PHYSICAL COMPUTING

WEEK 03

The Psychology of Everyday things

The world, and everyday things, are filled with misconceptions

Aristotle’s naive physics - our 'naive' way of explaining the phenomenon we witness in everyday life - often very practical but incorrect. People often have naïve, incorrect explanations for real world phenomenon (pushing cross walk buttons will make the light change faster)

Coincidence can set our ‘causal’ wheels rolling. What matters is that we ‘perceive’ causality, and whether or not that causality exists

This can create a problem / crisis later because we have a bad explanation of what is happening (3 Mile Island)

It must be me

* Spiral of silence / conspiracy of silence - not reporting errors / misconceptions that you think are your fault (you're in the minority and don't want to be singled out). Even though this may not be true- the majority might be having the same problem, and we need to find out.

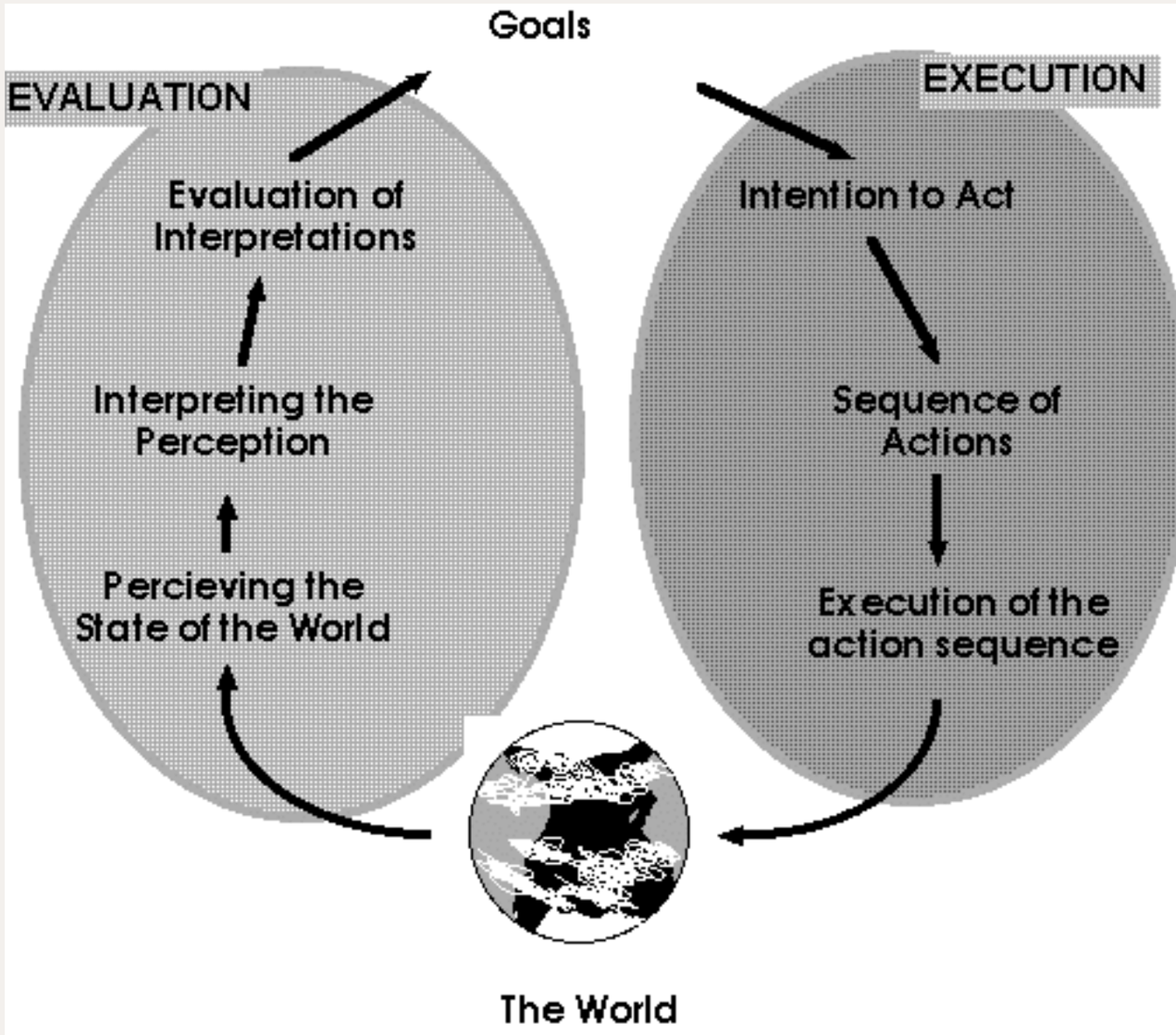
* Learned helplessness - after failing to do a talk multiple times, people often decide that they cannot do the task (they are helpless)

* Taught helplessness - perceived difficulty in one task generalizes to the whole, so that we feel (self-blame) that we cannot do tasks (such as in mathematics, where each successive task requires complete understanding of previous tasks). A sort of self-fulfilling prophecy that we are unable to accomplish a task due to previous difficulty / failure.

The 7 stages of action

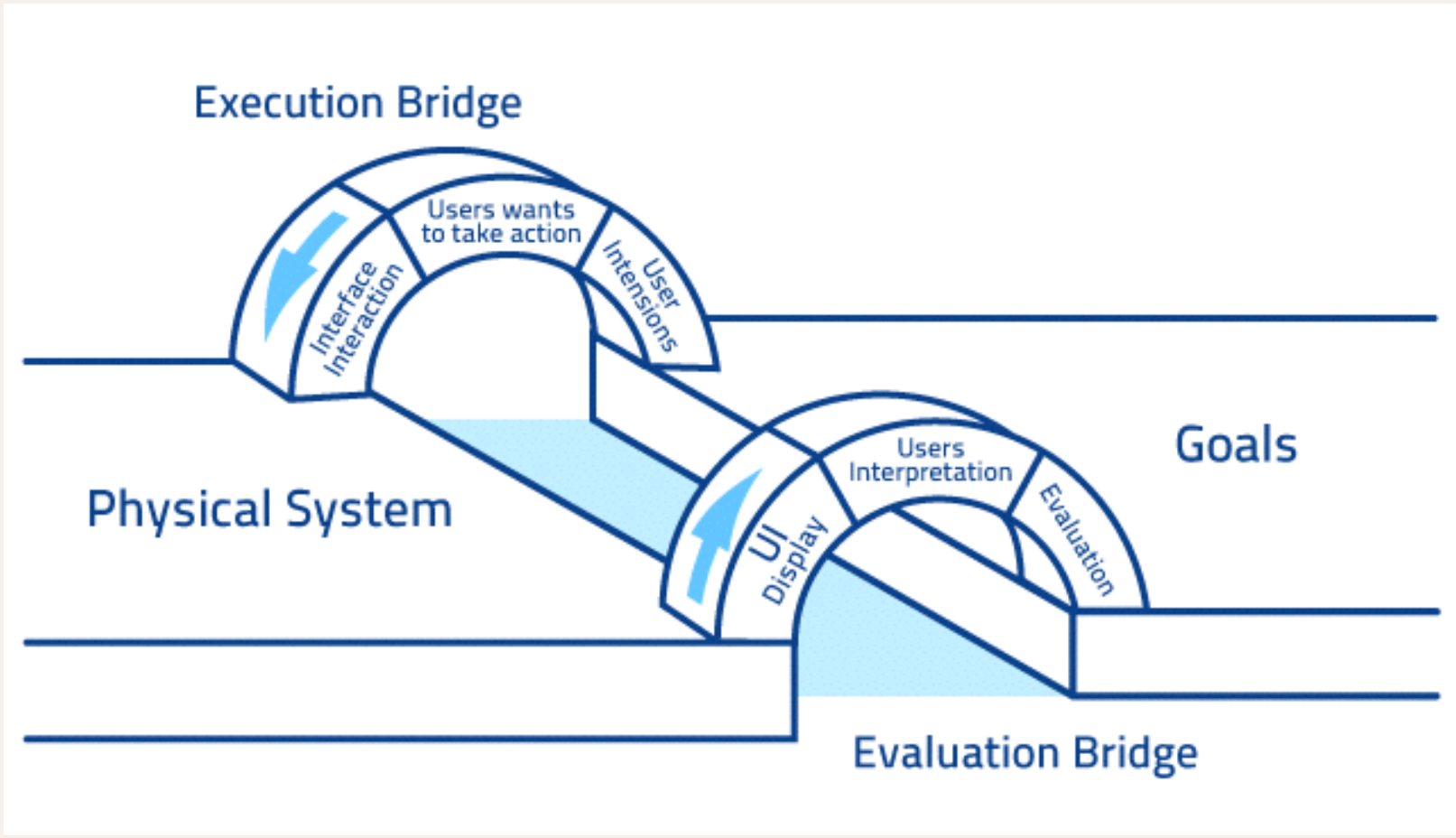
7 Stages of Action: 1 for goals, 3 for execution, 3 for evaluation:

Forming the Goal
Forming the intention
Specifying an action
Executing the action
Perceiving the state of the world
Interpreting the state of the world
Evaluating the outcome



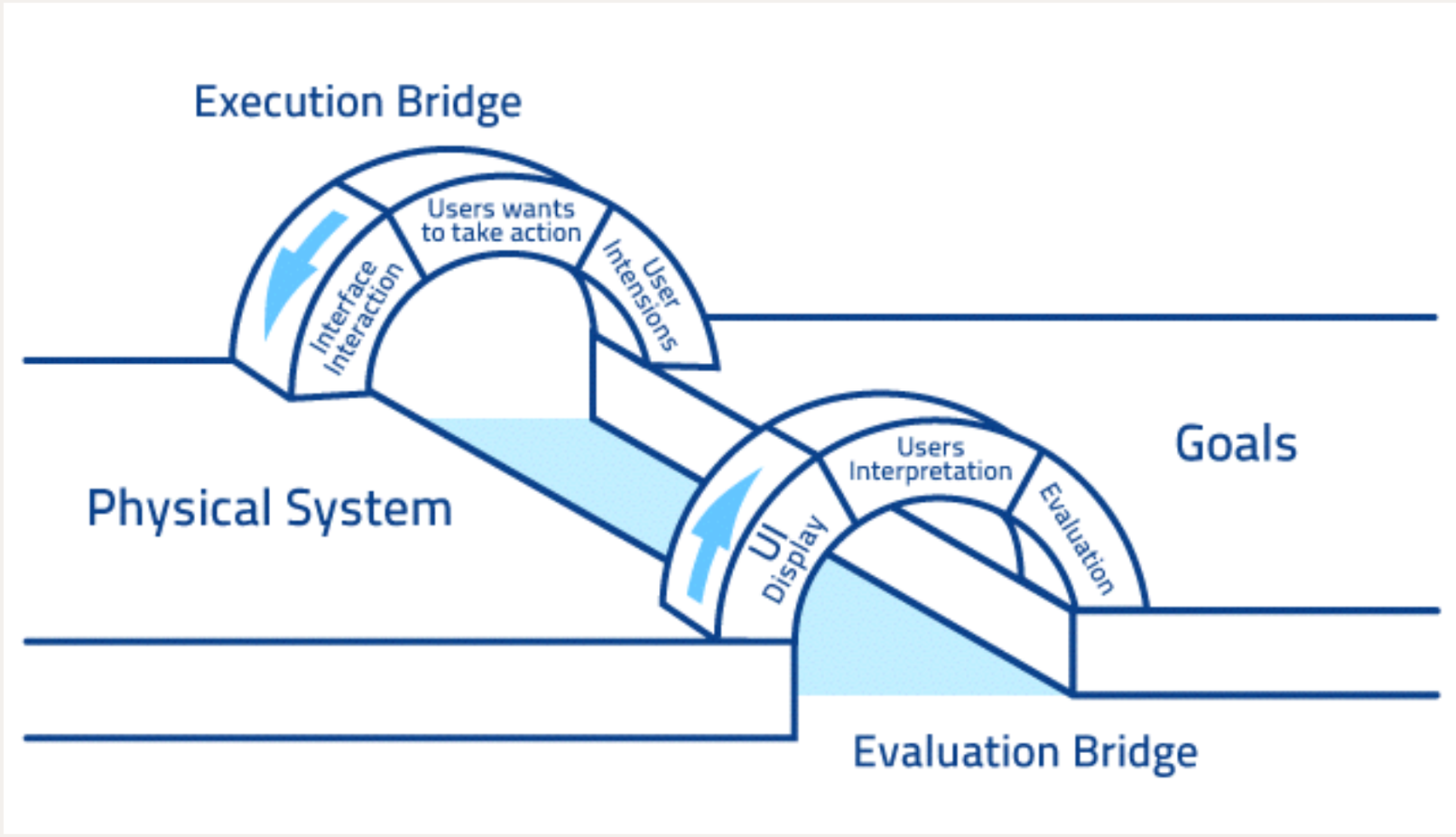
The Gulf of Execution

the gap between a user's goal for action and the means to execute that goal.



The Gulf of Evaluation

The degree to which the system/artifact provides representations that can be directly perceived and interpreted in terms of the expectations and intentions of the user.



Each of the seven stages are good for checking that the gulfs of execution and evaluation are bridged.

Design Questions

The seven stages of action prompt the following design questions: [Norman, p. 53]
How easily can one:

determine the function of the device?
tell what actions are possible?
determine mapping from intention to physical movement?
perform the action?
tell what state the system is in?
tell if system is in desired state?
determine mapping from system state to interpretation?

Last week, I screwed up a formula….

R_total = 1/r1 + 1/r2 + 1/r3 + ...

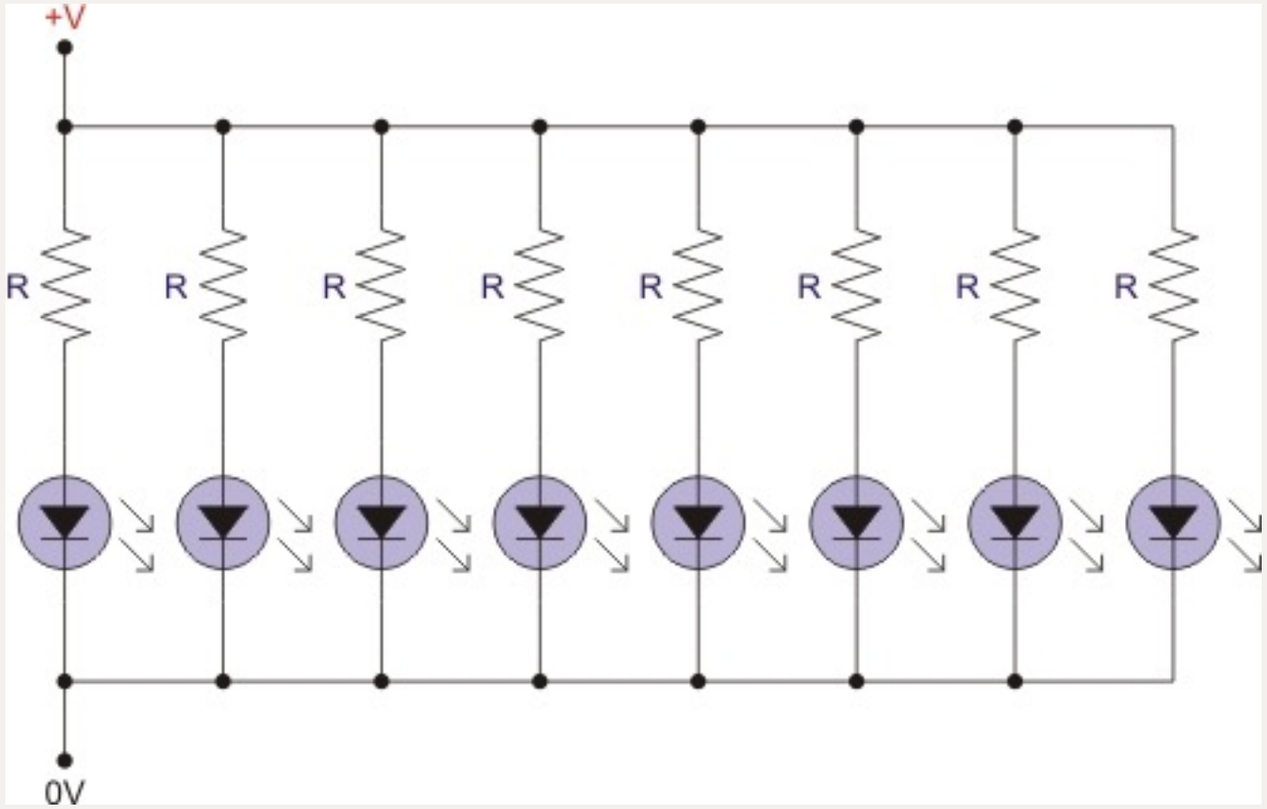
SHOULD HAVE BEEN….

1/R_total = 1/r1 + 1/r2 + 1/r3 + …

(the math is right, I only screwed up the formula itself)

Parallel Circuit (revisited)

All just connected to the same power and ground



1/R_total = 1/r1 + 1/r2 + 1/r3 + ...

1/R_total = 1/r1 + 1/r2 + 1/r3 + ...

For example, suppose we have a parallel circuit with resistors of 30 Ohms, 60 Ohms, 20 Ohms and 10 Ohms. Then the total resistance is:

$$\frac{1}{Rt} = \frac{1}{30} + \frac{1}{60} + \frac{1}{20} + \frac{1}{10}$$

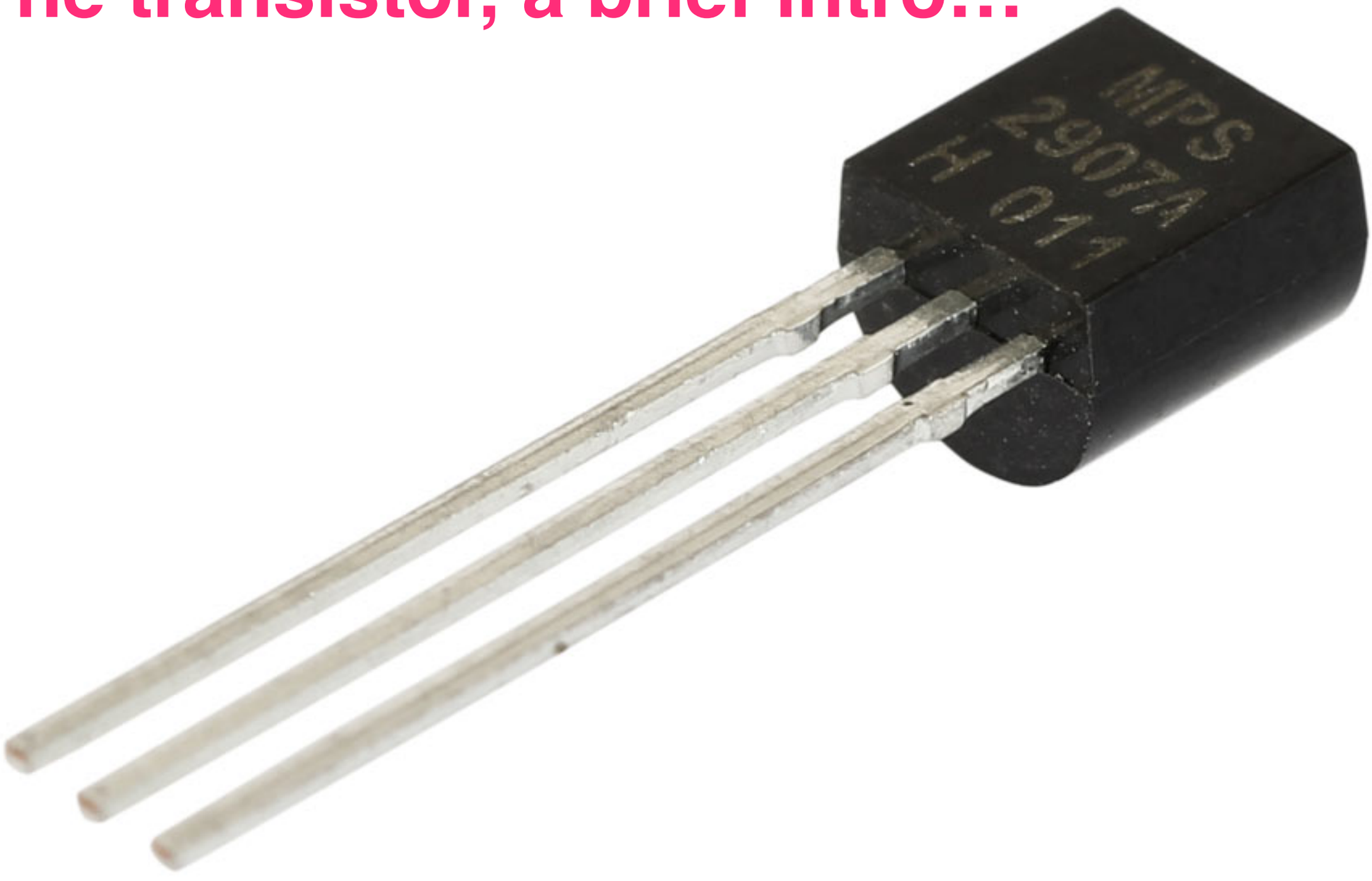
$$= \frac{2}{60} + \frac{1}{60} + \frac{3}{60} + \frac{6}{60}$$

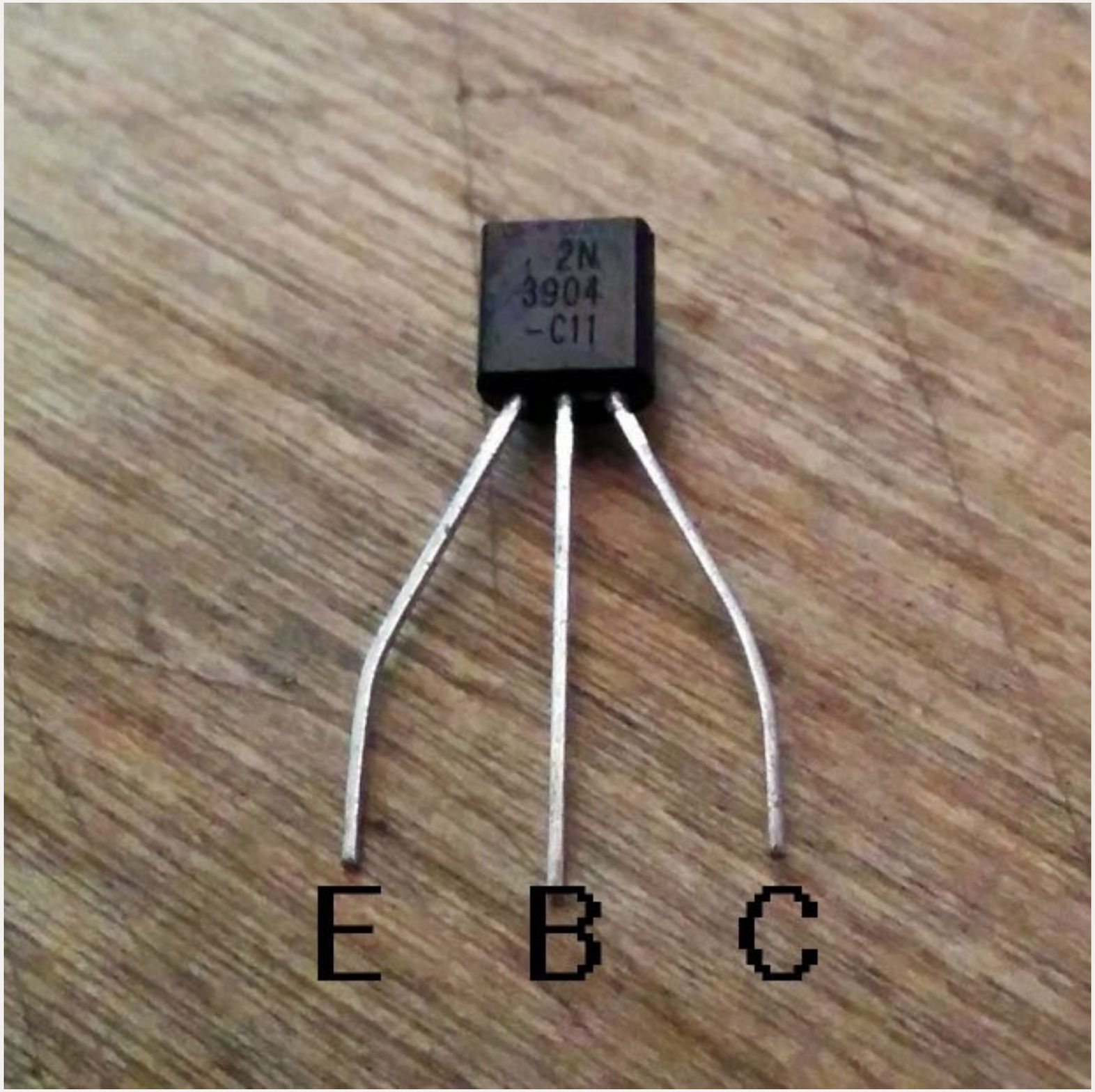
$$= \frac{12}{60} = \frac{1}{5}$$

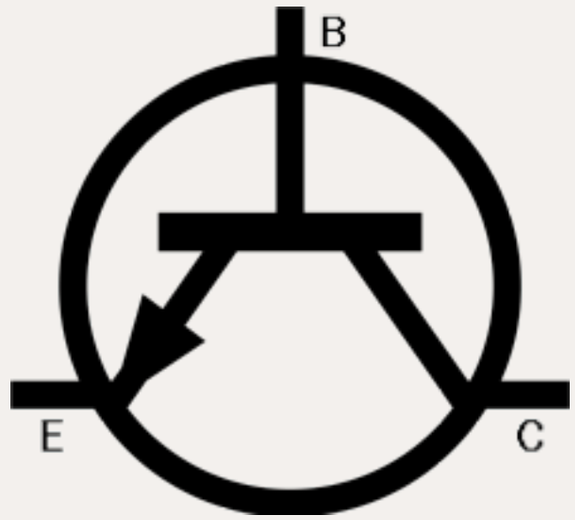
Thus

$$Rt = \frac{1}{1/5} = 5 \text{ Ohms}$$

The transistor, a brief intro…



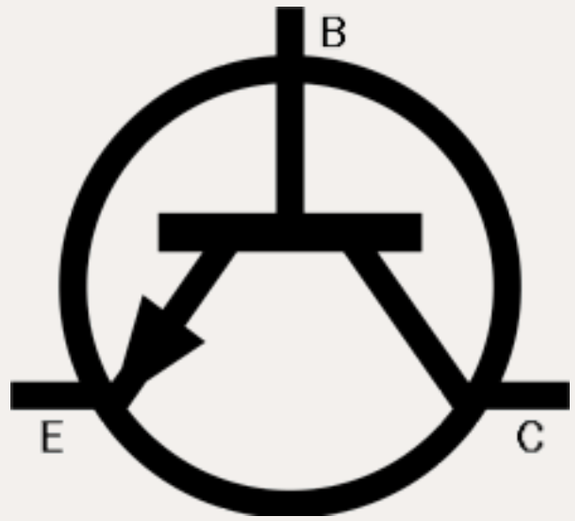




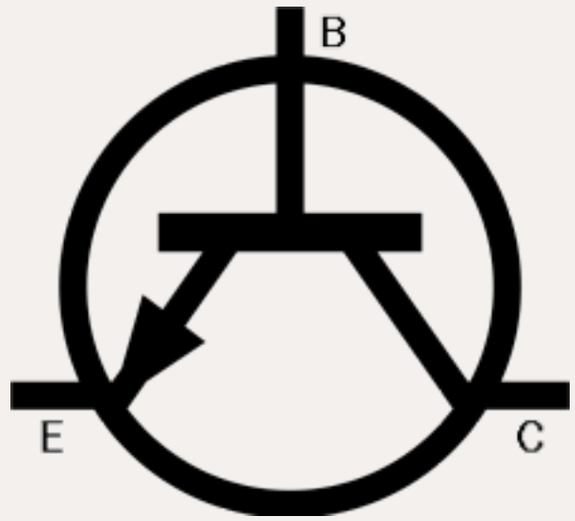
E = Emitter
B = Base
C = Collector

Doping

Adding impurities to an extremely conductive semiconductor to change how the current will flow



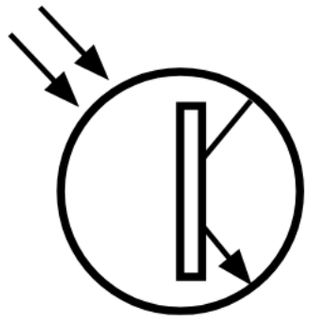
NPN
Not **P**ointing i**N**;
The collector goes to ground
and when the base gets the right voltage
it allows current to flow from the Emitter to the
Collector, completing the circuit



NPN
Not **P**ointing i**N**
This Semiconductor is P-doped between two N-doped layers.

N-doped = spare electrons
P-doped = spare electron holes

This allows a very small amount of current to trigger the flow of a larger amount of current

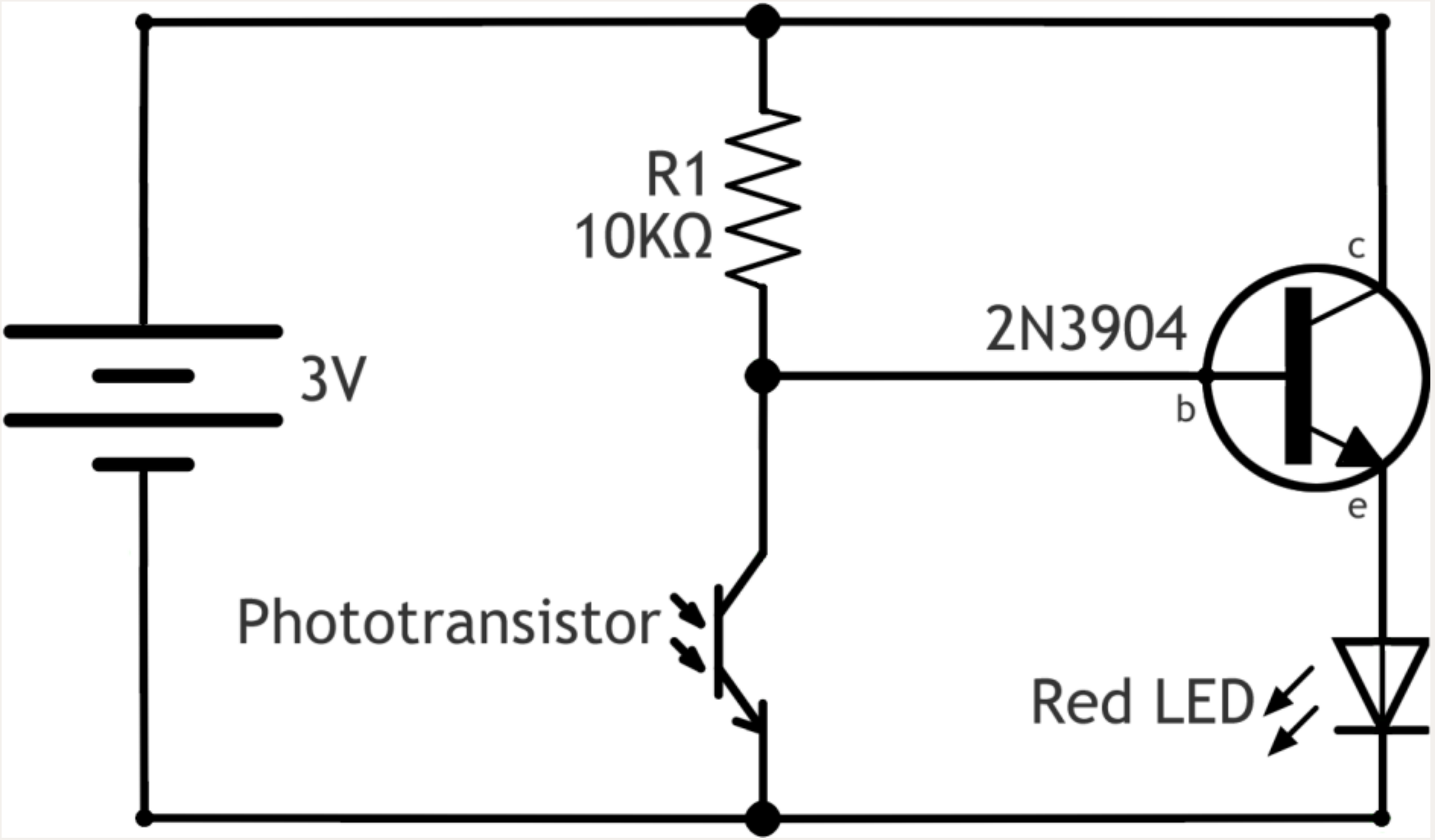


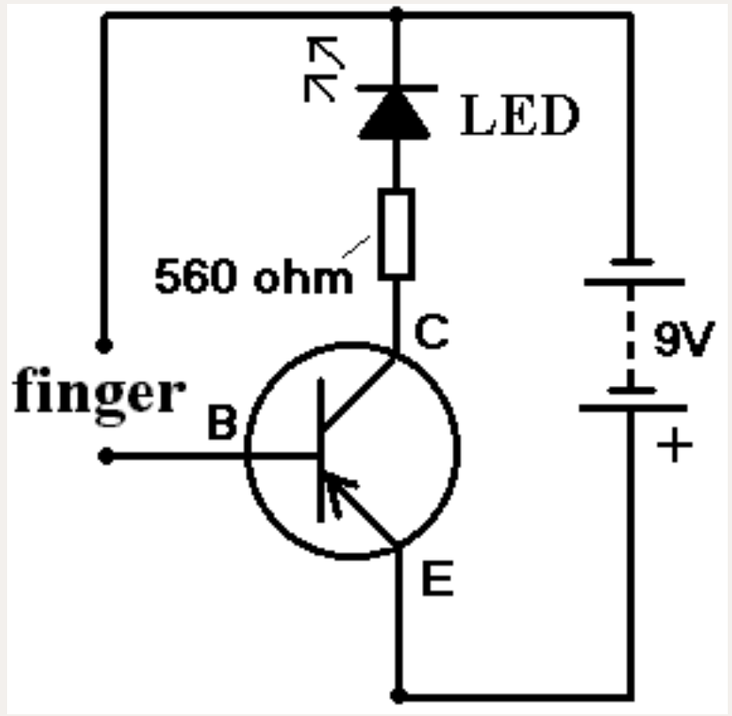
Phototransistor circuit symbol (for a device based around an NPN transistor)

NPN Phototransistor

The phototransistor is a semiconductor device that is able to sense light levels and alter the current flowing between emitter and collector according to the level of light it receives

The photo-transistor operates because light striking the semiconductor frees electronics / holes and causes current to flow in the base region.


R1
10KΩ
3V
2N3904
c
b
e
Phototransistor
Red LED



PNP

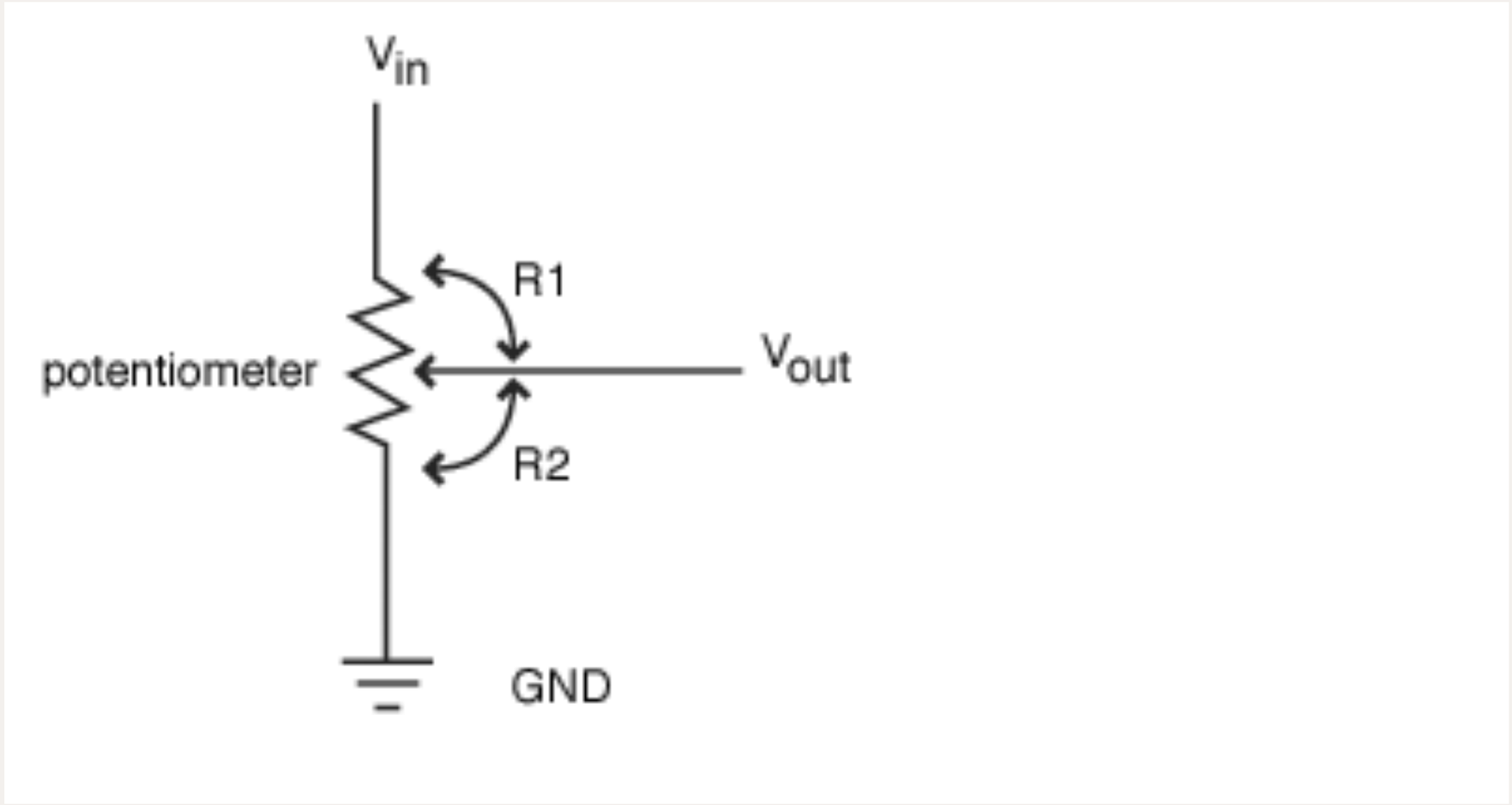
Points i**N** **P**roudly

PNP transistors use a small base current and a negative base voltage to control a much larger emitter-collector current.

In other words for a PNP transistor, the Emitter is more positive with respect to the Base and also with respect to the Collector.

PNP transistor are reversed which means that it “sinks” current into its Base as opposed to the NPN Transistor which “sources” current through its Base.

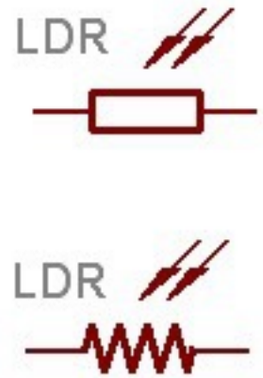
The voltage divider

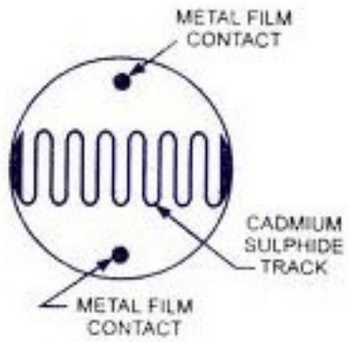


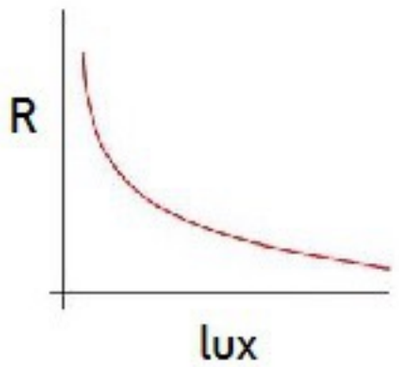
* Potentiometer can act like the R2 or R1 resistor and allow you to vary an LED's brightness, a servo's angle, or the speed of a motor using PWM

LDR

Light Dependent Resistor



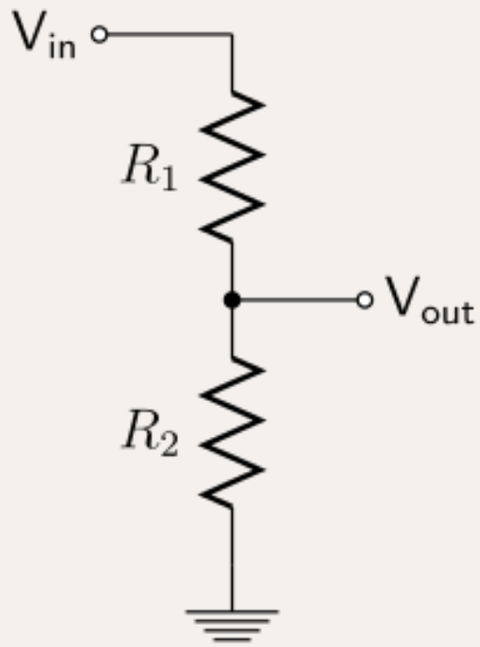


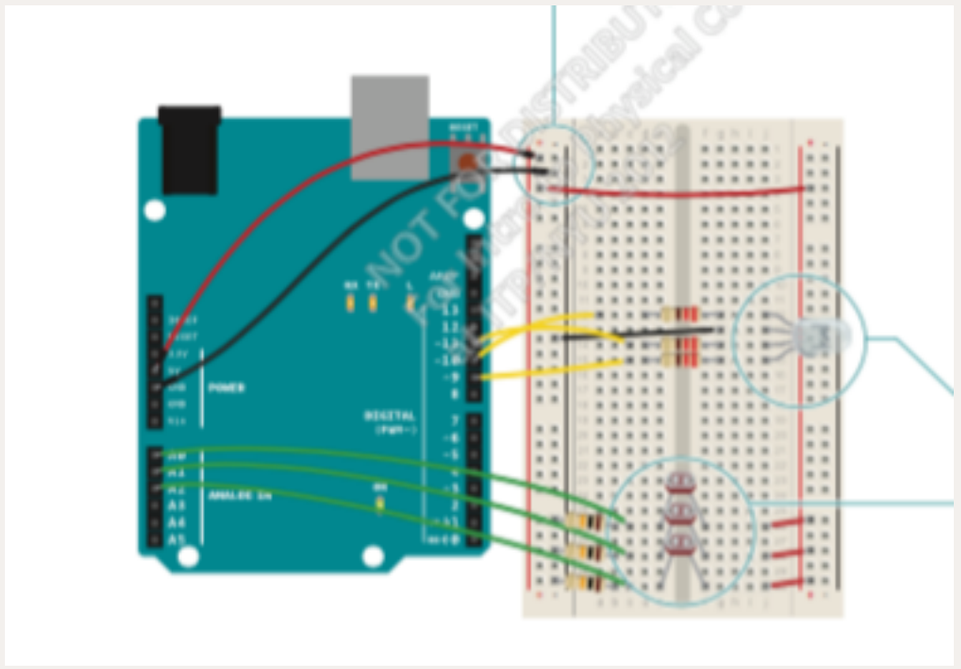


The voltage divider

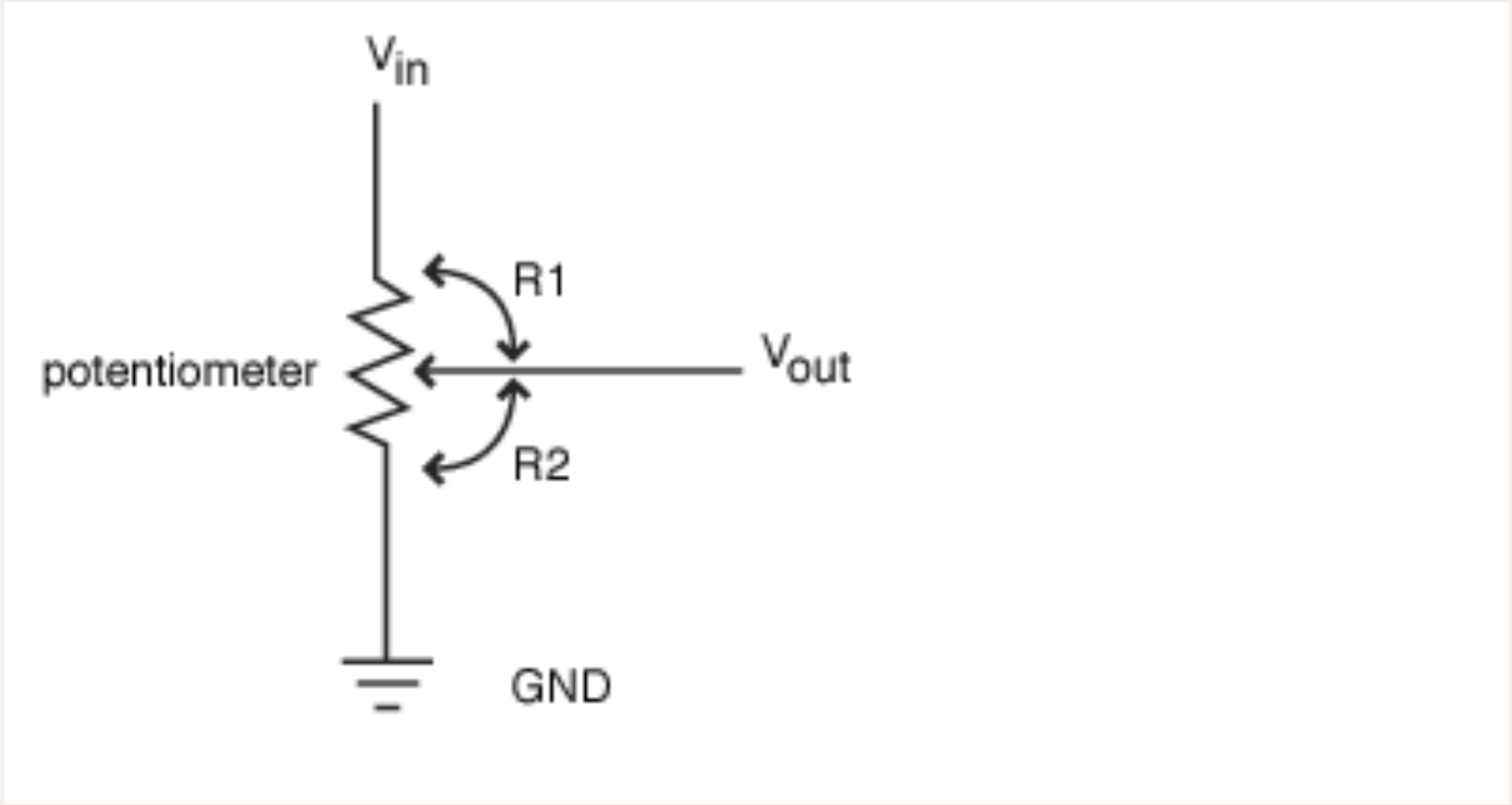
* this is used for an LDR because an LDR is a resistor!

$$V_{out} = V_{in} \cdot \frac{R_2}{R_1 + R_2}$$





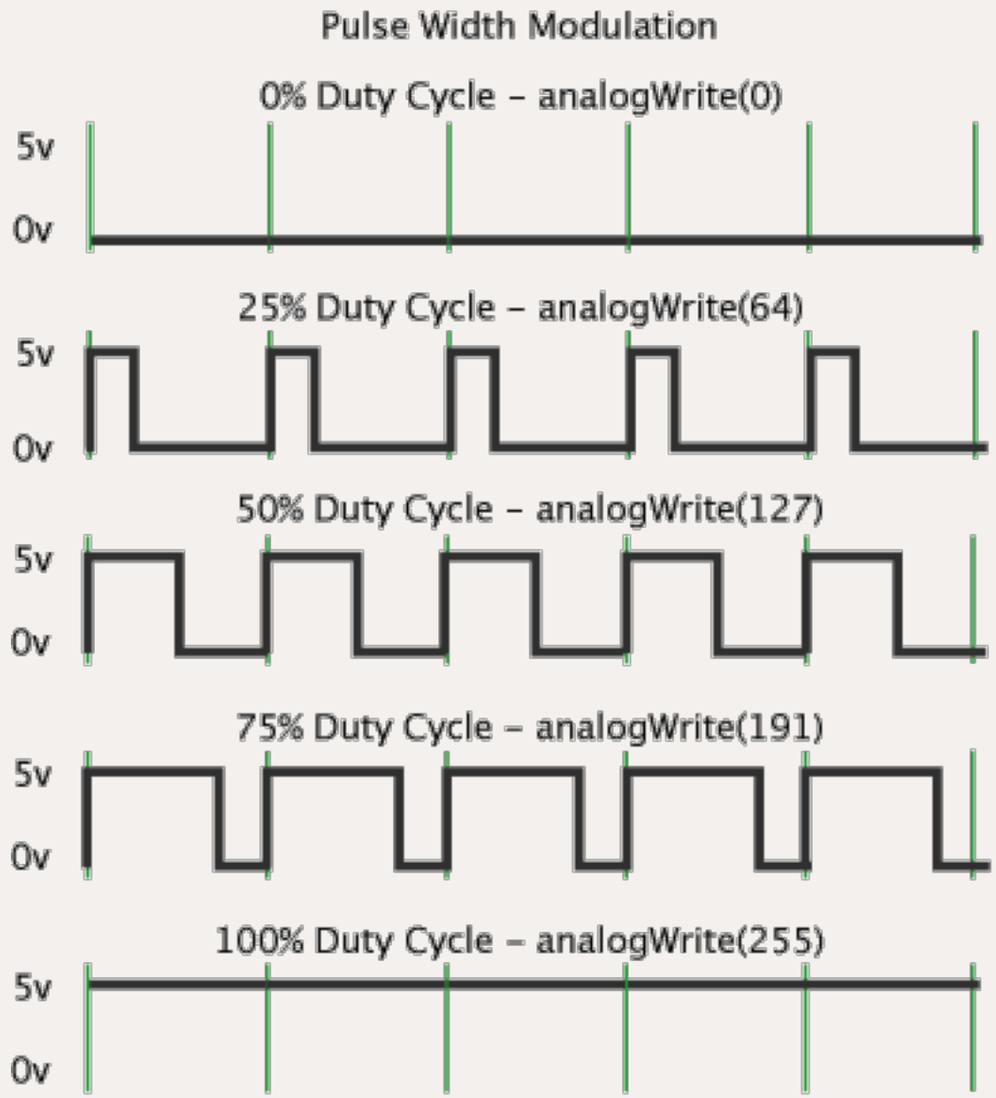
The voltage divider & Pot? One in the same.



* Potentiometer can act like the R2 or R1 resistor and allow you to vary an LED's brightness, a servo's angle, or the speed of a motor using PWM

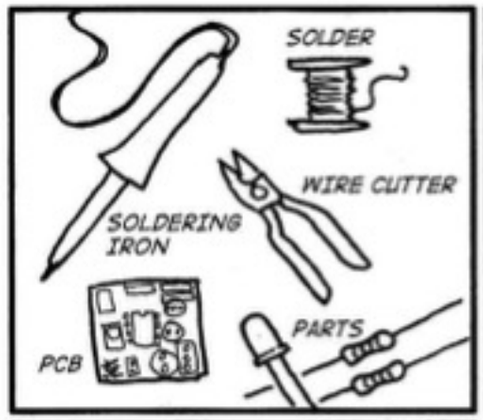
PWM (0-255), or how to control the voltage output of a pin

* makes a digital pin act analogish
* sends a little pulse every 20ms
* the length of the pulse indicates the value
* longer the value the higher the value and the more voltage sent
* they are indicated on the Arduino by a ~
* use it to turn a servo by a certain angle using the Arduino built in servo library
* Used for LEDs and motors commonly



SOLDERING IS EASY

HERE'S HOW TO DO IT

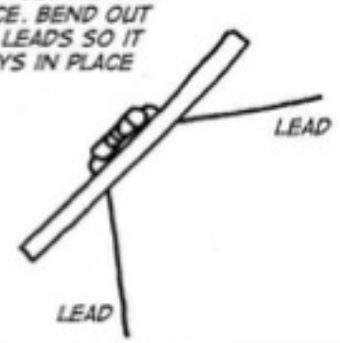


THE IRON IS HOT!! BE CAREFUL!

YOUR KIT SHOULD COME WITH INSTRUCTIONS FOR WHAT PARTS GO WHERE AND WHAT WAY!

CLEAN THE TIP OF YOUR IRON BEFORE EACH SOLDER CONNECTION!

PUT YOUR PART IN PLACE. BEND OUT THE LEADS SO IT STAYS IN PLACE



PUT THE PCB DOWN SO YOU CAN SOLDER.

CAREFUL WITH THE SURFACE UNDERNEATH!

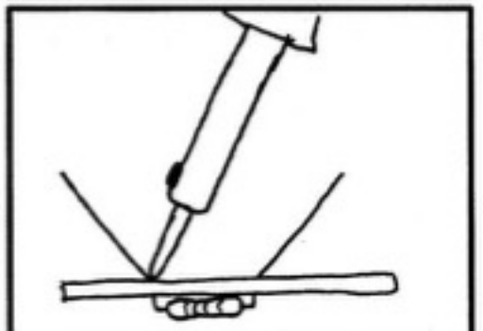
FIND SOME GOOD WAY TO KEEP IT STEADY

IF YOU NEED A THIRD HAND, YOU CAN MAKE A STANDING COIL OF THE SOLDER INSTEAD OF HOLDING IT IN YOUR HAND

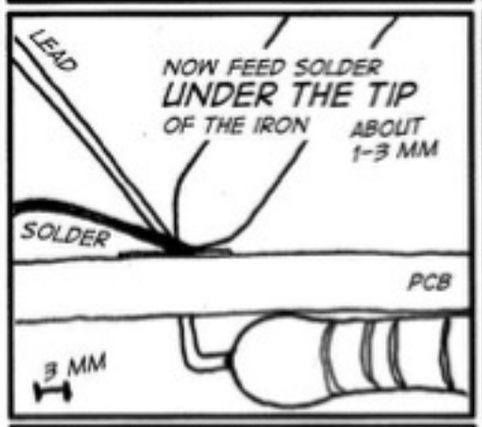
OK, LETS SOLDER!

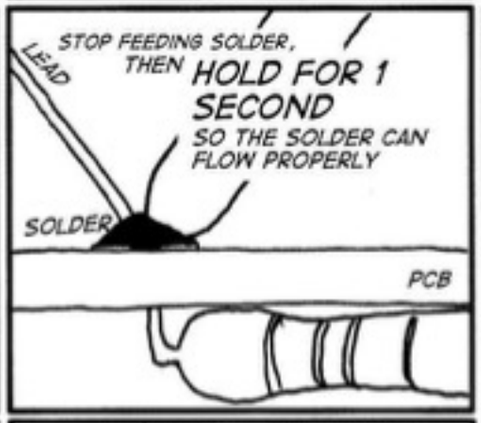
FIRST, YOU WANT TO **HEAT** BOTH THE PAD AND THE LEAD FOR ABOUT **1 SECOND**

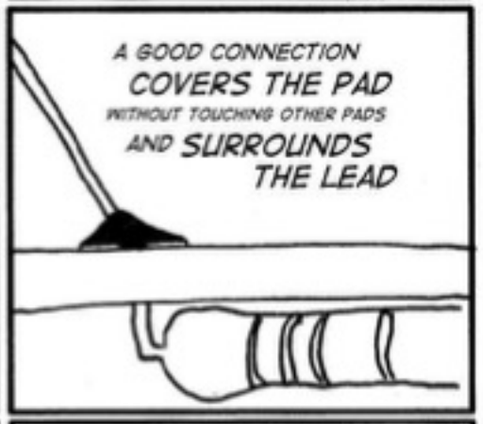
PSST! CLEAN THE TIP FIRST!



TOUCH THE SOLDERING IRON TO BOTH THE PAD AND THE LEAD!







CUT THE LEADS OFF WITH THE WIRE CUTTER

SOME LEADS ARE ALREADY SHORT, YOU DON'T NEED TO CUT THOSE.

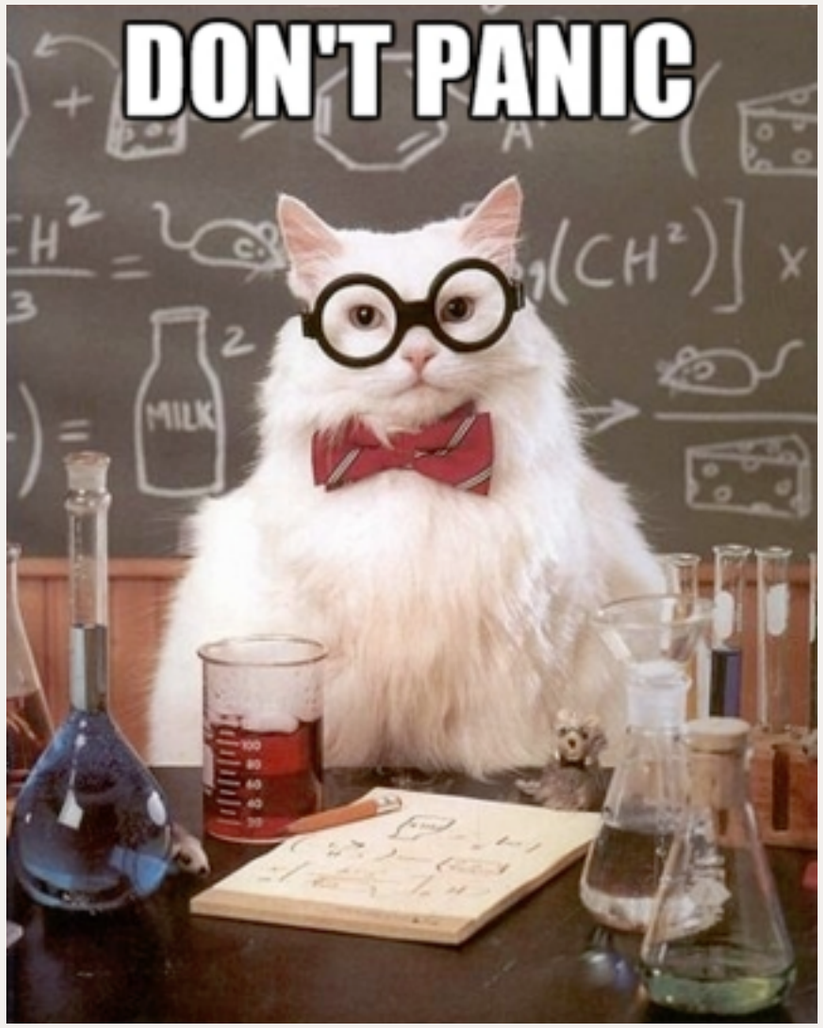
KEEP SOLDERING EACH PART IN ITS CORRECT PLACE. REMEMBER SOME PARTS NEED TO GO IN A CERTAIN WAY!

IF ALL YOUR CONNECTIONS ARE GOOD, YOUR CIRCUIT WILL JUST WORK!

THERE ARE MORE TRICKS YOU WILL LEARN AS YOU KEEP SOLDERING, BUT NOW YOU KNOW ENOUGH TO MAKE MANY COOL THINGS.

SOLDERING COURSE BY MITCH ALTMAN
HTTP://CORNFIELDELECTRONICS.COM

COMIC ADAPTATION BY ANDIE NORDGREN
HTTP://LOG.ANDIE.SE



* Keep your temp at about 317 - 321 C
* put the component between the iron and the solder
* wait until the solder starts to flow
* lift the iron
* if you end up with the solder stuck to the board, don’t panic. Just clip it


SOLDER WICK
SIZE
3.0 m/m
LENGTH
5 FEET
SOLDERING REMOVER


USE SAFETY GLASSES
MODEL 170

https://www.youtube.com/watch?v=QKbJxytERvg