

# Fundamentals of Physical Computing

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Instructor: Rob Faludi

# Plan for Today

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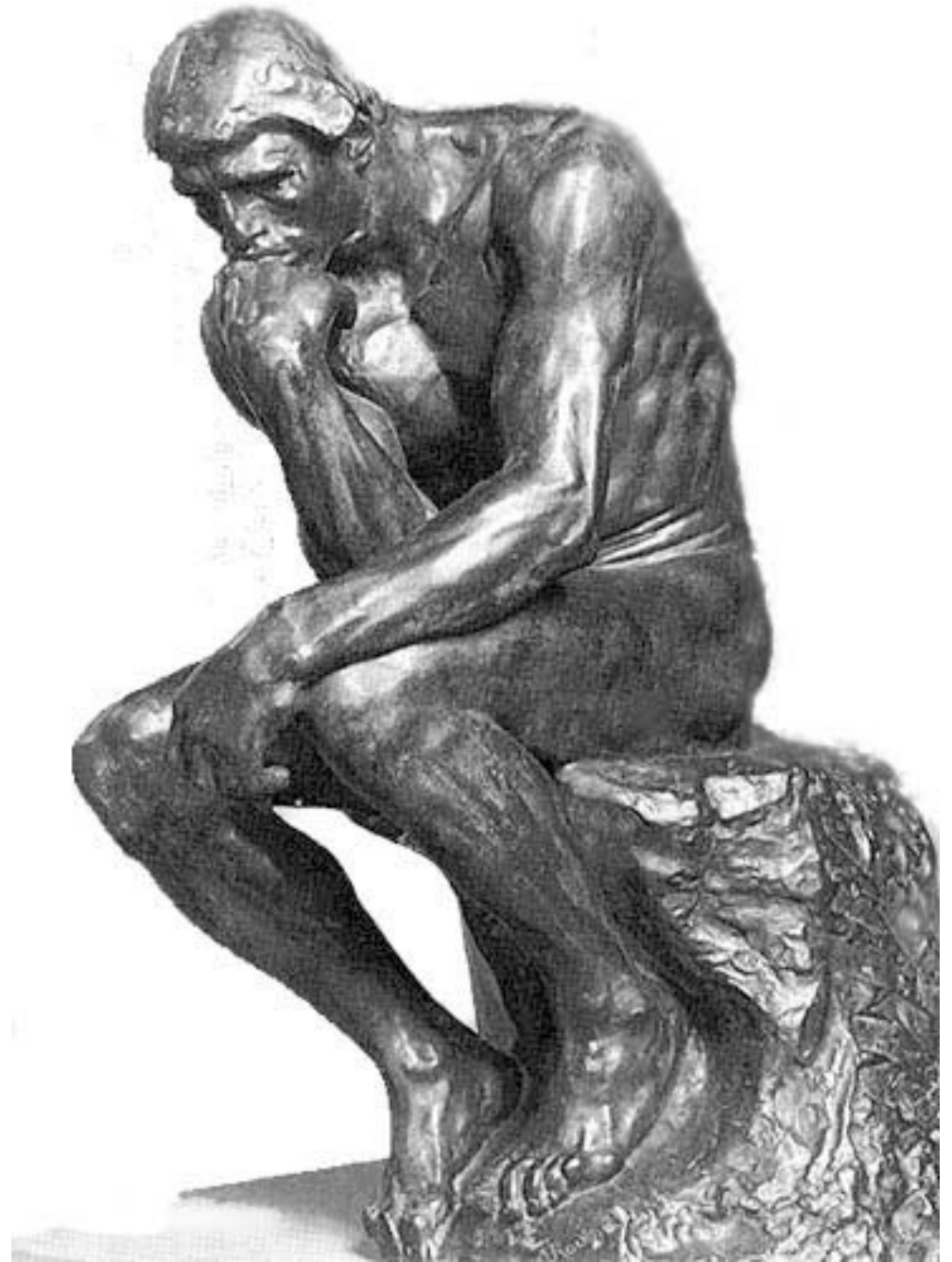
- Lab Review
- Affordances
- Motors
  - basics
  - speed
  - direction
- ASCII & Serial
- Readings & Assignments

# Lab Review

Affordances

# Thinking

is not for thinking



# Thinking is for doing

– Susan T. Fiske



# Basics

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- J.J. Gibson (1904-1979), Princeton, direct perception (James Jerome)
- “affordance”, I have made it up!
- things have properties
- beings have properties and capabilities
- affordance isn't a thing or being
- affordances are intersections

# What's an Affordance?

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- is this chair an affordance?
- what do stairs afford?
- can we say what something affords without specifying to who?
- therefore affordance cannot be an object property
- context is important too: knives are tools, dangers
- not all enabling, an affordance can be injurious



# Intersections

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- ground : locomotion, support, death for birds
- air : movement for us, locomotion for birds, safe in front, dangerous below
- water : locomotion when we swim, support for water bugs
- apples : <you do it>
- other animals, other people : <you do it>

# Perception

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- Thinking is for doing (Susan Fiske, Harvard, Princeton)
- affordances  $\neq$  perception (specification is separate from reality)
- covered hole vs. painted hole
- Norman gets it wrong, then corrects himself

# Direct Perception

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- understanding graspable as easily as understanding red
- things speak to us: a ball says throw me, a handle says grasp me
- exteroception meets proprioception: integration of two perceptual worlds
- Gibson says we perceive affordances, not qualities, and he makes an excellent point because we seem to feel affordances
- He feels it's the point of perception. Continuous process of perceiving action possibilities

# Affordances are Everywhere

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- concealment
- feeding
- fighting
- fleeing
- reproduction
- Let's go find some!

# Affordance Treasure hunt

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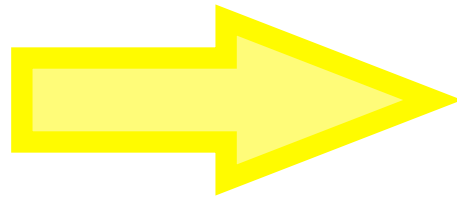
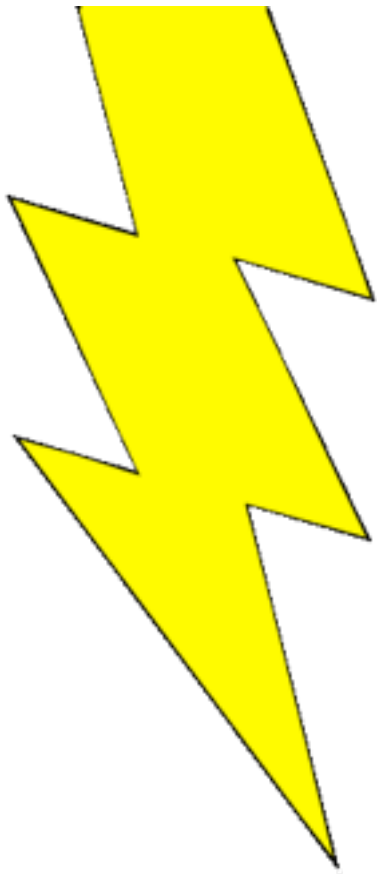
- An affordance for you
- Something that object doesn't afford you
- An affordance for someone else
- An affordance for something else
- A perceived affordance that isn't real
- A real affordance that isn't (easily) perceived.
- An attempt to lock out an affordance.
- An attempt to extend an affordance.
- Any affordance you think will surprise us

Motors



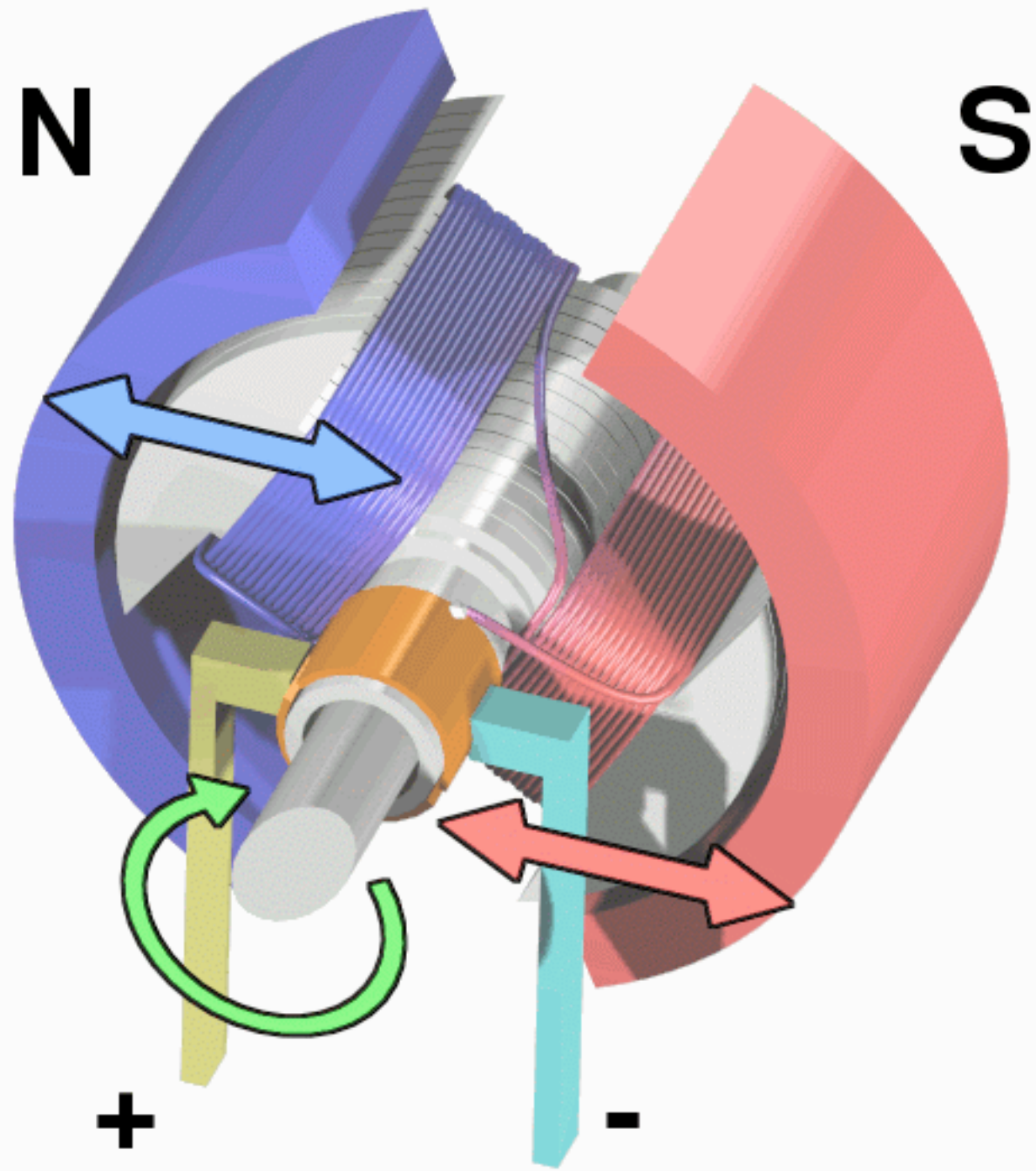
# Remember Transduction?

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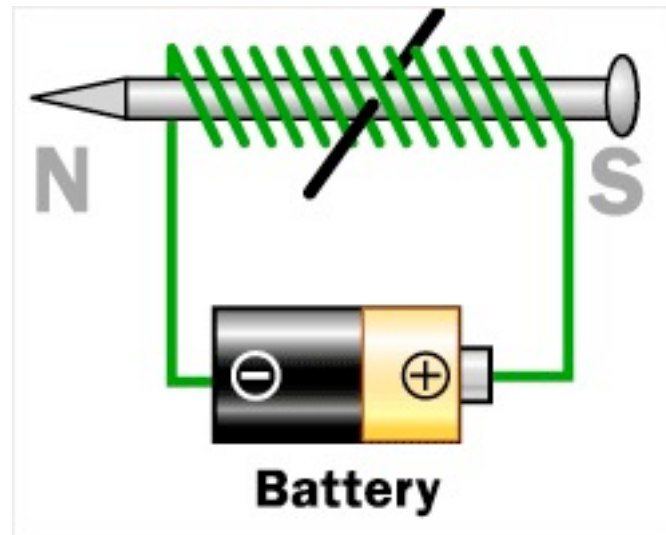






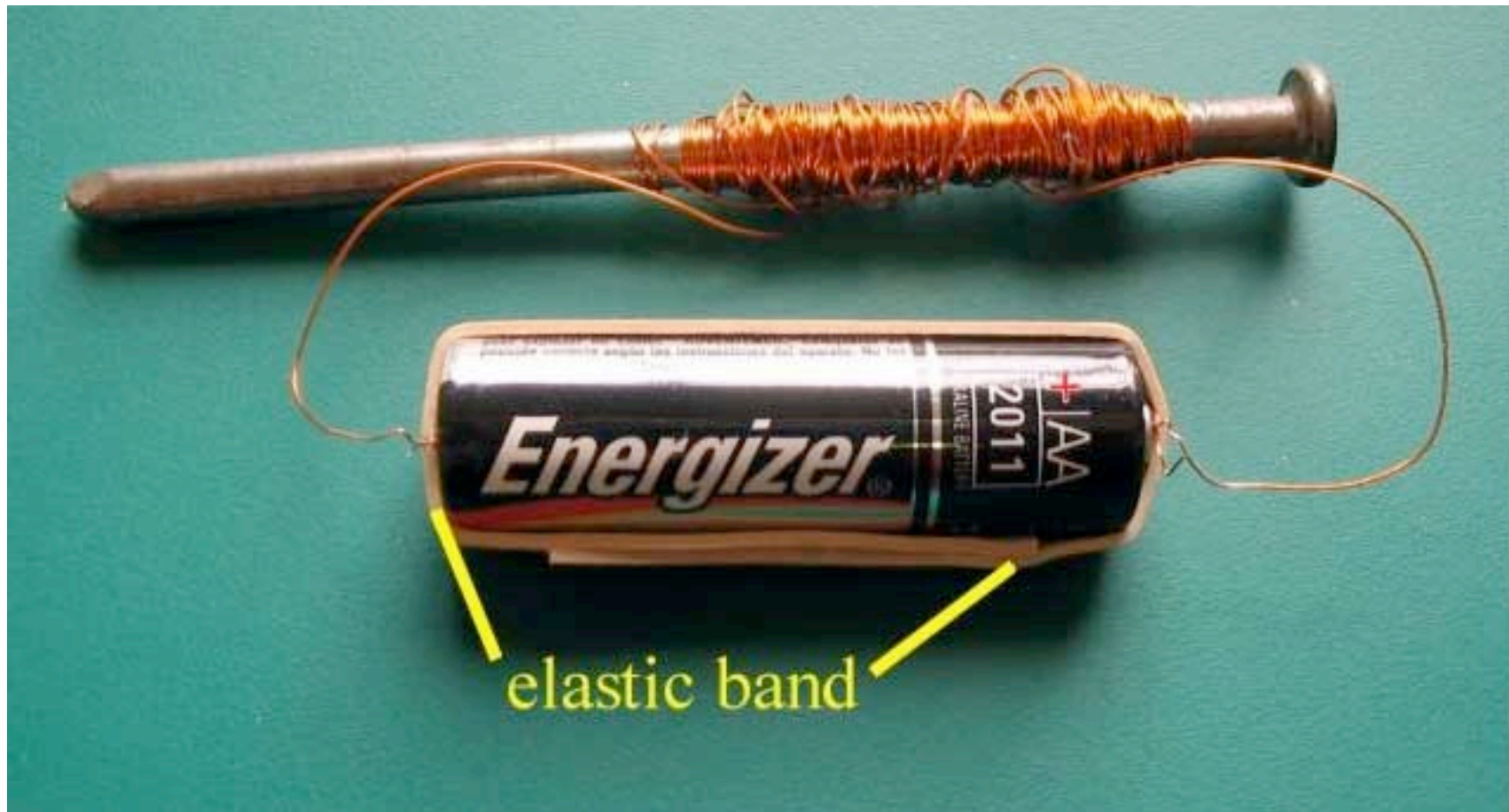
# Induction

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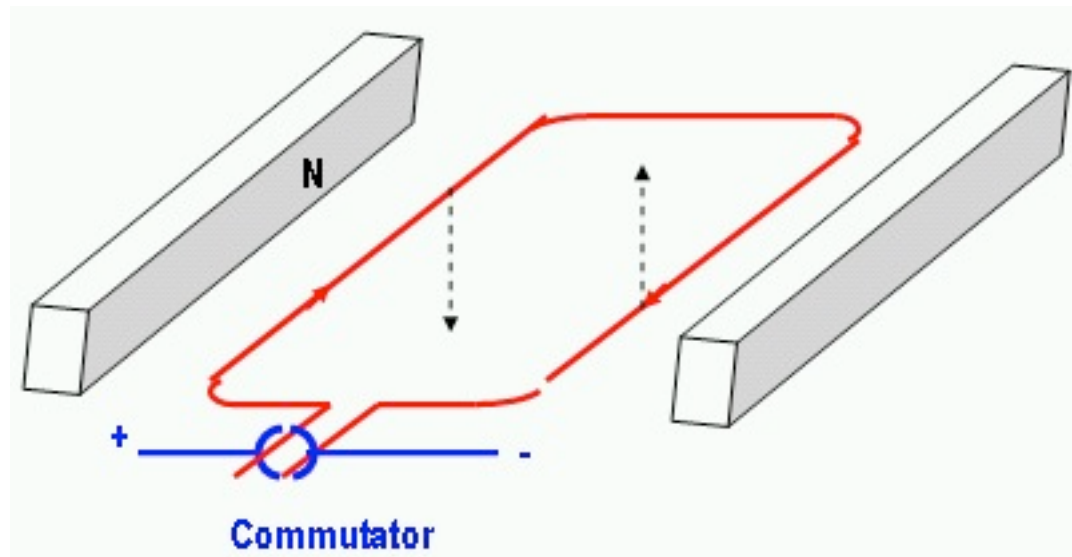
# DIY

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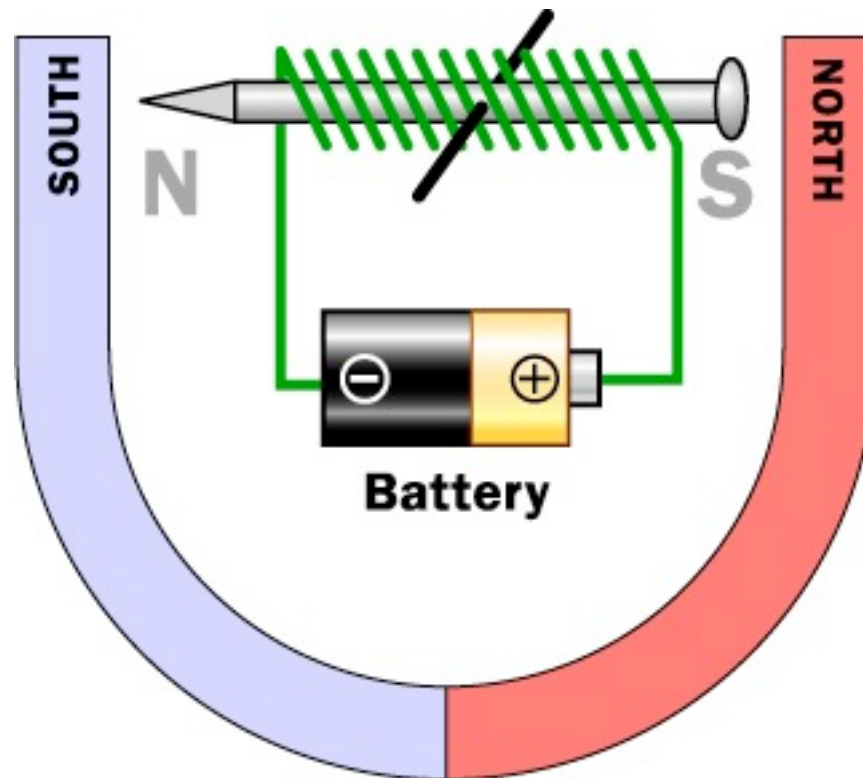
# Basic Principle

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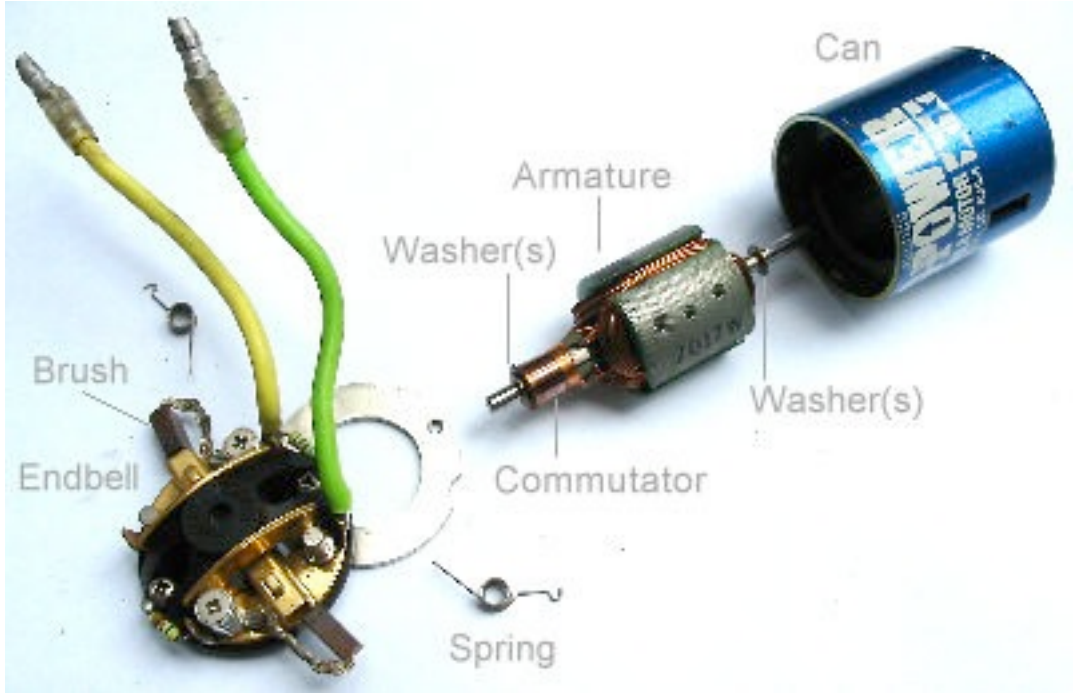
# Another View

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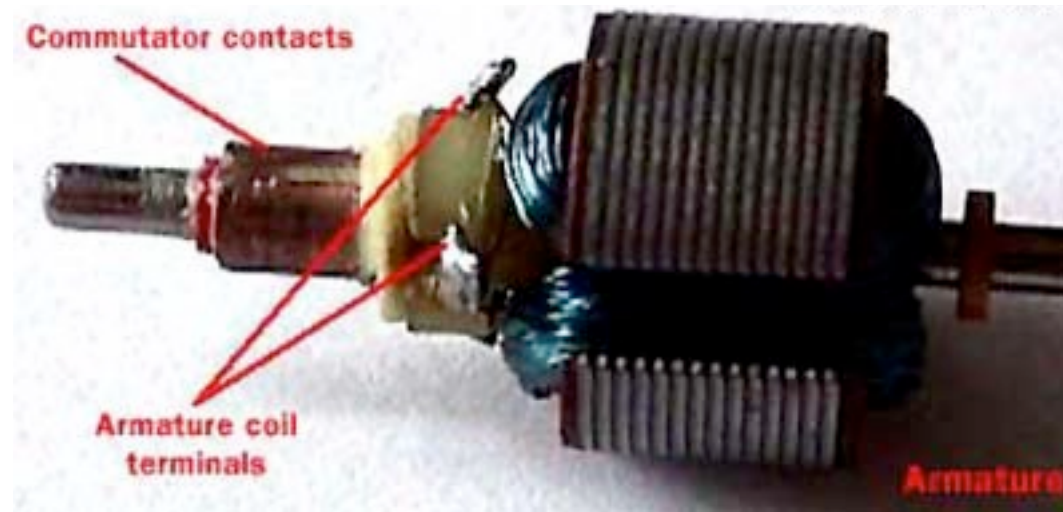
# All the Parts

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# Spinning Part

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# Fixed Part

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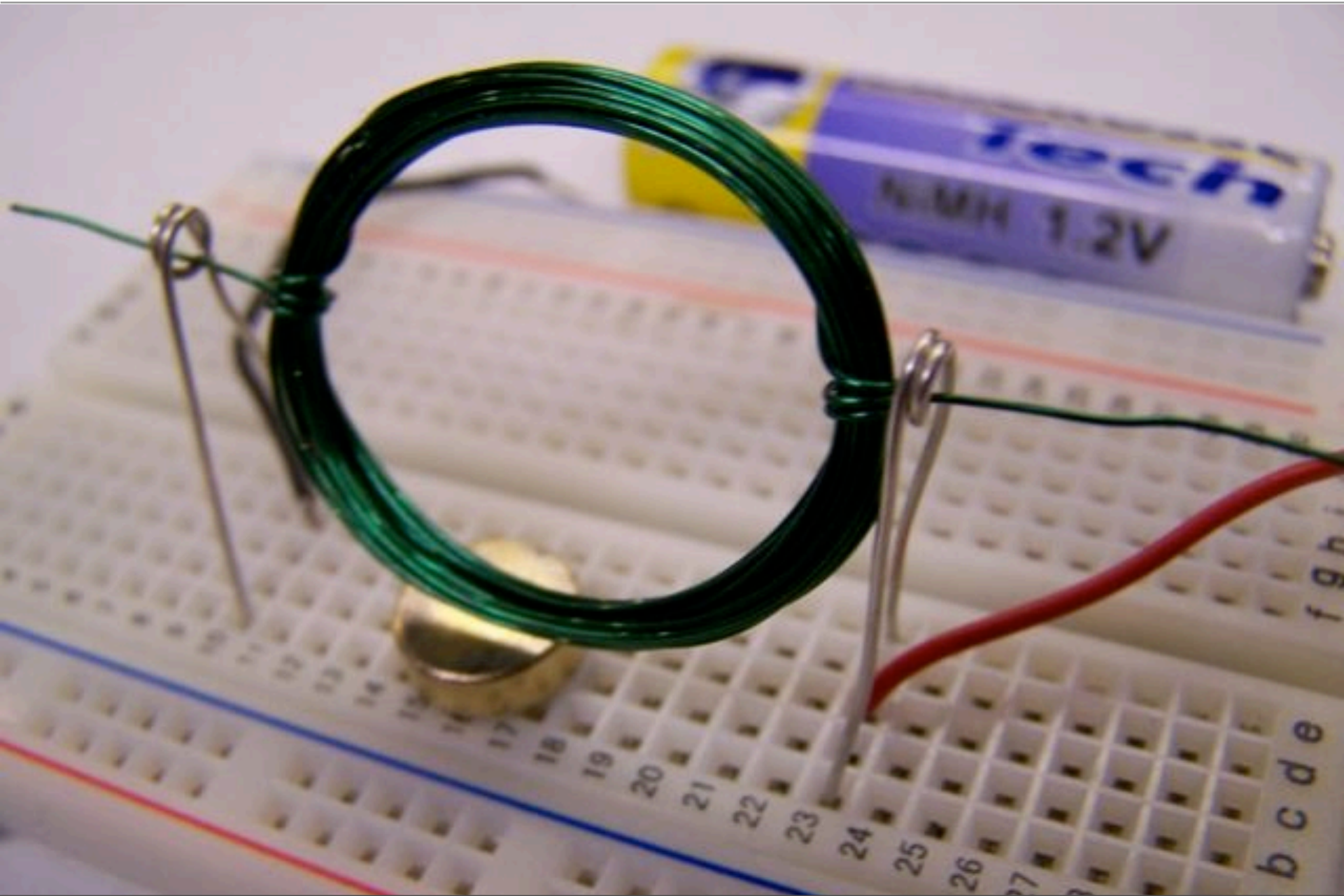
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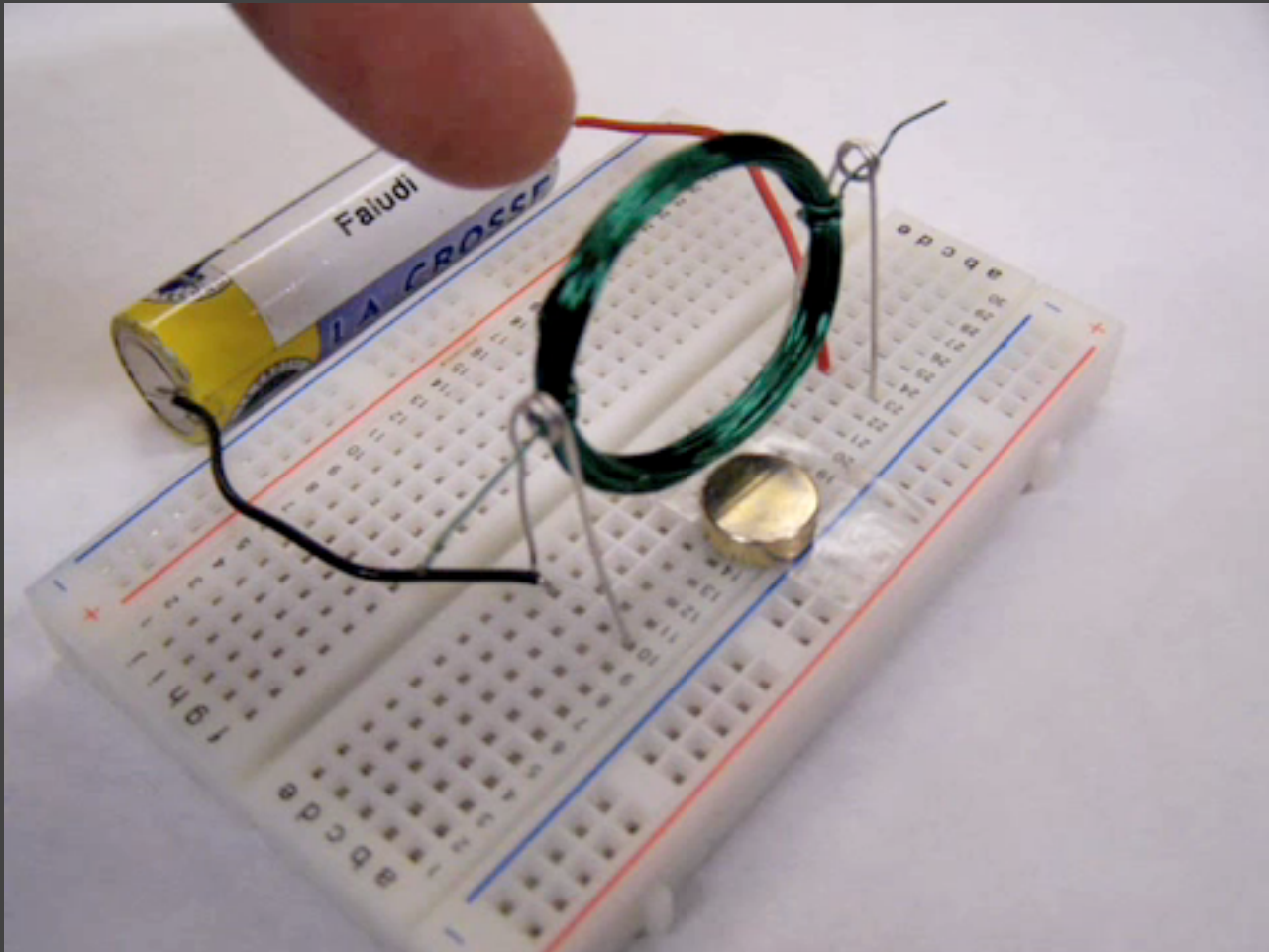
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DIY

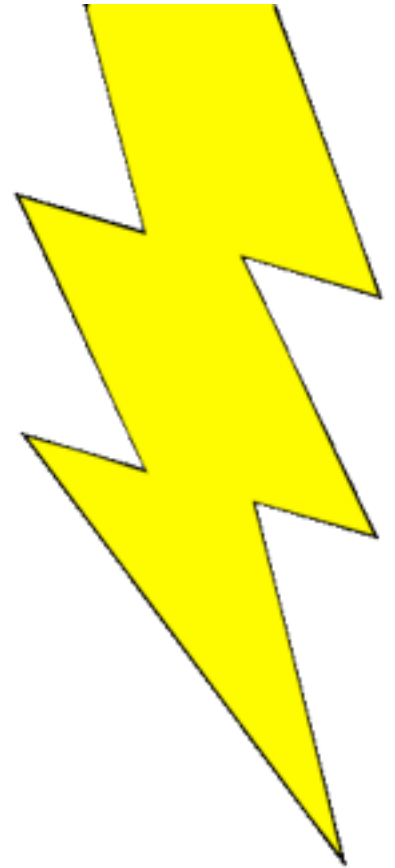
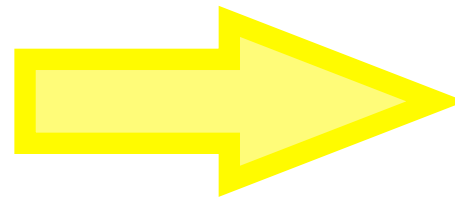






# Induction works both ways

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Varying Speed

# Getting Analog from Digital

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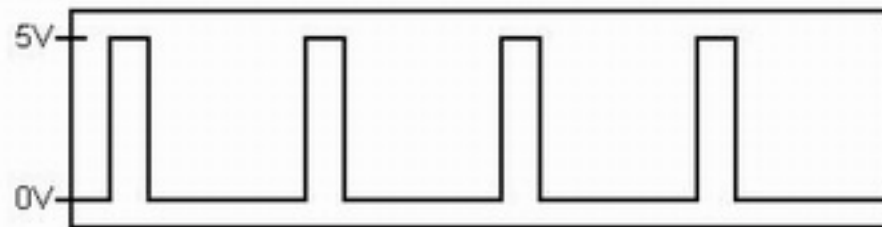


vroom....vroom...vroom

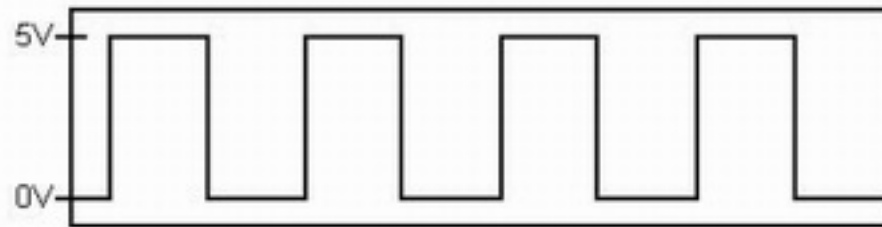
# Pulse Width Modulation (PWM)

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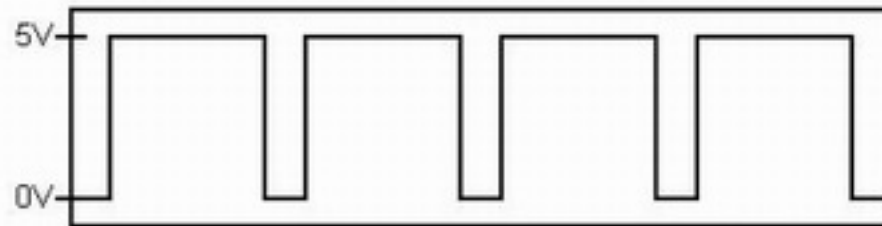
20% Duty Cycle



50% Duty Cycle

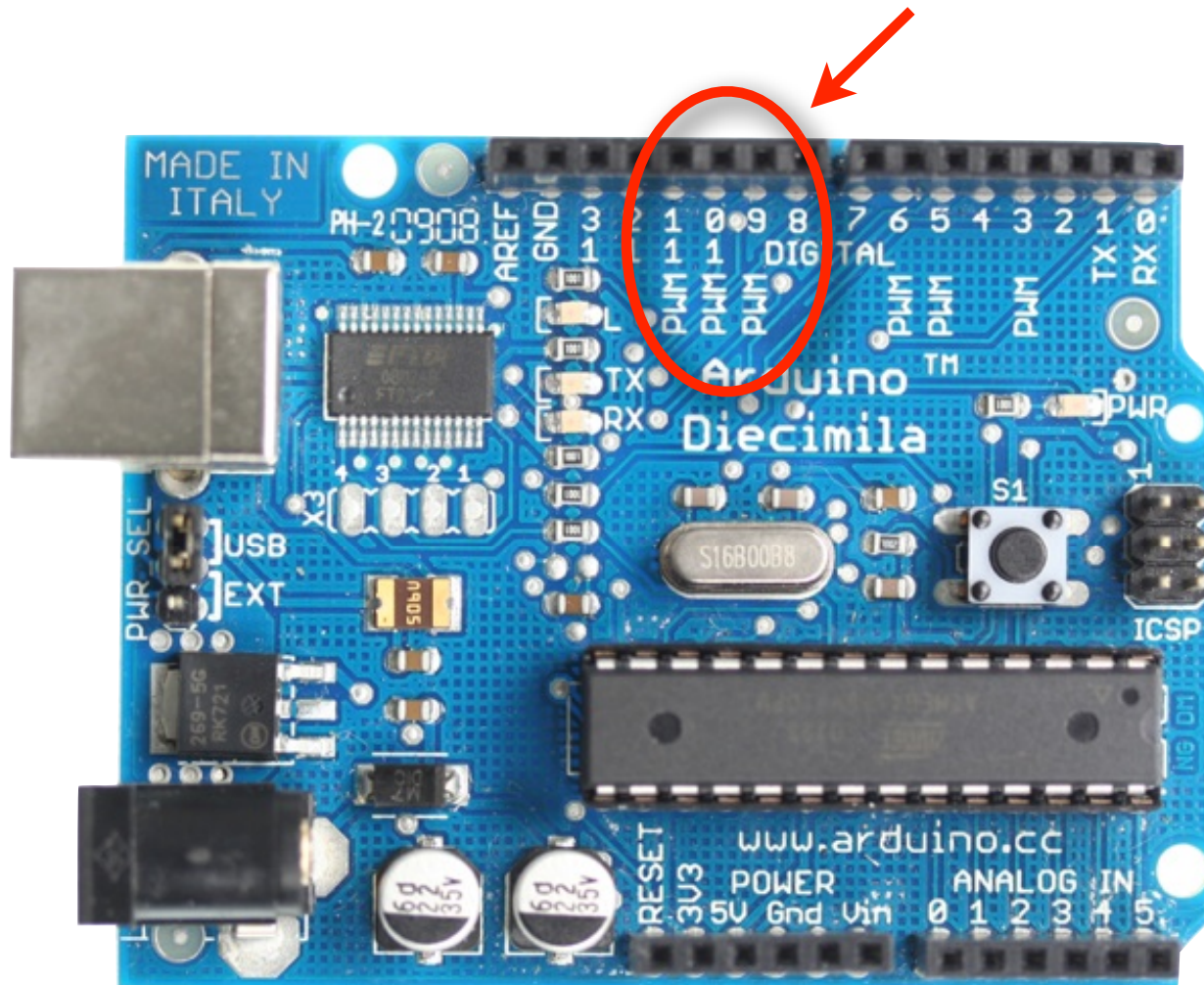


80% Duty Cycle



# Low-current PWM

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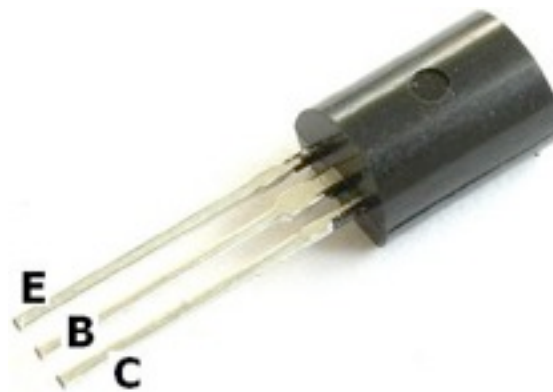




# Transistors

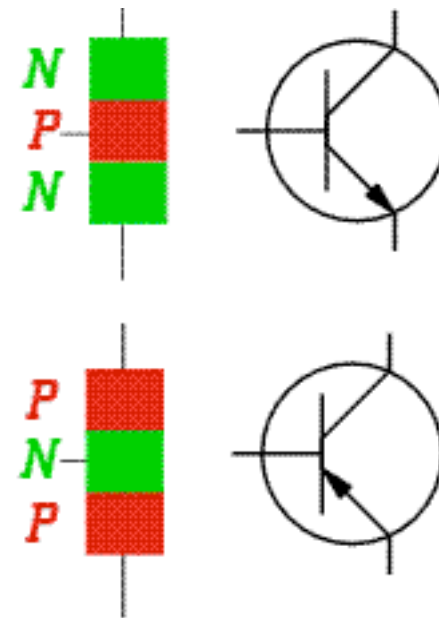
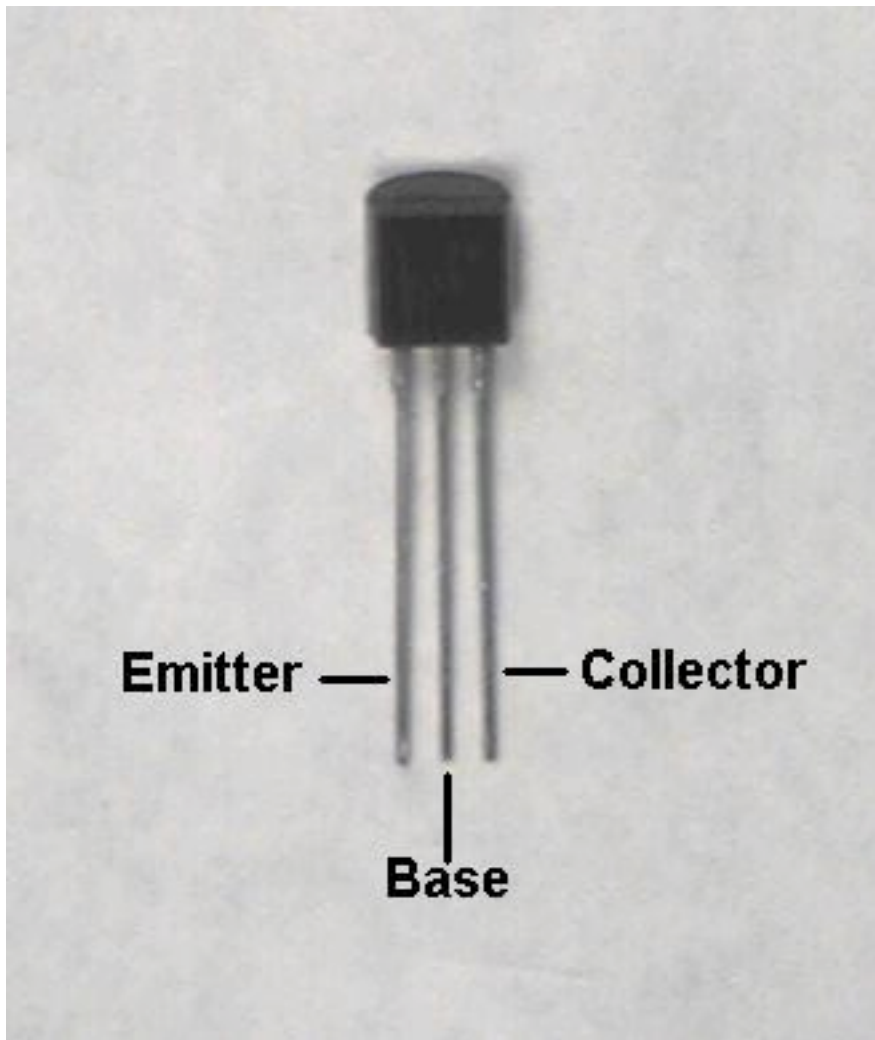
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- Use a smaller voltage to control a larger voltage



# Base, Collector, Emitter

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There are two types of transistors:

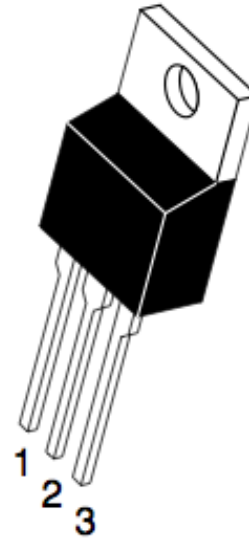
NPN - like normally open switch

PNP - like normally closed switch

Transistors have 3 pins:

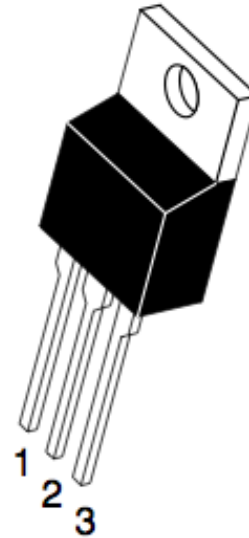
# Transistors have 3 pins:

1. base
2. collector
3. emitter

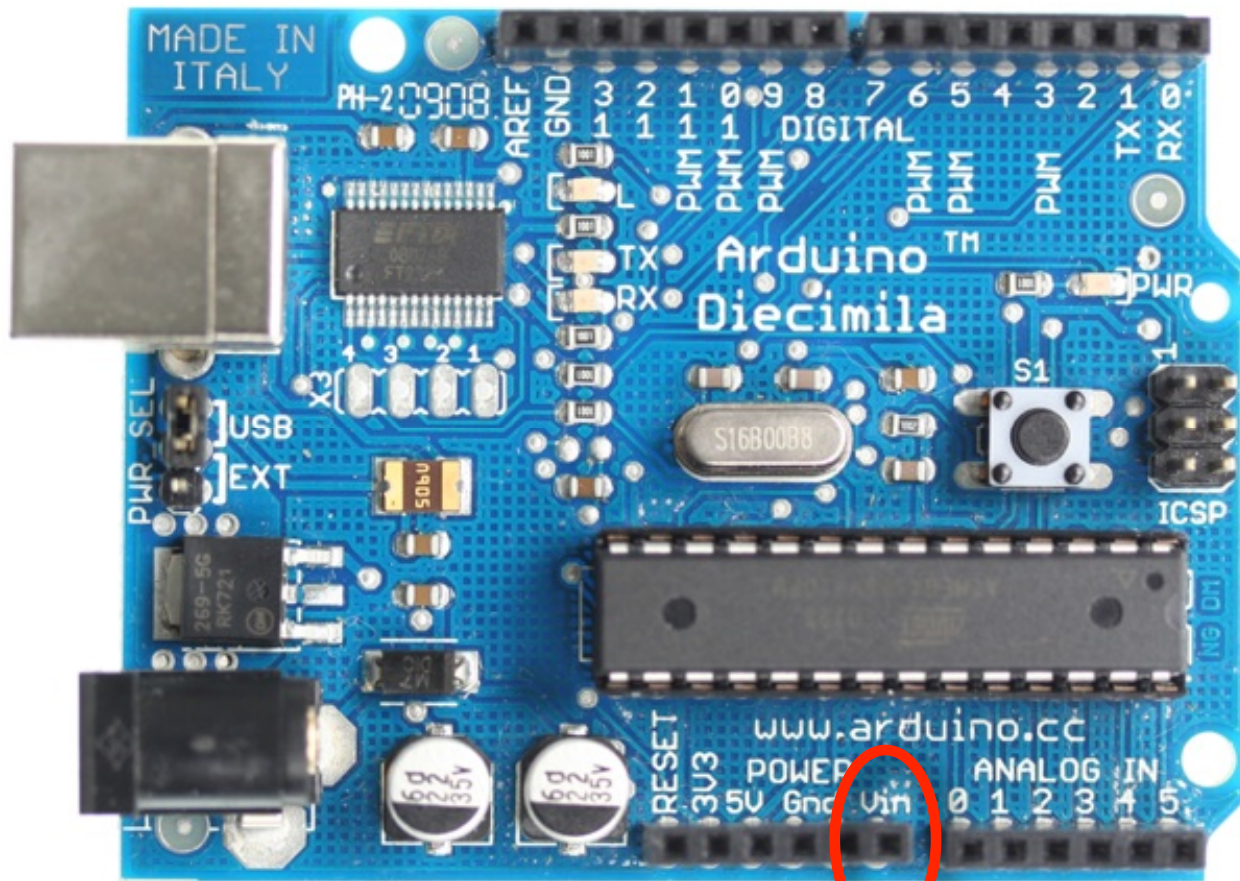


# Transistors have 3 pins:

1. base
2. collector
3. emitter



By putting a small voltage and current on the base, you allow a larger current to flow from the collector to the emitter.

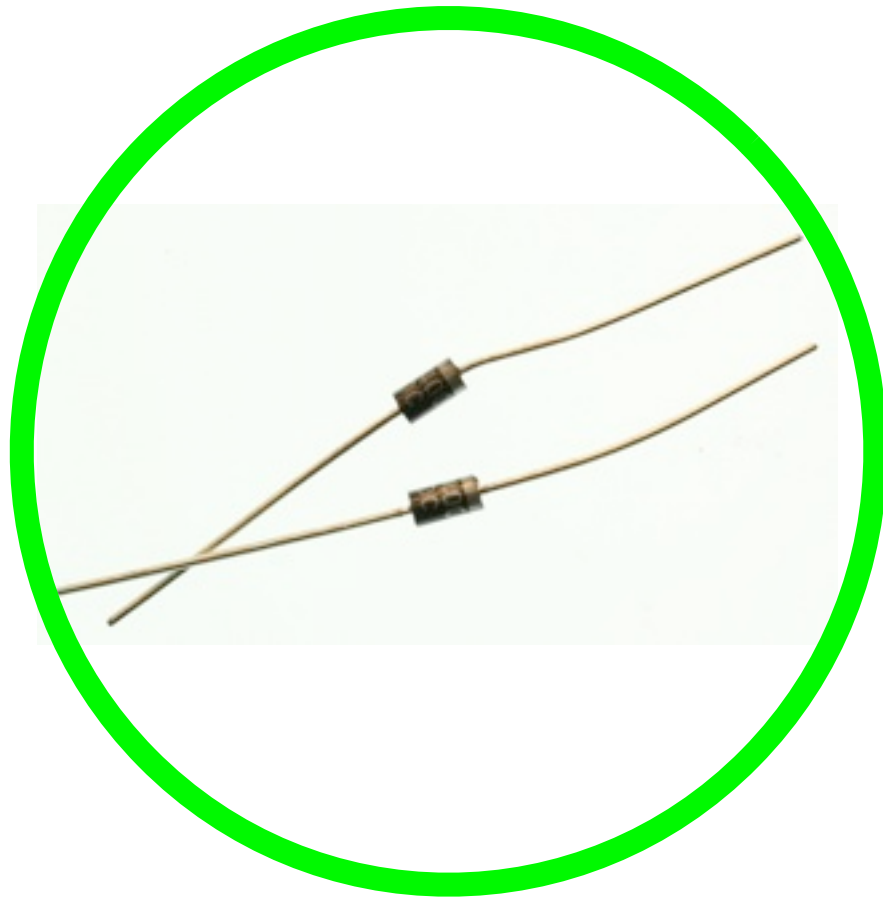


Voltage In = Full Strength of Power Supply

# diodes

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- prevent “blowback” voltage, when motor continues spinning





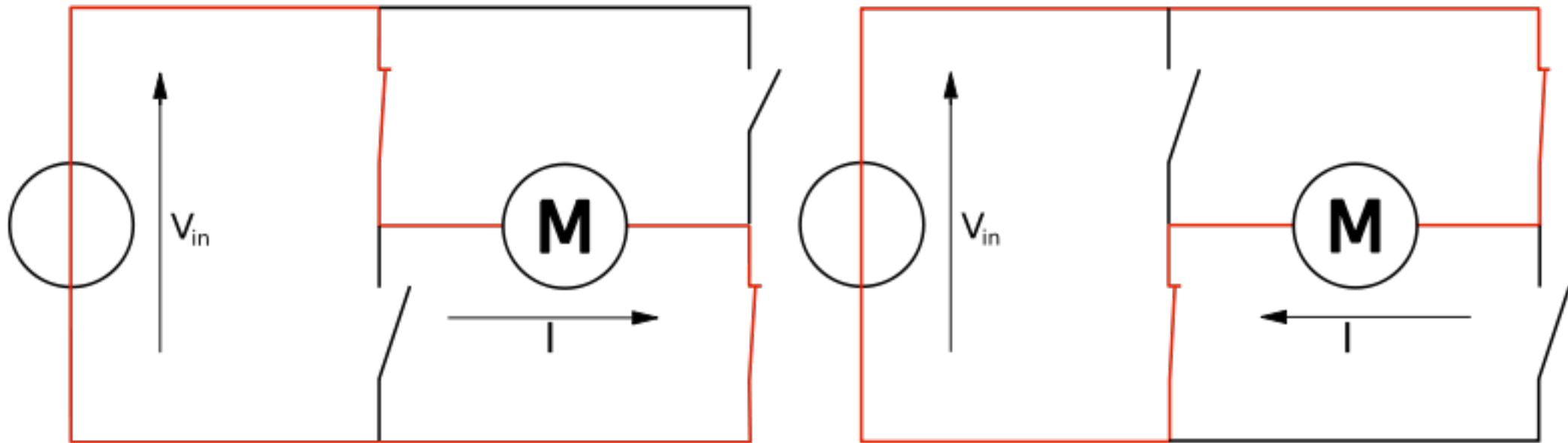
# Changing Directions

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- What controls a motor's direction?
- How could we change that?

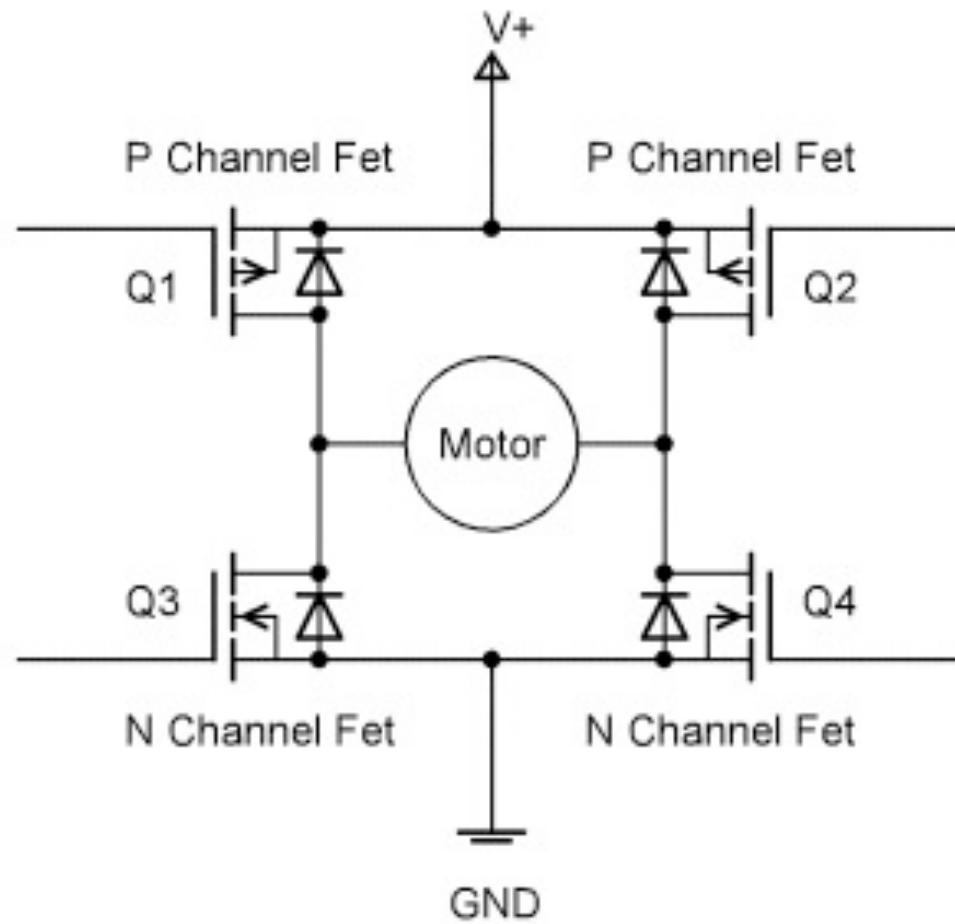
# H-Bridge Concept

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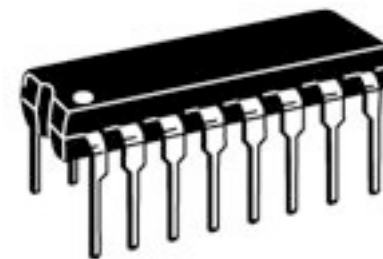
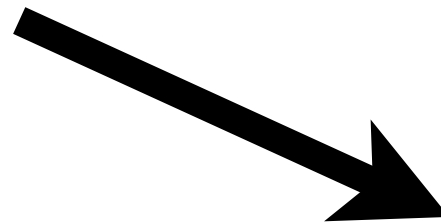
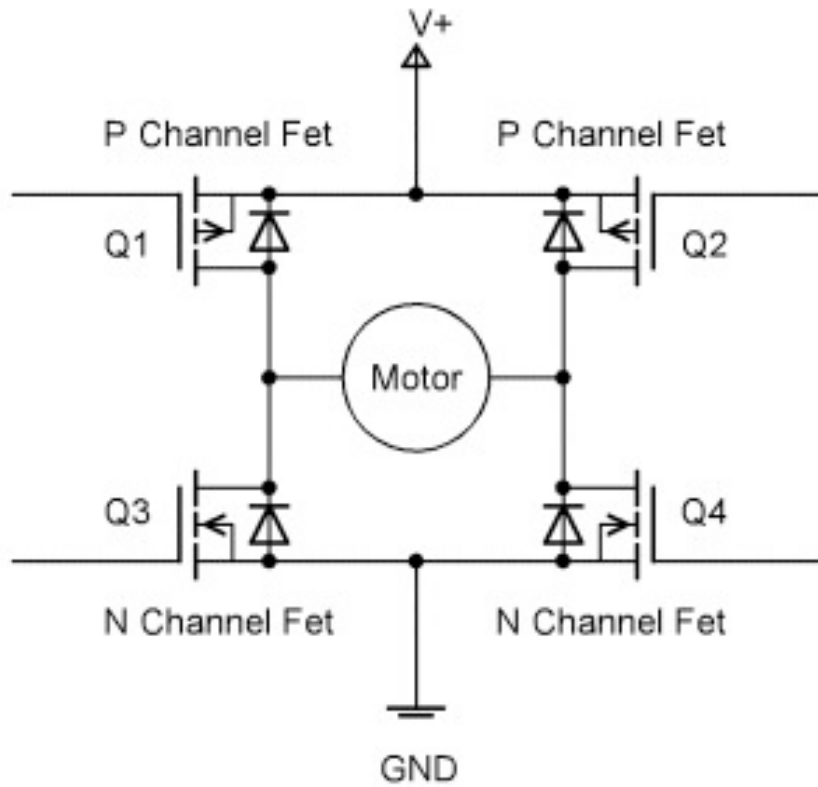
# H-Bridge with Transistors

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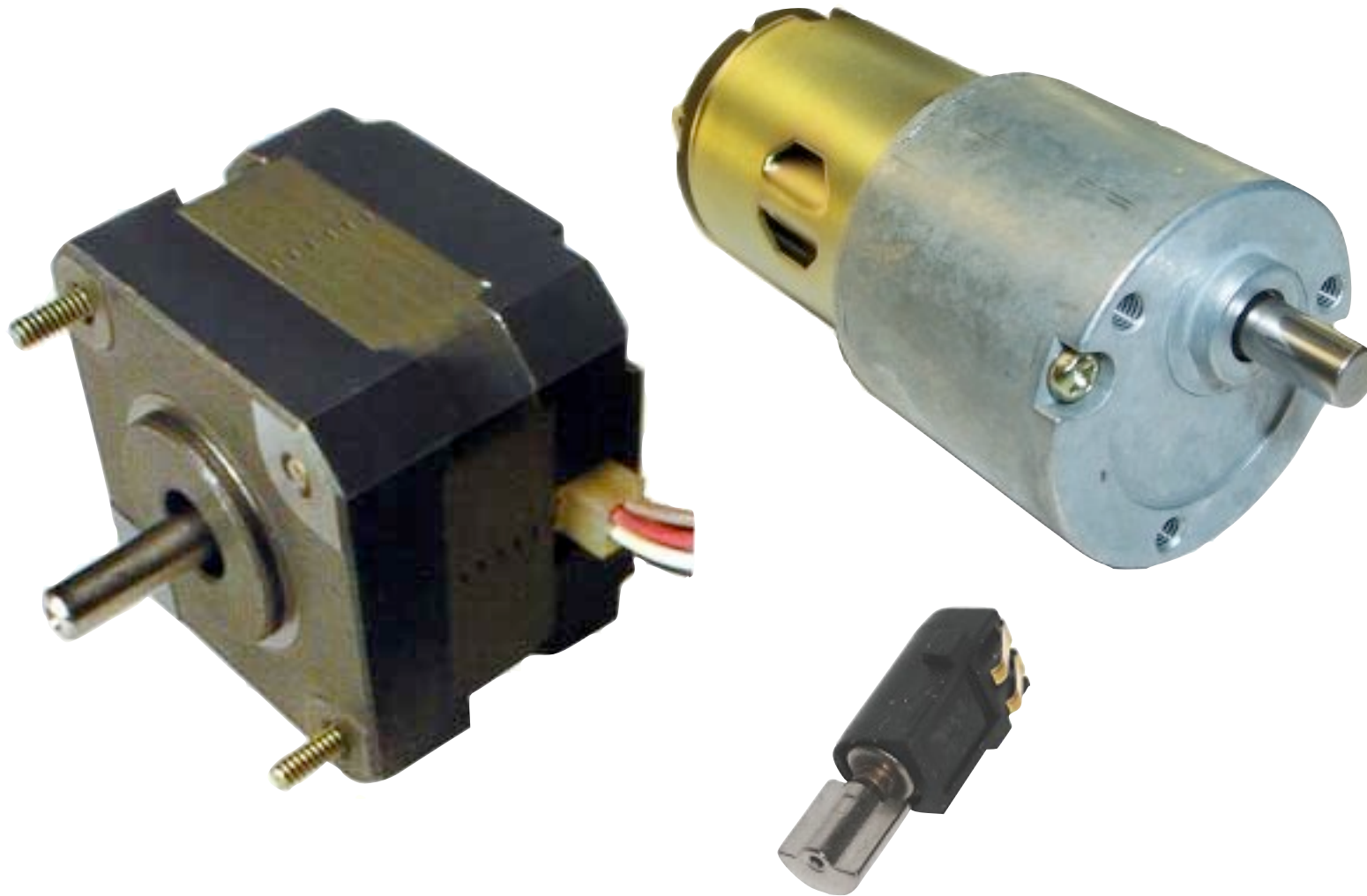
# H-Bridge Chip

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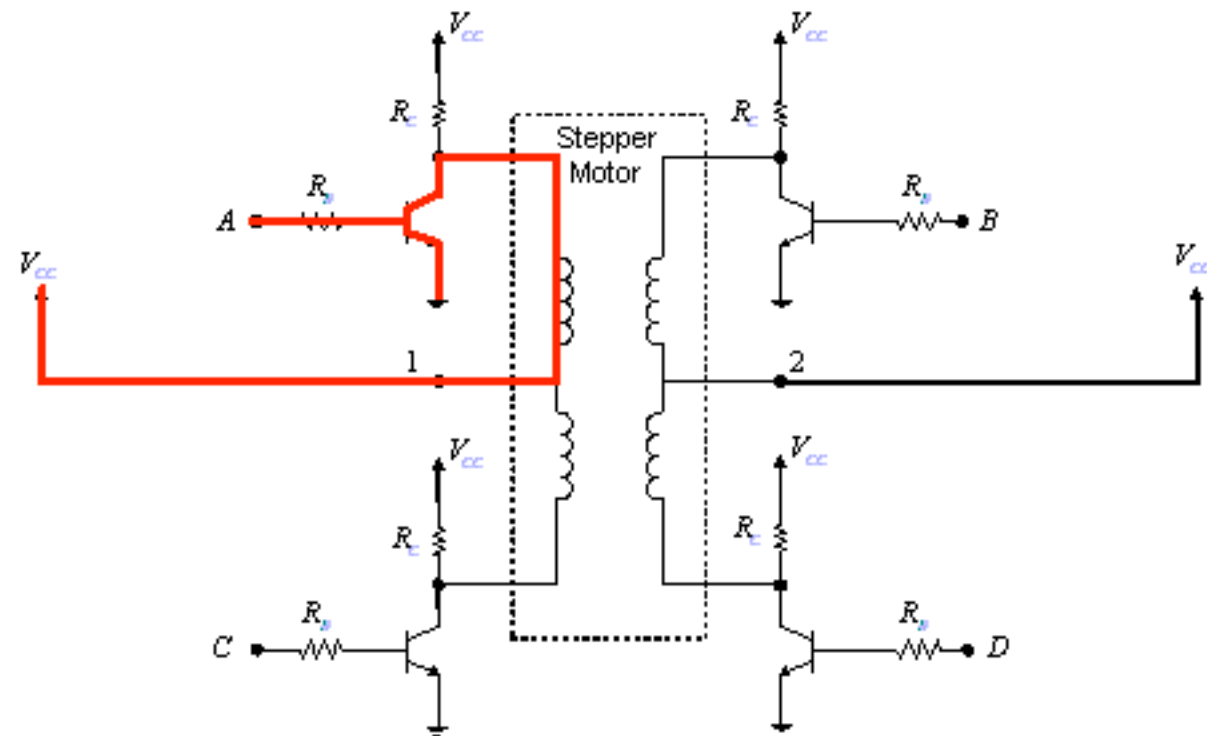
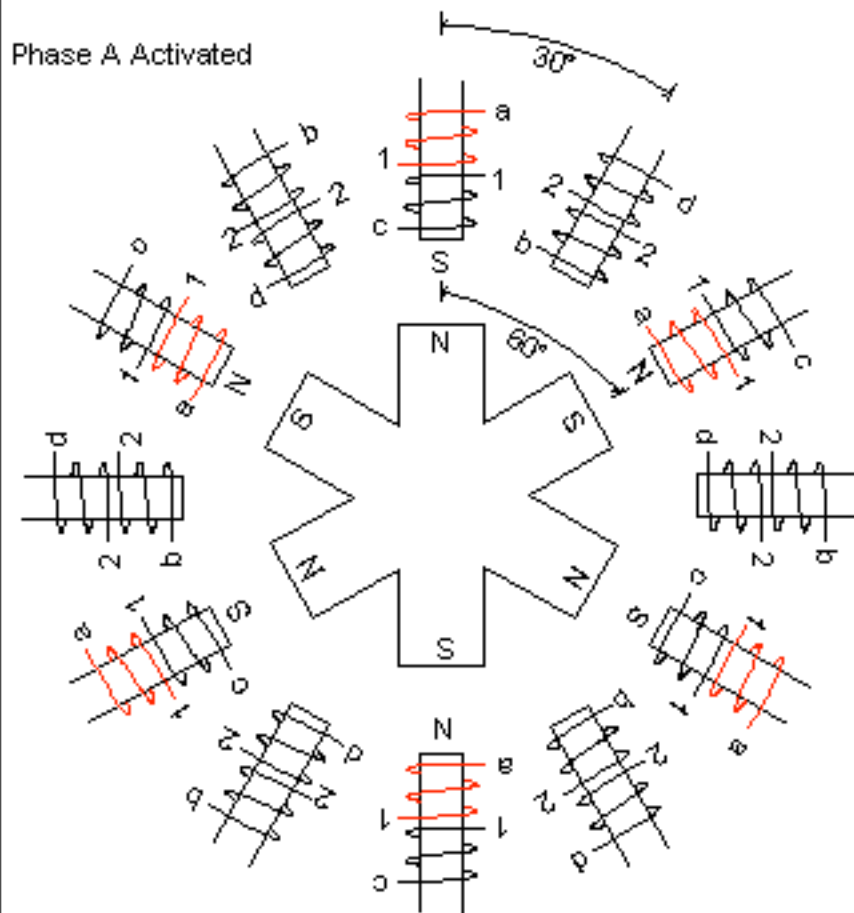


# Other Motors: Steppers, Gearheads, Vibrating

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# Stepper Function



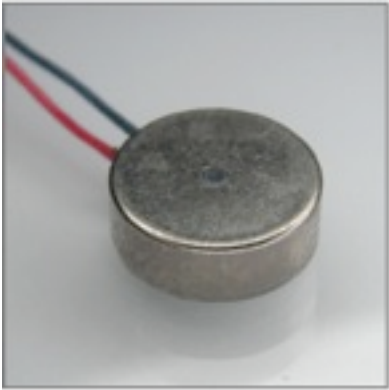
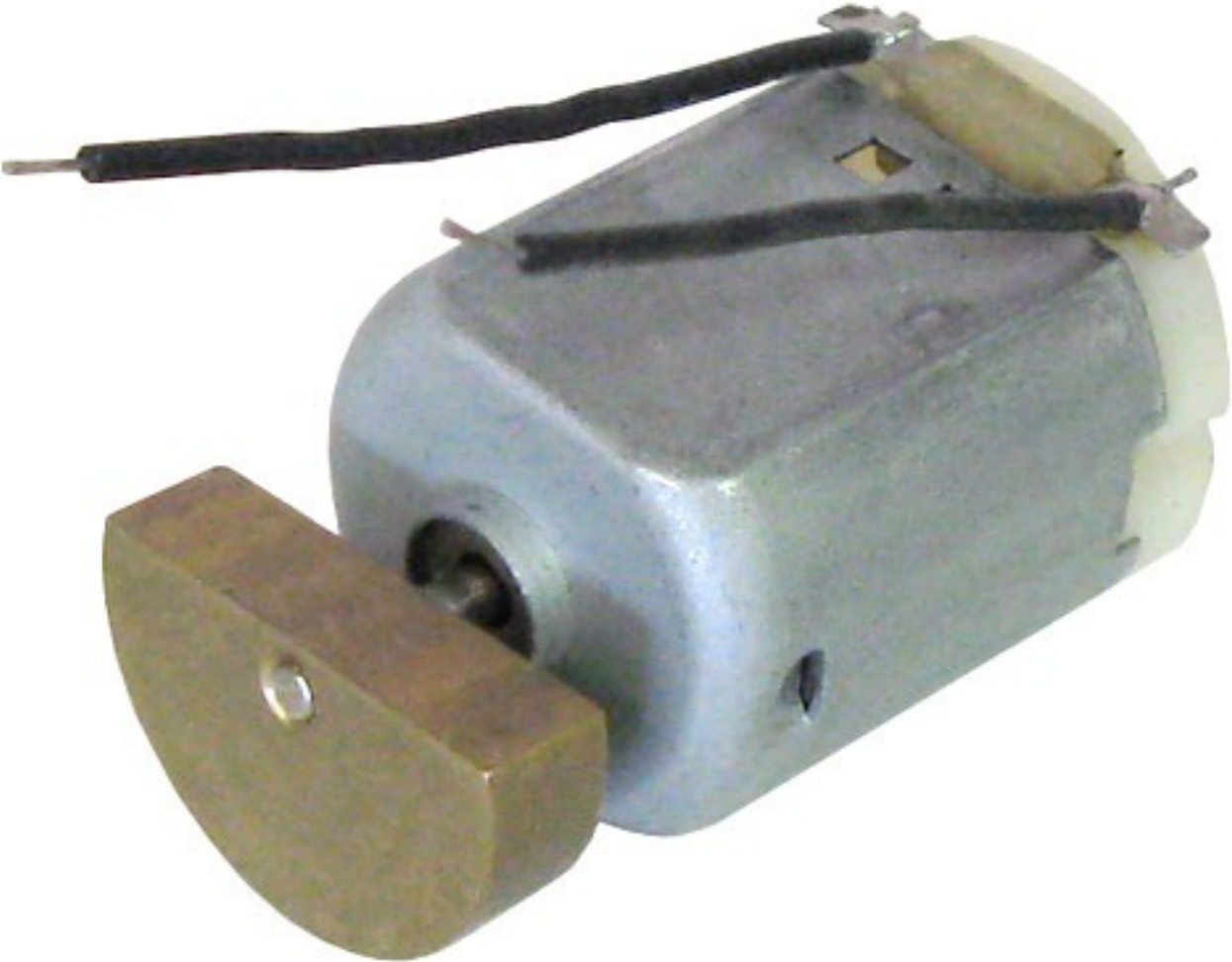
# Gearhead

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# Vibration Motors

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# Characteristics of Motors

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- **Rated Voltage:** The voltage at which it operates at peak efficiency.
- **Current:** Depends on the load. Usually more load means more current.
- **Stall Current:** The current it draws when it's stopped by an opposing force.
- **Running Current:** The current that it draws when it has no load.
- **Speed:** Given in RPM or RPS.
- **Torque:** The measure of how much force it can generate at a given distance from its center of rotation.

# Midterm Project

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- Design a New Solution for an Existing Problem.
- Work in groups to:
  - observe the situation
  - create an early prototype
  - test the prototype
  - ...and incorporate your findings into a revised solution system.

# Readings and Assignments

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- Readings
- Readings
  - Physical Computing, chapter 10
- Assignment
  - Motor Lab
  - Observation for Midterm Project: *Design a new solution for an existing problem. **Work in groups to observe the situation**, create an early prototype, test the prototype and incorporate your findings into a revised solution system.*