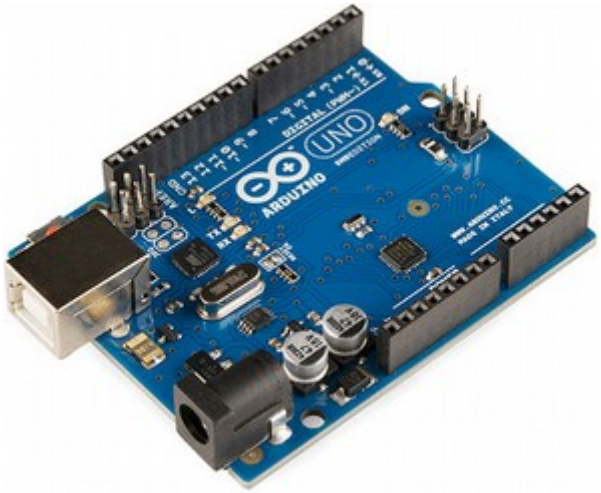

Scratch for Arduino
Lesson 3 – Analog Input

Potentiometers, Variables, and Etch-a-Sketch*

Etch-a-Sketch may be omitted due to safety concerns.

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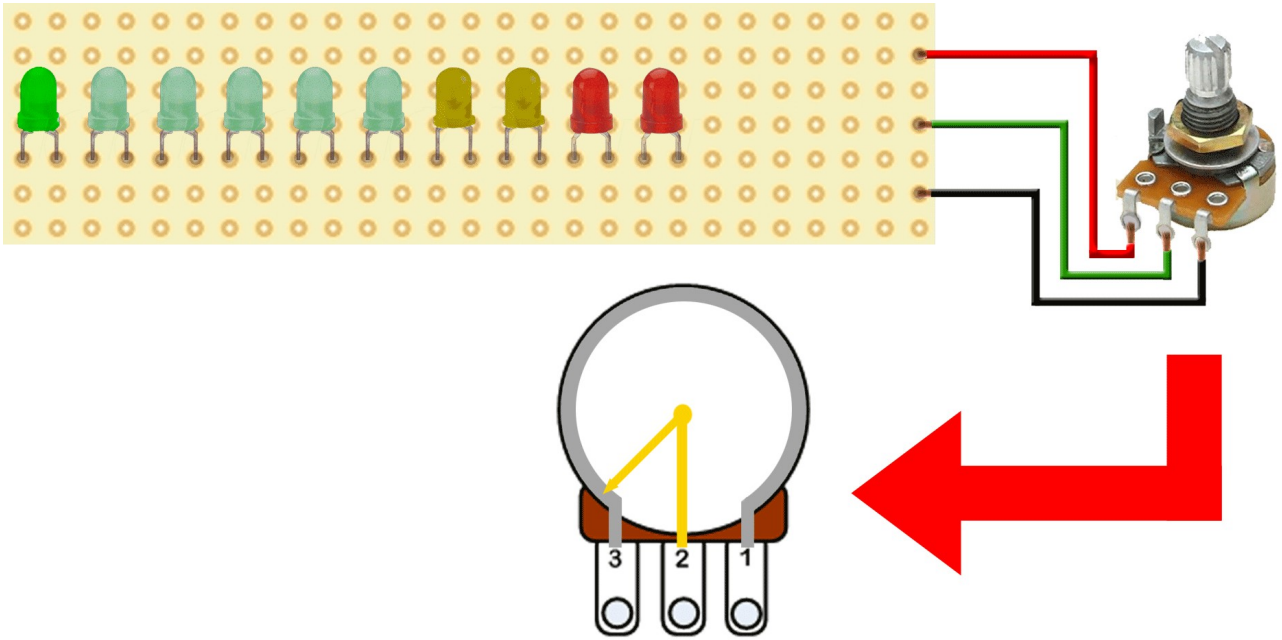
Analog Input

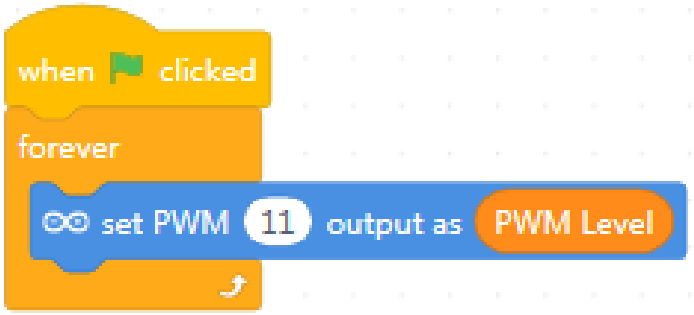
- Today we will extend the ongoing LED project by introducing an analog input device



Slides available at: http://a9i.sg/huayi

Graphical Dimmer Switch

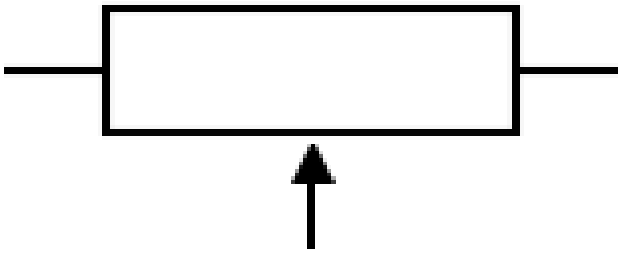
- Last week some of you may have completed the Graphical Slider control



Slides available at: http://a9i.sg/huayi

Physical Dimmer Switch

- Today we will be using a Potentiometer as a variable resistor, or Rheostat, to recreate the effect with a physical switch...



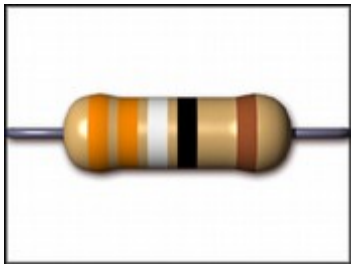
Resistors & Variable Resistors

- What is electrical resistance?

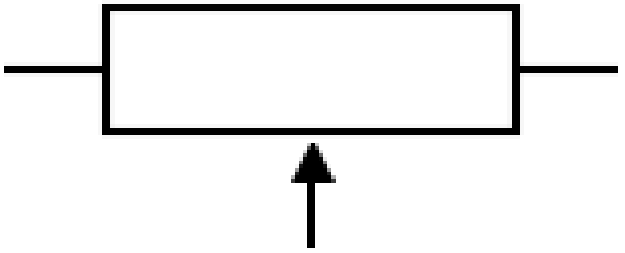
a measure of the difficulty to pass an electric current through a circuit element

Resistors & Variable Resistors

- Fixed Resistors have fixed resistance



- Variable Resistors have variable resistance



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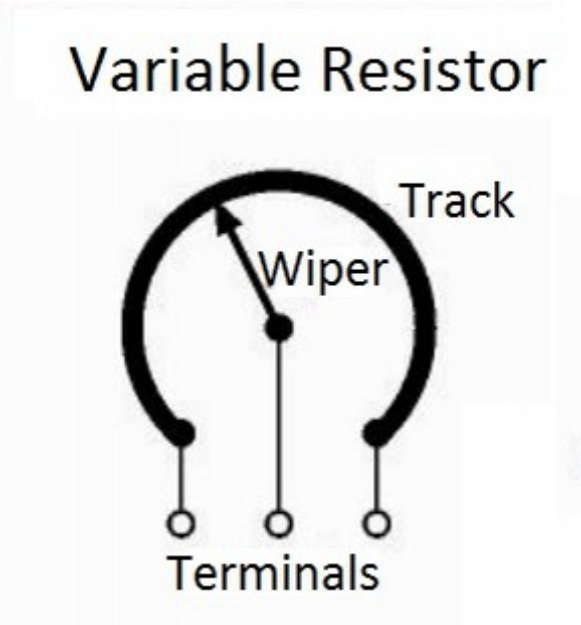
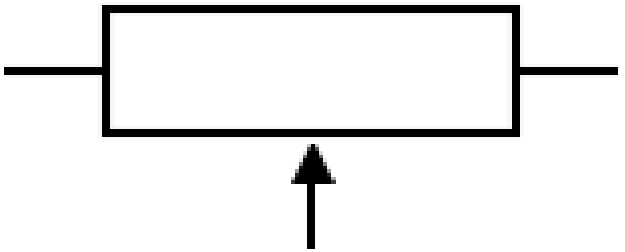
Variable Resistors

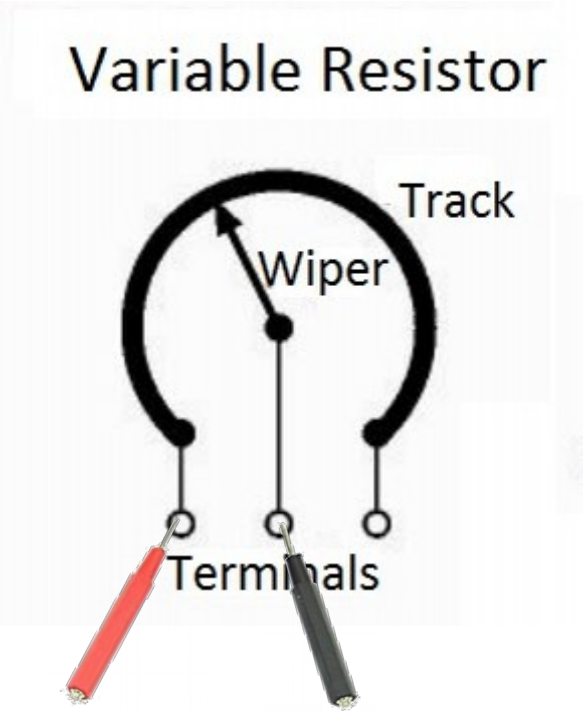
- Inside there's a fixed resistor and a wiper that points between the minimum and maximum terminals of the resistor

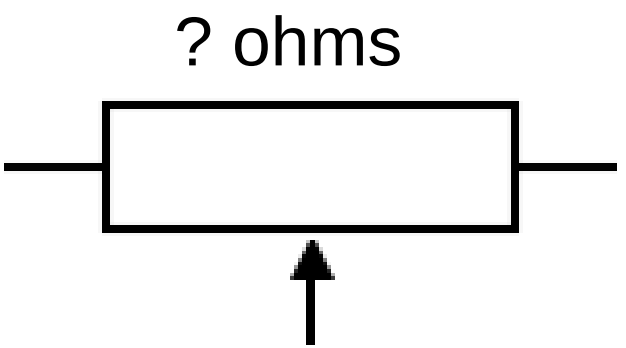




Variable Resistors

- Let's use a multimeter to measure the minimum and maximum resistance of the wiper terminal





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Variable Resistors

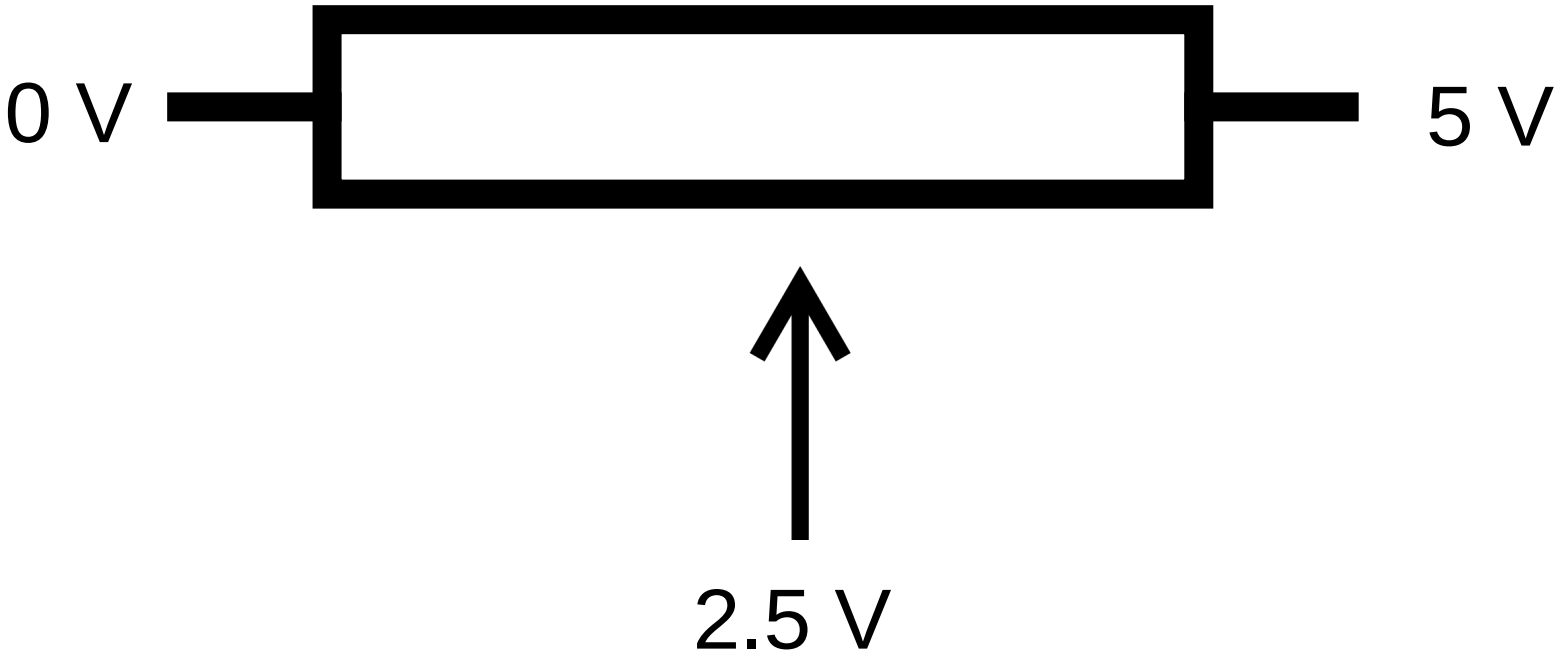
- Resistance causes voltage to drop, so the potentiometer also behaves as a Voltage Divider

Variable Resistors

- Resistance causes voltage to drop, so the potentiometer also behaves as a Voltage Divider

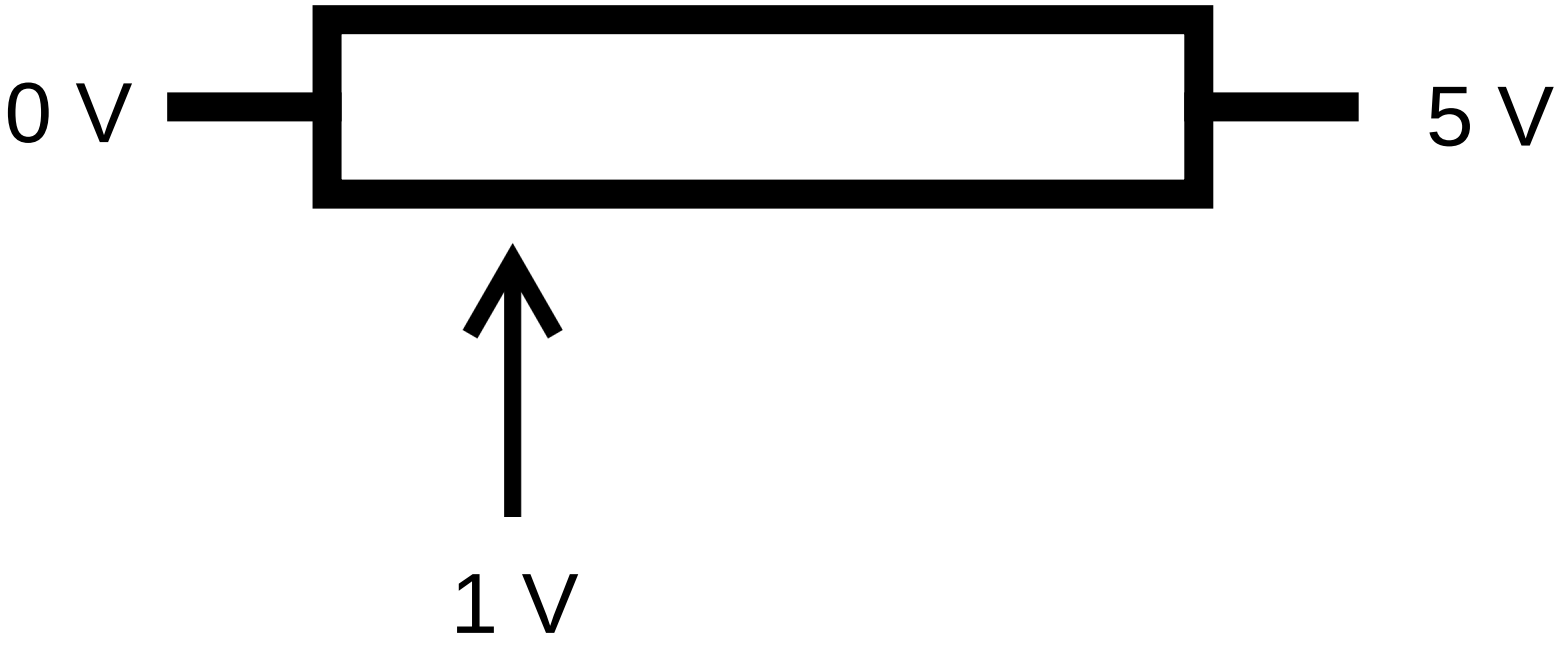
Variable Resistors

- Resistance causes voltage to drop, so the potentiometer also behaves as a Voltage Divider



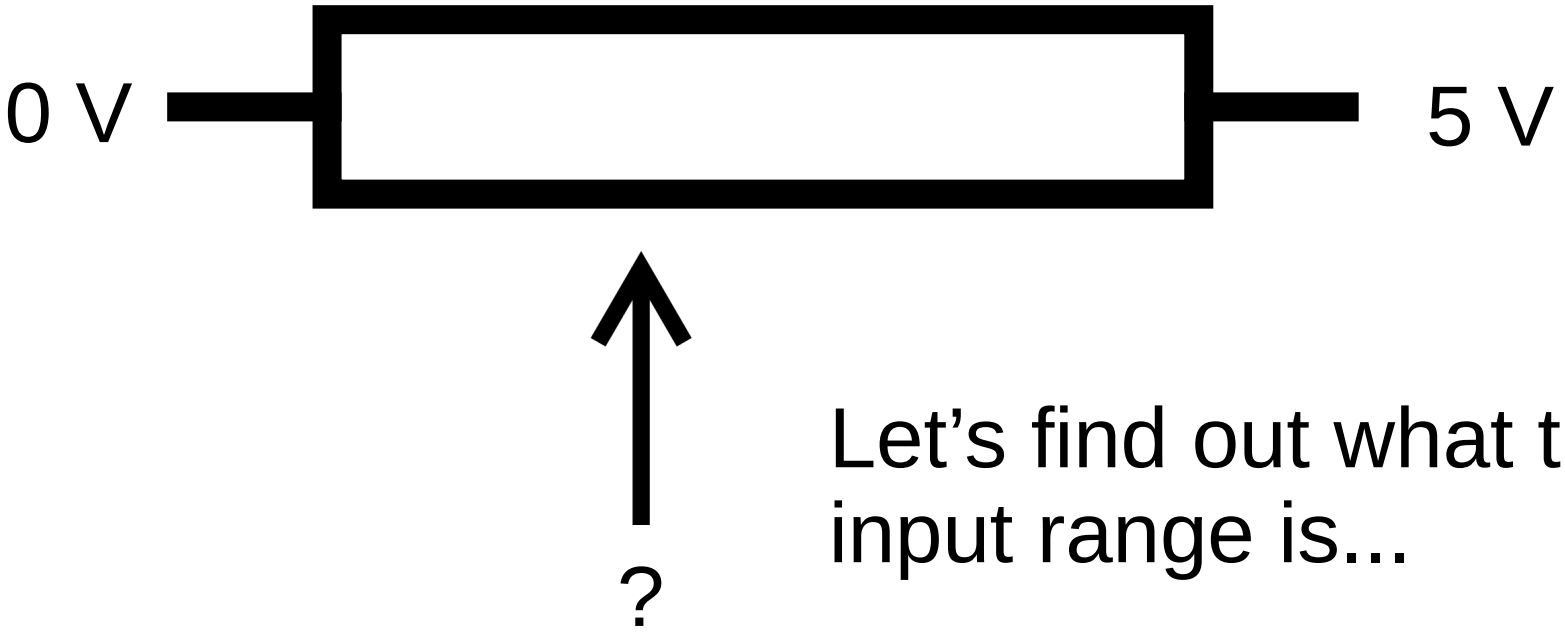
Variable Resistors

- Resistance causes voltage to drop, so the potentiometer also behaves as a Voltage Divider



Analog vs. Digital Input

- Unlike the digital pins which read either 0 or 1, analog inputs can read a range of values.



Let’s Get Hands-On

(the exciting part…?)

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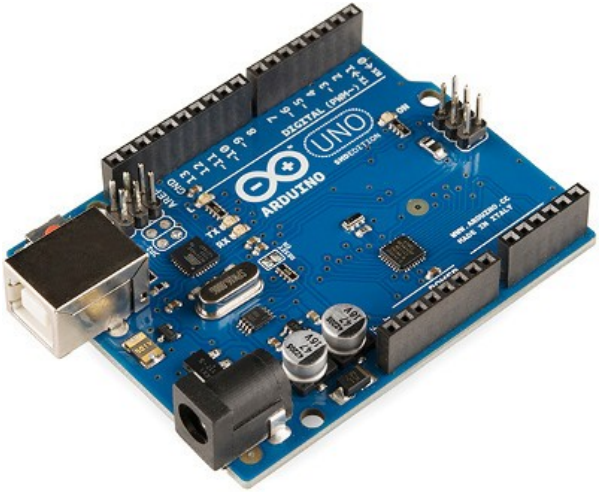
Connect to Arduino



Some of the LED on the Arduino should light up after connection

This end to computer

This end to Arduino

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Start up mBlock

- Don’t forget mLink 
- Go to **https://ide.mblock.cc** to start mBlock
- File → New

Get rid of this guy

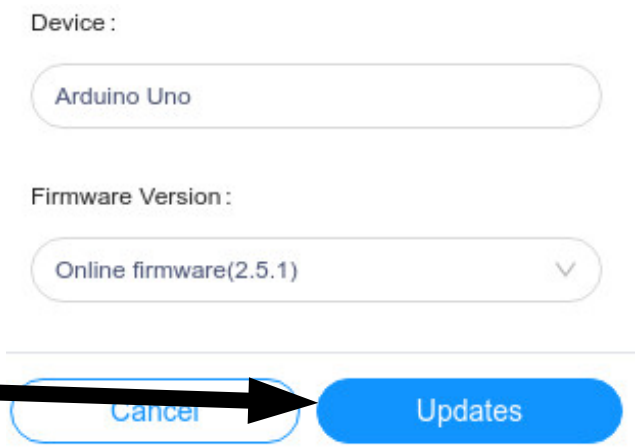
Add this one instead

Connect with Arduino

- Switch to “Live” mode and “Connect”

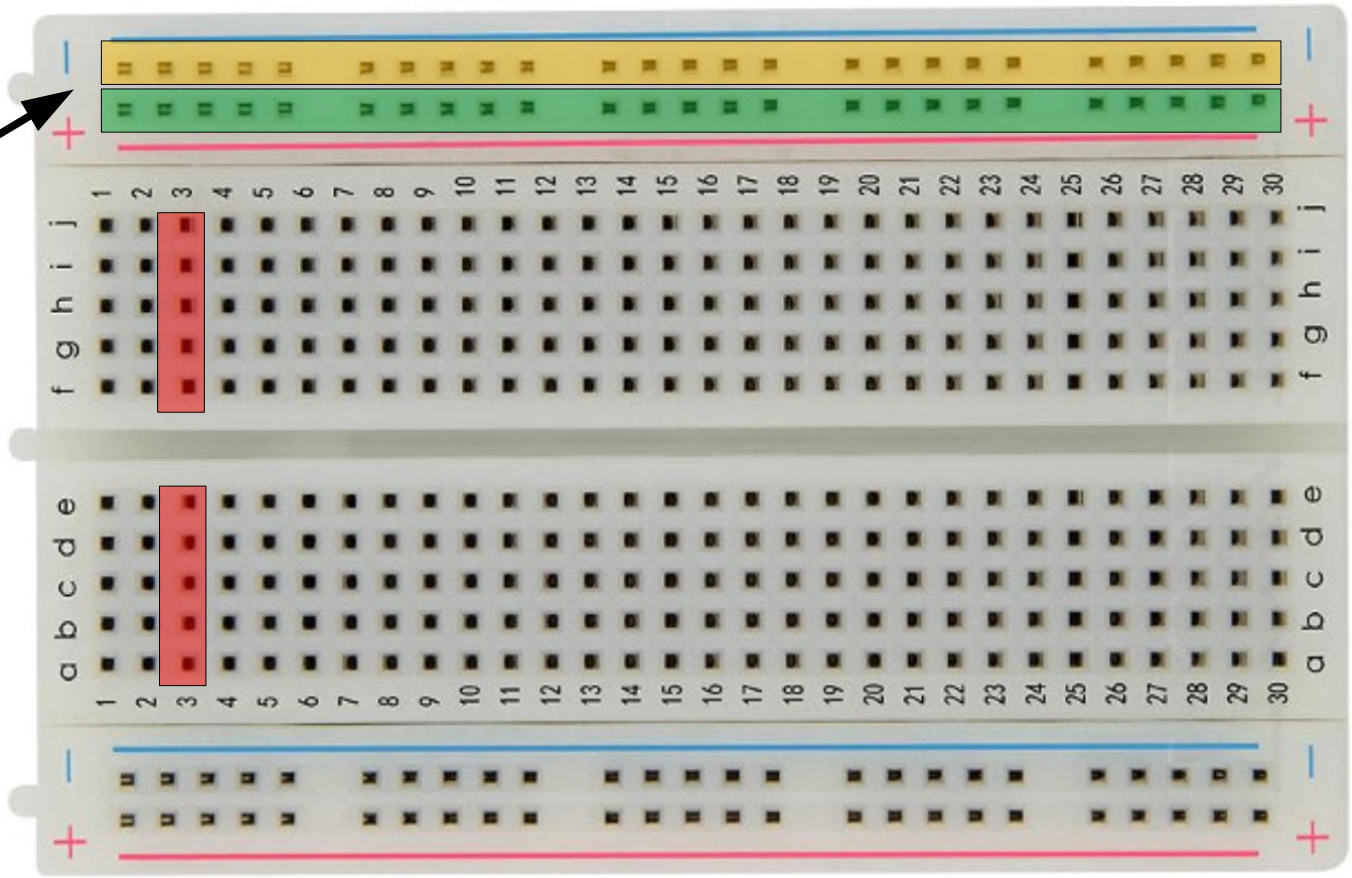
- Select a COM port
  [x] “Show all connectable devices”

- If  appears, click on it followed by  and “Updates”



Review Breadboard

Use long strips to create lots of pinholes for GND & 5v



Useful when connecting multiple devices

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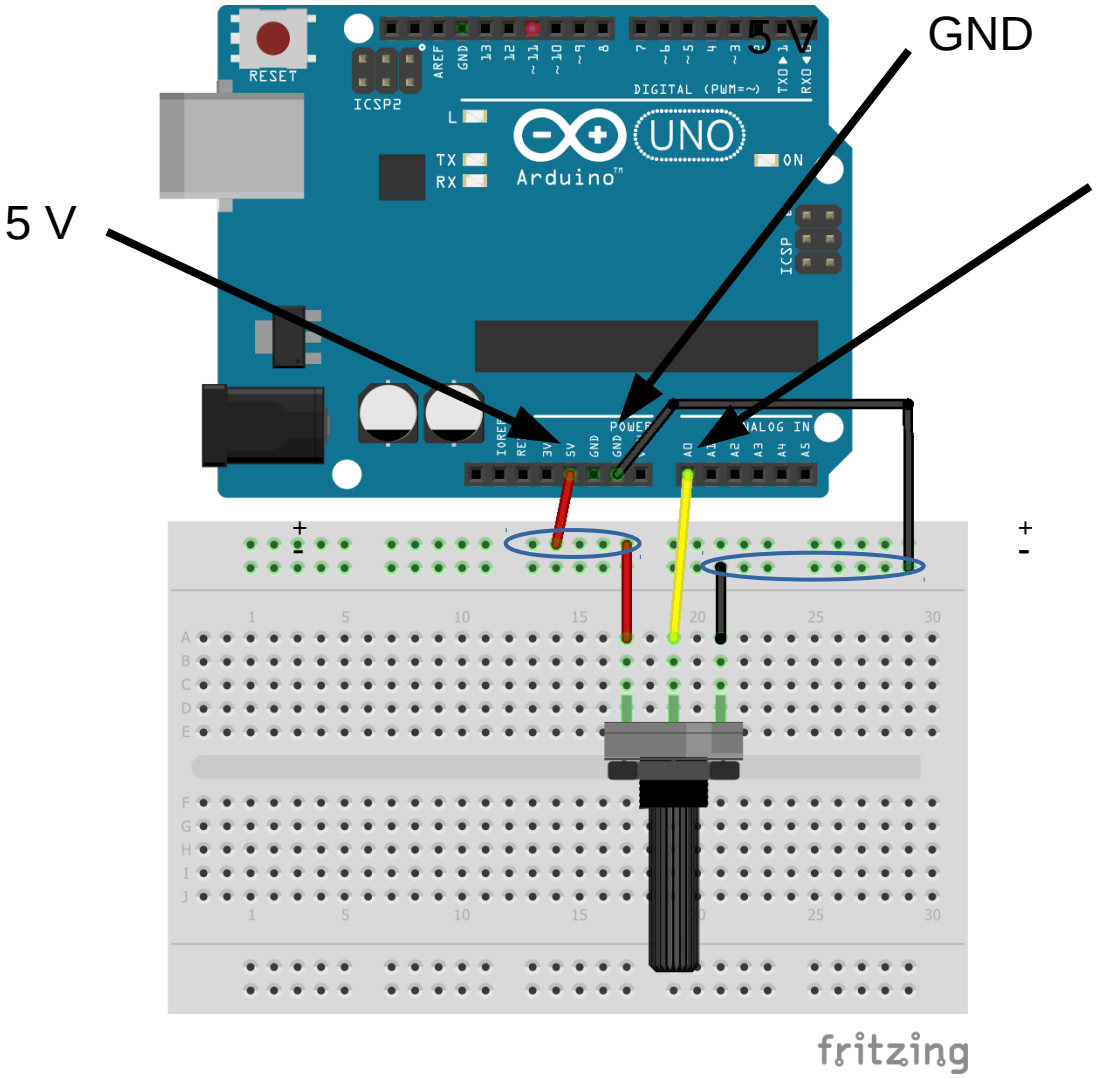
Potentiometer Circuit



A0 port will read the Potentiometer wiper.

GND & 5v connected through long strips.

Leave room for the LED circuit!

Exercise 3a

Read Analog Input

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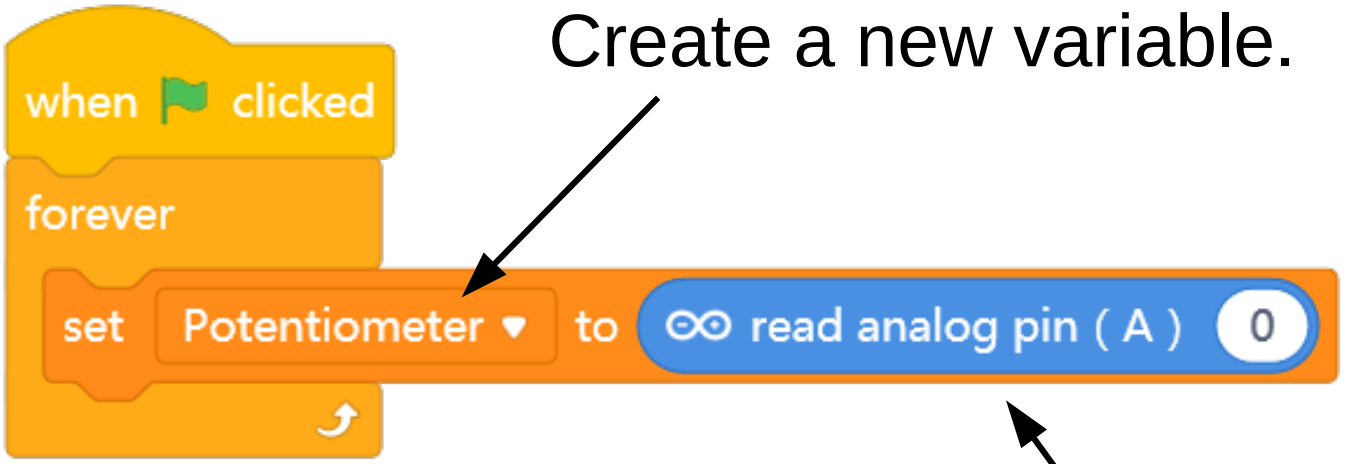
Read Analog Input

Need to do something with the value….

Read Analog Input



Create a new variable.

Keep reading the Analog Input pin A0 in a loop.
Set the variable to the value.

See Monitor on the Stage

Challenges

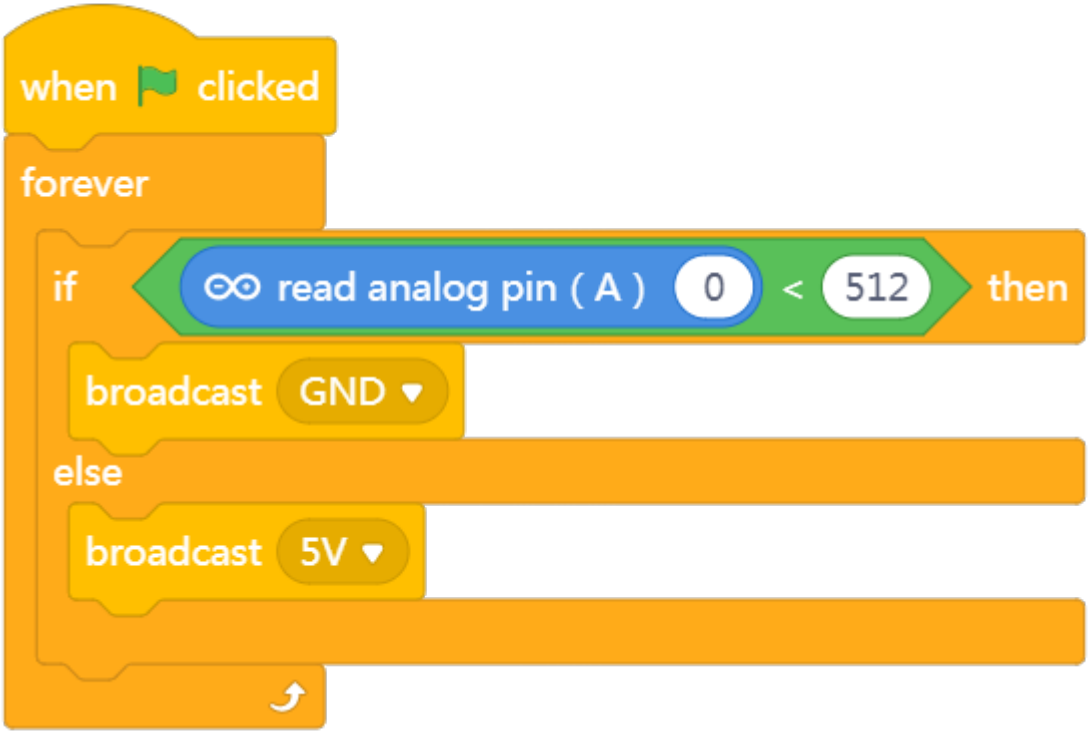
- Note in your Student Handout the **min/max values** for the **A0 readings** for the Potentiometer's Wiper

- Write a program that:

  1) checks if Potentiometer wiper is closer to GND or closer to 5V

  2) if closer to GND
     Panda says "GND"
  else
     Panda says "5V"

Condition on Analog Input



The “if – then” and “if – then - else” conditional constructs are very important in programming.

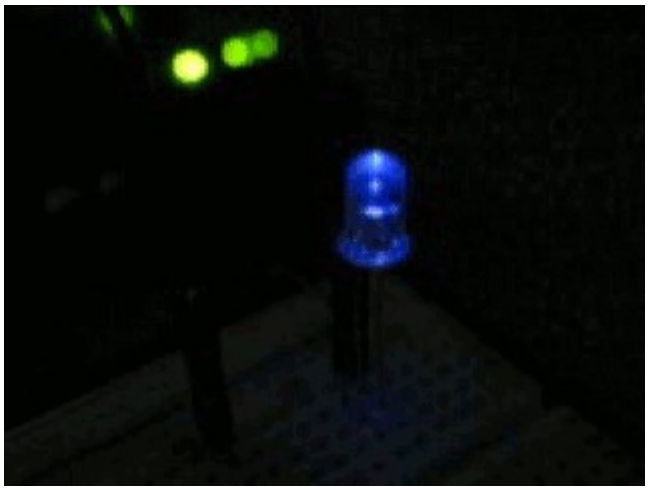
They allow you to change the behavior of your program based on input or state.

Add the Panda portion & Test it out!

Can you add conditions for 4 different outcomes?

Light Control

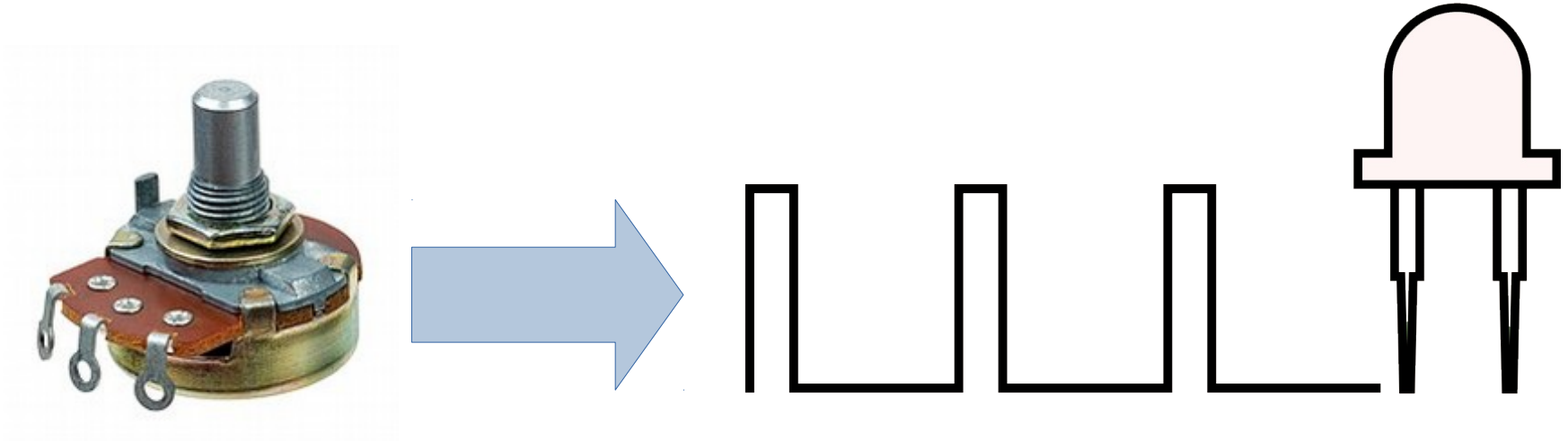
- Back to our dimmer effect...



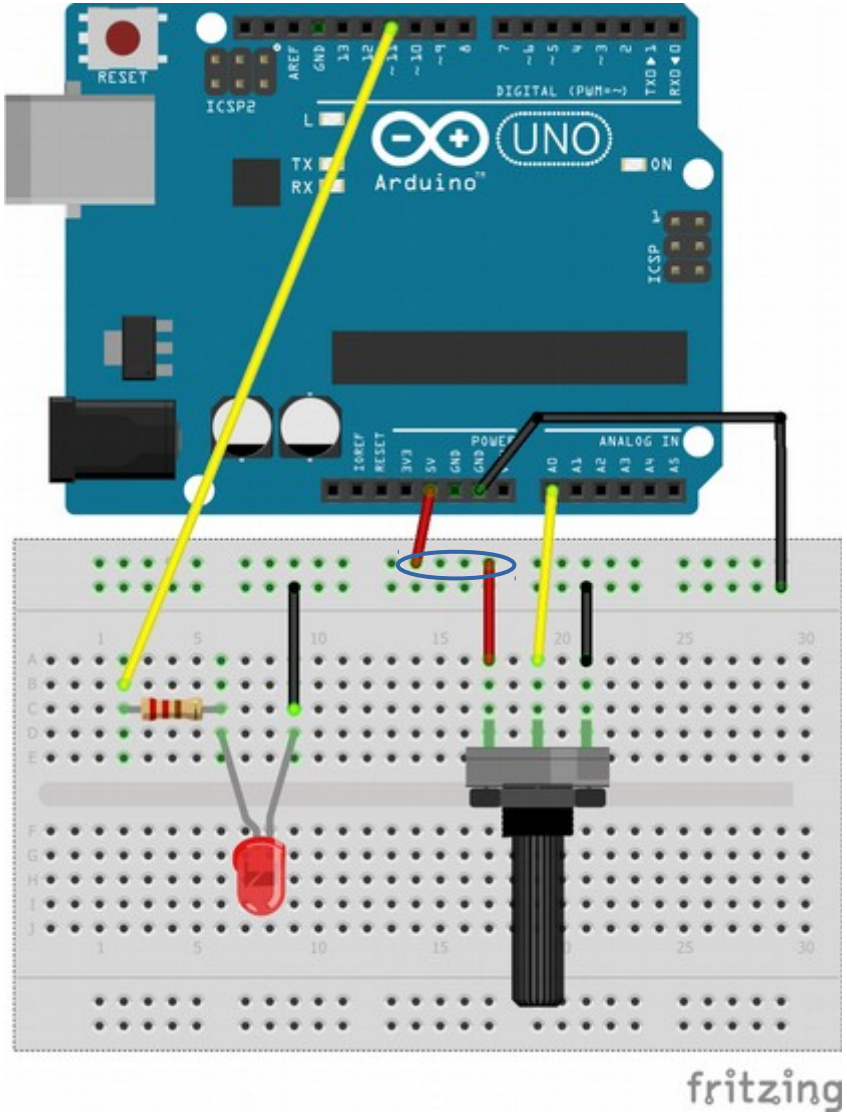
- Let’s combine our LED and Potentiometer circuits to re-create this effect.

Challenges

- Make a Physical Dimmer Switch:



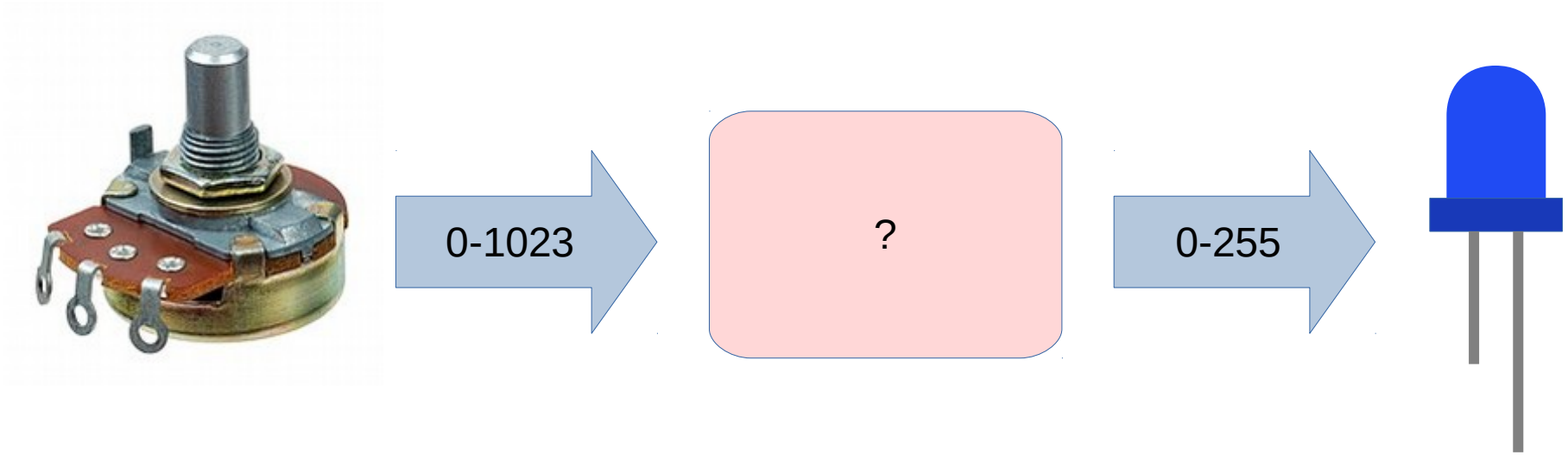
Dimmer Switch Circuit



Challenges

- In your **Handout,** note the math required to convert between 0-1023 (input) and 0-255 (output)

- Then program it in **mblock**
  *Hint: look at the **map block** under **Data***



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Exercise 3b

Mapping Input to Output

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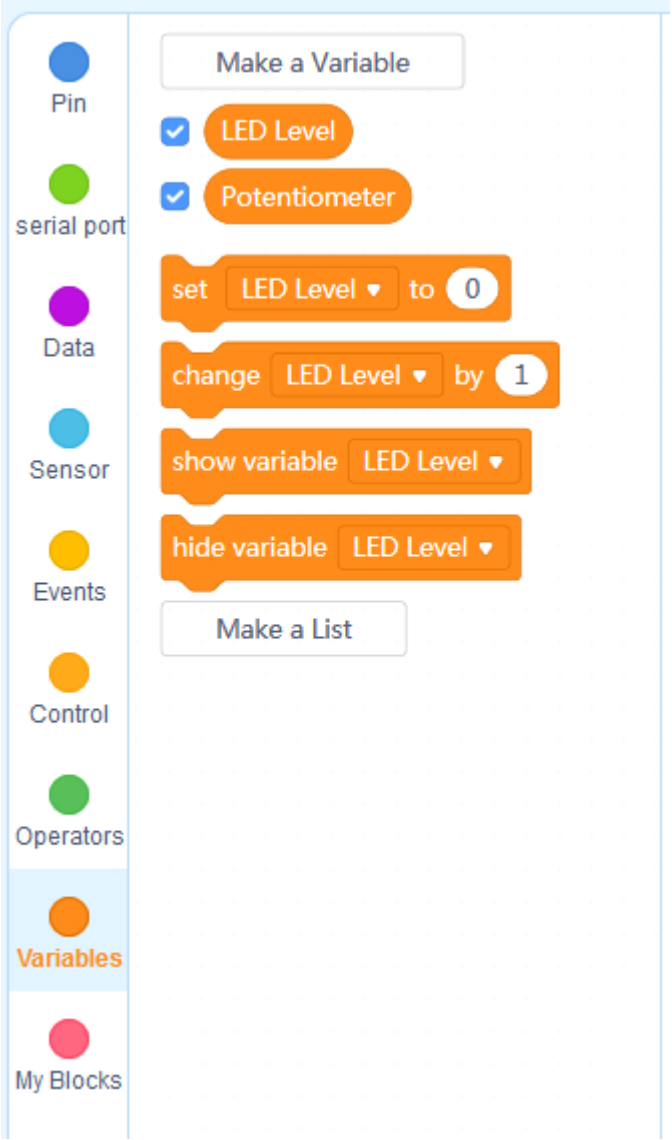
Variables

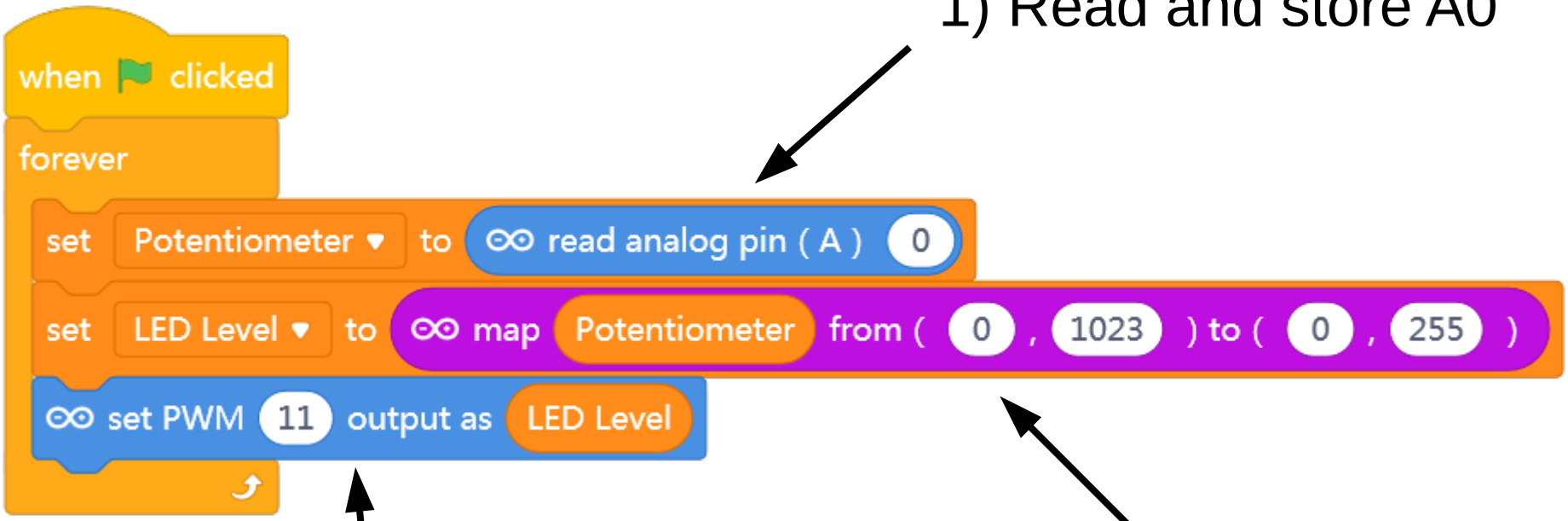


We should now have two variables.

One to read Potentiometer from A0.

Second to store the mapped output PWM (0-255).

Dimmer Program



1) Read and store A0

2) Map and store PWM output

3)Output PWM to the LED pin

Challenges

- Try to ***upload*** the program to the Arduino for a smoother effect.
  Just change the mode, and the start event to **when Arduino starts up**.

- Change the program so that the Potentiometer controls **how fast the LED blinks**, instead of its brightness level.

Exercise 3c

Move, Panda, Move!!!

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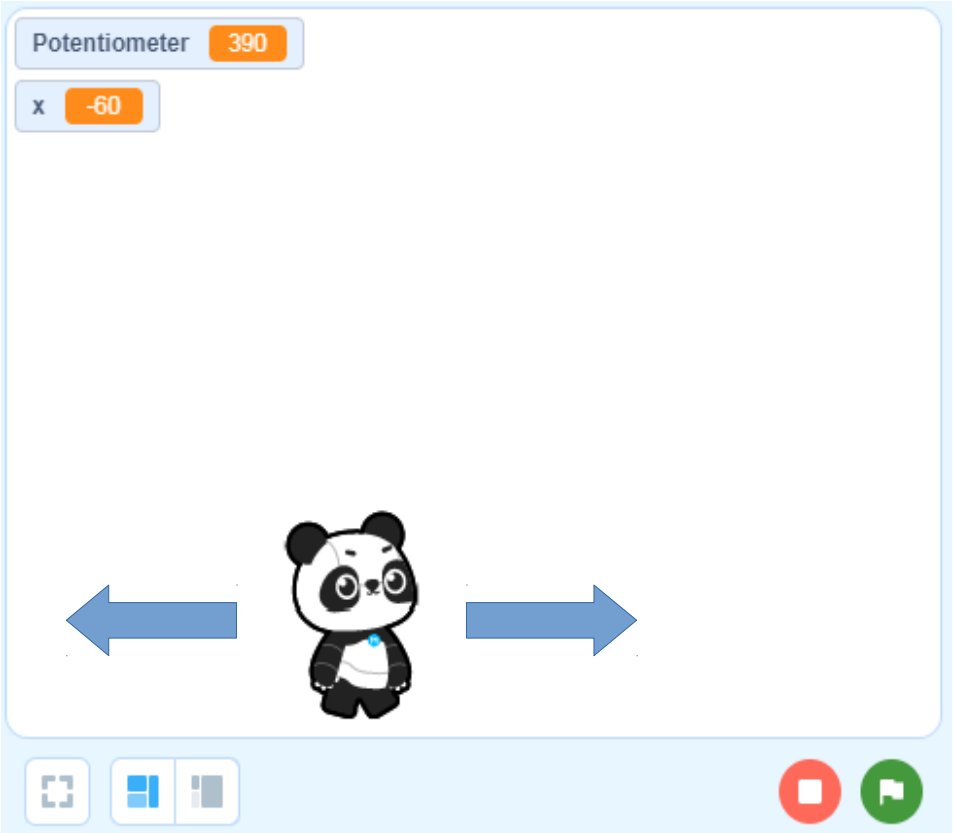
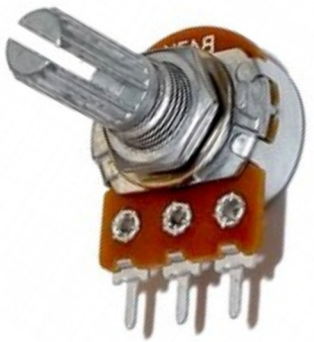
Move, Panda, Move!

- Make Potentiometer control Panda's X-axis position.

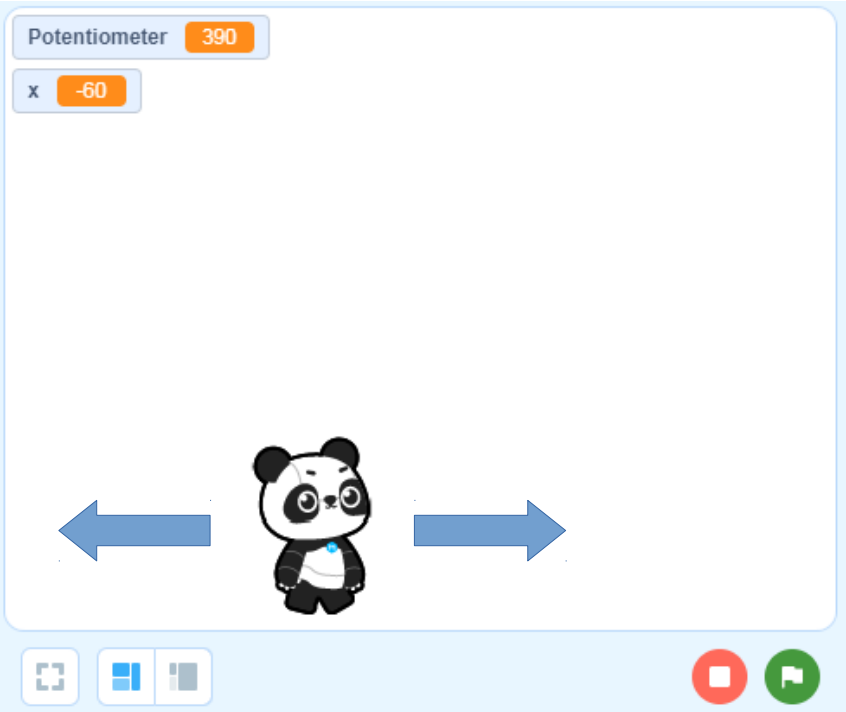


1-D Joystick

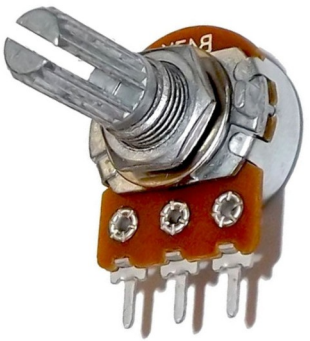


Move, Panda, Move!

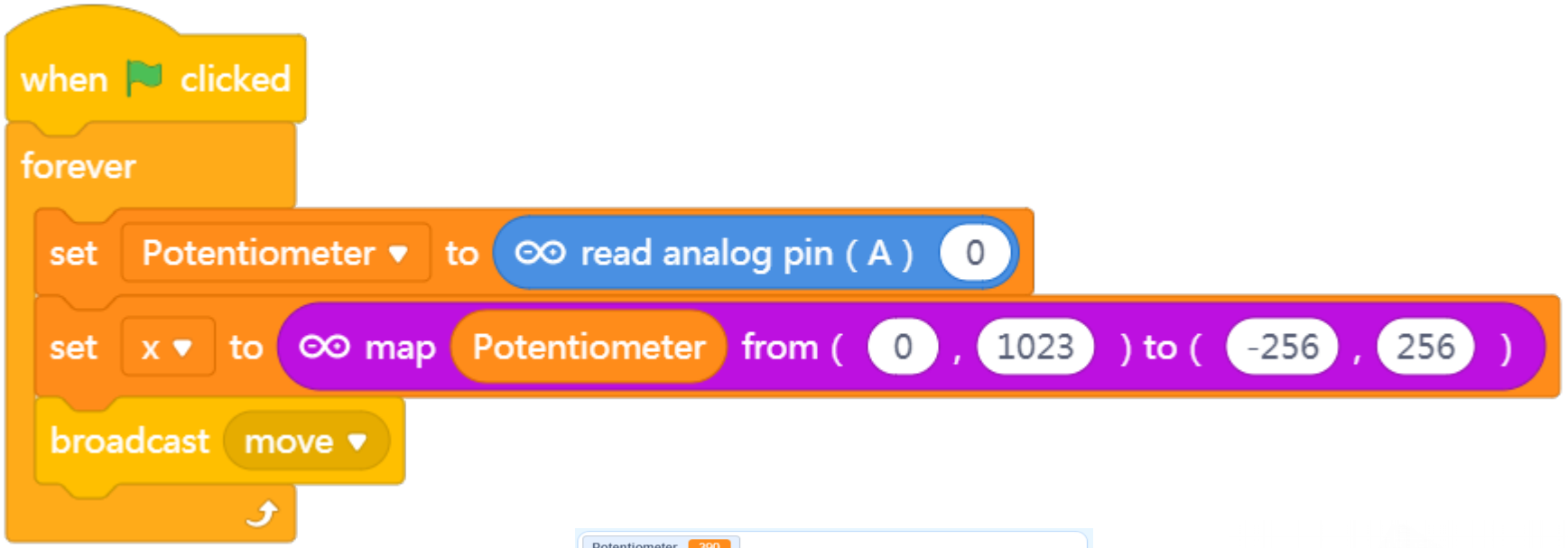
- Find Pand X-axis min and max (move it around)
- Map A0 to Panda's X-limits and store in a variable (for all sprites).
- Tell Panda to set its position to that saved value.

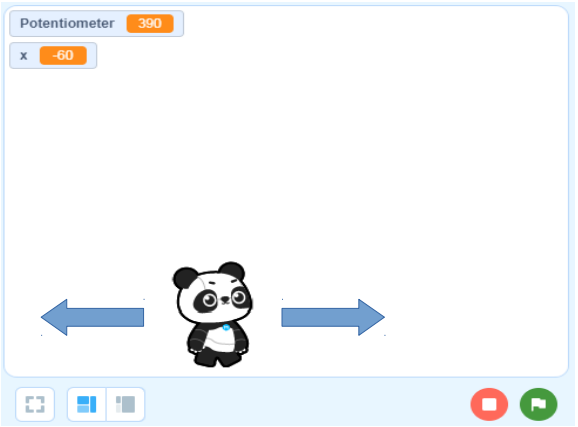


1-D Joystick

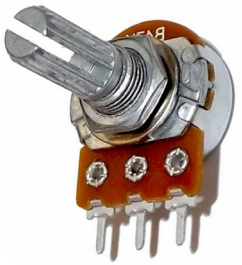


Move, Panda, Move!





1-D Joystick



Slides available at: http://a9i.sg/huayi

Challenges

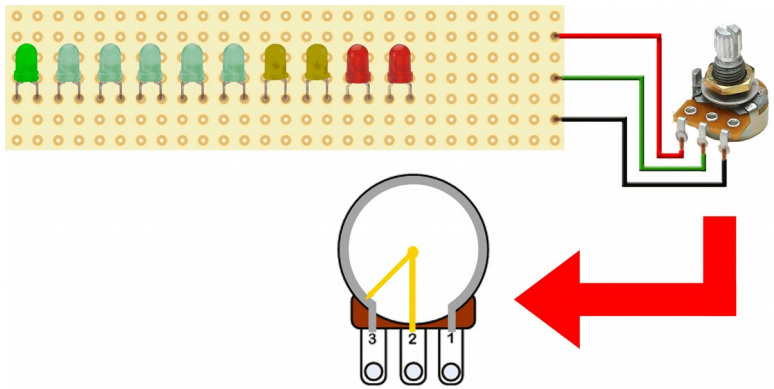
- Make Panda point towards the new X
- Make Panda look like it's walking by changing costumes
  - And make Panda only walk when it's moving…
- Add a second Potentiometer to control Y.
  Like an Etch-a-Sketch!

Extra Challenges

- Use multiple LEDs to create a **Metering Effect.** The bigger the reading, the more LEDs are lit.

  You can start with 3 LEDs, e.g.:

  if (A0 < 330) turn off everything
  else if (330 < A0 < 660) turn on 1
  else if (660 < A0 < 990) turn on 2
  else turn on 3



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