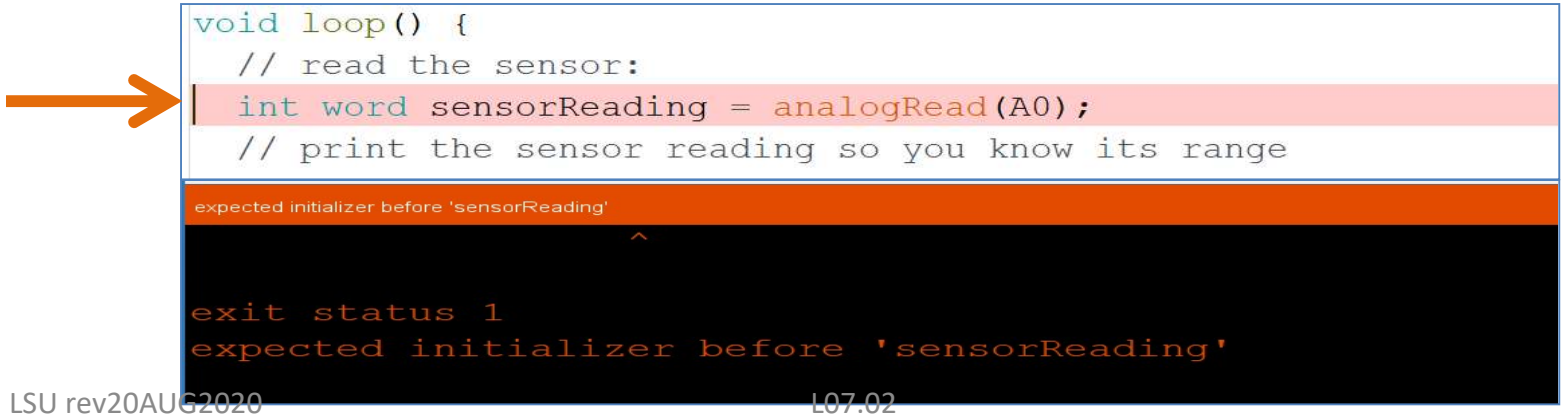
Debugging Code

- The debug window provides information based on normal expectations
- The example shows two conflicting data types assigned to one variable, int and word
- The debugger highlights the potential error in the text window (top) and alerts the programmer in the debug window (bottom)



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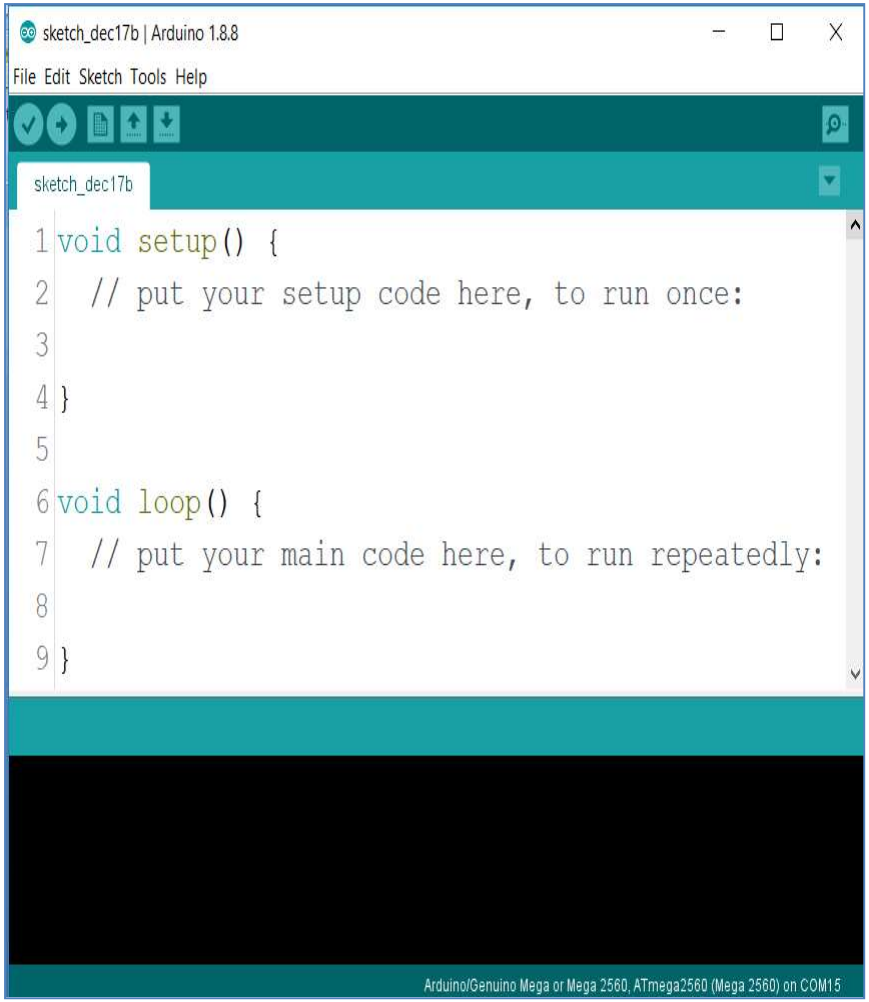
Getting Started

- Arduino breaks the sketch into two parts, void setup () and void loop ()
- Setup runs once whereas loop runs repeatedly



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Global Declarations

- Libraries and global variables go outside of the two main functions (setup and loop) and are visible to every line in the code
- The following example defines the **libraries** needed to initiate an SD card reader on lines 2 and 3
- It defines **global variables** on lines 5, 6, and 7

```
1
2 #include<Wire.h>
3 #include<SD.h>
4
5 const int chipSelect = 10;
6 int error = 0;
7 long timeStamp;
8
9 void setup() {
10   Serial.begin(9600);
```

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Void Setup

- Functions that only need to run once go under **void setup**
- Can declare **baud rate** and **initialize system checks**
- In the example, the SD card writes via chipSelect (pin 10 defined on slide 28). If it fails to write, it prints an error message in the serial monitor (at a rate of 9600) and stops running the code

```
 9 void setup() {
10   Serial.begin(9600);
11   Serial.print("Initializing SD card...");
12
13   pinMode(chipSelect, OUTPUT);
14
15   if (!SD.begin(chipSelect)){
16     Serial.println("Card failed, or not present");
17     error = 1;
18     return;
```

Void Loop

- Location of the main code that will loop repeatedly
- In the example, the variable dataString will store the reading from a sensor (sensorVal) with 4 measurements taken and it will create a timeStamp that repeats once every millisecond (millis); this will repeat indefinitely

```
22 void loop() {
23   String dataString = "";
24   timeStamp = millis();
25
26   for (int analogPin = 0; analogPin < 4; analogPin ++)
27   {
28     int sensorVal = analogRead(analogPin);
29     dataString += String(sensorVal);
```

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Troubleshooting

- Check syntax
  - Missing semicolons, brackets, etc.
- Libraries
  - Proper syntax and keywords; some libraries may conflict with one another
- Correct baud rate
- Case sensitive context
- Correct data types

References

- https://www.freeiconspng.com/img/12780
- https://www.iconfinder.com/icons/37037/apple_face_finder_mac_os_x_mettalic_icon
- https://www.flaticon.com/free-icon/linux_518713