# Week 1

Two good options that can be used for microcontrollers can be arduino or raspberry pi

* Arduino
  + No OS but uses their own firmware to operate
    - There are methods to still use ROS if needed.
    - We can use the ardunio’s IDEs as well, which seems very solid for different operations.
  + HC-05 wireless bluetooth allows for serial communication (like for the remote control if we need it)
    - Some Arduinos come with bluetooth, but not all of them. So, in that case we would need this type of hardware.
  + Commonly programmed in C/C++ but other languages can be used (setup required).
  + Price is more affordable being as low as $8 and average price being about $20 give or take. There are also many different kits available which can come with various components which can be useful instead of outsourcing compatible components.
  + The microcontroller platform is designed for executing more simple tasks but still can read sensor data or controlling motors. Ardunio has lower processing power (how much processing power is needed for tasks).
    - Usually an 8-bit or 32-bit processor
  + Less overhead due to no OS, so real-time operation
  + Usually less power consumption compared to the raspberry pi (depends on the model used of course)
  + Quick setup, beginner friendly, and has many different variants
  + Cannot handle more complex computations, data processing, or multithreading
* Raspberry pi
  + Uses operating system can be linux or the raspberry pi official OS which is Raspberry Pi OS
    - Linux OS can use ROS, and would have a high level of control for coordinating different parts of the robot
    - Raspberry Pi OS has beginner IDEs like Thonny, Python IDE, Mu editor, and greenfoot.
  + For most of the interactions of the raspberry pi there is on board bluetooth
  + Coding languages can be basically any like python, C/C++, or others.
  + Price is on the higher side being ~$35 at the least lowest and the average being about $80 plus (price affects which components you get)
  + The single-board computer can handle more complex computations. Usually has higher processing power (again how much processing power is needed; ie senors needed)
    - Usually an 64-bit ARM processor
  + Some overhead due to OS, but with OS allows for file management, mult-threading, and networking.
  + Usually more power consumption compared to the arduino (depends on the model used of course)
* Opencv is computer vision which can be used with either raspberry pi or arduino.
  + Uses python usually, but can be used with other languages.
* Tensorflow machine learning, deep learning, and more can work with either raspberry pi or arduino
* Power battery pack can be used for the components, but an estimate of overall power consumption needs to be made before power concerns.
  + Voltage regulator would be important for keeping the more sensitive components safe.

Rough notes for pins needed currently

Ultrasonic sound senor (4)

-2 pins each

PIR (at least 2 or 3)

-3 pins

Sound sensor (1 or 2)

-1 pin

Encoders from motors ()

Motor controller

Lights flash

Sound of speakers

# Week 2

* Arduino Uno
  + 14 Digital (6 can be used for PWM)
  + 6 Analog
  + 2KB SRAM
  + 32KB Flash Memory
  + 1KB EEPROM
  + 1 UARTS
* Ardunio Mega
  + 54 Digital
  + 16 Analog
  + 15 PWM Output (PWM = Pulse Width Modulation)
  + 8KB SRAM
  + 256KB Flash Memory
  + 4KB EEPROM
    - More space to run programs, write programs, and store data
  + 4 UARTS (used for other modules bluetooth, or others)
  + If needed many different kit shields which can be added on (these can be modules that are attached to the board)

Purchasing arduino (price checked on 10/14/2024)

* Official website (~55.80)
  + <https://store.arduino.cc/products/arduino-mega-2560-rev3>
* Amazon (Arduino Official)
  + [Arduino Mega 2560 REV3](https://www.amazon.com/ARDUINO-MEGA-2560-REV3-A000067/dp/B0046AMGW0/ref=cm_cr_arp_d_product_top?ie=UTF8) ($53)
  + [Arduino Mega 2560 REV3 with kit](https://www.amazon.com/Arduino-Starter-Kit-English-Official/dp/B009UKZV0A/ref=sr_1_3?crid=2ZYVFJS26Y299&keywords=arduino+starter+kit&qid=1636675074&qsid=130-8919317-3781661&sprefix=ardui%2Caps%2C214&sr=8-3&sres=B009UKZV0A%2CB01D8KOZF4%2CB01EWNUUUA%2CB00UET6VJ6%2CB07B7JJQMF%2CB01CZTLHGE%2CB092Z449GX%2CB01DGD2GAO%2CB074WMHLQ4%2CB07RF9LB17%2CB097PB341P%2CB00BT0NDB8%2CB07K9L716J%2CB08B4JY95V%2CB08CZ778DJ%2CB07W3NFBSG) ($88.32)
* Amazon (Elegoo offbrand, but highly rated)
  + [ELEGOO MEGA R3 Board ATmega 2560](https://www.amazon.com/ELEGOO-Compatible-Arduino-Projects-Compliant/dp/B01H4ZLZLQ/ref=sr_1_1?dib=eyJ2IjoiMSJ9.C9li7QlUOdnawgCr8xZlUVsoHu9l9PdZgCa7N7yN-ml8bYidvL-XmvdczkIbYvmNP6kJF0AbJ3DpU5CA3Mb7yQaiLAhxI4weOpOrw_5wwGsnCphaVK_VxSV6JWOnuwUMxPnFZZ7PxG8FdOkf1KoxysBYdTPOua_4gYQwAOcFYDoS2jkFv2A5Z6TpuJ4qdykjRPSO9QQk9d26z-vVdwdtrry9ek33m_CwhmE3f1XZRGg.hDHi-Ju4EaGTwiRrSY55HUJo_8m5Ct_pDv21wBmk9AA&dib_tag=se&keywords=arduino%2Bmega&qid=1728922822&sr=8-1&th=1) ($21.99)
  + [ELEGOO MEGA R3 Board ATmega 2560 with kit](https://www.amazon.com/EL-KIT-008-Project-Complete-Ultimate-TUTORIAL/dp/B01EWNUUUA/ref=sr_1_2_sspa?crid=2ZYVFJS26Y299&keywords=arduino+starter+kit&qid=1636675166&sprefix=ardui%2Caps%2C214&sr=8-2-spons&psc=1&spLa=ZW5jcnlwdGVkUXVhbGlmaWVyPUEzQzQ1UUpOSjhRS0Q1JmVuY3J5cHRlZElkPUEwMjUzODU3MUxZR0hEV1Y4VVhLSiZlbmNyeXB0ZWRBZElkPUEwNTQyNzgzMllKVEdLM0pFNURRViZ3aWRnZXROYW1lPXNwX2F0ZiZhY3Rpb249Y2xpY2tSZWRpcmVjdCZkb05vdExvZ0NsaWNrPXRydWU=) ($65.99)
    - List to all parts included (pdf download) [link](https://www.elegoo.com/blogs/arduino-projects/elegoo-mega-2560-the-most-complete-starter-kit-tutorial)
    - Noteable components I saw
      * Servo motor SG90, stepper motor, and uln2003 stepper motor driver module
        + We of course need more motors, but we can test what we like and could get more of the ones we like the best (also comes with stepper motor driver module)
      * GY-521 module
        + is a breakout board that can be a 3-axis gyroscope, a 3-axis accelerometer, digital motion processor, and temperature sensor.
      * RC522 RFID module
        + Used to identify and track objects using a reader and tags
      * IR receiver
        + This can detect signals from a remote (there is a remote in the kit as well)
      * HC-SR501 PIR Motion Sensor Module
        + PIR motion sensor which can detect motion
      * Sound sensor module
        + Detects sound waves via the sound intensity, and then converts it to electric signal
      * Ultrasonic Sensor HC-SR04 (same one from class)
      * Rotary encoder module
        + This converts the angular position of a knob into an output signal that can be used to determine which diffraction the knob is turned
      * Power supply module
      * Power
        + 9V 1A Adapter outlet
        + 9V battery snap on
      * IC 74HC595
        + High speed CMOS device. Which converts data between serial and parallel formats, allowing additional input or outputs to be added to a microcontroller.
      * I293D
        + Used for drive motors. But can also be used to drive any inductive load.
      * 830 tie-points Breadboard (longer than usual ones from class)
        + w/ jumper cables (also dupont male to female cables)
      * Numerous electronic displays and also has module that connects to displats (MAX7219)
      * Various small components like resistors, leds, capacitors, transistors, etc
    - Other components which comes with the kit which could be useful

-Side note for determining distance a VL53LOX time-of-flight sensor could be good.

