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After the Break

Arduino

file → ex → basics → link.

Digital Right

arduino

small computer with tiney memory.

⇓

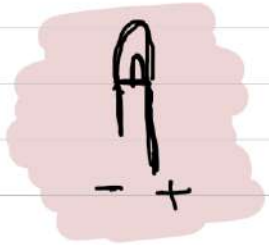
Use for interface

Digital vs. Analogue. ← Use it (analogue Write)

on - off

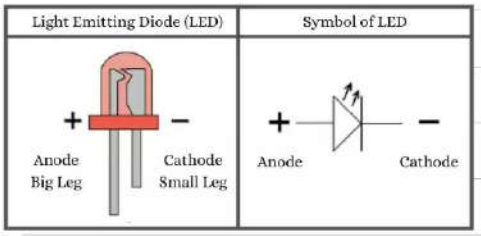
Fast - Slow

bright - Dim

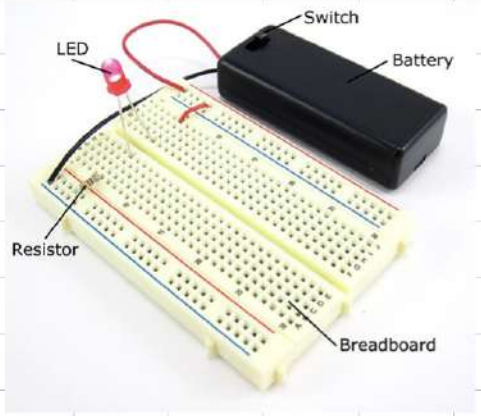


Solderless breadboard help us creat resistors

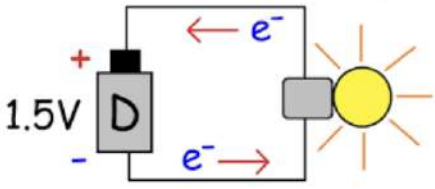
resistors Lower current limit it



Solderless Board



Basic Electricity



electrons move from

Circuit

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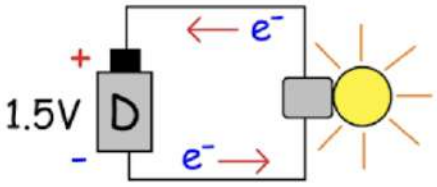
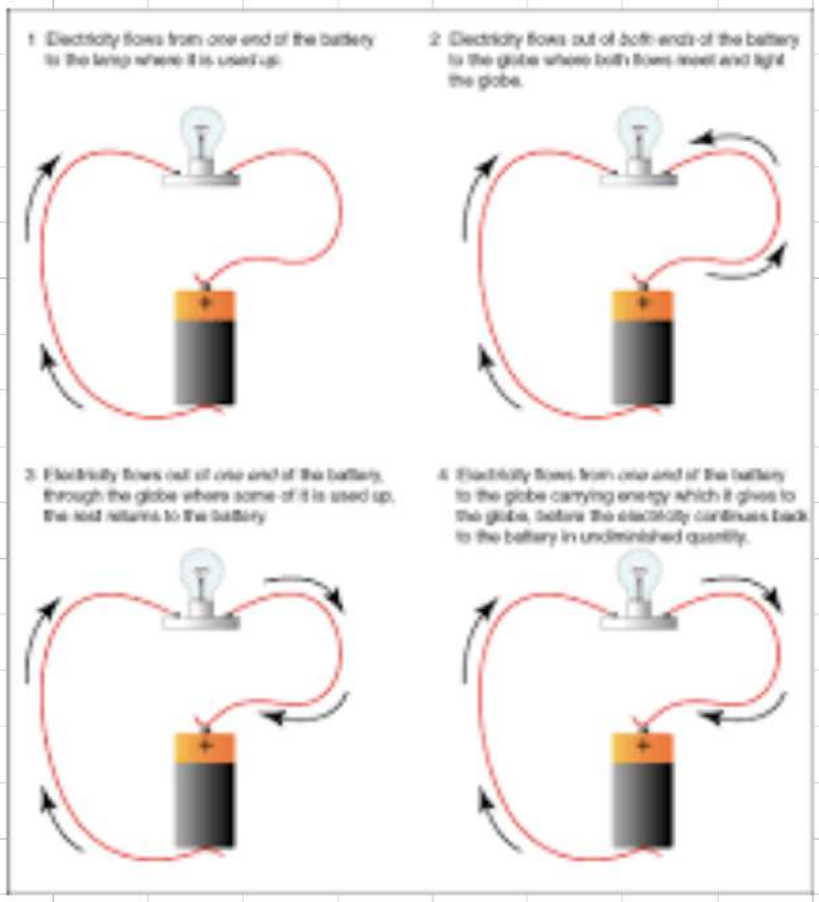
Basic Electricity



electrons move from higher potential energy to lower potential energy

Electricity moves in a conductor

Circuit

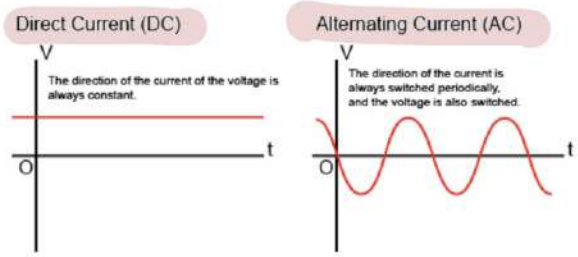


There are two methods of electric current. These are direct current (DC) and alternating current (AC).

Direct current is a method in which electricity always flows in a certain direction, as compared to the flow of a river. It refers to the flow of electricity obtained from batteries, batteries, solar cells, etc.

On the other hand, alternating current (AC) is a method in which the positive and negative sides are constantly switched periodically and the direction of the flow of electricity changes accordingly. This is the flow of electricity obtained from a generator or outlet. The electricity produced at power plants and sent to homes is also transmitted as alternating current.

The diagram below shows the flow of DC and AC electricity.



In direct current, the voltage is always constant, and the electricity flows in a certain direction. In contrast, in alternating current, the voltage periodically changes from positive to negative and from negative to positive, and the direction of the current also periodically changes accordingly.

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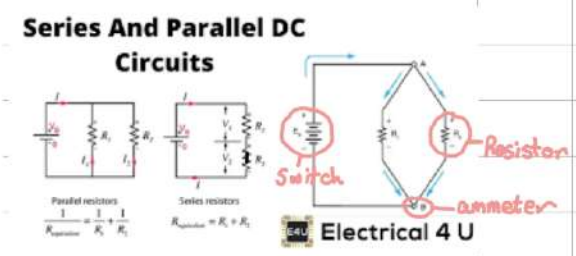
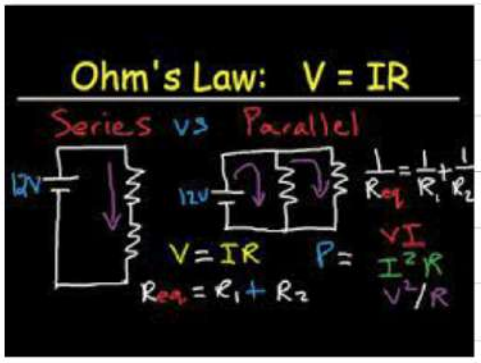
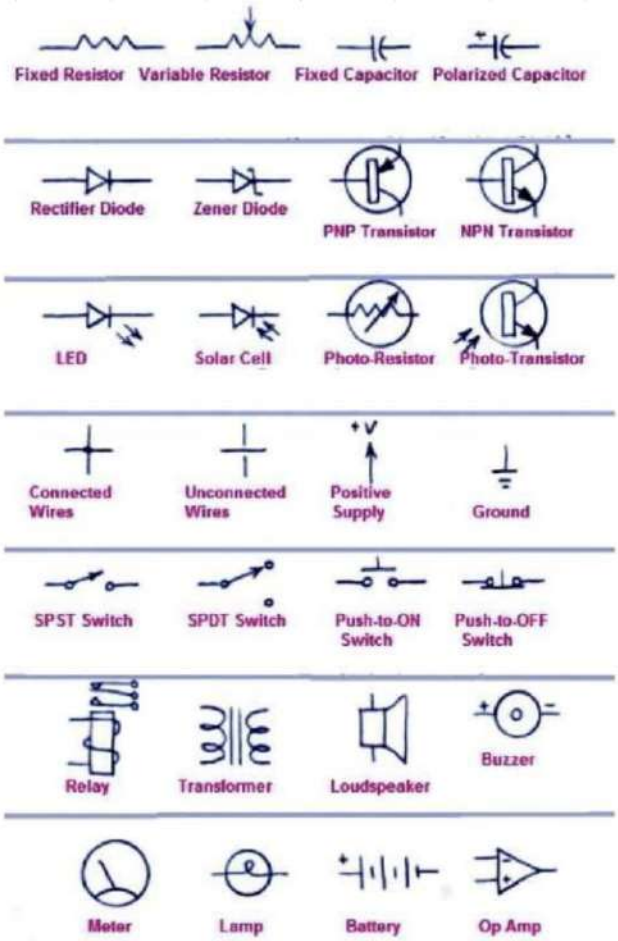
Circuet → A circular path that electricity flow through



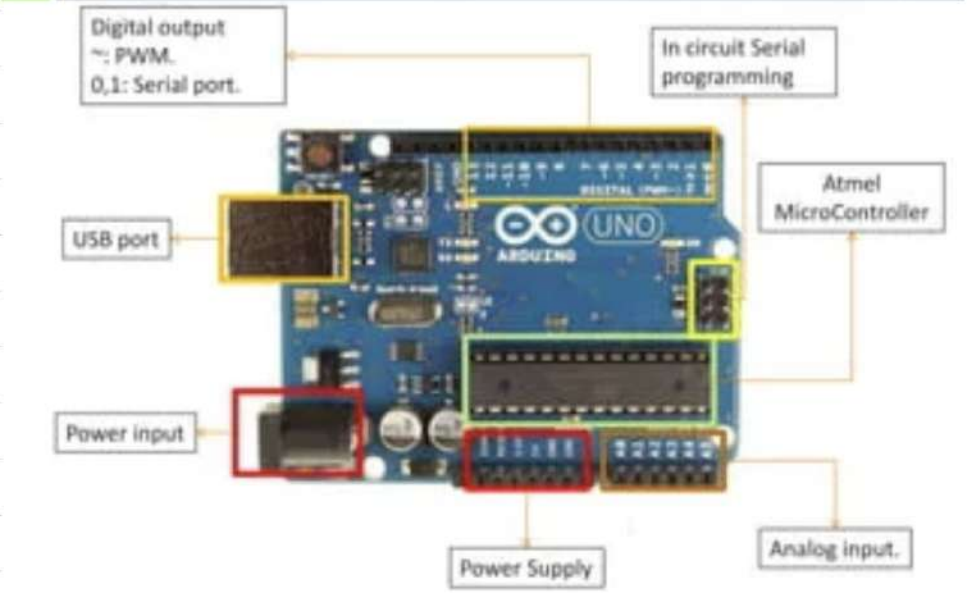
*Circuet provides diff. in potential that will cause electrons to move.
ie: Battery, charger, USB port
→ Produces a power supply



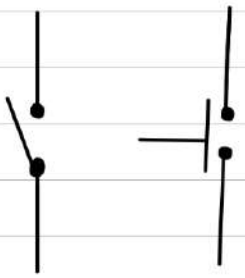
Arduino
are conductors that allow electrons to move.
→ Components or other things that convert electrical energy to some other energy form.
(Sound, heat, light, mvmnt)



Arduino UNO:



Switches & Buttons



Switch push button.

when they are open it means that they are in the normal position which is closed.

Push button: momentary switchers
brings two pieces of metal together when you push down on it.
- Stay closed as long as you hold them

Switch:
a mechanism that brings 2 pieces of metal together using some form of level action.

* A single switch can control more than one set of contact.

Single Pole Switch

↳ Has only one set of contact that closes or opens

Dual Pole Switch

↳ have 2 sets of contacts being controlled by the same mechanism.

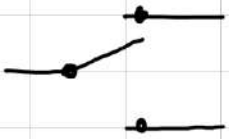
Can switch 2 circuits at the same time

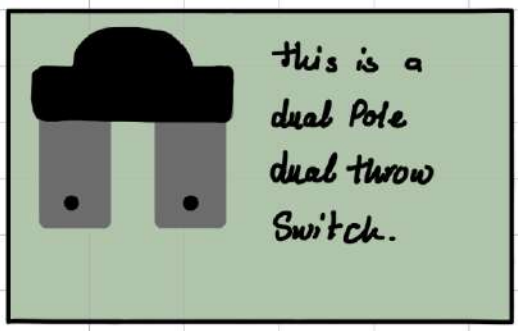
Single throw

has one contact

Dual throw

has 3 contacts.
- It moves a center contact from one outer contact to the other outer contact





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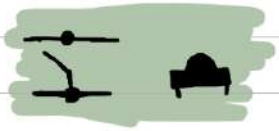
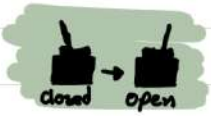
*Roller Switchers are push buttons with a lever & a roller attached

*Tactile Switcher have a tactile click. Designed to be soldered to a circuit board



*Arcade Button popular in games. Big & Robust. Often have a built in led.

*Toggle Switch stay closed in one position & open on the other



*Magnetic Switcher
Magnitic Snaps.

*Whisker Switchers

*tilt Switchers.

emotion attractive

- occasion - context & mood

-color power on emotions

Design = UIsability + beauty

affect & Cognition
↓
regulates
how we solve
Problems & preform
tasks.

Her Code IVo Human on the Moon

→Margret Hamilton → 1960
dev. software
Apello

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Electricity Basics.

is the flow of electrical energy via conductive material.

Physical computing helps figure out what form of energy a person is putting out & what kind of transductor to read that energy

- transform some form of energy into electrial energy.
  - mic changes sound waves into electrical volt

Transduction
↳ change one energy into another a process.

Transductors are the devices that change one energy into another

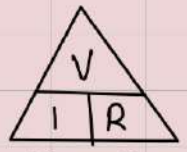
Current - I
is a measure of the magnitude of the flow of electrons in a circuit.
Ampers, Amps

→ amount of electricity flow at a certain point
* the ↑er the amps the ↑ electrical flow

Voltage - V
is the measure of electrical energy of a circuit.
Volts

→ electrical pressure

$V = I * R$



$I = \frac{V}{R}$ $R = \frac{V}{I}$

Resistance - R
is the measure of a materials ability to oppose the flow of electricity. Ohms

→ Limits the current

Electrical Power (P) (Watts)

Watts = Volts • Amps
W = V • A

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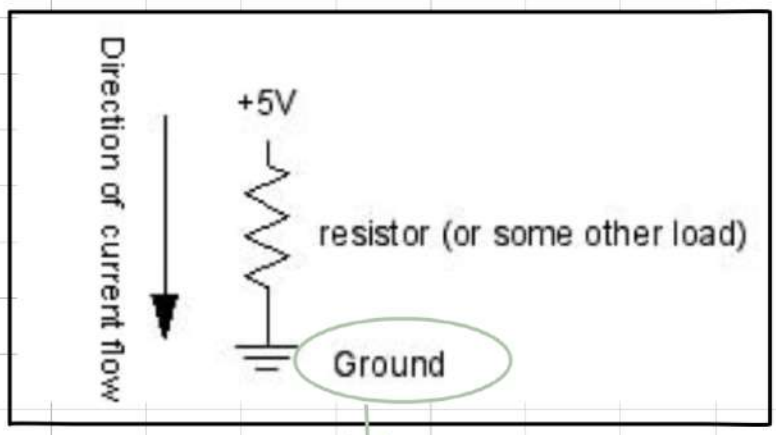
electrical current comes from the flow of ↑ potential energy to places of lower potential energy. from +ve to -ve.



is the place in a circuit where the potential energy of the electrons is zero

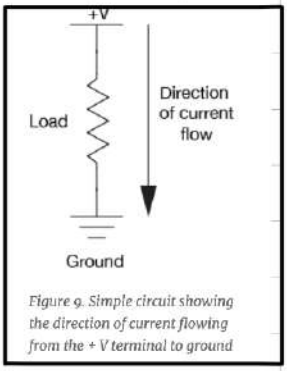


Figure 9. Simple circuit showing the direction of current flowing from the + V terminal to ground

Series

- volt drops across each resistor &

$\Delta R = R_1 + R_2 + R_3 \ldots$

$\Delta V = V_1 + V_2$ ----

to calculate the voltage at each point

$V = I * R$

Series vs Parallel

Parallel

Voltage is =

but the Current is divided to them equally.

$\Rightarrow I_1 + I_2 = \Delta I$

Rules

1- Current flows the path of least resistance to the ground.

2- In any given circuit the total volt around the path of the circuit is zero

3- the amount of current going into any point in a circuit is the same as the amount coming out of that point.

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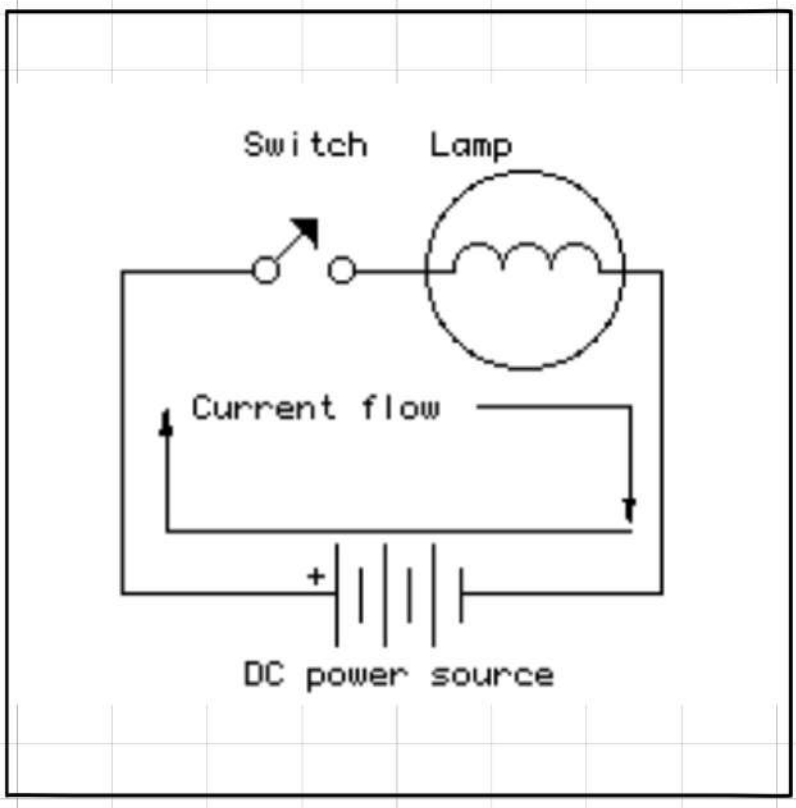
Circuit
is a closed loop containing a source of electrical energy & a Load converts electrical enrgey to some other form of energy

*Short Circuits do not have load.



2 types of Circuits

- **Direct Current**
  - 1D flow
- **Alternating Current**
  - reversed in a regular repeating cycle

Conductors are materials which electrical current moves freely

Insulators are materials which prevent the flow of electricity

Resistors help resist the flow of electricity.

Capacitors store electricity while current is flowing into them then release energy when the incoming current is removed.

Note:
If a capacitor is polarized make sure you wire it correctly otherwise it will explode

Polarized Capacitor

not polirized

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Diodes

permit the flow of electricity in one direction & blocks it in the other direction

to volt to ground

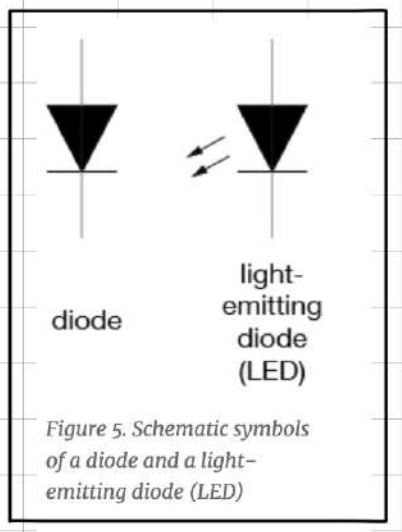


Figure 5. Schematic symbols of a diode and a light-emitting diode (LED)

Watts = Volts * Amps

or

P = V * I

Light-Emitting Diodes (LED)

a spacial type which emit light when current flow throught them

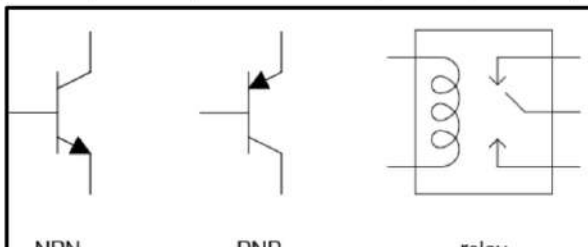


Figure 7. Schematic symbols for an NPN transistor, a PNP Transistor, and a Relay

Switchers

Control the flow of the current

transistors - relays

Switching devices.

NPN transistor PNP transistor

Thermosistor change resistor in rxn to varying temp.
Photoresistor change resistor in rxn to varying light
flex sensors change resistor in rxn to being bent or flexed
piezoelectric devices creat varying voltage in rxn to slight change in pressure.

Sensors
are components that convert other forms of energy into elect. energy so we can read the changes in those other forms.

Actuators
are components that convert electrical energy into other forms

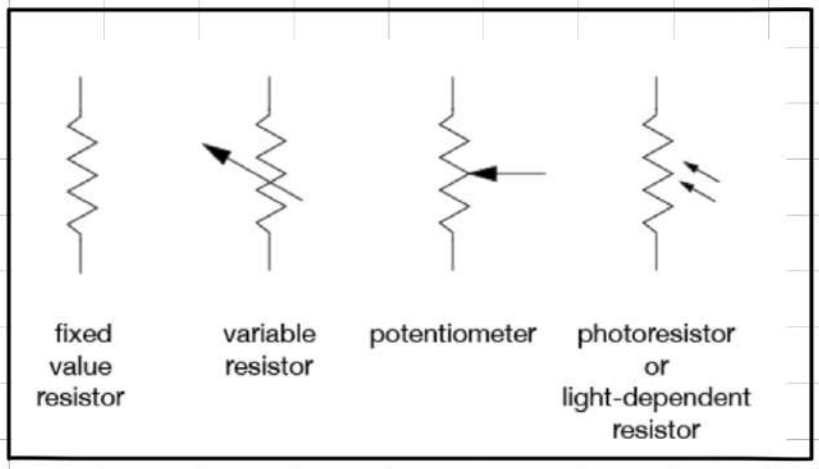
Electronics
refer to reading changes in electrical properties as info.

Transduction
is the process of changing one energy into another

Schematic Diagram
Diagrams of circuits that represent the electrical relationships btwn the components in the circuit.

Electrical Circuit
/ Power source

\ Comp that convert elect. energy into other form of energy



Digital \ Binary inputs _ 0, 1

↳ off or on. If a voltage is open "On" or not flowing "off"

Figure 1 shows the electrical schematic for a digital input to a microcontroller. The current has two directions it can go to ground: through the resistor or through the microcontroller. When the switch is closed, the current will follow the path of least resistance, to the microcontroller pin, and the microcontroller can then read the voltage. The microcontroller pin will then read as high voltage or HIGH. When the switch is open, the resistor connects the digital input to ground, so that it reads as zero voltage, or LOW.

On an Arduino module, you declare the pin to be an input at the top of your program. Then you read it for the values 1 (HIGH) or 0 (LOW), like so:

```
void setup() {
 // declare pin 2 to be an input:
 pinMode(2, INPUT);
 declare pin 3 to be an output:
 pinMode(3, OUTPUT);
}

void loop() {
 // read pin 2:
 if (digitalRead(2) == 1) {
   // if pin 2 is HIGH, set pin 3 HIGH:
   digitalWrite(3, HIGH);
 } else {
   // if pin 2 is LOW, set pin 3 LOW:
   digitalWrite(3, LOW);
}
```

Digital inputs
Sense activities which have 2 states

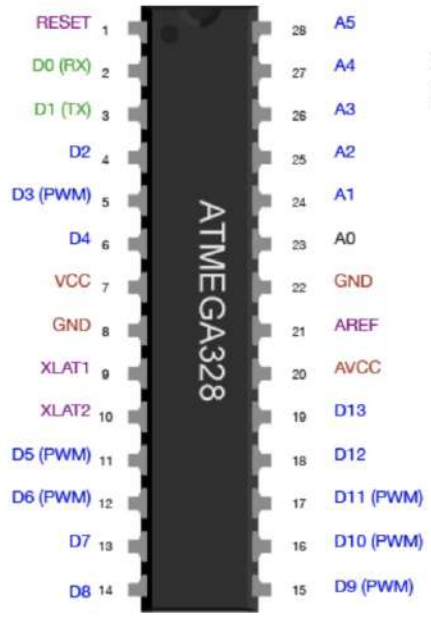
Digital/binary outputs
Control activities which can have 2 states

Microcontrollers
Simple computers that take input from the out world & control output devices in the physical world

Bootloader
is a firmware program that lives in a part of the controller's memory & can re-program the rest of that memory.

Operating System
a program that maneges other programs

Digital Write ()
- HIGH
- LOW



Microcontroller Ports

- Power connectors
- GPIO connectors
- Communication connectors (also GPIO)
- Special function connectors

Figure 4. ATMEGA328 pin diagram

The **applications** that an operating system runs also live on external storage devices like disk drives.

Firmware	Stored On	Detail
Single Program	Processor's program memory	Is the only program running; must be loaded by hardware programmer
Bootloader	Processor's program memory	Must be loaded by hardware programmer; Takes small amount of program memory; can load another program into the rest of program memory
BIOS	Processor's program memory	Usually loaded by bootloader; can load operating system into RAM memory

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Tool chain is the combination of Complers & linkers needed to convert the instructions written into Binary Files that the microcontroller can interpret as its instructions & the programmer software needed to upload that into the processor.

Software	Stored on	Details
Operating System	External mass storage	Runs other programs; loaded into RAM by BIOS; unloaded from RAM on reset
Drivers	External mass storage	Controls access to other processors, like disk drivers, keyboards, mice, screens, speakers, printers, etc. These are usually loaded into RAM on startup of the OS, and controlled by the OS, not the user.
Applications	External mass storage	Loaded into RAM by operating system and unloaded as needed

Integrated dev. env. (IDE)
Is needed to connect the programmer to the toolchain
→ Contains a text editor with UI elements to send text to toolchain to proceosor.