

Introduction to Microprocessors: Arduino

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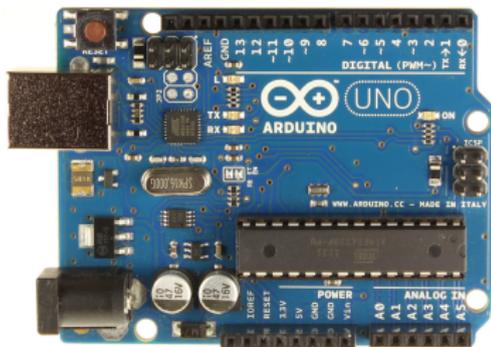
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What is an Arduino?

- Open Source
 - Reference designs for hardware
 - Firmware
 - Programming tools + GUI
- Mostly based around 8-bit Atmel AVR chips
- There is also some ARM variants
- Several 'official' varieties with different chips, extra functionality, different shapes and sizes

- ATmega328
- 14 Digital I/O Pins (6 can do PWM)
- 6 Analog Input Pins
- 32 KB Flash Memory, 2 KB SRAM, 1 KB EEPROM
- 16 MHz Clock

Arduino Uno

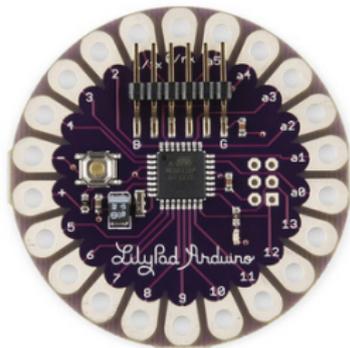


Arduino Mega2560

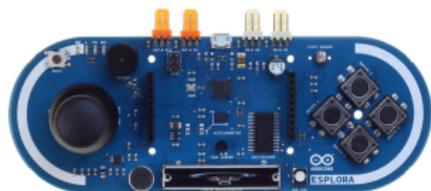
- ATmega2560
- 54 Digital I/O Pins (15 can do PWM)
- 16 Analog Input Pins
- 256 KB Flash Memory, 8 KB SRAM, 4 KB EEPROM
- 16 MHz Clock



Some Others



Lilypad
Aimed at wearable
electronics projects



Esplora
Designed to be a games
controller or (with a screen) a
portable games device

Some slightly different Arduinos

What is it?

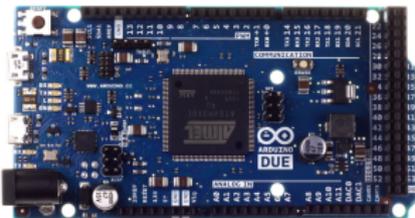
Official versions

Shields

Programming

Projects

The End



Due

Based around a Cortex-M3
ARM processor



Yun

Micro-SD, WiFi, Ethernet and
USB host connected to an ARM
processor running Linux¹

Bigger version “Coming soon” (Tre) which includes HDMI and audio I/O

¹Linino - OpenWRT derivative

Arduino Shields

- Extension boards that stack on top of other (rectangular) Arduino boards
- Add extra hardware that communicates with the Arduino using some of the existing I/O pins
- Available shields include:
 - Ethernet/WiFi/XBee + SD Card shields
 - Motor shield
 - GSM shield
- Plenty of other ways to connect things

Programming Arduino devices

What is it?

Official versions

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The End

- Programs (*Sketches*) written in C or C++
- Require two functions: `setup()` and `loop()`
- `setup()` is run once when the board is reset
- `loop()` is (as the name suggests) run repeatedly
- Lots of libraries available

In other words, the bootloader runs this:

```
void main() {  
    setup();  
    do {  
        loop();  
    } while(1);  
}
```

A simple example

Blink an LED at 1Hz:

```
int led = 13; // Most boards have an LED on pin 13

void setup() {
  pinMode(led, OUTPUT);
}

void loop() {
  digitalWrite(led, HIGH); // turn the LED on
  delay(500);              // wait for 500ms
  digitalWrite(led, LOW); // turn the LED off
  delay(500);              // wait for 500ms
}
```

Serial communication

[What is it?](#)[Official versions](#)[Shields](#)[Programming](#)[Projects](#)[The End](#)

```
const int redPin = 3;
const int greenPin = 5;
const int bluePin = 6;

void setup() {
  Serial.begin(9600);
  pinMode(redPin, OUTPUT);
  pinMode(greenPin, OUTPUT);
  pinMode(bluePin, OUTPUT);
}

void loop() {
  while (Serial.available() > 0) {
    int red = Serial.parseInt();
    int green = Serial.parseInt();
    int blue = Serial.parseInt();

    if (Serial.read() == '\n') {
      red = 255 - constrain(red, 0, 255);
      green = 255 - constrain(green, 0, 255);
      blue = 255 - constrain(blue, 0, 255);

      analogWrite(redPin, red);
      analogWrite(greenPin, green);
      analogWrite(bluePin, blue);

      Serial.print(red, HEX);
      Serial.print(green, HEX);
      Serial.println(blue, HEX);
    }
  }
}
```

What are people doing with Arduino?

- Lots of examples listed at <http://playground.arduino.cc>
- GardenBot: Open source garden monitoring system
<http://gardenbot.org/>
- OpenEnergyMonitor: Modular power monitoring system
<http://openenergymonitor.org/emon/>
- Beer bottle opener:
Uses an Arduino to control a 2.8hp two stroke engine to open
swing top bottles
<https://www.youtube.com/watch?v=0Yrnya6z410>
- ArduPlane/ArduCopter: Fixed-wing and rotary-wing UAVs
<http://www.ardupilot.co.uk/>

Much of the material for this talk was stolen/reused from:

- <http://arduino.cc/>
 - In particular, <http://arduino.cc/en/Guide/>
- <https://en.wikipedia.org/wiki/Arduino>
- The slides I used at our previous microcontrollers talk

Slides will be available at <http://sucs.org/~tswsl1989/talks/>
or on the Hackspace site

Thanks for listening

Any questions?