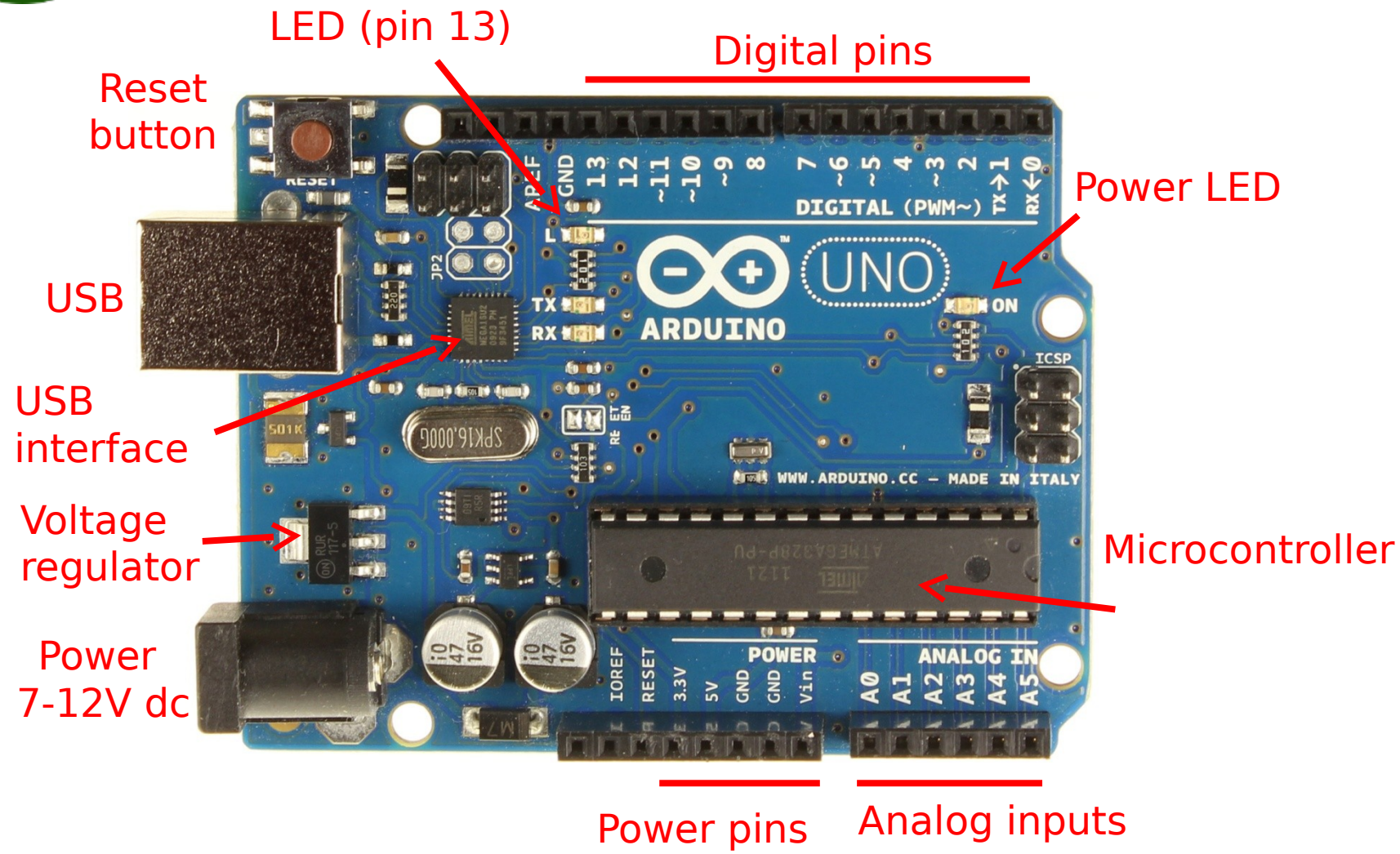
Introduction to ARDUINO

How to use electronics to make your projects better!

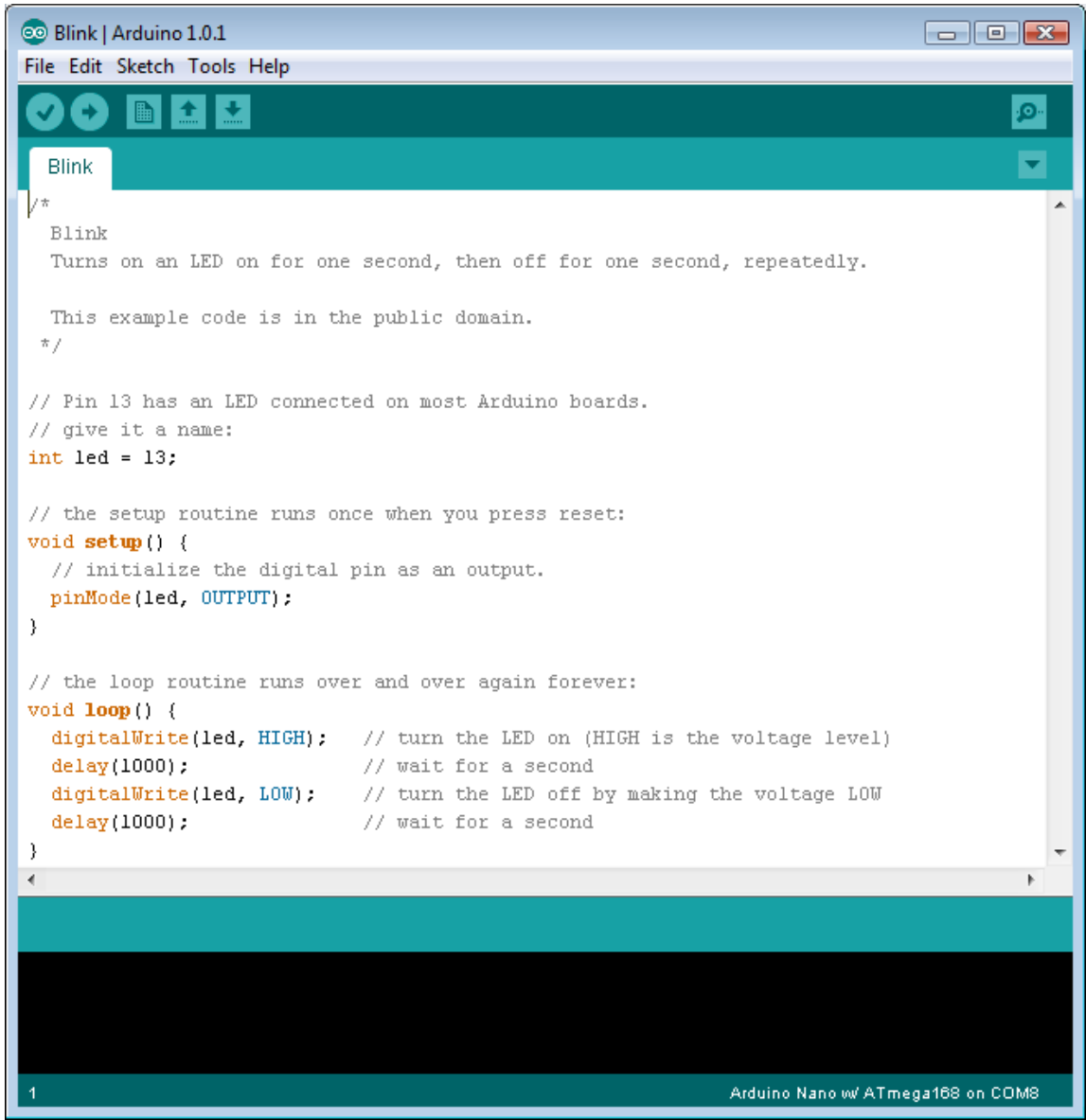
Presentation: http://wiki.nottinghack.co.uk/wiki/Arduino101
Software: http://arduino.cc/en/Main/Software

Arduino Uno


LED (pin 13)
Digital pins
Reset button
Power LED
USB
USB interface
Voltage regulator
Microcontroller
Power 7-12V dc
Power pins
Analog inputs
DIGITAL (PWM~)
POWER
ANALOG IN
UNO
ARDUINO
ON
ICSP
WWW.ARDUINO.CC – MADE IN ITALY

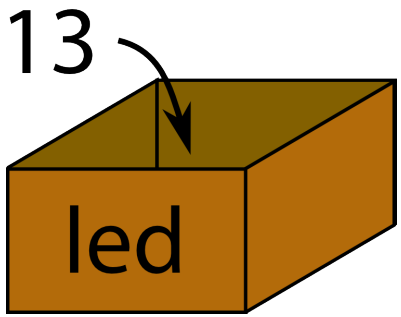
Programming

- Arduino IDE (Integrated Development Environment)
- Program is called a “sketch”



Programming 2

Variables : Named places (think “labelled boxes”) to store data like numbers, text, true/false.



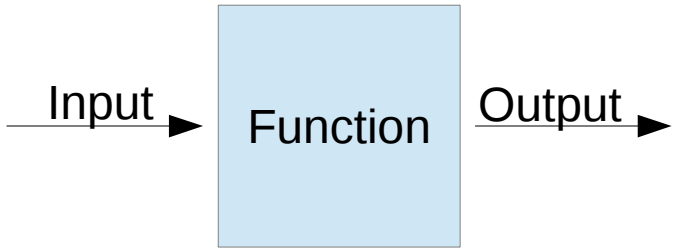
Statement: A single line of code that does one job.

```
int led = 13;
```

Datatype Name Initial Value Semicolon

Functions: Named blocks of statements that perform a particular job

```
int getNewSensorValue(void)
{
      int value = analogRead(3);
      value = value * 4;
      return value;
}
```



Blink a LED

You must have this. All initialisation goes here.

```
int ledPin = 13;                // LED connected to digital pin 13

void setup()                    // run once, when the sketch starts
{
  pinMode(ledPin, OUTPUT);  // sets the digital pin as output
}
```

You must have this. The main code goes here.

```
void loop()                     // run over and over again
{
  digitalWrite(ledPin, HIGH);  // sets the LED on
  delay(1000);                 // waits for a second
  digitalWrite(ledPin, LOW);   // sets the LED off
  delay(1000);                 // waits for a second
}
```

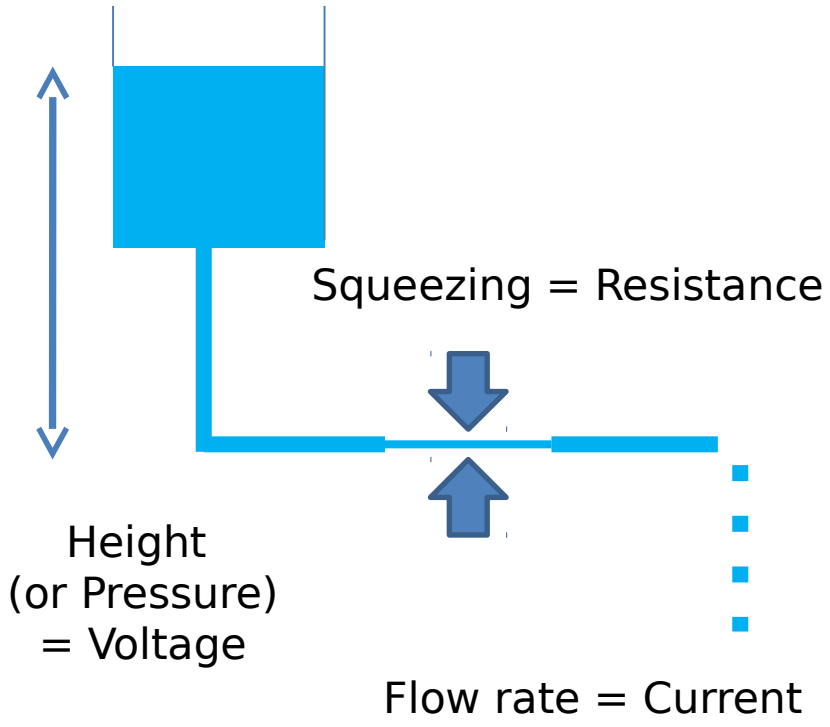
Serial monitor

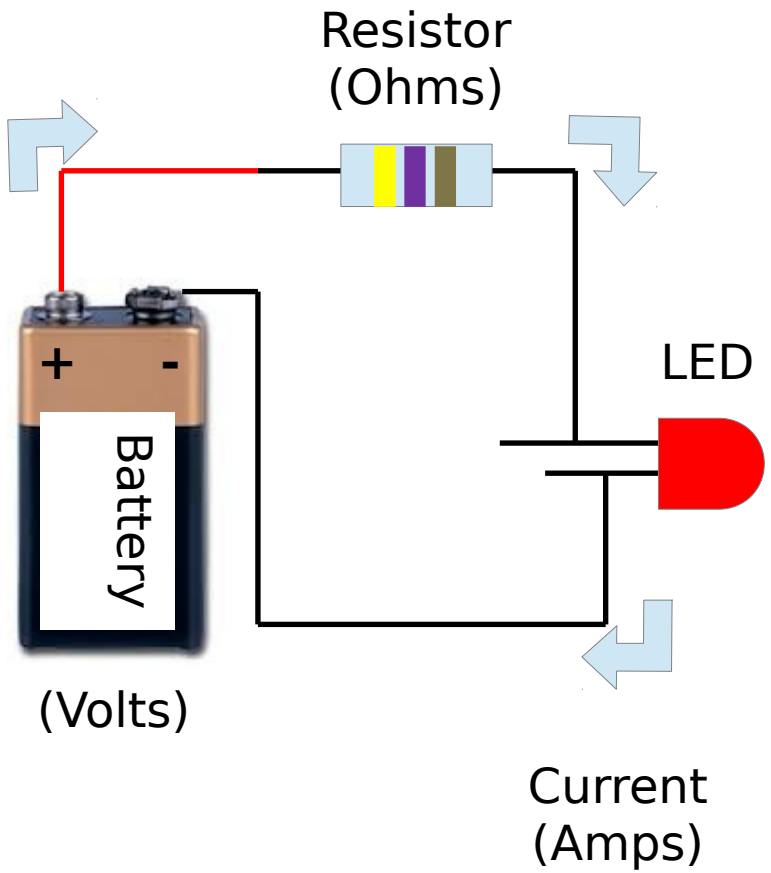
```
int ledPin = 13;                  // LED connected to digital pin 13

void setup()                      // run once, when the sketch starts
{
  pinMode(ledPin, OUTPUT);   // sets the digital pin as output
  Serial.begin(9600);             // start the serial port at 9600 baud
}

void loop()                       // run over and over again
{
  digitalWrite(ledPin, HIGH);   // sets the LED on
  Serial.println("LED on");
  delay(1000);                    // waits for a second
  digitalWrite(ledPin, LOW);    // sets the LED off
  Serial.println("LED off");
  delay(1000);                    // waits for a second
}
```

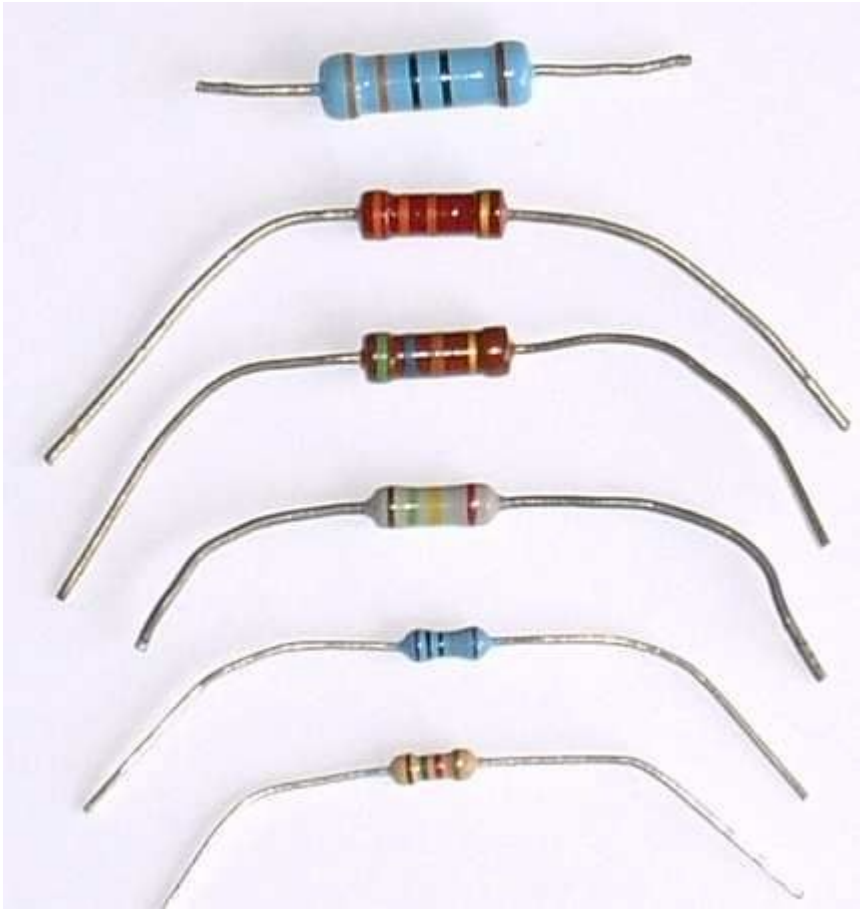
Electrical concepts



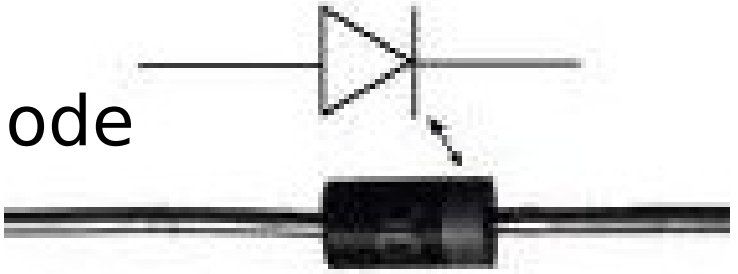


Components

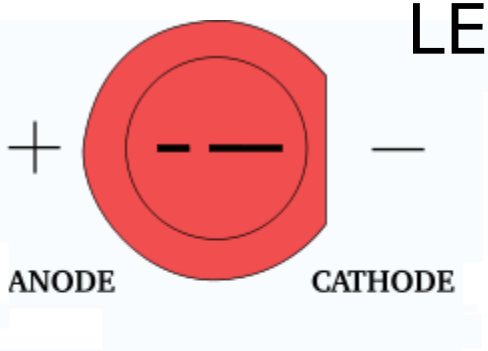
Resistor

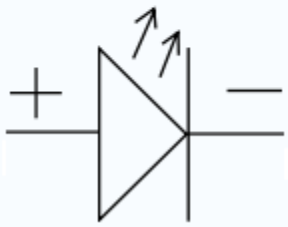


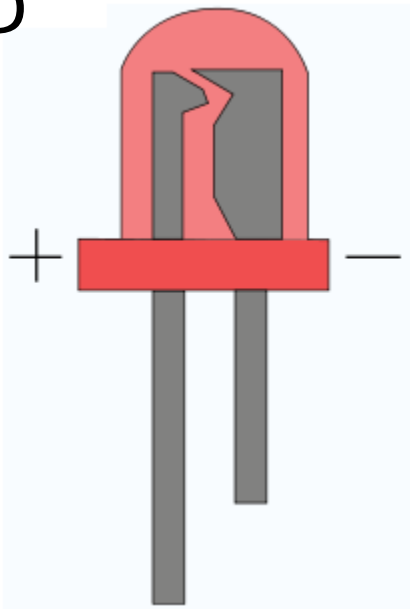
Diode



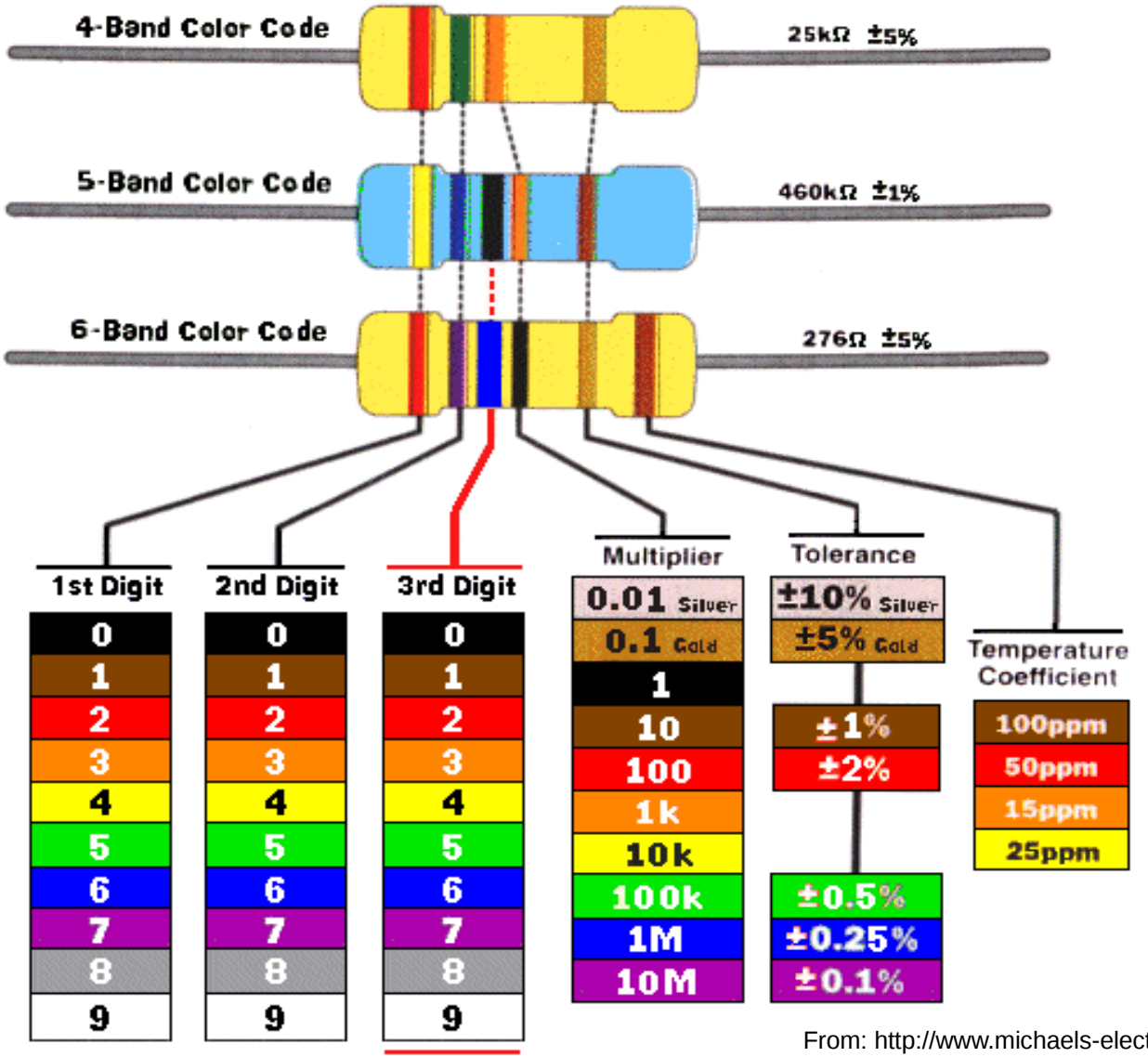
LED





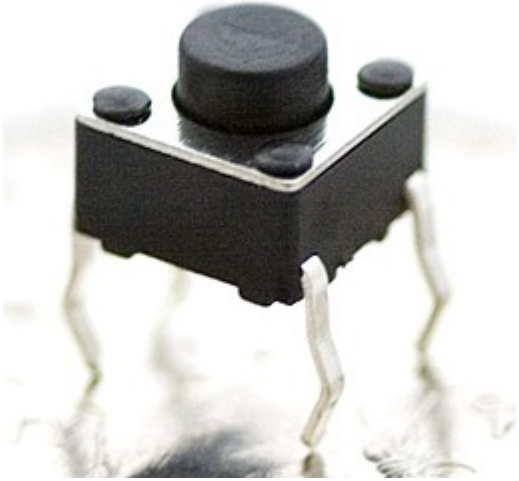


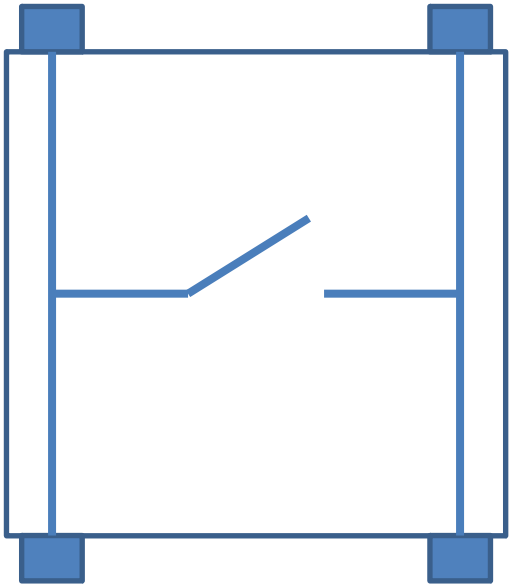
Resistor colour codes



From: http://www.michaels-electronics-lessons.com/

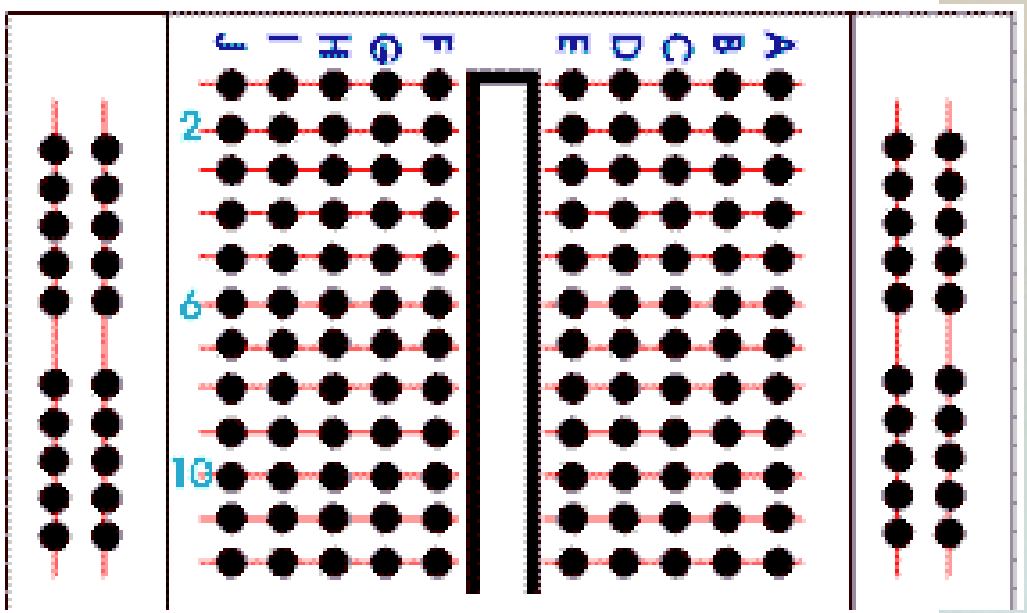
Switch

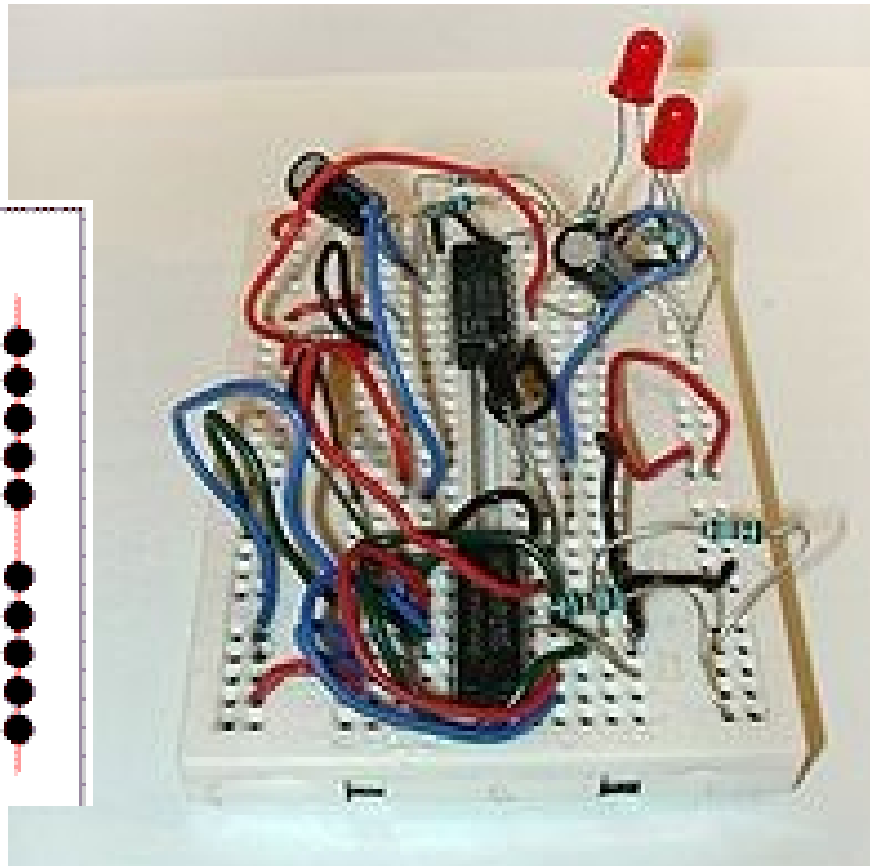




Tools

Breadboard





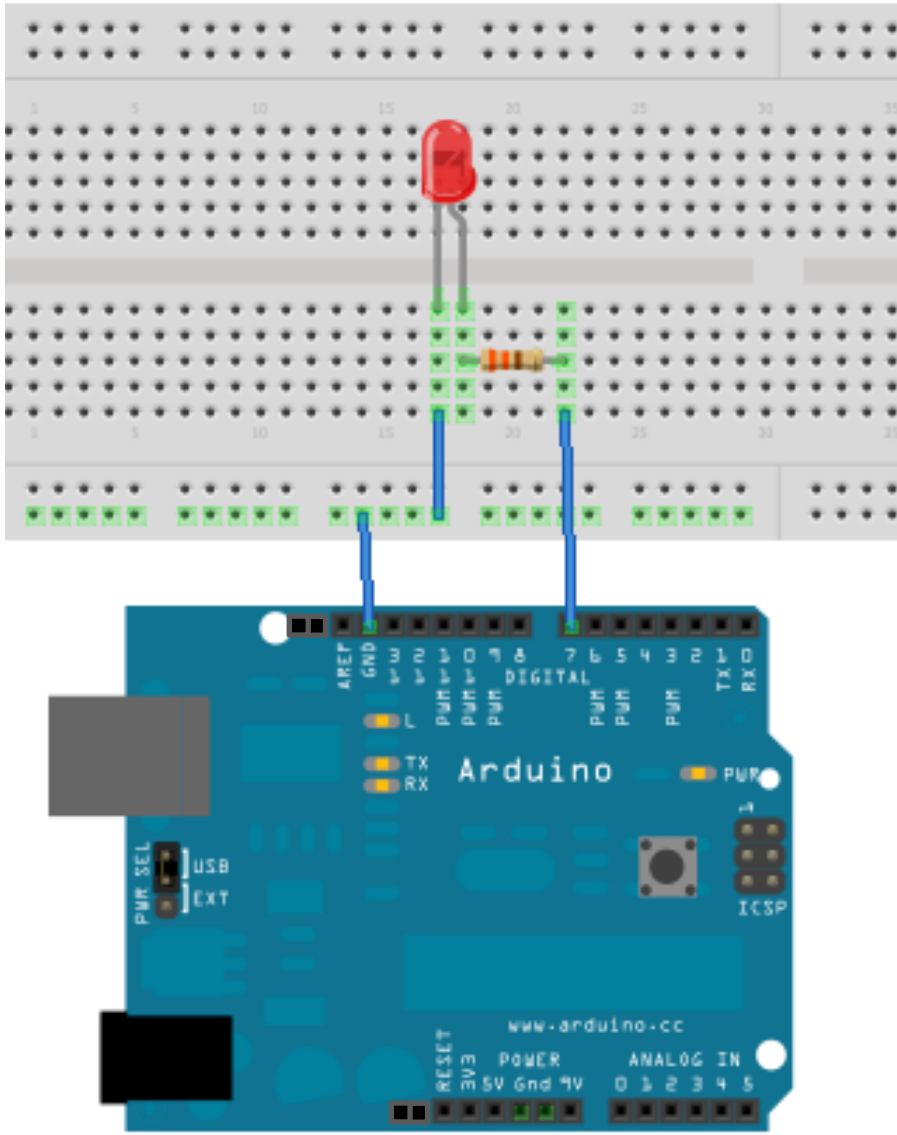
Blink another LED

Alter the previous sketch:

```
int ledPin = 13;
```

to

```
int ledPin = 7;
```



Exercises:

- Alter the blink frequency
- Two short blinks and one long blink
- Blink both LEDs alternately

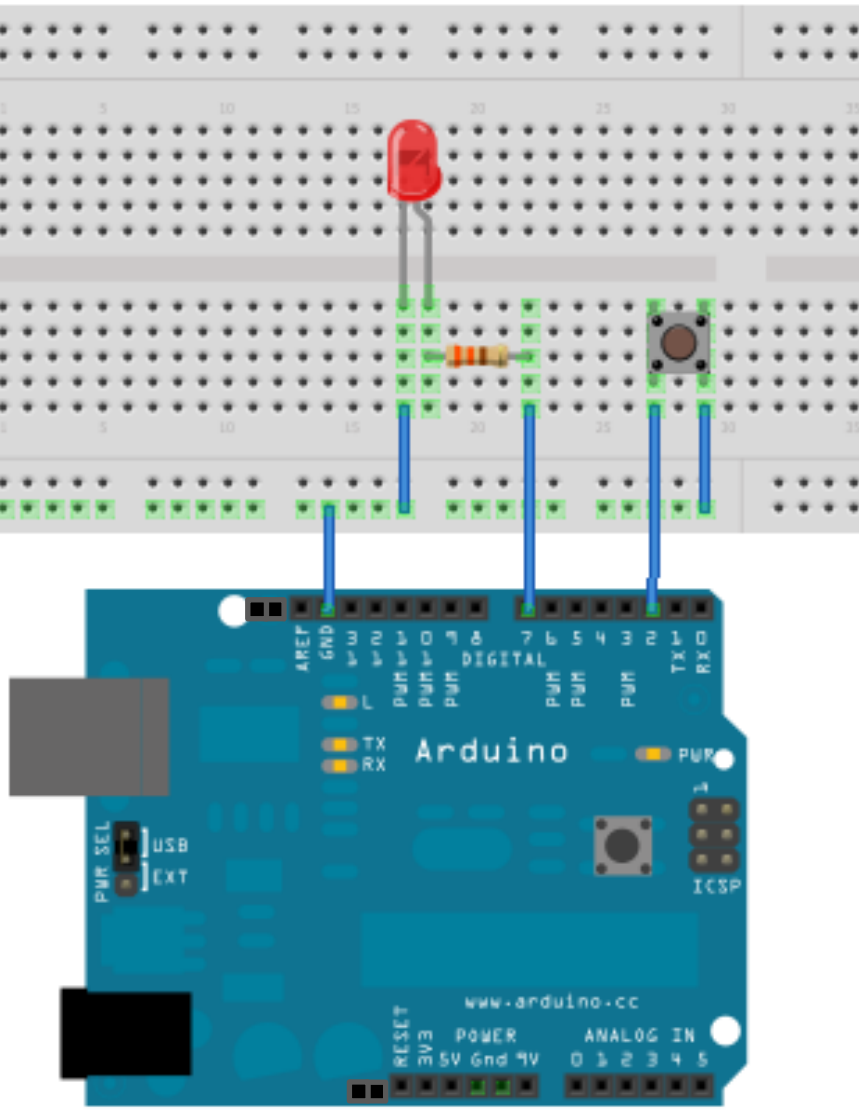
Switch controlling LED

```
int ledPin = 13;
int switchPin = 2;

int switchvalue;    // store the switch value

void setup ()
{
  pinMode(ledPin, OUTPUT);
  // Set the switch pin as input with pull-up
  pinMode(switchPin, INPUT_PULLUP);
}

void loop ()
{
  // read the switch value
  switchvalue = digitalRead(switchPin);
  // and write it to the LED
  digitalWrite(ledPin, !switchvalue);
}
```



Exercise

Blink the LED twice each time the switch is pressed.

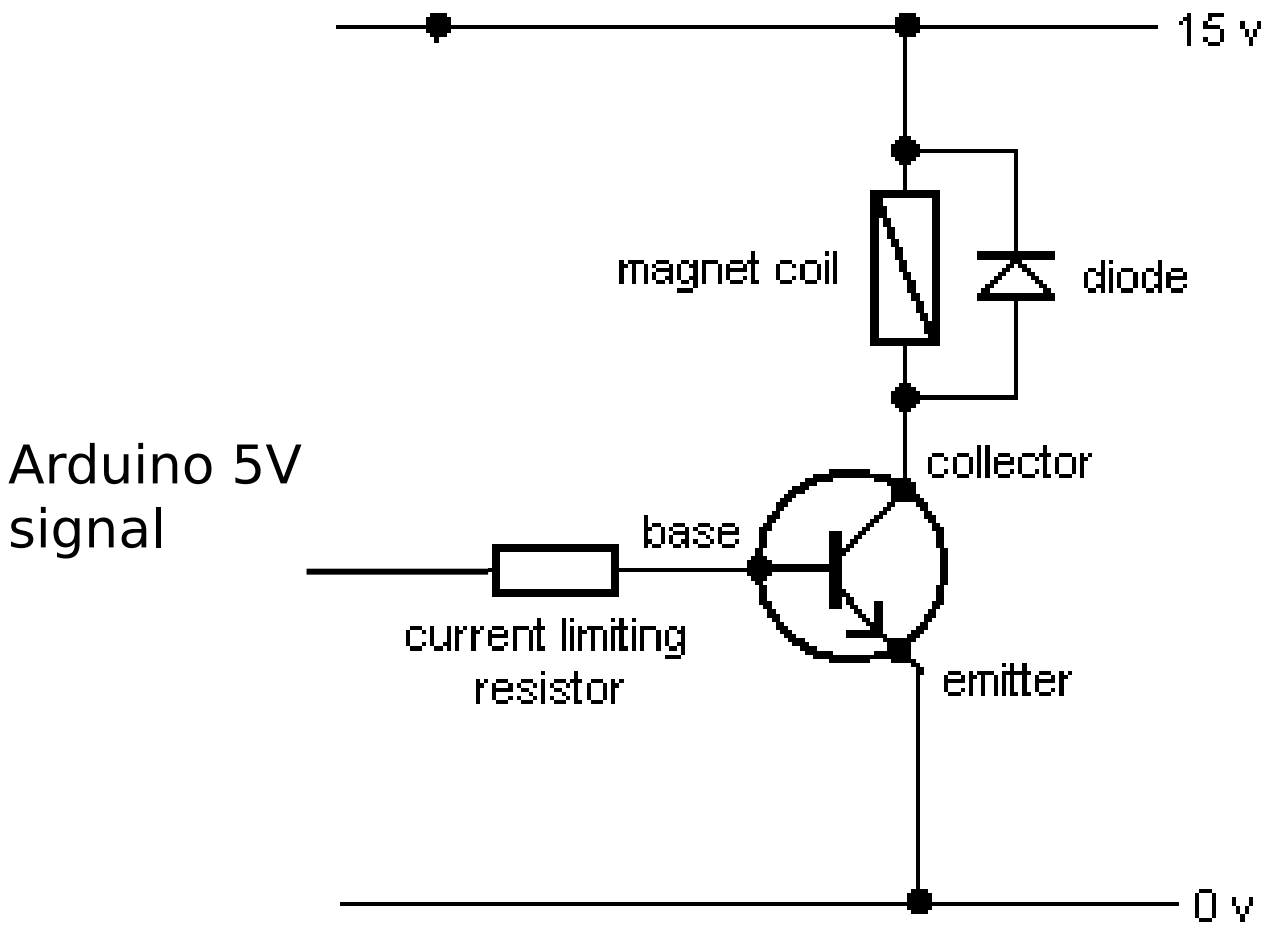
Hint use an “if” statement

```
if (switchvalue == LOW)
{
 … code to blink LED twice …
}
```

Motors and relays

- These devices need more current than the Arduino can supply.
- We use a transistor to increase the current available.
- Transistor acts as a Arduino controlled switch.
- Need protection from inductive loads (usually wound coils such as motors and relays).
- NPN Bipolar and N-channel MOSFET are commonly used with the Arduino.
- Voltage of the load (motors, etc.) can be higher than Arduino voltage.

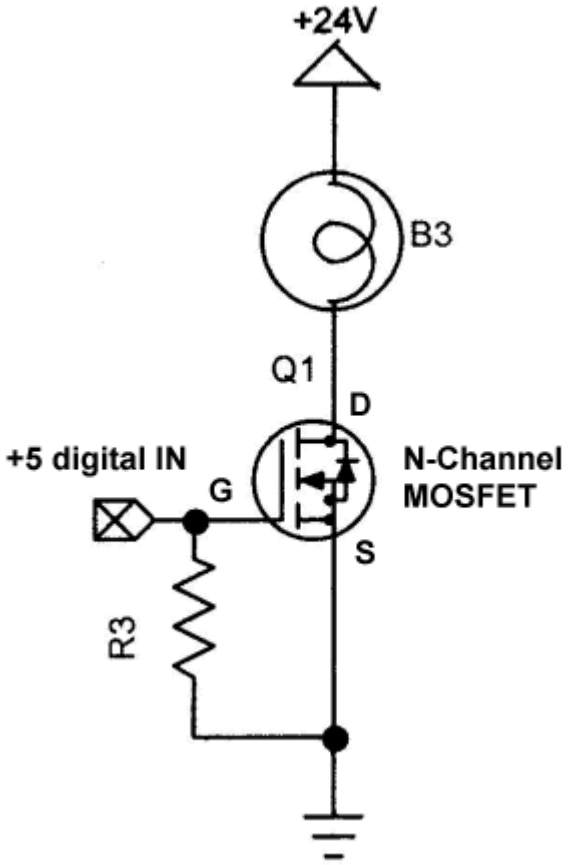
NPN Bipolar transistor



N-channel MOSFET

Voltage controlled device

R3 ensures that the MOSFET turns off if the input is disconnected



Speed control
Pulse Width Modulation (PWM)

Drives motor at full voltage.

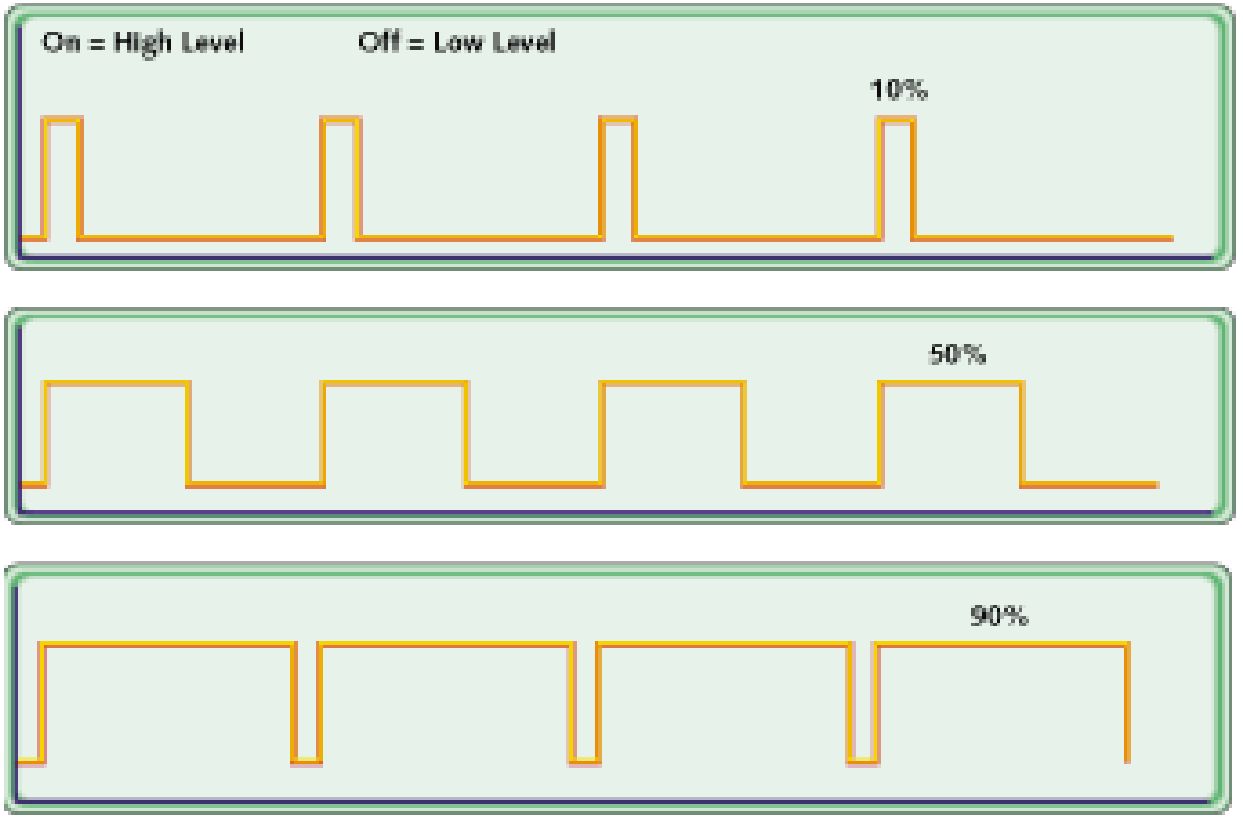
This gives high torque even at low speeds.

Used on Arduino pins 3, 5, 6, 9, 10, 11

Code:

```
analogWrite(pin,value);
```

Value 0 - 255

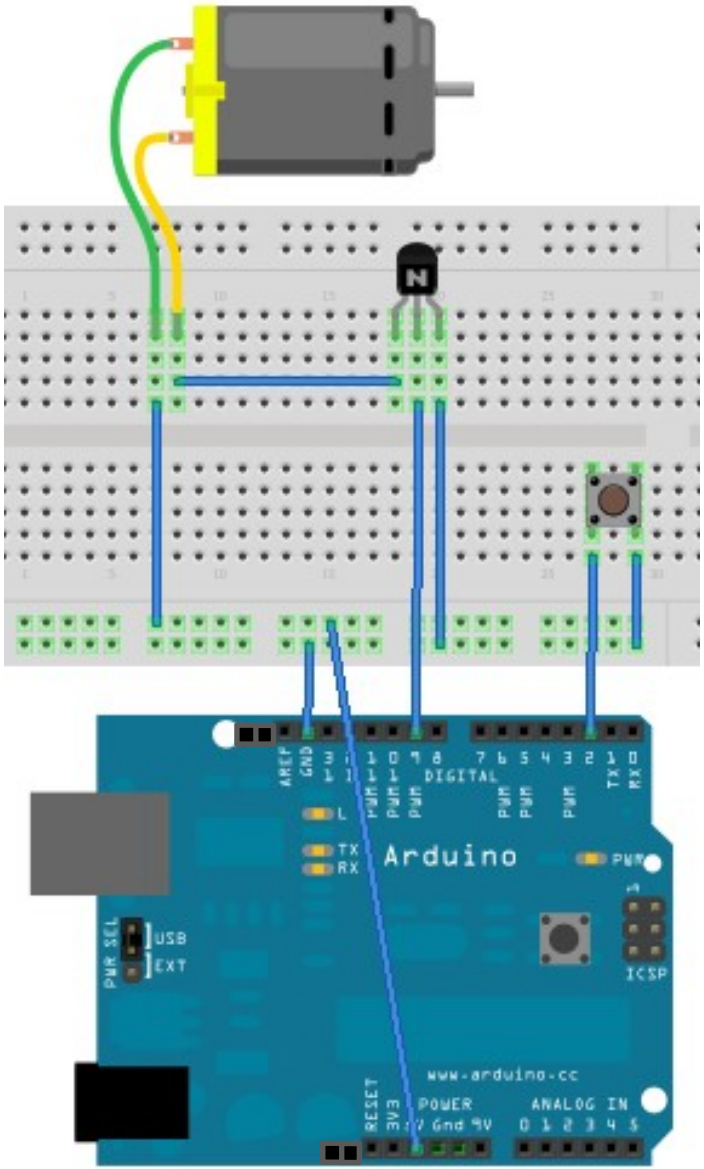


Arduino motor control

Motor control according to switch

```
void setup() {
  pinMode(9, OUTPUT);
  pinMode(2, INPUT_PULLUP);
}

void loop() {
  if (digitalRead(2) == 0) {
    analogWrite(9,100);
  }
  else {
    analogWrite(9,0);
  }
}
```



Reading analog signals

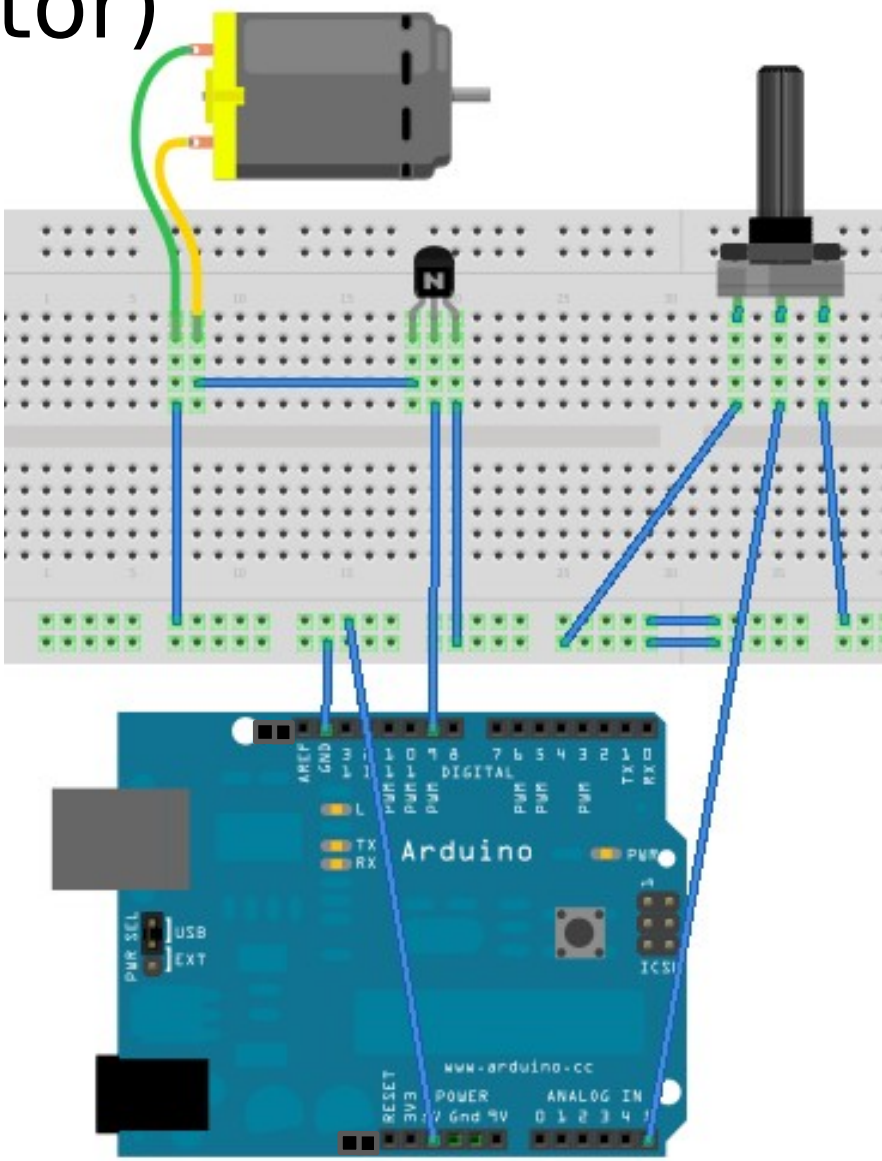
- Arduino has 6 analog inputs
- Read with:
  - int value = analogRead(pin);
  - Pin is 0-5 or A0-A5
  - Value from 0 to 1023 representing voltage of 0-5V

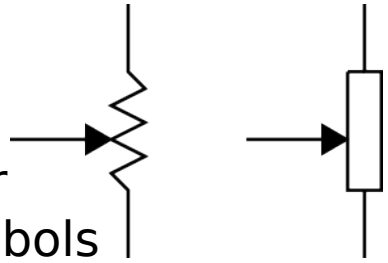
Potentiometer (variable resistor)

Speed control using potentiometer

```
void setup() {
  pinMode(9, OUTPUT);
}

void loop() {
  int light = analogRead(5);
  analogWrite(9, light/4);
}
```





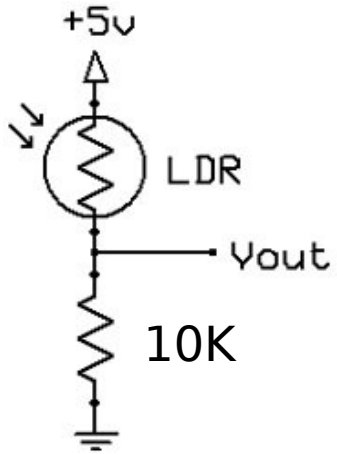
Potentiometer electrical symbols

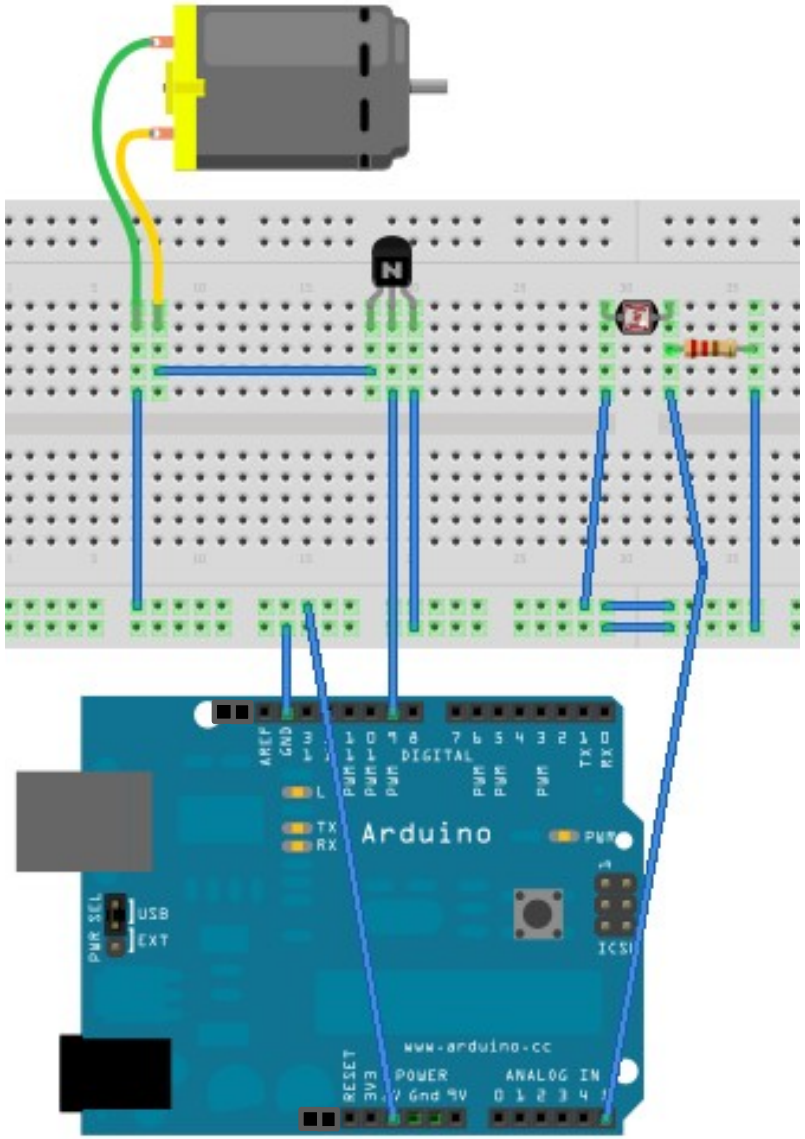
Light dependent resistor

Speed control according to light level

```
void setup() {
  pinMode(9, OUTPUT);
}

void loop() {
  int light = analogRead(5);
  analogWrite(9, light/4);
}
```





Challenges!

- “Knightrider” LEDs
- Colour changing RGB LED
- Traffic lights (single set, or perhaps two sets with a pelican crossing?)
- Make some noise! (play a tune, or perhaps create a “light Theremin”? Hint: use LDR and *tone()* function)
- Line following robot
- Your own project?