Introduction to Art Engineering

Medway High School

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Goals

Art Engineering

- Science, technology, engineering and maths; in service of Art.
- Allows unprecedented interaction
- Opens doors to new funding sources, non-traditional gallery space.

Unlondon

Shawn: Biohacking

@scanlime: Micah Elizabeth Scott, Art Engineer

"...she explores the boundaries between technology, society, and creative expression, using her unique perspective to try and help illuminate what makes us human." [1]

- Eclipse
- Forest
- Zen Photon Garden

[1] Micah's Portfolio Website: misc.name

@kimalpert: Kim Alpert, Aesthetic Engineer

"With a background in fine art, world music, and carpentry, Kim Alpert" brings an attention to detail and diverse style to her work." [2]

- Bodyphonic @ National Music Center, Calgary

[2] Kim's Portfolio Website: `http://aestheticengineer.com`

What's in your kit?

Kit Contents

- Arduino Uno R3 Clone
- Solderless Breadboard
- Connecting wires
- LEDs
- Resistors, Potentiometer
- Buzzer
- IR Remote
- IR Receiver

What is Arduino?

μC + reset button + led + USB communication

It's a kit (on a board) with the bare minimum components to easily use the μC hardware. They do the basic, boring design needed for any board, so users only need to add the neat stuff.

Arduino UNO

The Arduino variety that we are using is the Arduino UNO.

- Processor: Atmel Atmega328p
- Memory: 2K RAM + 32K Flash
- FT232RL Logic-level Serial$\leftrightarrow$USB Chip

Arduino Software

The Arduino folks also adapted an *Integrated Development Environment* (IDE) to their boards. This IDE allows users to easily write programs for their boards and then write the programs to the μC.

Get the Arduino IDE:

`https://www.arduino.cc/en/Main/Software`

Circuit Basics

Current

Current is the flow of charge through a circuit. Conventionally we think of this as happening from $+$ to $-$ of the power supply of the circuit.

Voltage / Potential / Resistance

Voltage is how fast the current can move in the circuit. River metaphor:

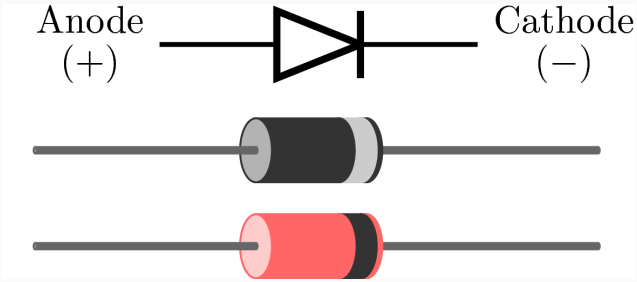
- current = flow rate: $(\mathrm{L\,s^{-1}})$
- voltage = change in height: (m)

Other devices in a circuit can impede / effect current flow. We'll call them resistance(s).

Circuit Devices

Diode

- One way value for current[1]
- LED ≡ Light Emitting Diode
- Band marks (-)[2]
- Longer leg marks (+)



[1] https://learn.sparkfun.com/tutorials/diodes

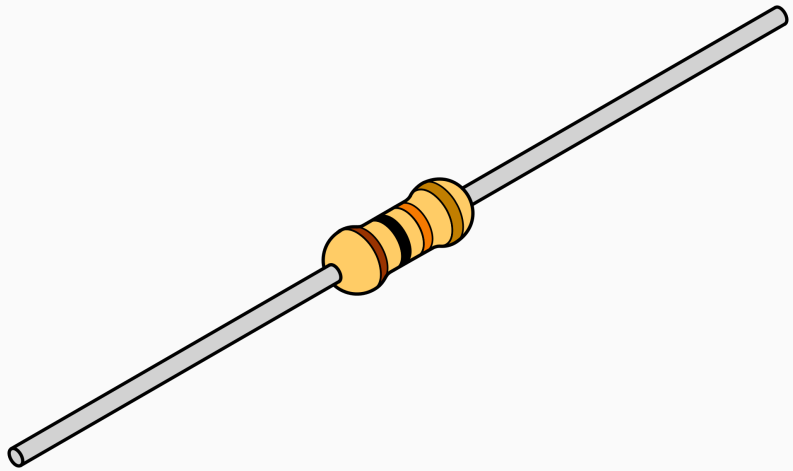
[2] https://learn.sparkfun.com/tutorials/polarity/diode-and-led-polarity

Diode Problems

- Diodes don't limit current
- Diodes aren't perfect (some current turned to heat)
- Too much current = Too much heat = **BANG**
- How do we limit current?

Resistor

- *Resist* the flow of current
- Needed for LEDs: $\approx 400\,\Omega$
  (safe for $\leq 6\,\mathrm{V}$)
- Button Pull-up/down:
  $\geq 10\,\mathrm{k}\Omega$
- Color coded, Google it



Buttons

- Buttons connect *or* disconnect two wires/parts
- Momentary Switch: Normally Closed (NC), Normally Open (NO)
- Toggle Switch

Digital Signals

- Vcc: The power supply of the digital circuit elements
- GND: The reference voltage (usually 0 V)
- Connecting a part to Vcc = Logical 1
- Connecting to GND = Logical 0

Transducers

Transducers turn electrical energy into another sort of energy:

Speaker	Electrical $\rightarrow$ Sound
Microphone	Sound $\rightarrow$ Electrical
LED	Electrical $\rightarrow$ Light
LED	Light $\rightarrow$ Electrical
Piezoelectric	Electrical $\rightarrow$ Motion

Piezo Buzzer

- Piezoelectric elements change shape when voltage is applied
- Thin discs can be made to oscillate and create sound.
- Contains oscillator circuit
- Two connections: Vcc, GND
- Use a switch; connected = annoying tone, disconnected = glorious silence

Power

The power supply provides the energy to drive the system *and* defines logical 1.

Can be a:

- Voltage Regulator (converts one potential to another)
- Batteries
- Solar Panel

In our circuits, your laptop is converting it's power source to 5 V and delivering power to our circuit via USB. You also have a battery pack for computer-free shenanigans (6 V).

μController

Microcontroller (μC) is a *processor*, *memory* and a few *peripherals* on a standalone chip.

Processor	is a group of transistors that understands a few dozen commands (ADD, SUB, JUMP..)
Memory	a circuit that can hold values.
Peripherals	Vary chip to chip, but often include timers, radios, communication interfaces

Seems complicated, but really simple. They literally read a command from memory, then execute the command. At the end of the command, read the next command from the next memory cell and repeat[3]

[3] some commands change the next command memory address

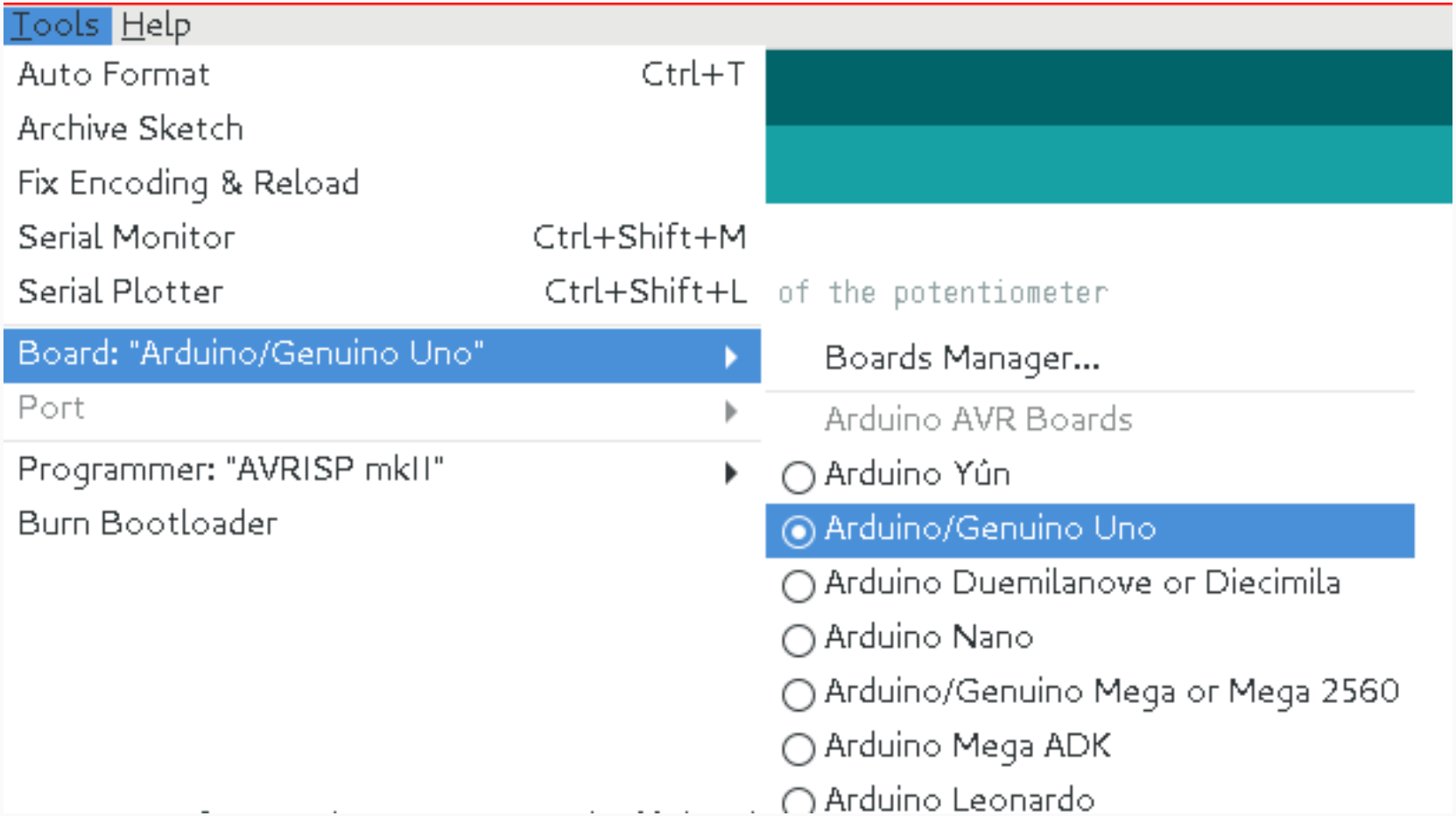
μC + Digital Signals as Switches

If one end of an LED is connected to ground, and the other end is connected to a pin on a μController, then:

If the μC sets the pin HIGH (5 V) then current will flow from the pin through the LED to GND, if LOW ($0 V) then the current will not flow and the LED is off.

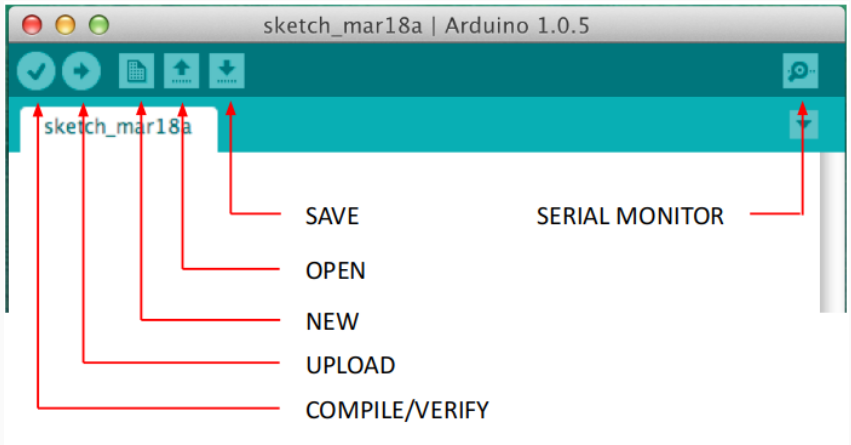
Let's start programming

Configure Arduino



- Board: Arduino UNO
- Processor: ATmega328
- Port: ...

The Code Environment



Your first Program

```
/* the setup function runs once on reset / power */
void setup() {
  /* set pin 13 as an output */
  pinMode(13, OUTPUT);
}

/* the loop function repeats forever */
void loop() {
  digitalWrite(13, HIGH);   // turn on LED
  delay(1000);              // wait for a second
  digitalWrite(13, LOW);    // turn the off LED
  delay(1000);              // wait for a second
}
```

The End?

Questions?