



Introduction to

ARDUINO

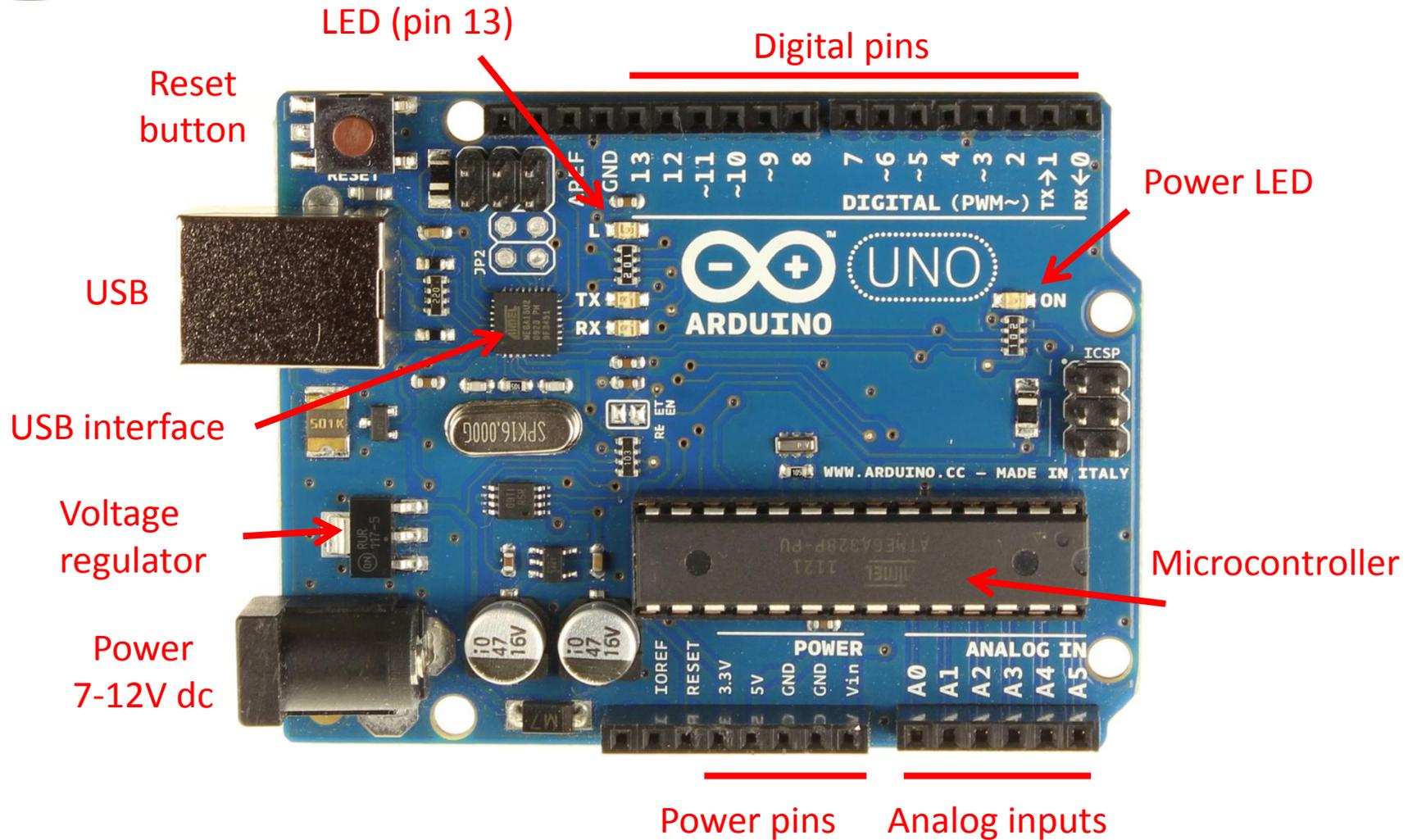
How to use electronics to make your projects better!

Presentation: <http://wiki.nottinghack.co.uk/wiki/Arduino101>

Software: <http://arduino.cc/en/Main/Software>



Arduino Uno





Programming

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

The screenshot shows the Arduino IDE interface with the 'Blink' sketch loaded. The code is as follows:

```
Arduino IDE | Blink | Arduino 1.0.1
File Edit Sketch Tools Help

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

  This example code is in the public domain.
  */

// Pin 13 has an LED connected on most Arduino boards.
// give it a name:
int led = 13;

// the setup routine runs once when you press reset:
void setup() {
  // initialize the digital pin as an output.
  pinMode(led, OUTPUT);
}

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

1
Arduino Nano w/ ATmega168 on COM8
```



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

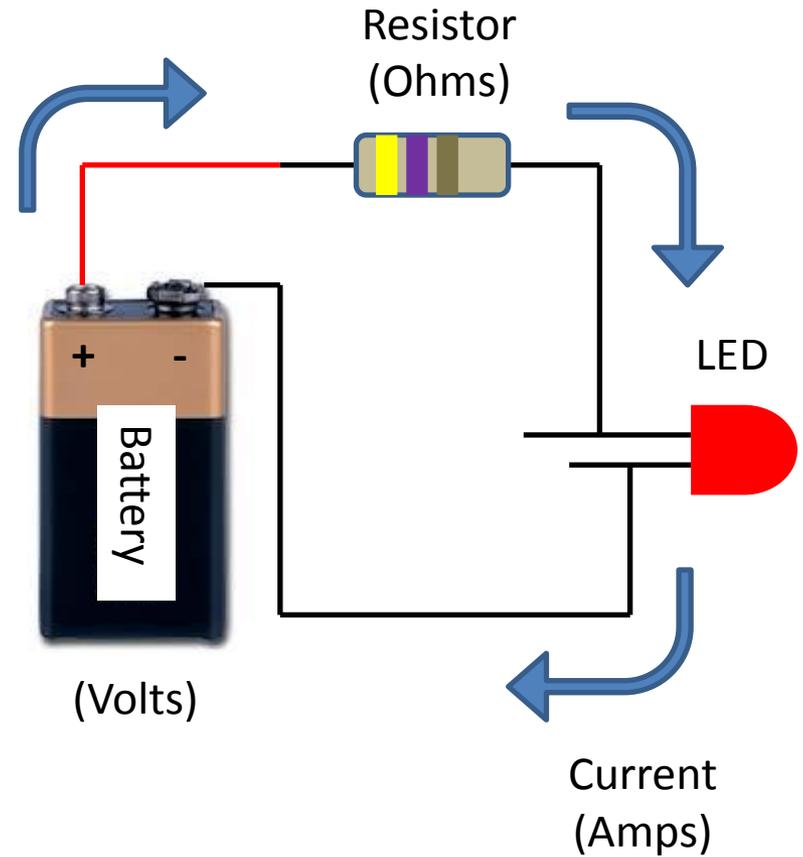
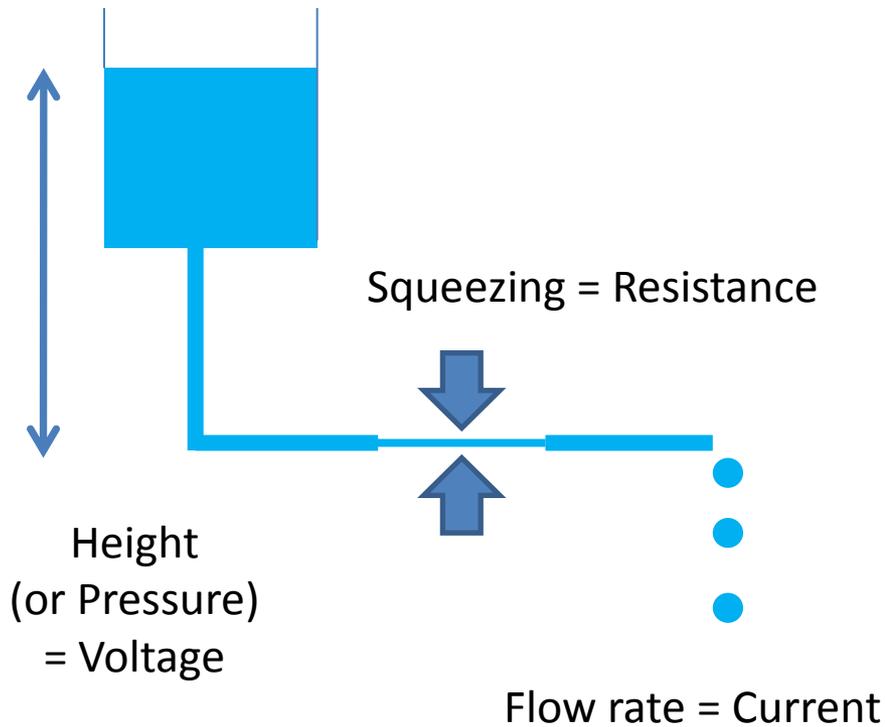
```
int ledPin = 13;           // LED connected to digital pin 13

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
}
```



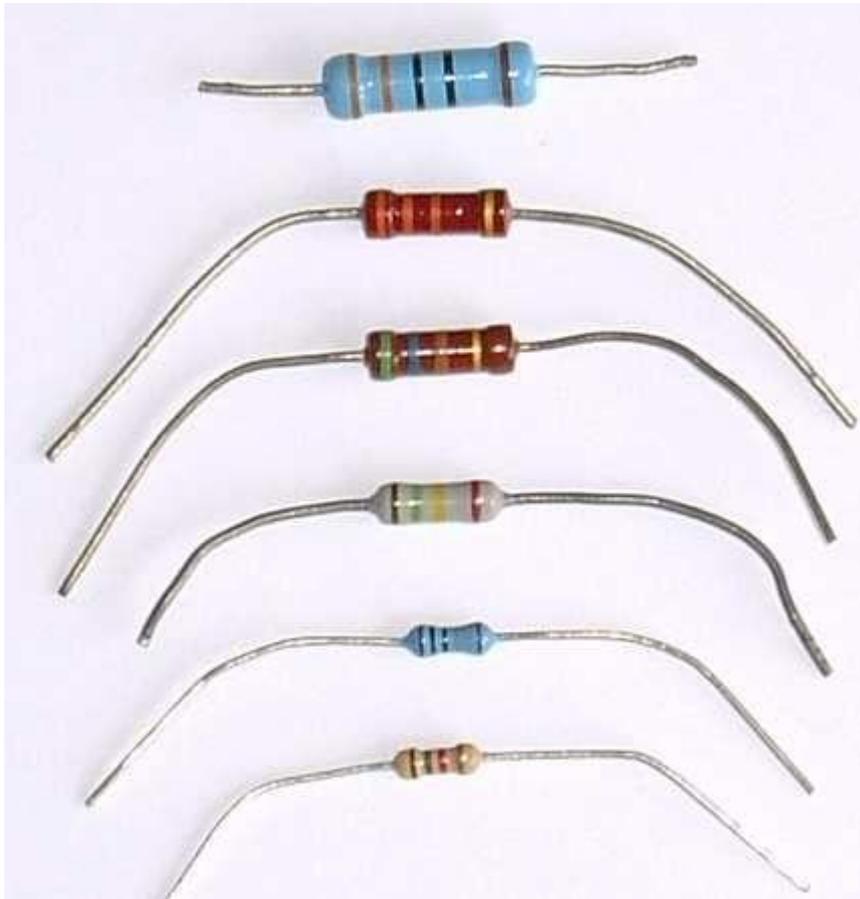
Electrical concepts



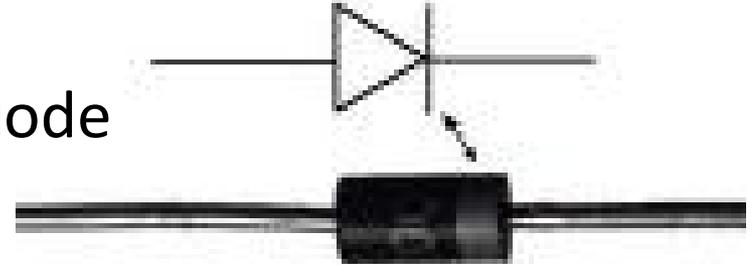


Components

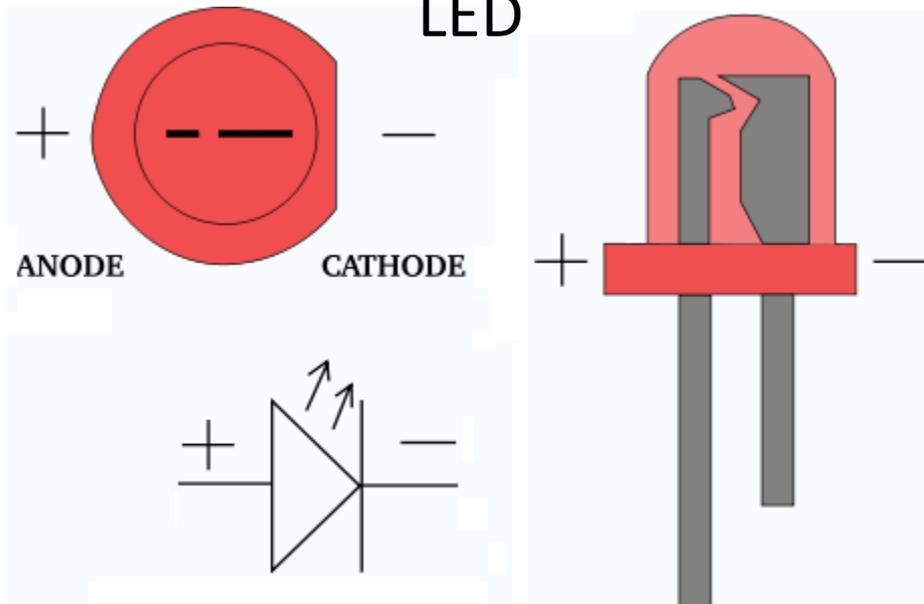
Resistor



Diode

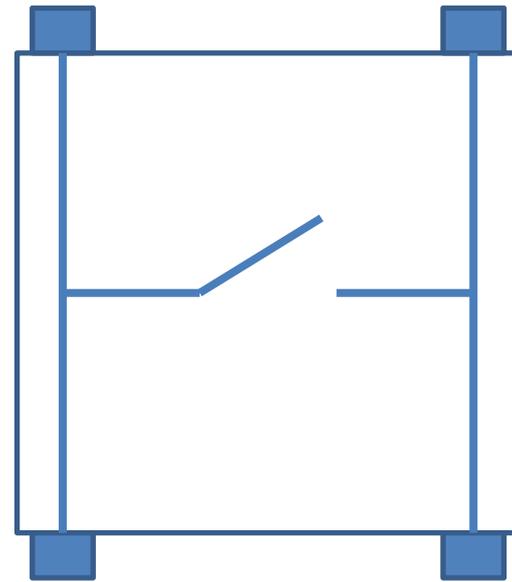
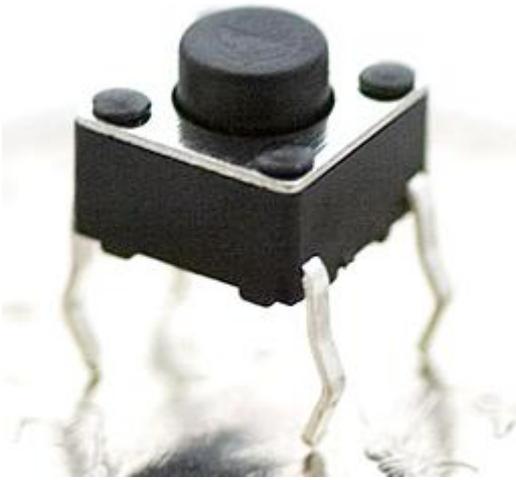


LED





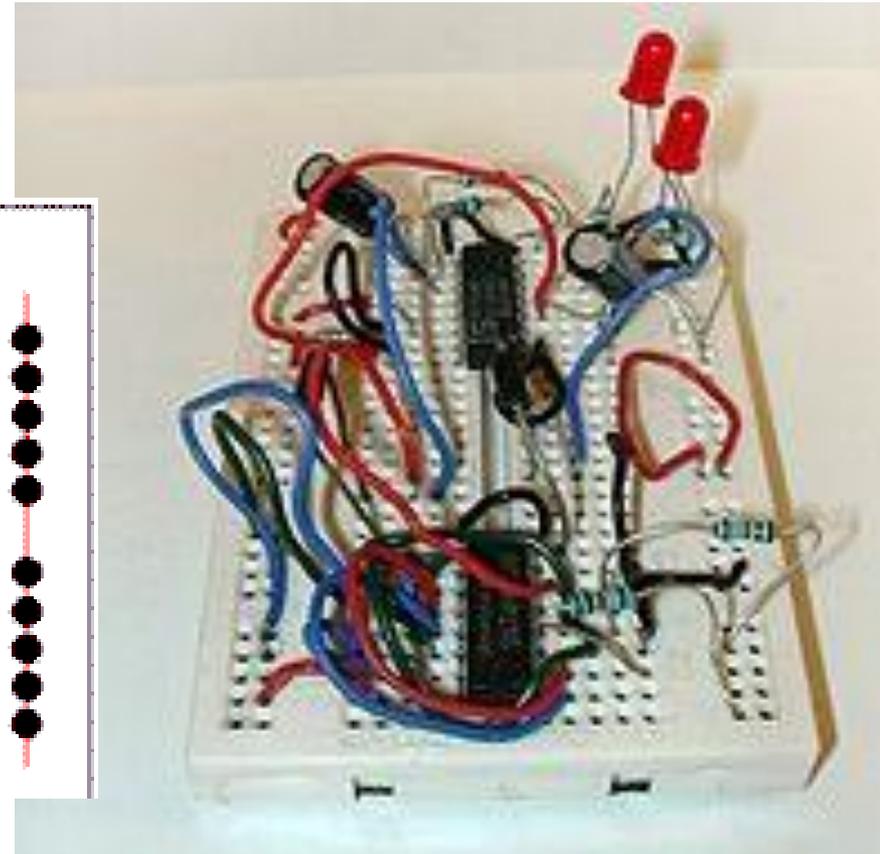
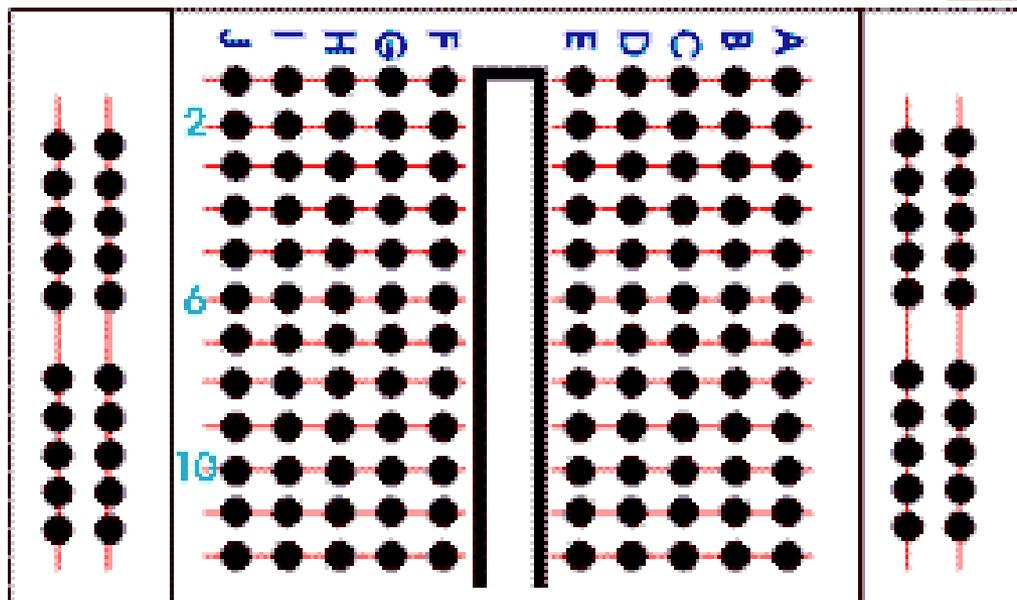
Switch





Tools

Breadboard





Blink another LED

Alter the previous sketch:

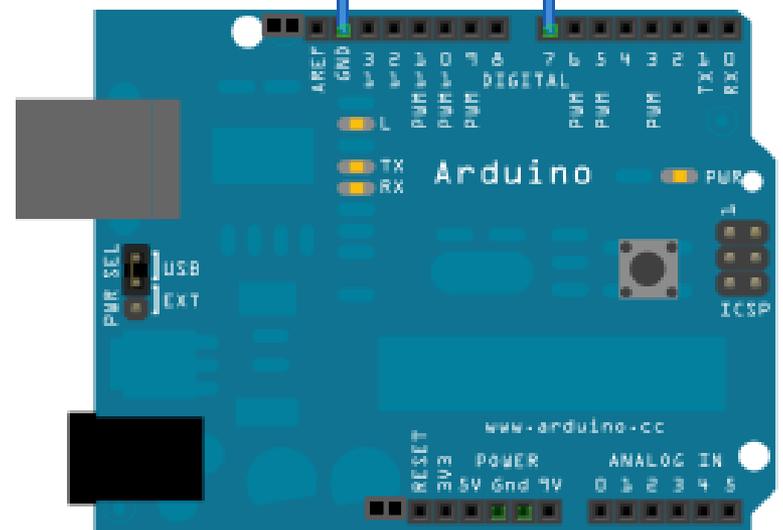
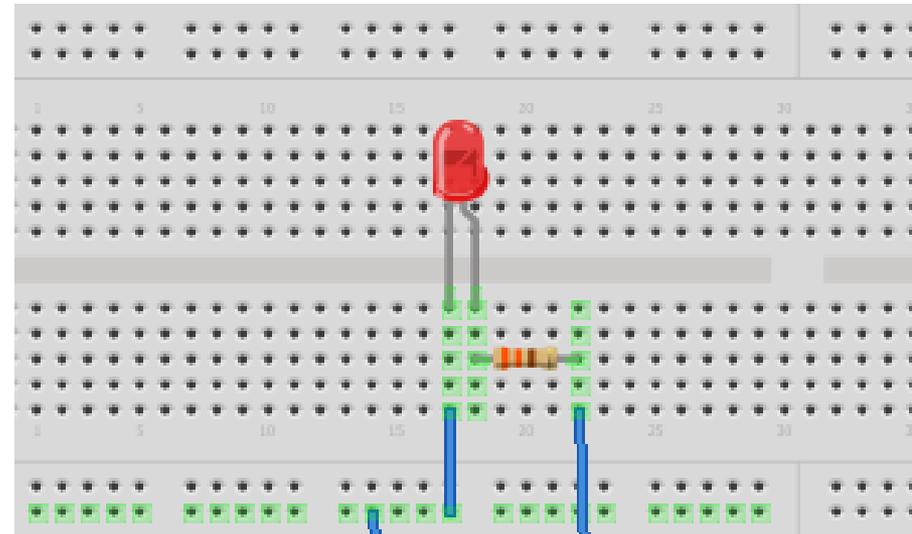
```
int ledPin = 13;
```

to

```
int ledPin = 7;
```

Exercises:

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





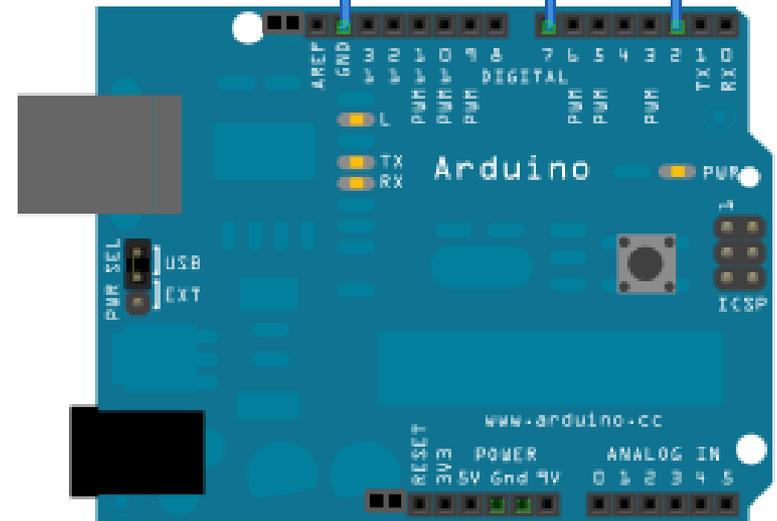
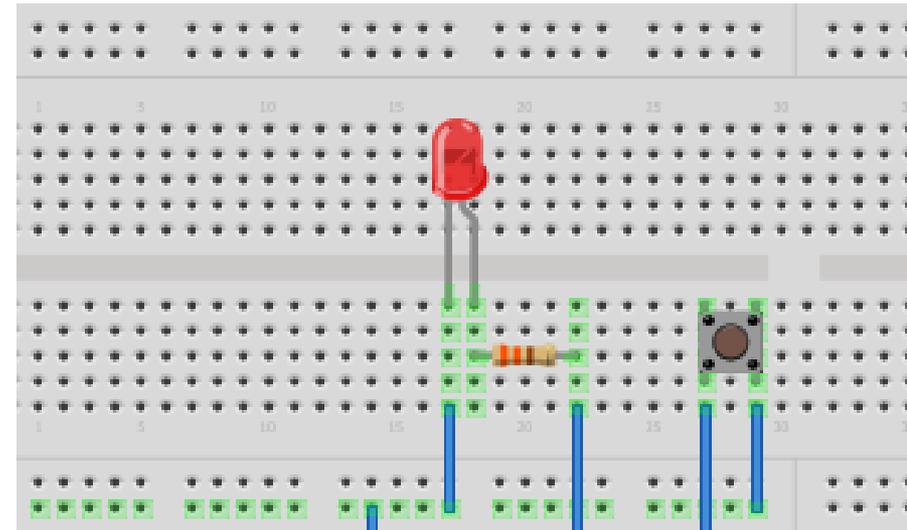
Switch controlling LED

```
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 ...
}
```

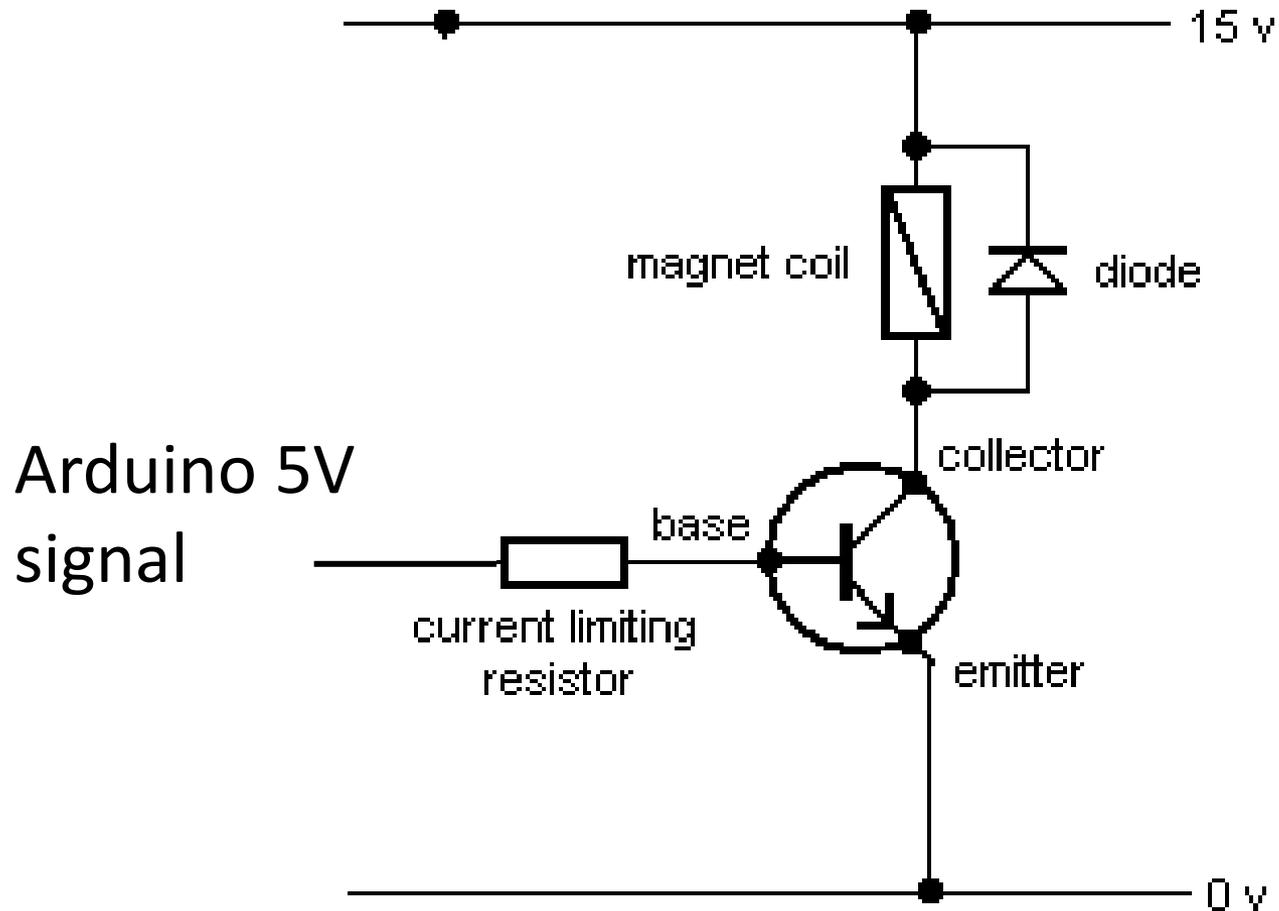


Motors and relays

- 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

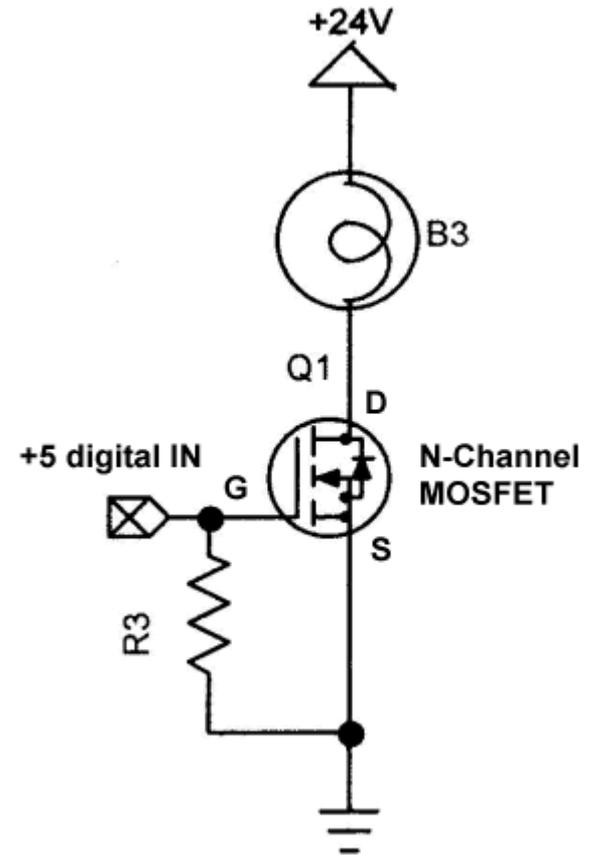




N-channel MOSFET

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.

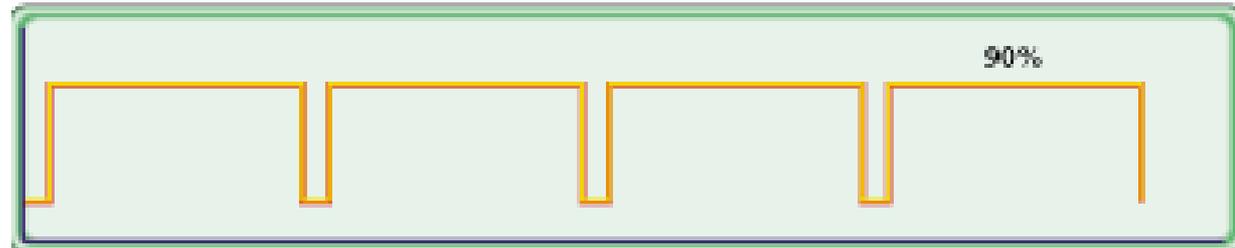
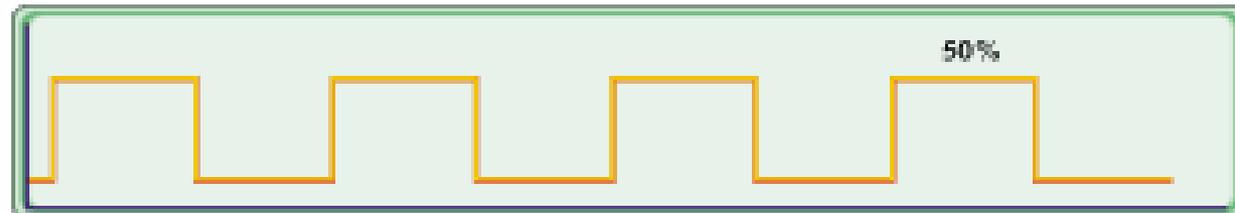
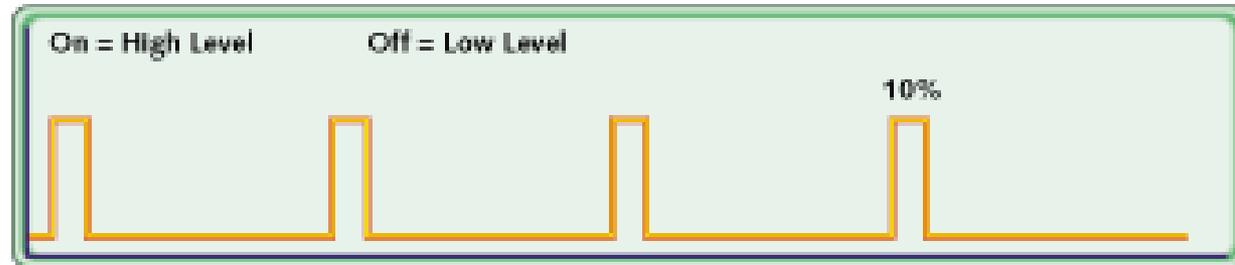
This gives high torque even at low speeds.

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

Code:

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

Value 0 - 255



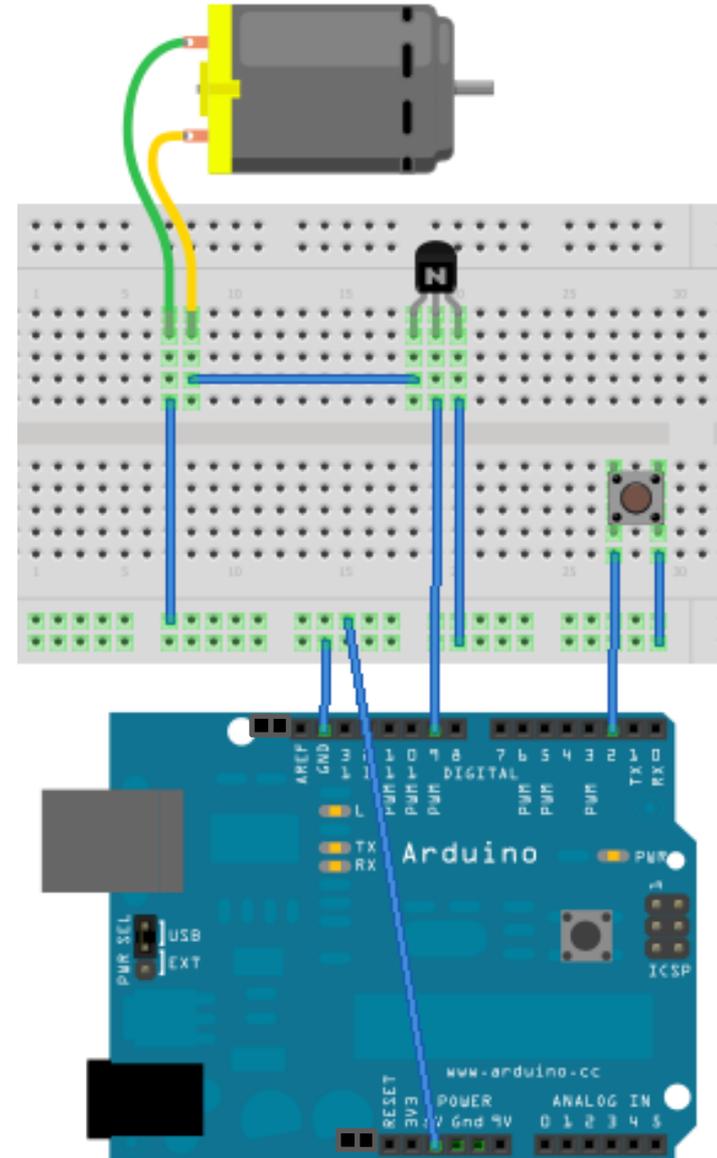


Arduino motor control

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



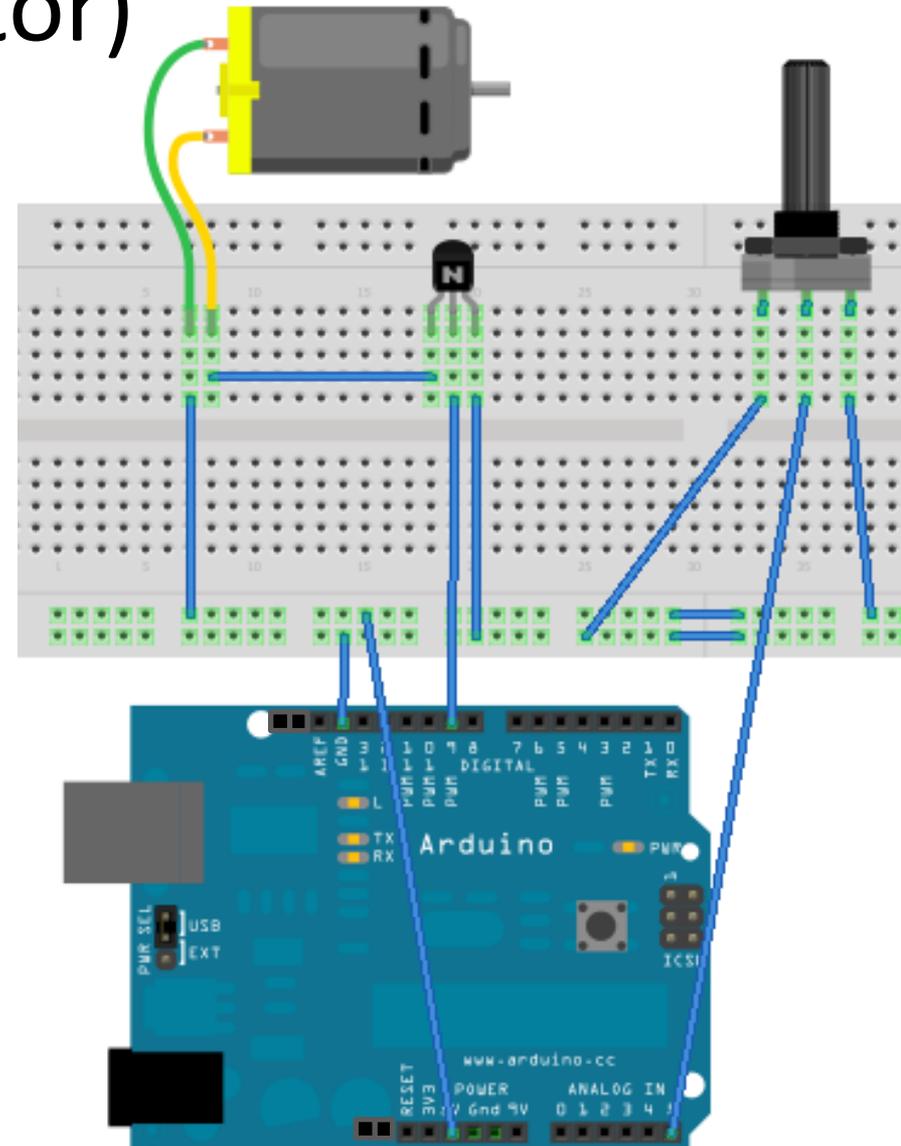
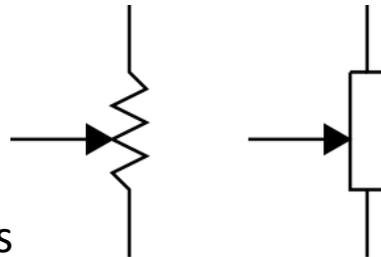
Potentiometer (variable resistor)

Speed control using potentiometer

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

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

Potentiometer
electrical symbols



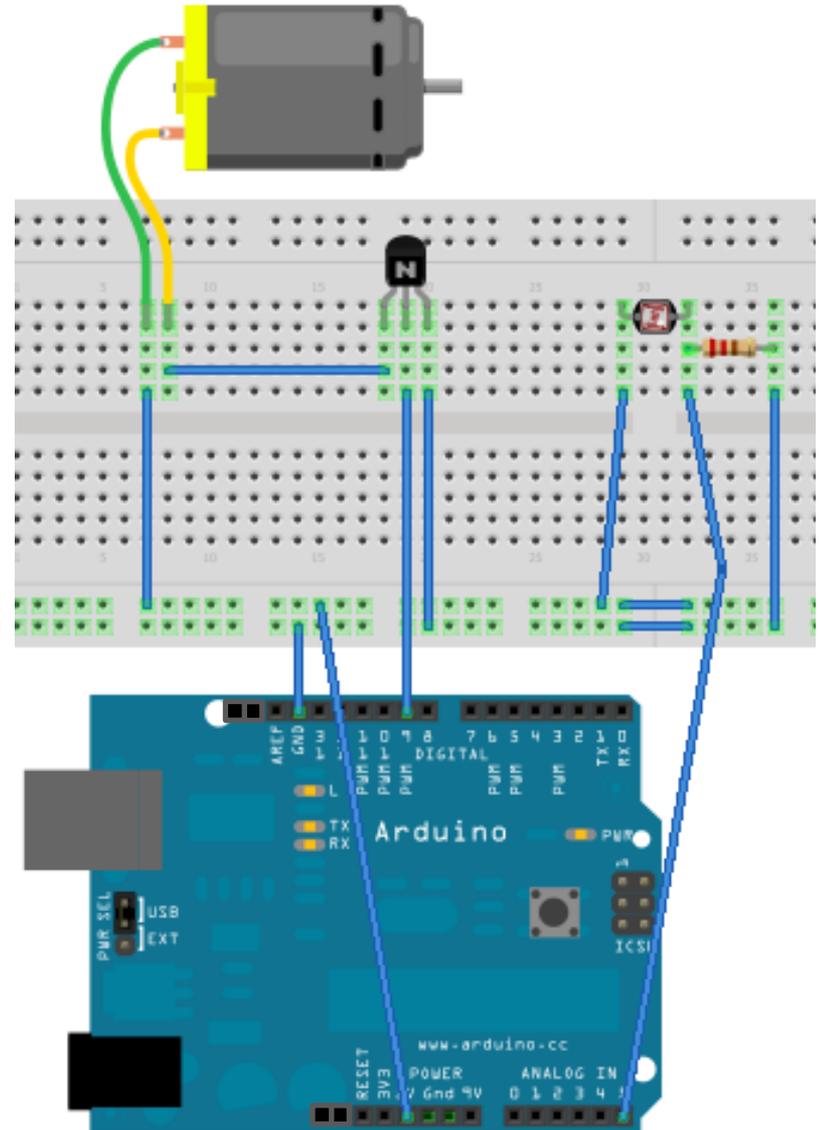
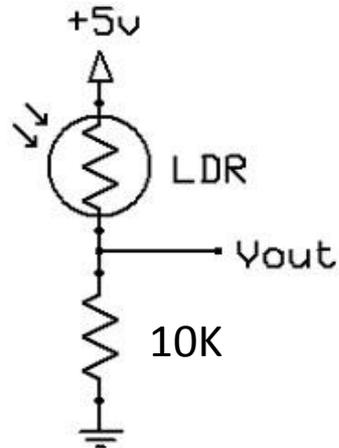


Light dependent resistor

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?