Arduino Programming Part 1: Connecting to a Host and Running Blink

ME 120

Mechanical and Materials Engineering

Portland State University

Overview

Arduino Environment

Connecting to a Host Computer

- ❖ Selecting the Board

- ❖ Selecting a Serial Port

Basic code components

- ❖ Two required functions: startup() and loop()

- ❖ Variables

- ❖ Calling built-in functions

Arduino Web Site References

Overview of the development environment

❖ http://www.arduino.cc/en/Guide/Environment

Language reference

❖ https://www.arduino.cc/reference/en/

Code tutorials

❖ http://arduino.cc/en/Tutorial/HomePage

Basic Process

Design the circuit if using external devices

- ❖ What are electrical requirements of the sensors or actuators?
- ❖ Identify analog inputs (sensors)
- ❖ Identify digital inputs & outputs (buttons, LEDs, relays)
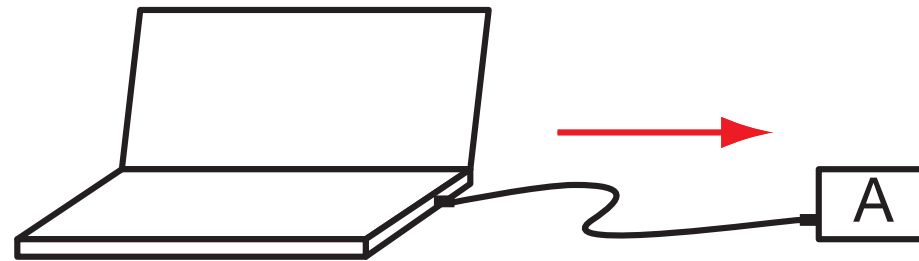
Write the code

- ❖ Build incrementally
  - ‣ Get the simplest piece to work first
  - ‣ Add complexity and test at each stage
  - ‣ Save and Backup frequently
- ❖ Use variables, not constants
- ❖ Comment liberally
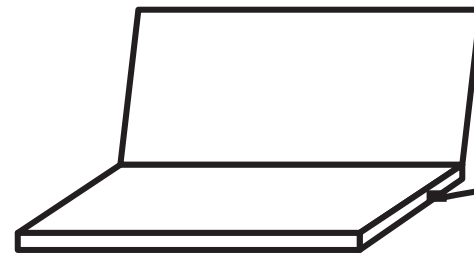
Writing and Downloading Code

Write sketch on PC
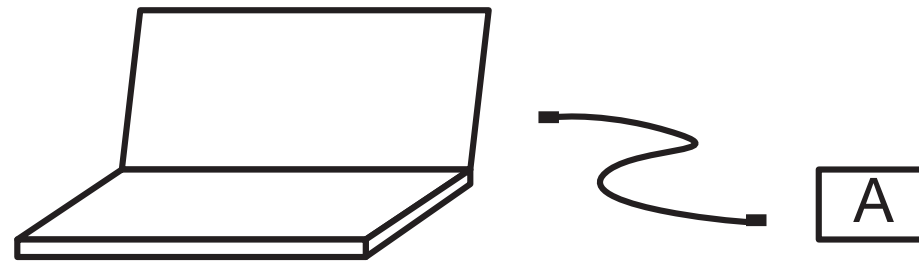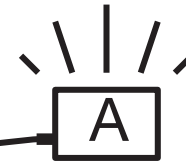

Download sketch to Arduino

Running Code While Tethered
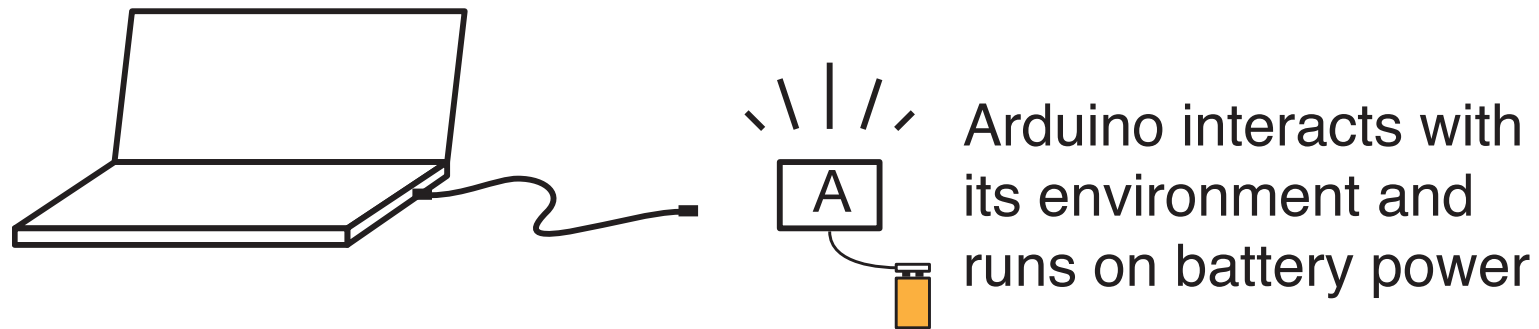
Run sketch on Arduino
and send data back to PC

Arduino interacts
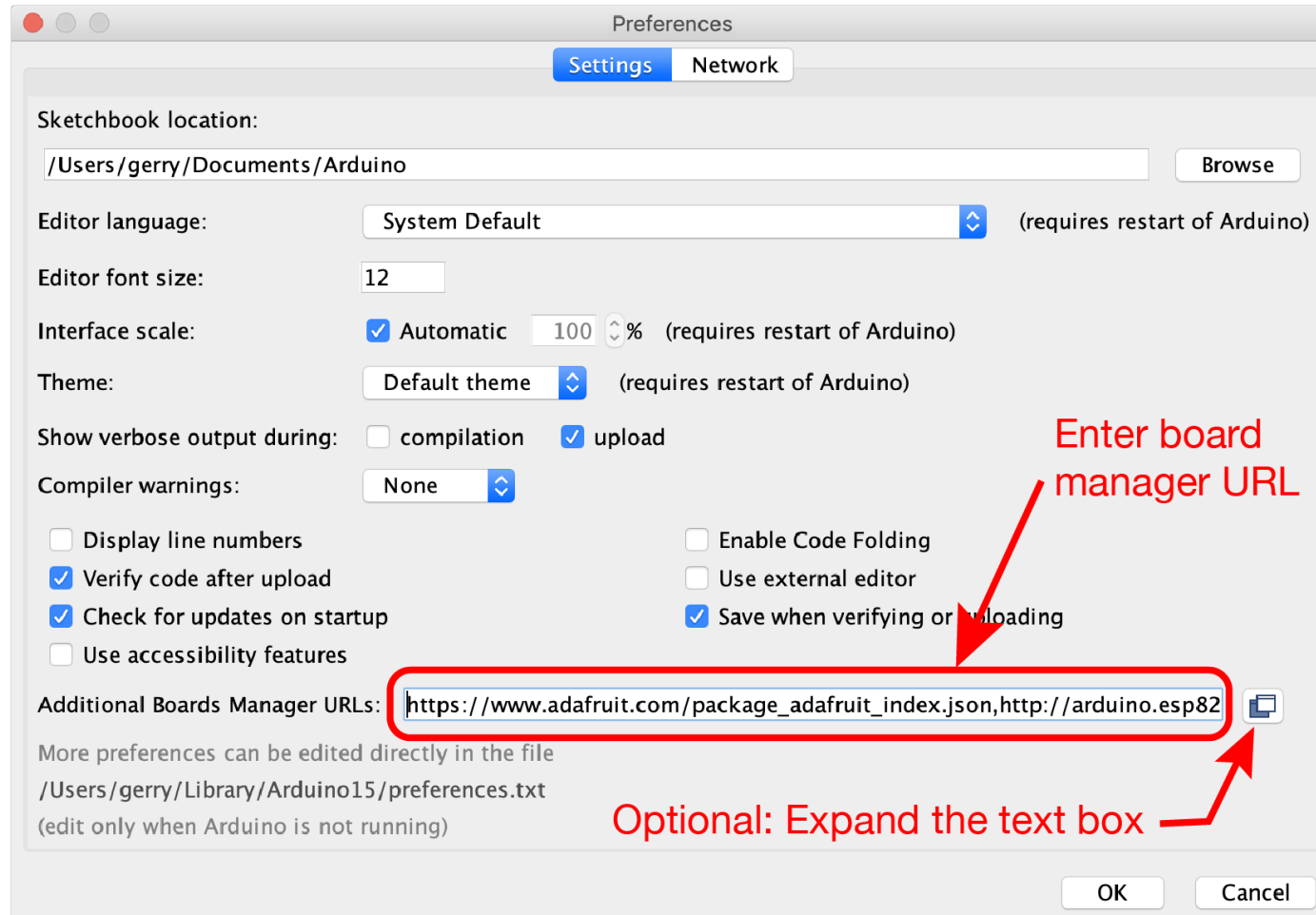with its environment

A

Serial communication
back to host

Running Code Stand-Alone
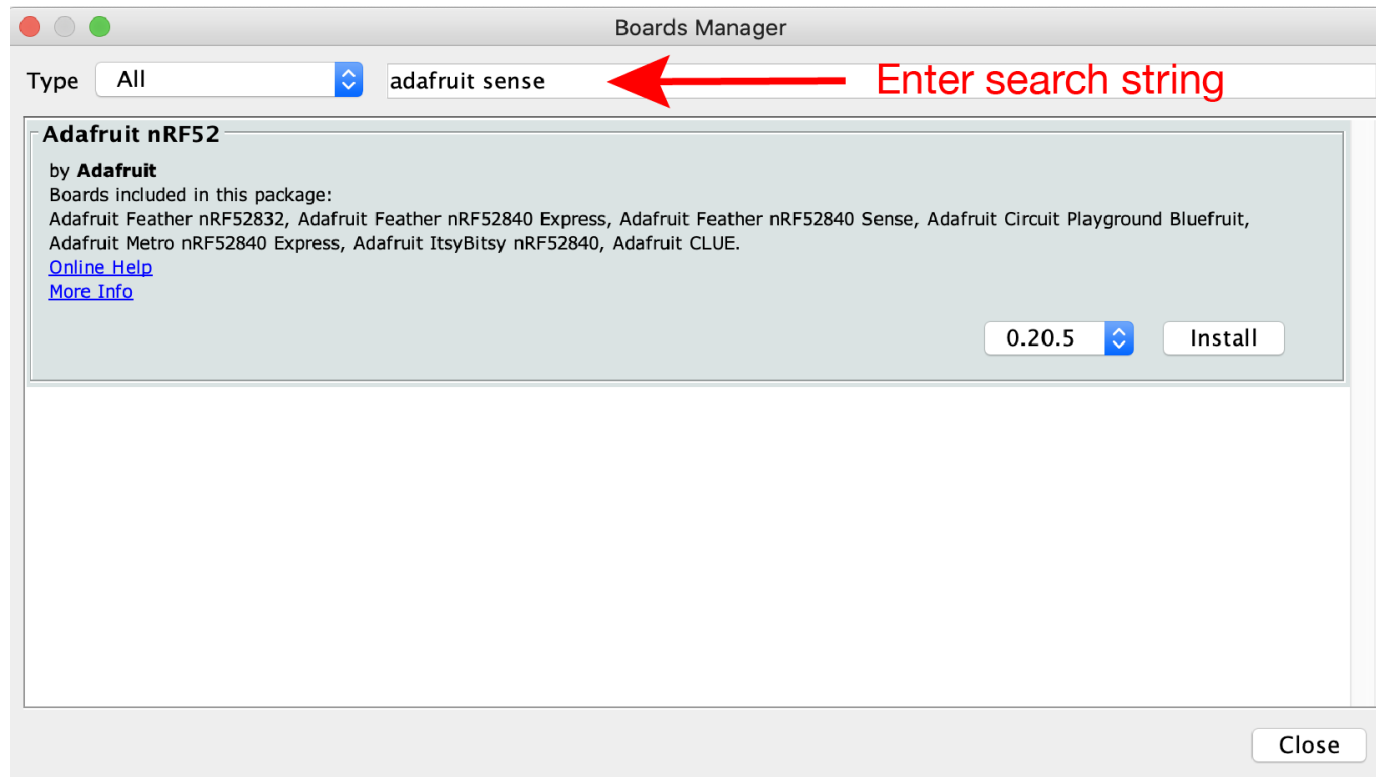
Run Arduino in stand alone mode

Arduino interacts with its environment and runs on battery power

Connecting to a Host Computer

Add Board Manager URL in Preferences

Preferences

Settings   Network

Sketchbook location:

/Users/gerry/Documents/Arduino   Browse

Editor language: System Default   (requires restart of Arduino)

Editor font size: 12

Interface scale: ☑ Automatic   100 ⏷ %   (requires restart of Arduino)

Theme: Default theme   (requires restart of Arduino)

Show verbose output during: ☐ compilation   ☑ upload

Compiler warnings: None

☐ Display line numbers   ☐ Enable Code Folding
☑ Verify code after upload   ☐ Use external editor
☑ Check for updates on startup   ☑ Save when verifying or uploading
☐ Use accessibility features

Enter board
manager URL

Additional Boards Manager URLs: https://www.adafruit.com/package_adafruit_index.json,http://arduino.esp82

Optional: Expand the text box

More preferences can be edited directly in the file
/Users/gerry/Library/Arduino15/preferences.txt
(edit only when Arduino is not running)

OK   Cancel

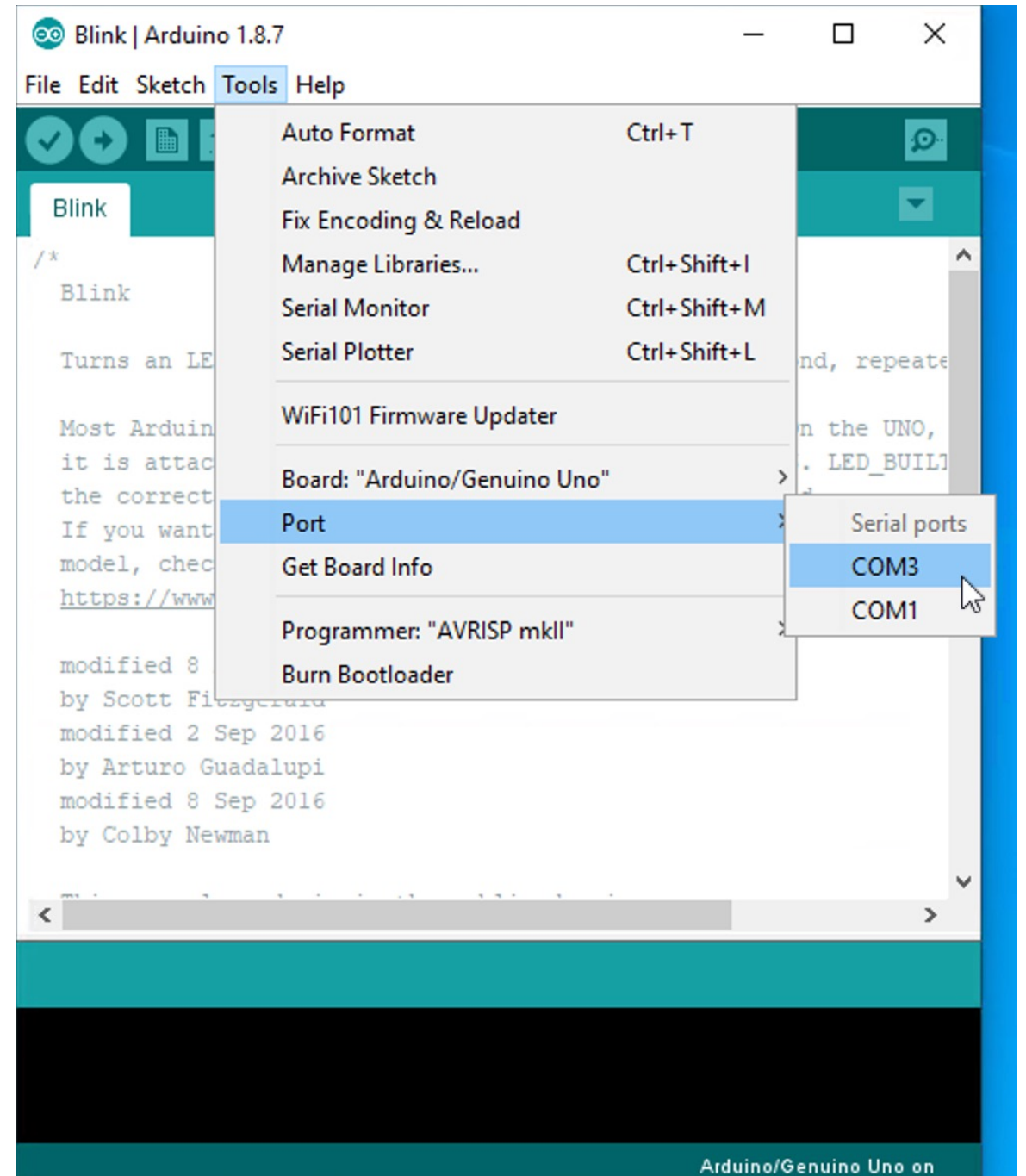# Select the Feather Board

Tools → Boards → Board Manager ...
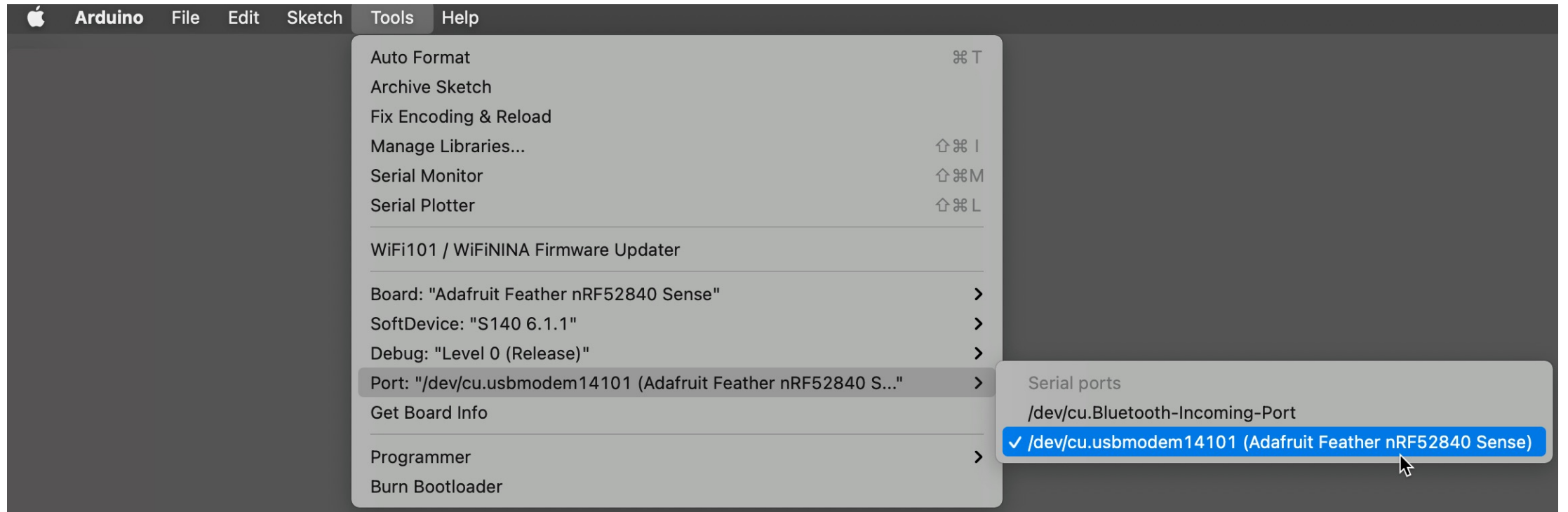
Add support for Adafruit nRF52

Select the Serial Port

Select the Port on a Windows computer:
Port label is COM3, COM4, ...
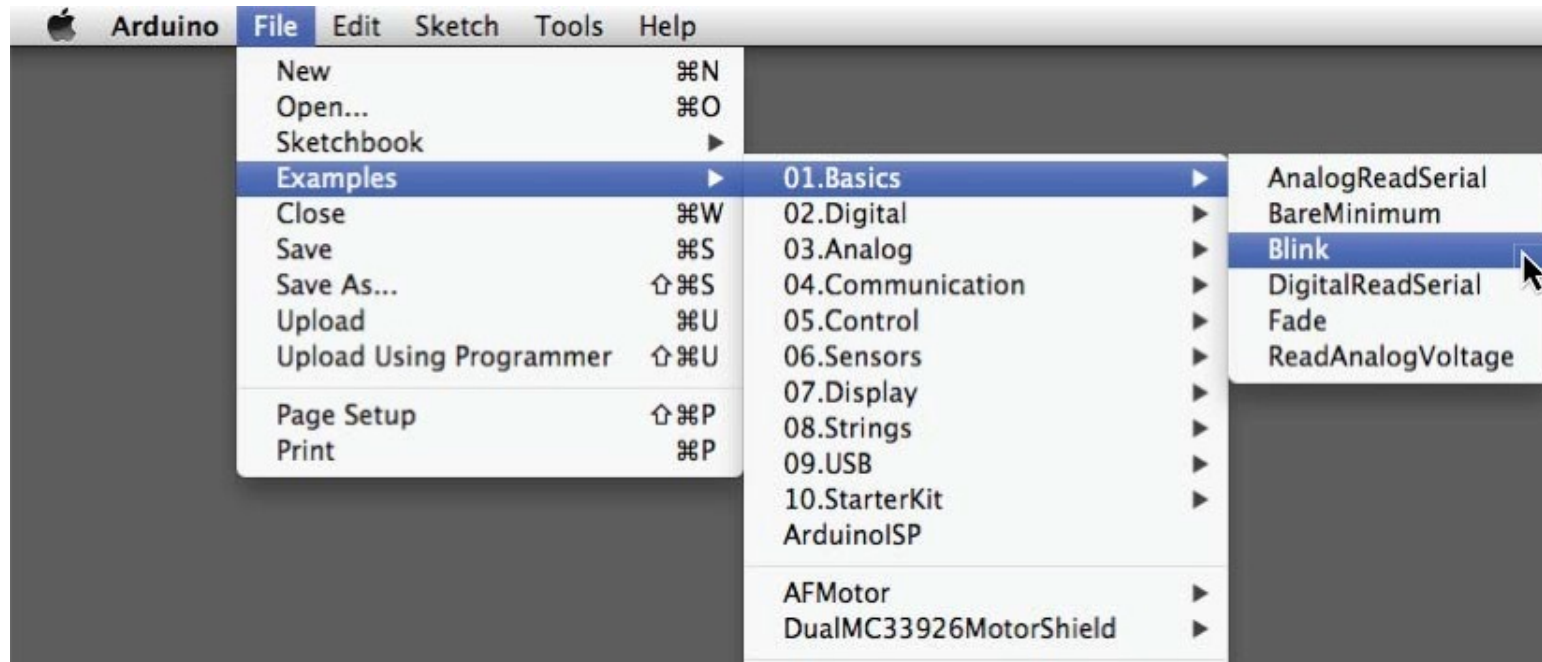
Select the Serial Port

Select the Port on a Macintosh: Port label is /dev/cu.usbmodemxxxxx

Open the example sketch, Blink.ino

Load "Blink" from the built-in examples

File → Examples → 01.Basics → Blink

Arduino IDE

IDE = Integrated
    Development
    Environment

http://www.arduino.cc/
en/Guide/Environment

Upload to Arduino

New sketch

Open sketch

Serial monitor

Verify/Compile

Save sketch

Tabs

Blink | Arduino 1.8.15

Blink

```
/*
  Blink

  Turns an LED on for one second, then off for one second, repeatedly.

  Most Arduinos have an on-board LED you can control. On the UNO, MEGA and ZERO
  it is attached to digital pin 13, on MKR1000 on pin 6. LED_BUILTIN is set to
  the correct LED pin independent of which board is used.
  If you want to know what pin the on-board LED is connected to on your Arduino
  model, check the Technical Specs of your board at:
  https://www.arduino.cc/en/Main/Products

  modified 8 May 2014
  by Scott Fitzgerald
  modified 2 Sep 2016
  by Arturo Guadalupi
  modified 8 Sep 2016
  by Colby Newman

  This example code is in the public domain.

  https://www.arduino.cc/en/Tutorial/BuiltInExamples/Blink
*/

// the setup function runs once when you press reset or power the board
void setup() {
  // initialize digital pin LED_BUILTIN as an output.
  pinMode(LED_BUILTIN, OUTPUT);
}

// the loop function runs over and over again forever
void loop() {
  digitalWrite(LED_BUILTIN, HIGH);   // turn the LED on (HIGH is the voltage level)
  delay(1000);                       // wait for a second
  digitalWrite(LED_BUILTIN, LOW);    // turn the LED off by making the voltage LOW
  delay(1000);                       // wait for a second
}
```

Code pane

Message pane

1   Adafruit Feather nRF52840 Sense, S140 6.1.1, Level 0 (Release) on /dev/cu.usbmodem14101

Common Code Structure

Arduino sketches have at least three basic parts

1. Header
2. setup function
3. loop function

Code Structure: Header

Header provides overview comments. In other sketches, the header will contain code

Comment statements

Block comments

```
/* First line of comments
   Comment statements
   Next line is end
*/
```

Example

```
/* ME 120 Homework 3
   Jane Programmer, 11 Oct 2021
   File:  blink_three_colors.ino

   Blink three different colors on
   the NeoPixel of Feather nRF52840
   Sense.
*/
```

Comment statements

In-line comments

```
// A comment
// A separate comment

// ----------- separator
```

In-line comments can also be on the same line as code

```
pinMode(LED_BUILTIN, OUTPUT);    // Enable digital I/O pin for output
```

Code Structure: setup function

setup() is executed just once. Code to run when sketch starts goes here.

Code Structure: setup function

```
●●●                        Blink | Arduino 1.8.15

  Blink

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  Blink

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  delay(1000);                       // wait for a second
}
```
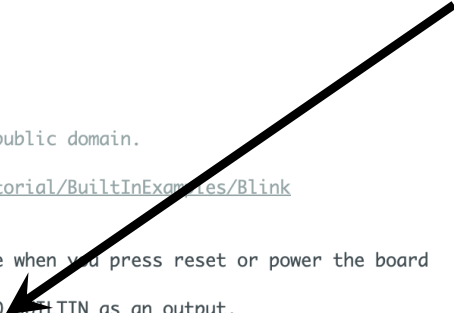
`loop()` is repeated indefinitely.

`Adafruit Feather nRF52840 Sense, S140 6.1.1, Level 0 (Release) on /dev/cu.usbmodem14101`

Details of the Blink Code

Preparing an Output Pin with `pinMode`


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  Blink

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  delay(1000);                       // wait for a second
}
```

`pinMode(LED_BUILTIN, OUTPUT)`

Prepare pin number "`LED_BUILTIN`" for output of logic-level signal. Logic level is 3.3V for Feather and 5V for UNO

"`LED_BUILTIN`" is a pre-defined variable

Turn on an output pin with `digitalWrite`


```
digitalWrite(LED_BUILTIN, HIGH);
```

Set the `LED_BUILTIN` pin to `HIGH`, which means "on"

```
delay(1000);
```

Tell the microcontroller to do nothing for 1000 ms = 1 s

Turn off an output pin with `digitalWrite`


```
digitalWrite(LED_BUILTIN, LOW);
```

Set the `LED_BUILTIN` pin to `LOW`, which means "off"

```
delay(1000);
```

Tell the microcontroller to do nothing for 1000 ms = 1 s

Built-in functions

Blink code uses these built-in functions

pinMode   Configure a digital I/O pin for either input or output

                                       Examples: pinMode(5, OUTPUT);   pinMode(6, INPUT);

digitalWrite   Change the state of a digital I/O pin

                                       Examples: digitalWrite(5, HIGH);   digitalWrite(5, LOW);

delay   Block execution, i.e. wait, for a specified number of milliseconds

                                       Example: delay(1000);

For additional info, see https://www.arduino.cc/reference/en/