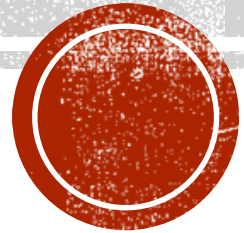
RAPID PROTOTYPING

Week 3 Electronics



PLANNED AGENDA

1. Check up on 3D design/printing status
2. Arduino overview
3. Getting to blink on the Arduino
4. Soldering basics
5. The lamp app
6. 2D with Tinkercad and Cricut
7. Demonstration of a prototyping project

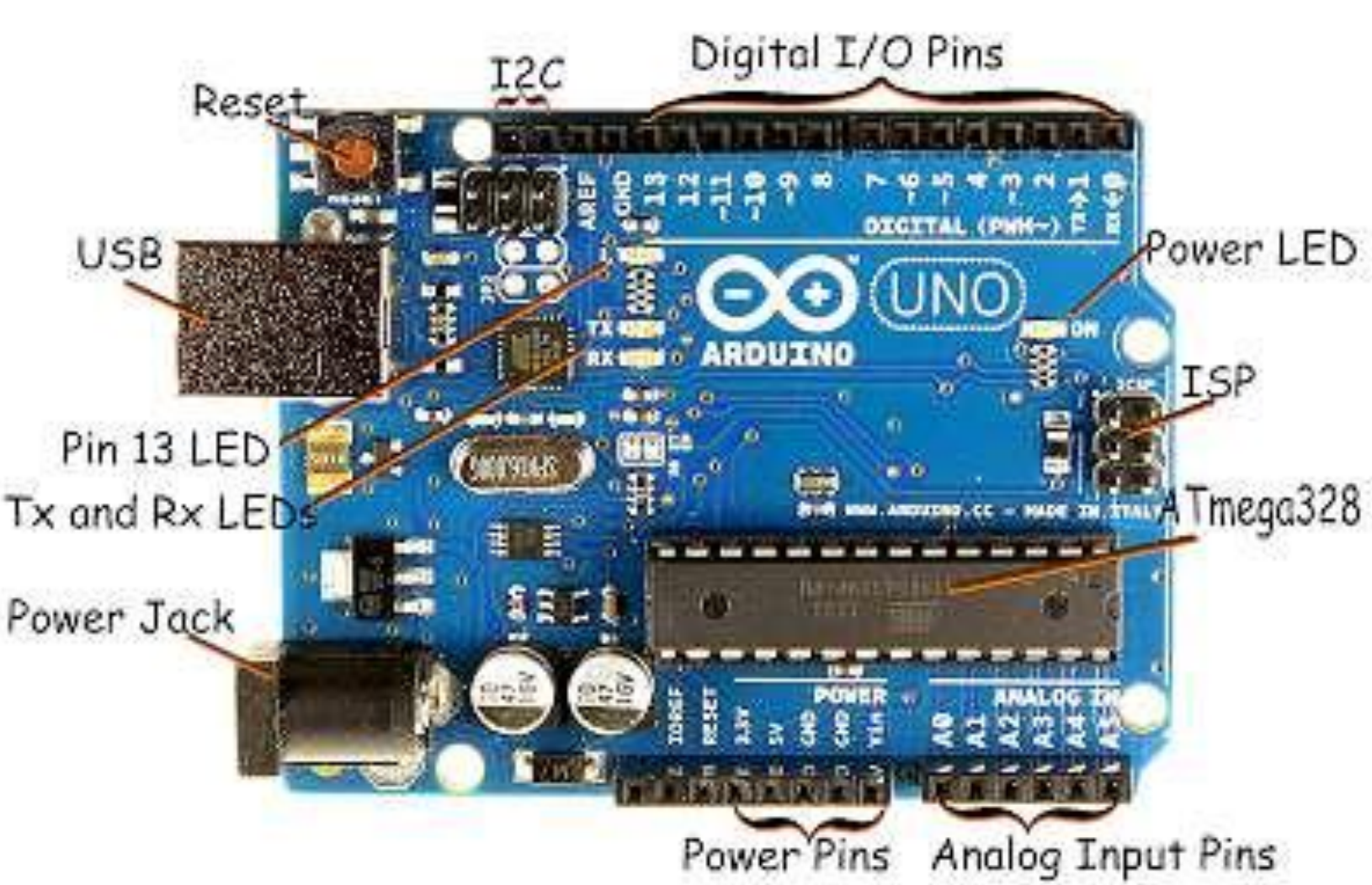
1. 3D PRINTING CHECK UP

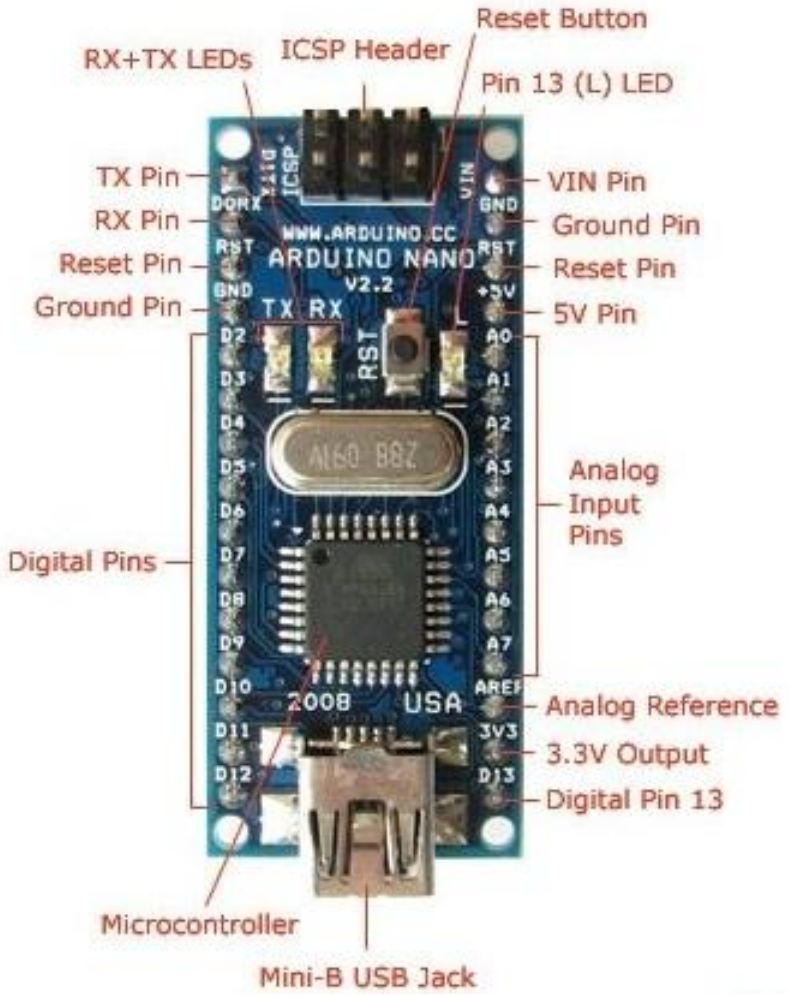
- Software (specfic apps vary by site)
  - Cura – setup and slicer
  - Pronterface – machine control
- Filament, material, diameter, and quality
- Extrusion, temperatures, speed, nozzle health & cooling
- Bed preparation, material, leveling, additives
- Print removal, tools & techniques
- Post print finishing, clipping, sanding, painting

2. ARDUINO OVERVIEW

- Open source hardware and software to digitally control sensors and outputs.
- Originally targeted at students, artists, hobbyists.
- Ubiquitous, cheap, and extremely well supported with hardware and software accessories and education.
- Starting to fragment.
- Limited power, no networking.
- More powerful descendants: Raspberry pi, Intel Edison, Photon, etc.

Microcontroller	ATmega328
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limits)	6-20V
Digital I/O Pins	14 *(of which 6 provide PWM output)*
Analog Input Pins	6
DC Current per I/O Pin	40 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	32 KB (ATmega 328) *of which 0.5 KB used by bootloader*
SRAM	2 KB (ATmega328)
EEPROM	1 KB (ATmega328)
Clock Speed	16 MHz


Reset
I2C
Digital I/O Pins
USB
Power LED
Pin 13 LED
ISP
Tx and Rx LEDs
ATmega328
Power Jack
Power Pins
Analog Input Pins


RX+TX LEDs
ICSP Header
Reset Button
Pin 13 (L) LED
TX Pin
RX Pin
Reset Pin
Ground Pin
VIN Pin
Ground Pin
Reset Pin
5V Pin
Analog Input Pins
Digital Pins
Analog Reference
3.3V Output
Digital Pin 13
Microcontroller
Mini-B USB Jack

3. GETTING TO BLINK ON ARDUINO

A. The class project hardware:
   1. Arduino
   2. WS2812 ring
   3. Pushbutton
   4. Resistor
   5. USB cable
   6. Diffusion material
   7. Wire

B. Downloading and installing
   1. Arduino software
   2. CH340 serial chip software

- The IDE
- The compile/ download/ run process
- Blink and Arduino sketches

Blink

```
/*
  Blink
  Turns on 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 and
  Leonardo, it is attached to digital pin 13. If you're unsure what
  pin the on-board LED is connected to on your Arduino model, check
  the documentation at http://arduino.cc

  This example code is in the public domain.

  modified 8 May 2014
  by Scott Fitzgerald
 */


// the setup function runs once when you press reset or power the board
void setup() {
  // initialize digital pin 13 as an output.
  pinMode(13, OUTPUT);
}

// the loop function runs over and over again forever
void loop() {
  digitalWrite(13, HIGH);   // turn the LED on (HIGH is the voltage level)
  delay(1000);              // wait for a second
  digitalWrite(13, LOW);    // turn the LED off by making the voltage LOW
  delay(1000);              // wait for a second
}
```

4. SOLDERING BASICS

- Tools and safety
- Wire
- Soldering techniques
- Project connections, Arduino to button/ring:
    1. 3V3 to button
    2. GND through resistor to button other side (shrink)
    3. D2 to button other side (pull up)
    4. D6 to data input on ring
    5. +5V to Power 5V DC on ring
    6. GND to Power Signal Ground on ring

5. THE LAMP APP

- Adafruit NeoPixel guide: http://tinyurl.com/l863jst

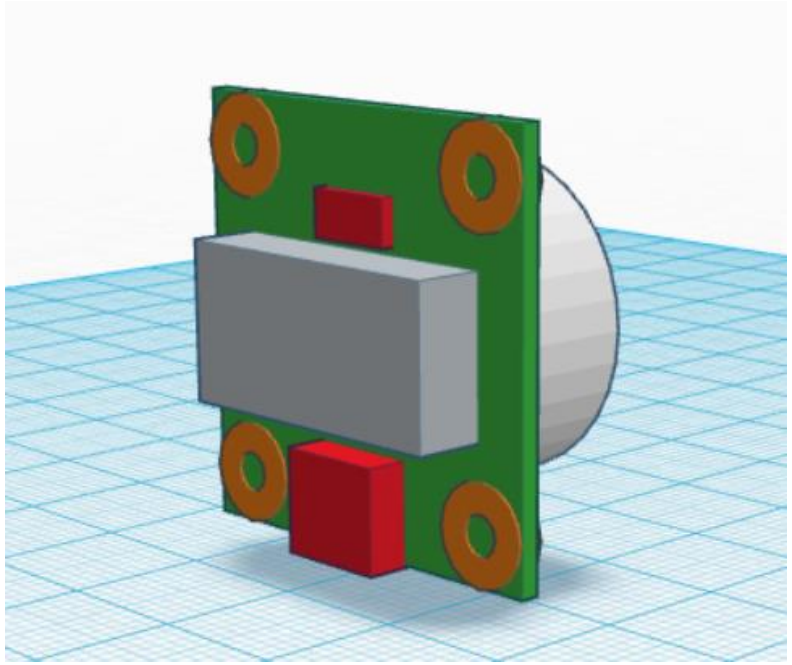
5. 2D WITH TINKERCAD AND CRICUIT

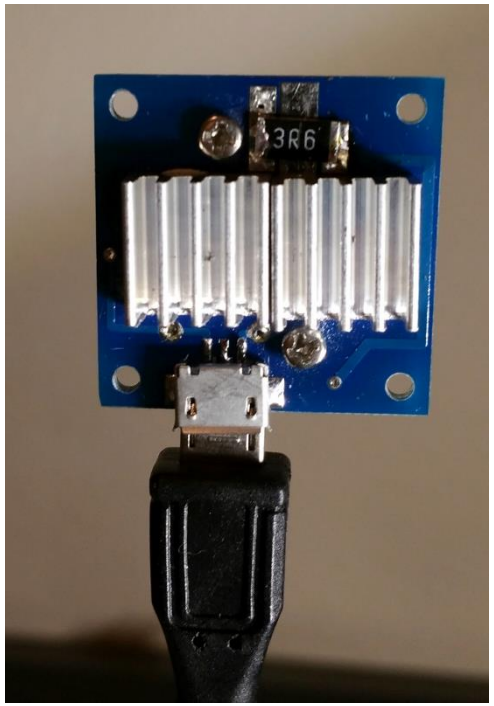
- 2D output from Tinkercad
- Other software to generate SVG files
- 2D digital fabrication
- Cricuit hardware
- Designspace software

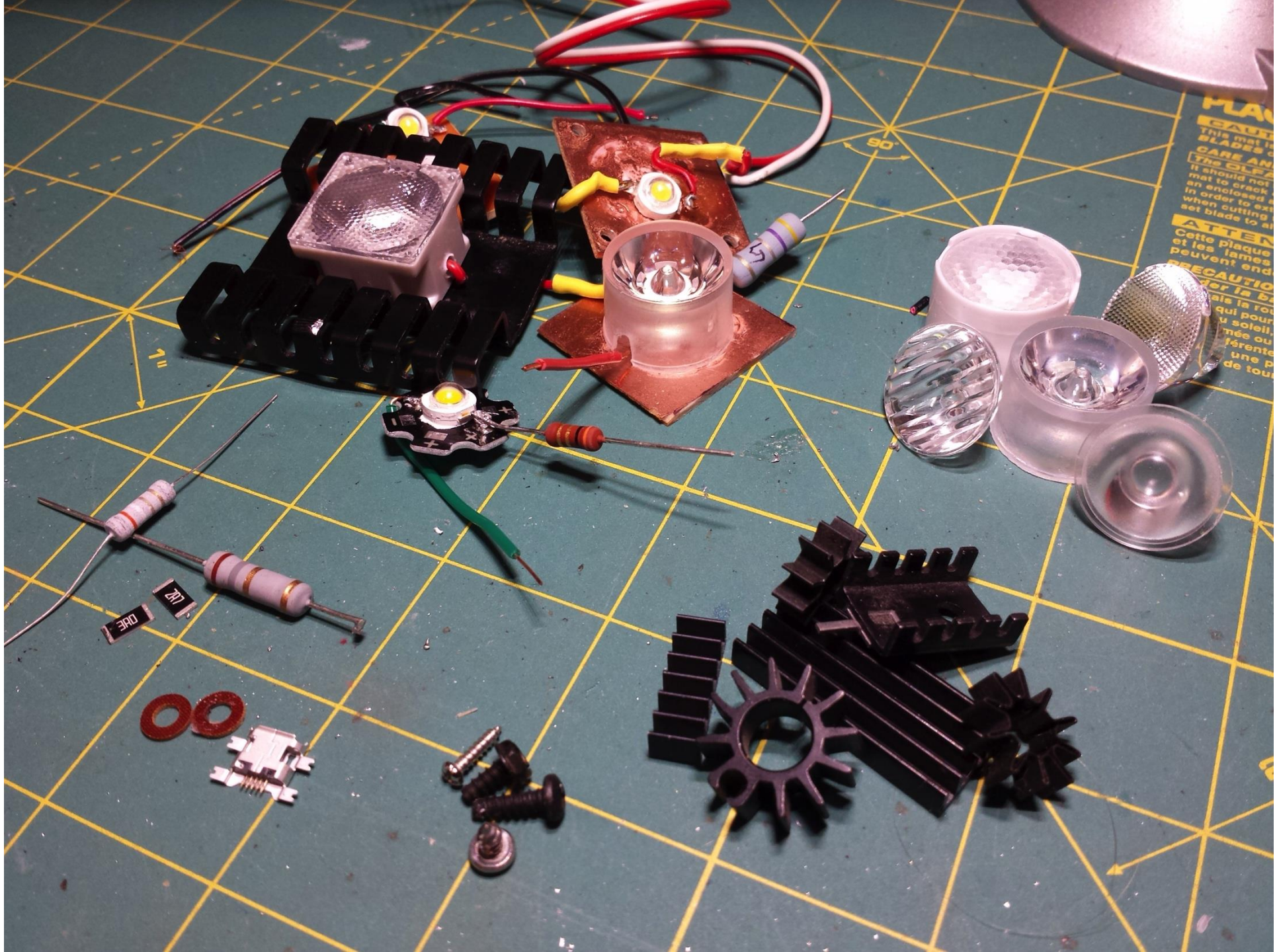
7. DEMONSTRATION OF A PROTOTYPING PROJECT

- Goal of the project: to provide 3D printer owners something functional to create with their machine.
- Product: a LED lamp module for sale and accompanying free 3D design files for printing.
- Process (for the LED module):
  - Scan for competing products
  - Paper sketches
  - 3D designed and printed looks-alike prototypes
  - Hand fabricated works-alike prototypes

- Iterating prototypes of the LED module to balance:
  1. Small size
  2. Low cost
  3. Minimal part count
  4. Design for manufacturing
  5. High light output
  6. Neutral light color
  7. Good light dispersion
  8. Appropriate power consumption
  9. Acceptable heat generation
  10. Flexibility for different applications
  11. Ease of use






90
1"

- Individual prototypes were made for:
  1. Electronics schematic
  2. Component placement (switch, USB jack)
  3. Color of LED emitter
  4. Lens spread and surface pattern
  5. Heat sinks
  6. Overall size
  7. 3D printed mounting rings
  8. 3D printed lamp components