



# Advanced Manufacturing Academy 2016



## ROBOTICS Part 1 - Assembly

College of Engineering and Technology

East Carolina University

# Documentation - Contacts

- All robot documents posted online
  - [www.roboxsumo.com](http://www.roboxsumo.com)
- Contact me for information
  - Bill McClung
  - [Juhling@suddenlink.net](mailto:Juhling@suddenlink.net)
  - Cell – 252-347-3498

# Our Robot – Our Plan

- Keep it Simple!
- Building a very basic robot
- Want to show you....
  - Anybody can do it
  - Utilize powerful technology and concepts
  - Low cost
  - How robotics can connect all the facets of advanced manufacturing.

# Imbedded Processing

- Utilize a modern “Microcontroller”
  - Small computer
  - Meant to be installed (imbedded)
- Imbedded processing allows us to:
  - Collect data
  - Monitor systems
  - Control the world around us
  - The “Internet of Things” (IoT)
- Robot is just a great example.

# Building the Robot

- Let's get started!
- The Plan
  - Parts Review
  - Show you each of the assembly steps
  - You assemble your robot
    - ✓ Stay together as a group
  - Load sample code
  - Test the robots

# Assembly – The Parts

- Parts List
  - Base Plate
  - Arduino Controller
  - Servos – Continuous rotation
  - Wheels
  - Roller Assembly
  - Jumpers & Breadboard
  - Battery holder
  - Fasteners/spacers/zip ties/tape

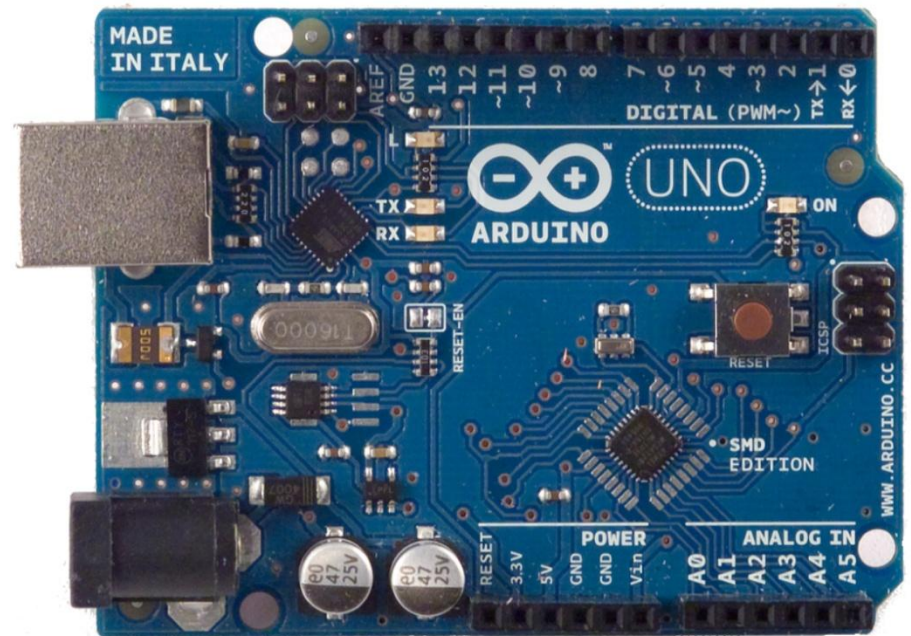
# Robot Parts – Base Plate

- Base plate
  - Predrilled
  - Note Orientation
  - FRONT/TOP



# Robot Parts – Arduino

- Arduino Uno
  - Surface Mt.
  - CAREFUL!!
    - ✓ Static sensitive
  - Main Parts
    - ✓ Power Connect
    - ✓ USB Connect
    - ✓ User Connection
      - ❖ Power
      - ❖ Analog
      - ❖ Digital





# Robot Parts – Servo

- The SERVO
  - Feetech FS90R
  - Continuous Rotation
  - Combined functions
    - ✓ Motor
    - ✓ Feedback control
    - ✓ Gearbox



[www.pololu.com](http://www.pololu.com)

# Robot Parts – Wheels

- Molded plastic wheels
  - Pololu #290
  - Intended for Futaba
  - Slight mod for us



# Robot Parts – Roller Assembly

- 3/8" Ball Caster Assembly
  - Pololu #950
  - Provides third wheel



**Pololu ball caster with 3/8" plastic ball.**

# Robot Parts – Jumpers/Breadboard

- You Build a Custom Wire Harness
  - Need wires to connect
  - Make your own
  - SO MANY variations



# Robot Parts – Battery Holder

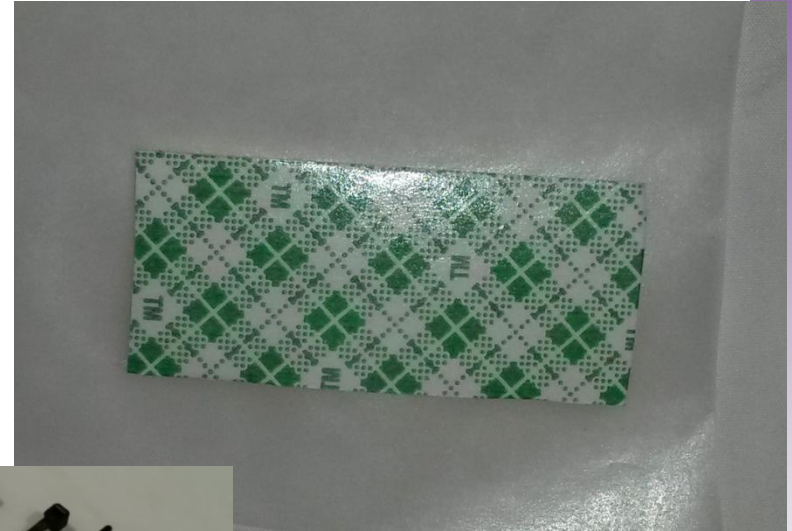
- Battery Holder
  - Jameco 2207030
  - No switch
  - On/Off – Pull the plug





# Robot Parts – Miscellaneous

- Fasteners and small parts
  - 4-40 screws
  - Spacers/Brackets
  - Tape and zip ties



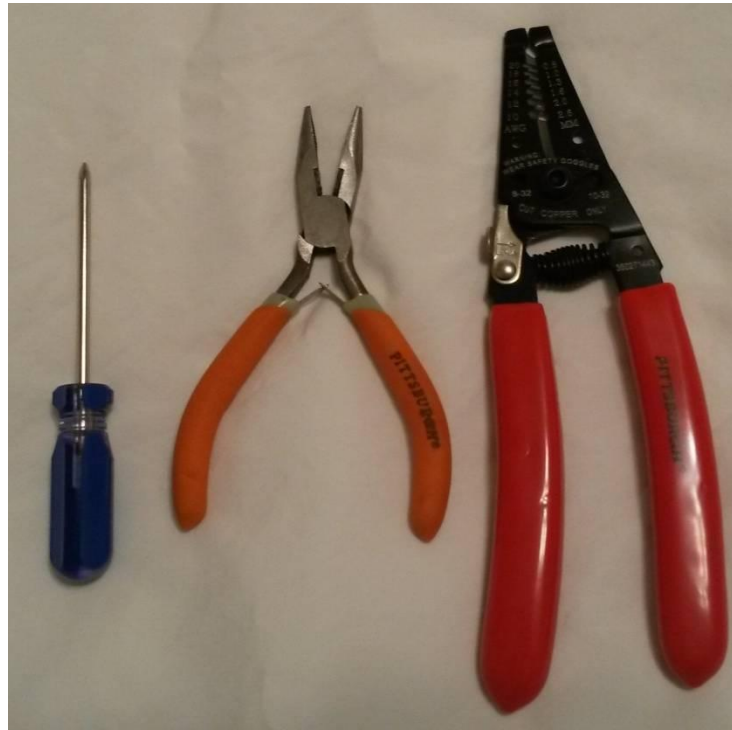
# Introducing – My Thumb

- Star of many pictures



# Assembly – Tools

- Most assembly steps can be done with pliers and screwdriver shown
- Any additional tools will be noted.





# Assembly – Step 1

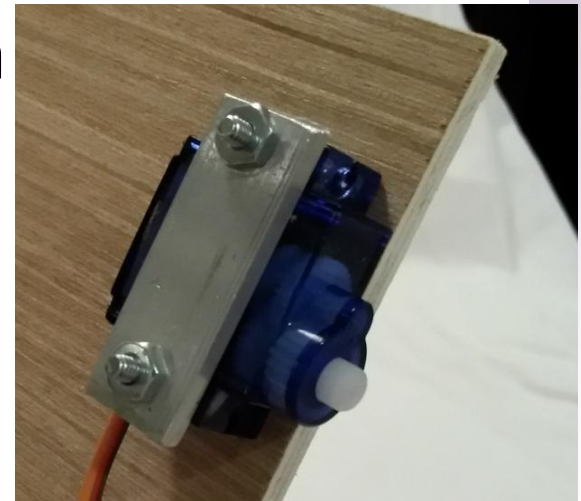
- Install Wheel/Servo Assemblies
- You will need:
  - Base Plate
  - Wheel/Servo Assembly (2 pieces)
  - Servo Mount brackets
  - 4 – 40 x 1 screws (4 pieces)
    - ✓ **Watch out - screw with flat spot**
    - ✓ Don't use the screw with flat
    - ✓ Need that one for later operation
  - 4 – 40 nuts (4 – pieces)



2 X Per Robot

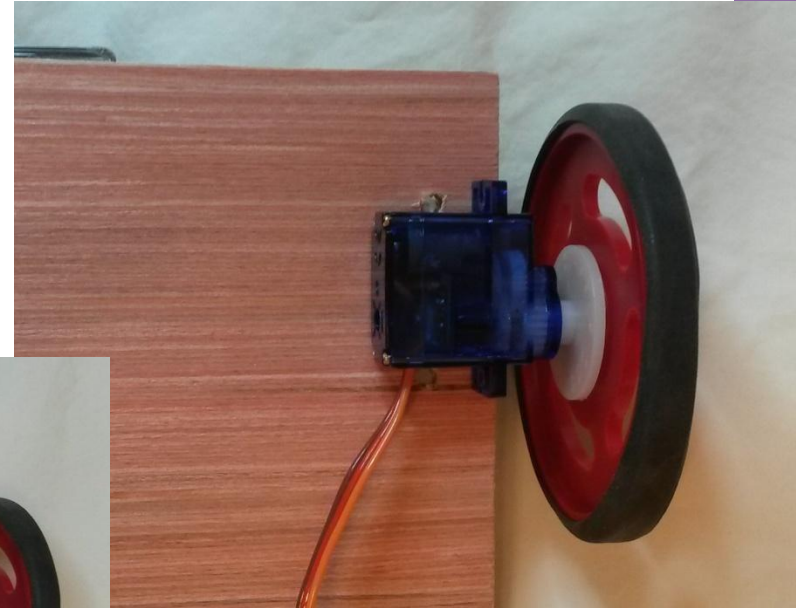
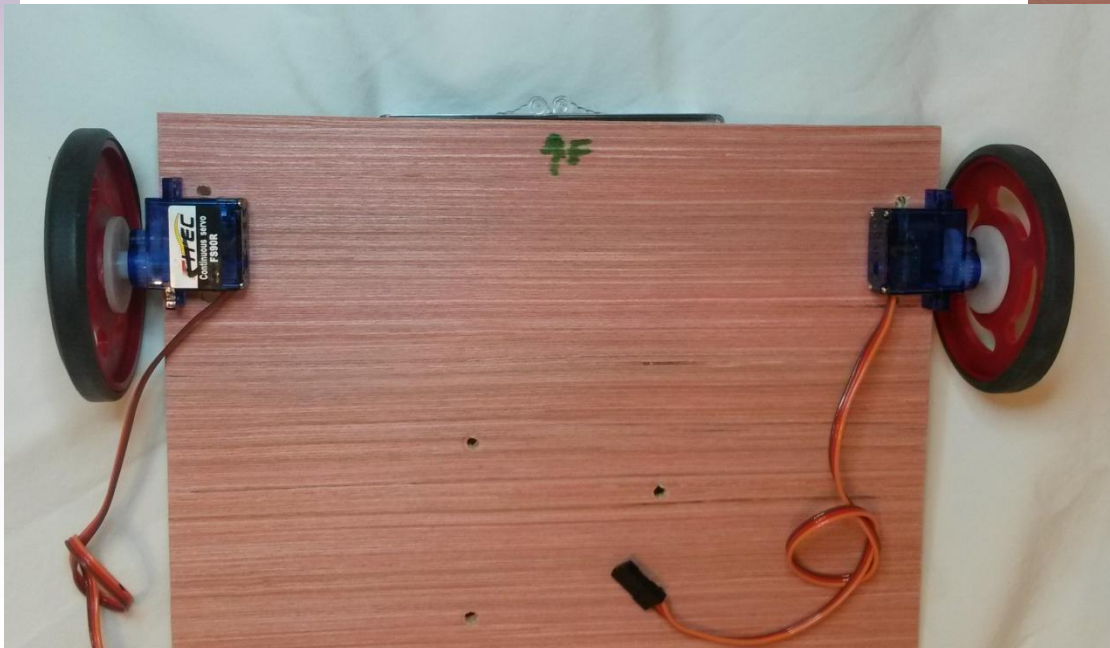
# Assembly – Step 1 (cont)

- Install continuous rotation servos
  - Note top/front orientation of base plate
    - ✓ Wheel removed for clarity – don't remove
  - Align servo as shown
  - Place bracket over the servo
  - Install screws from underneath
  - Install nuts on top of plate
  - SNUG the screws
    - ✓ Do not over tighten
  - Same assembly for both sides



# Assembly – Step 1 (cont)

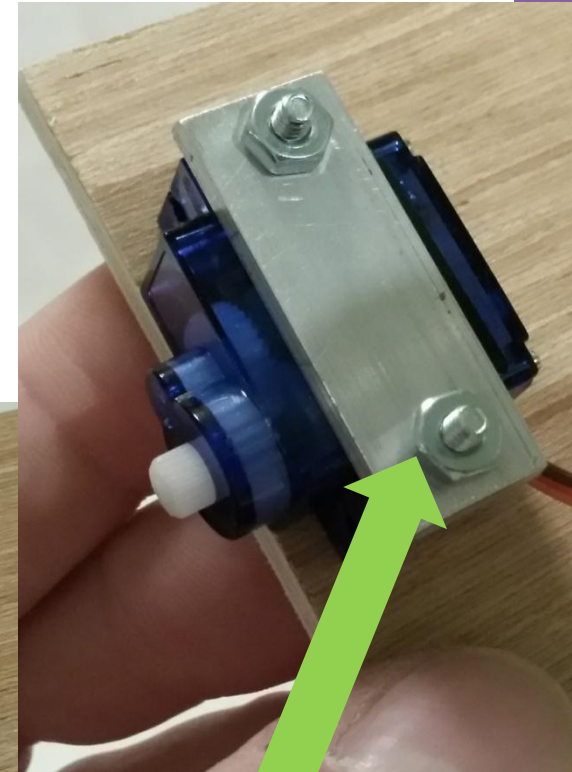
- Align servo with edge between holes
- NOTE:
  - Servo orientation (L&R)
  - Location



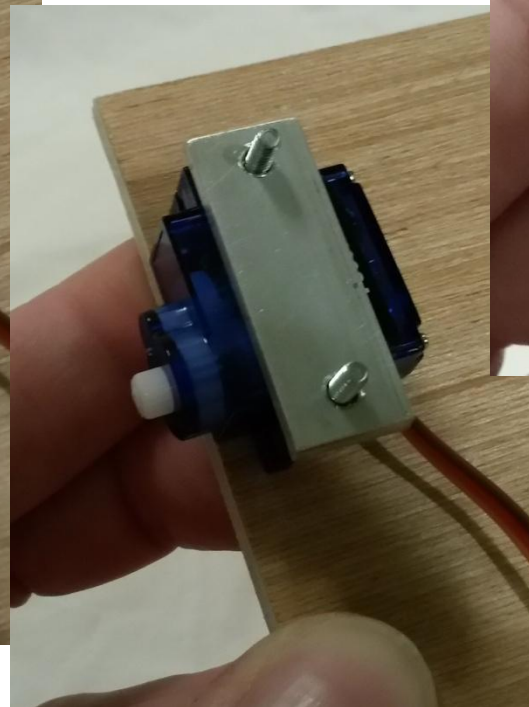
# Assembly – Step 1 (cont)

- Assemble like this....

Wheel not shown for clarity – DO NOT REMOVE WHEEL



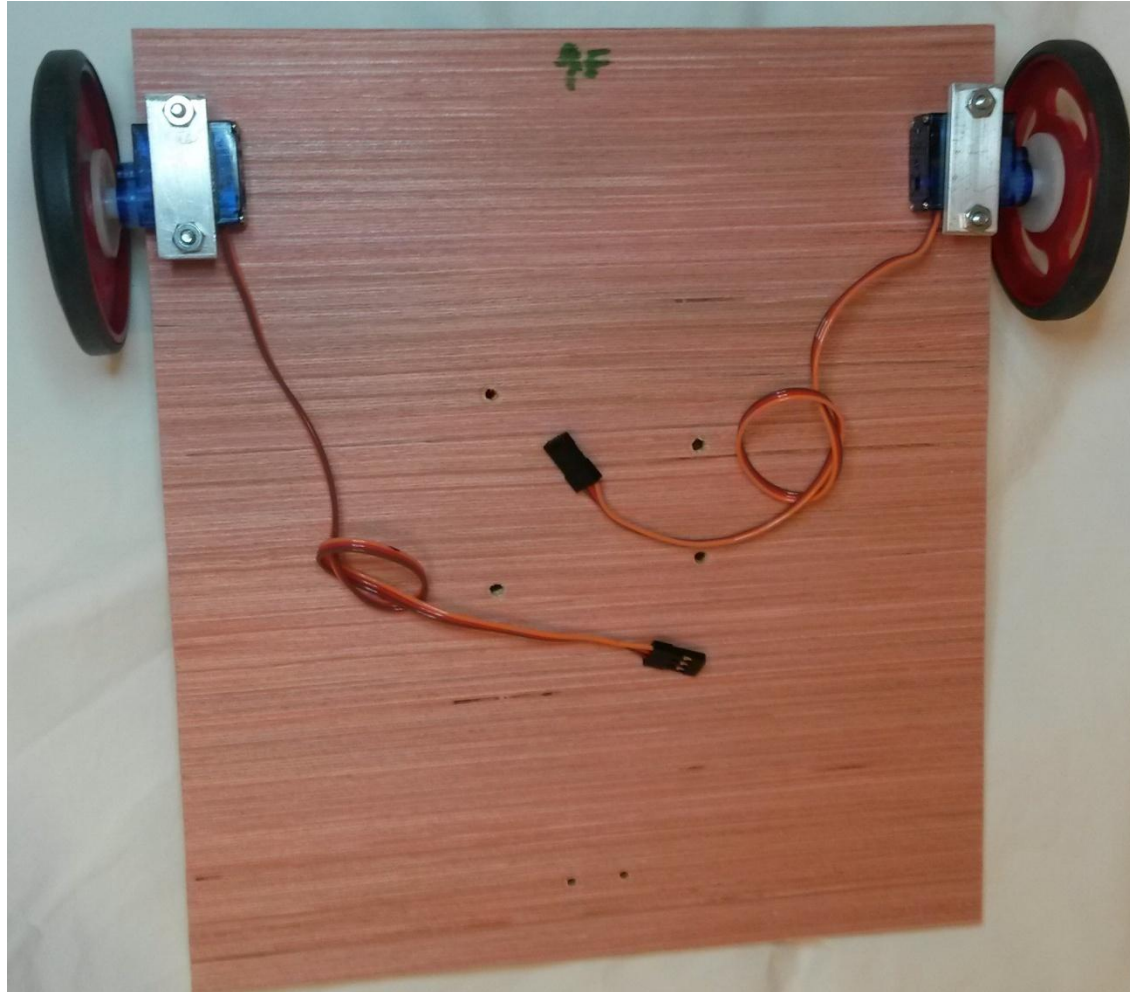
SNUG – NOT TOO TIGHT





# Assembly – Step 1 - Done

- Should look like this.

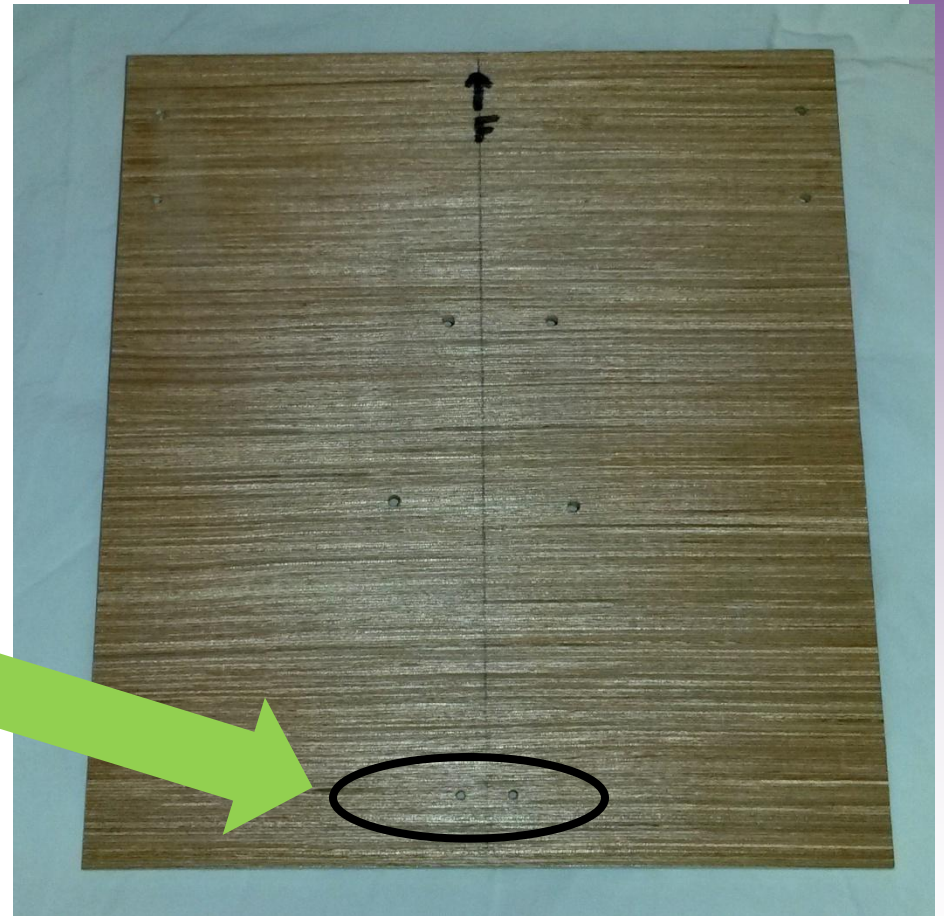


# Assembly – Step 2

- Install Ball Caster!
  - Goes under robot



Pololu ball caster with 3/8" plastic ball.



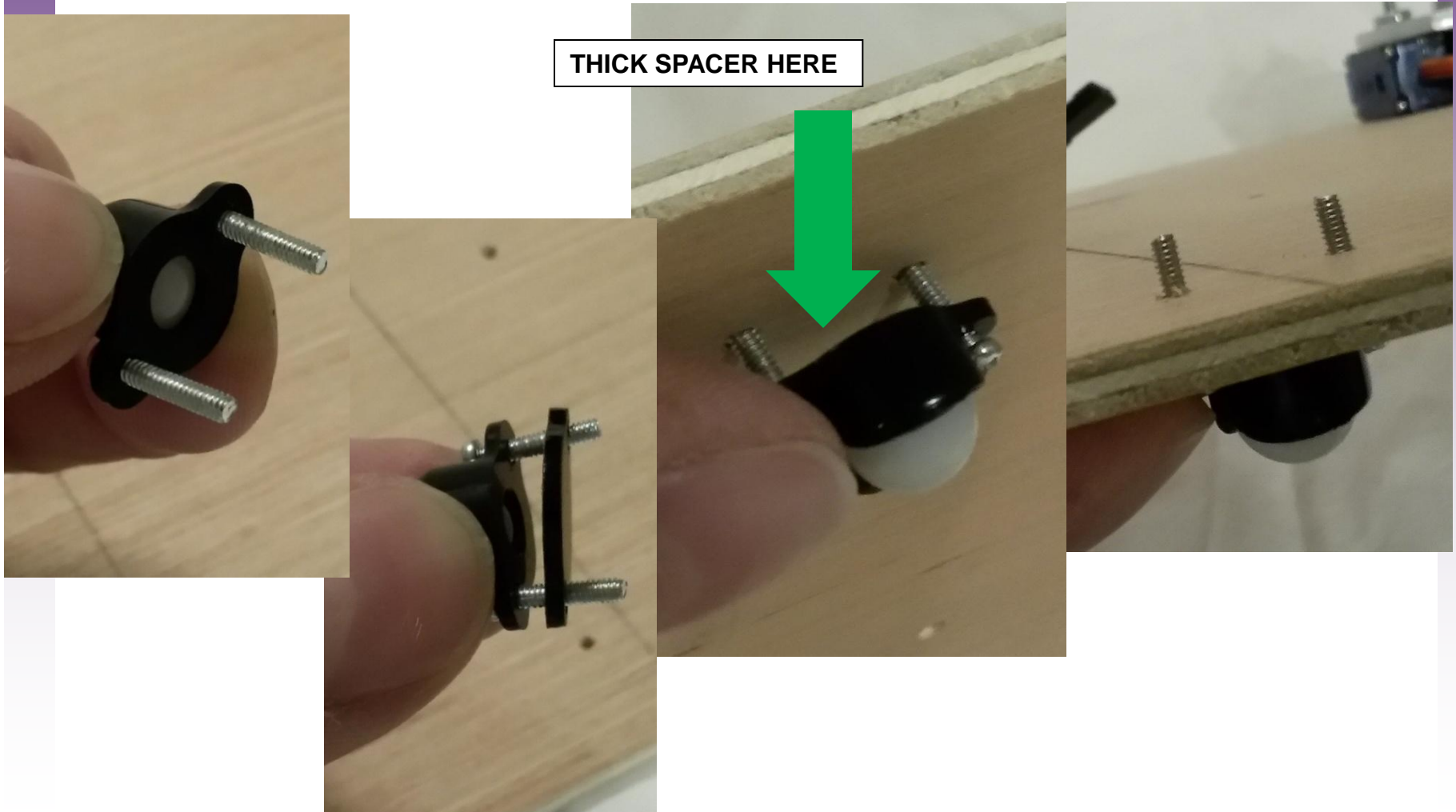
# Assembly – Step 2 (cont)

- Assemble caster like this...
  - Install screws through ball caster
  - Install spacer (THICK)
  - Push screws through holes in plate
    - ✓ Goes under the robot (Bottom side)
  - Install nuts on top side
  - Snug up nuts with pliers and screwdriver



# Assembly – Step 2 (cont)

- Assemble caster like this...

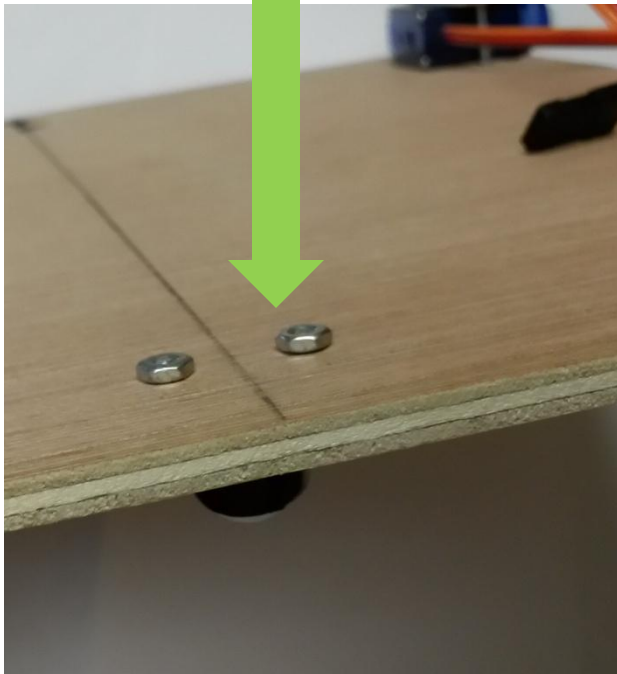




# Assembly – Step 2 - Done

- Add the nuts and it looks like this...

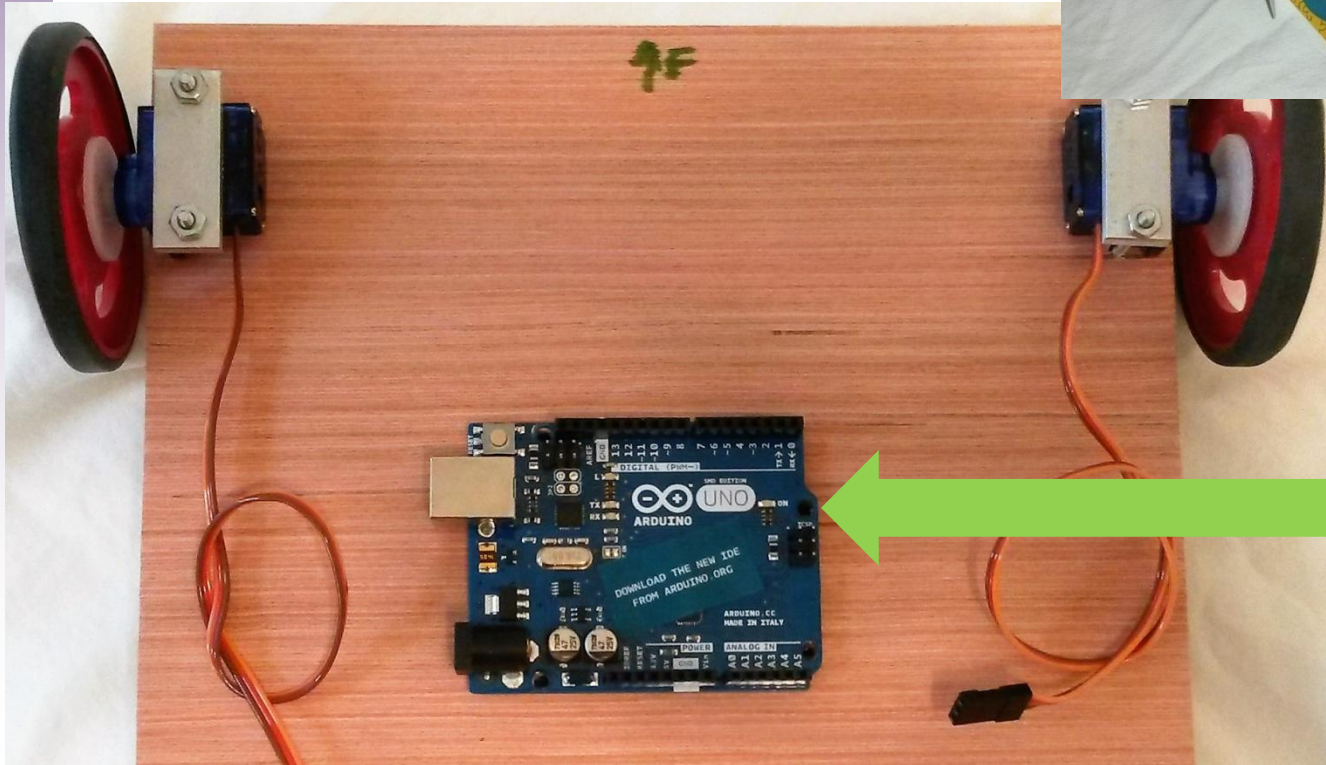
Gently tighten these nuts using pliers and screwdriver.





# Assembly – Step 3 (cont)

- Unwrap Arduino
- Check hole alignment
  - Align as shown

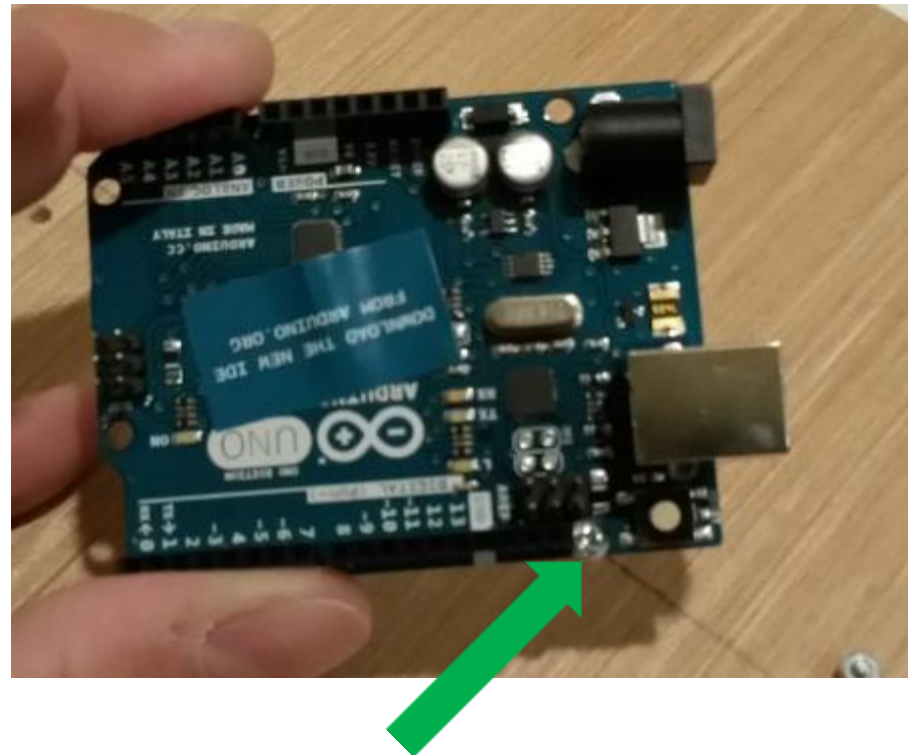


**Make sure the mounting holes line up – easier to modify before installation. 4 PLACES.**



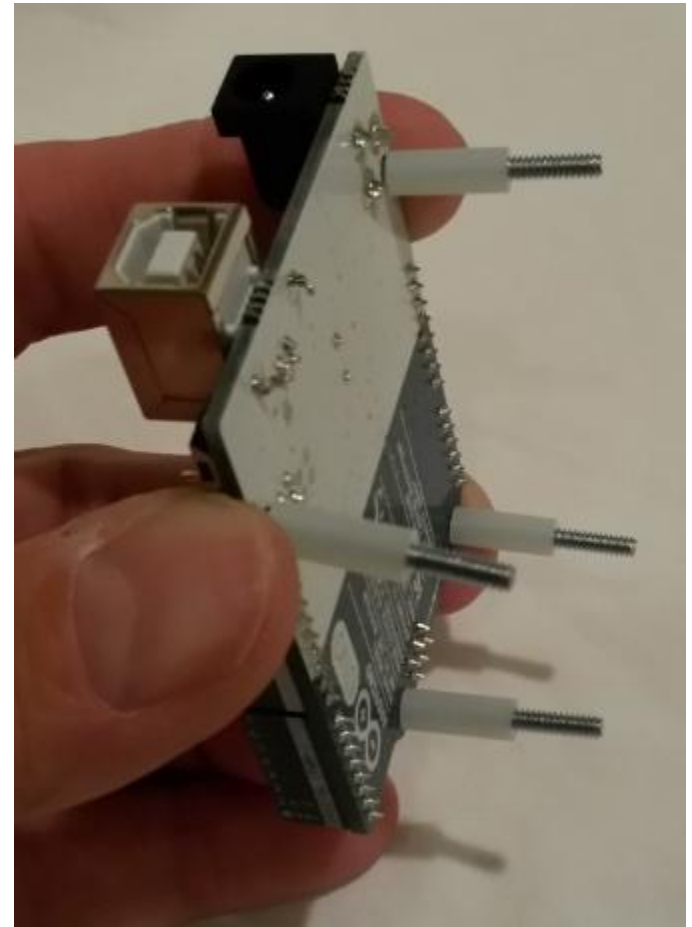
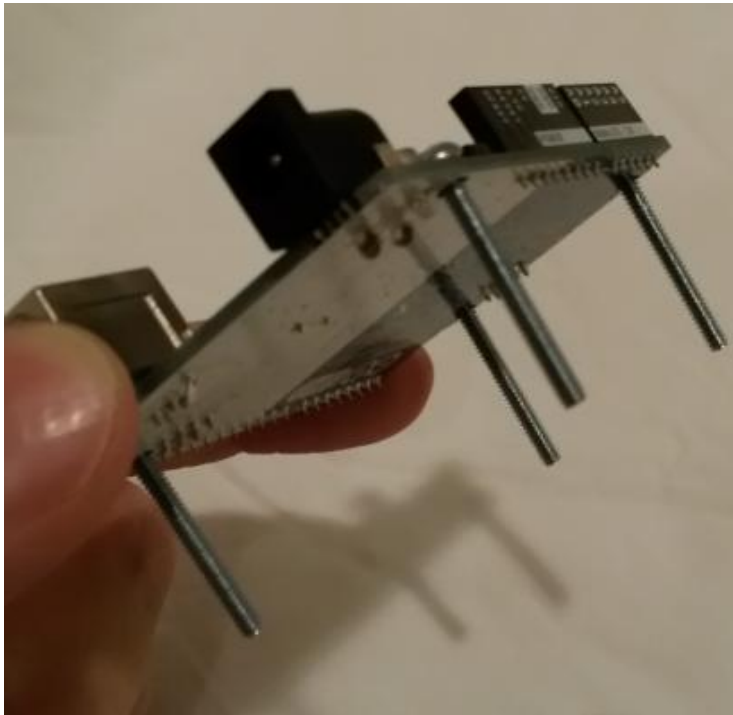
# Assembly – Step 3 (cont)

- One Screw is not like the others
  - Bottom right in picture need flat spot to fit
  - Make sure to locate flattened screw to this location.



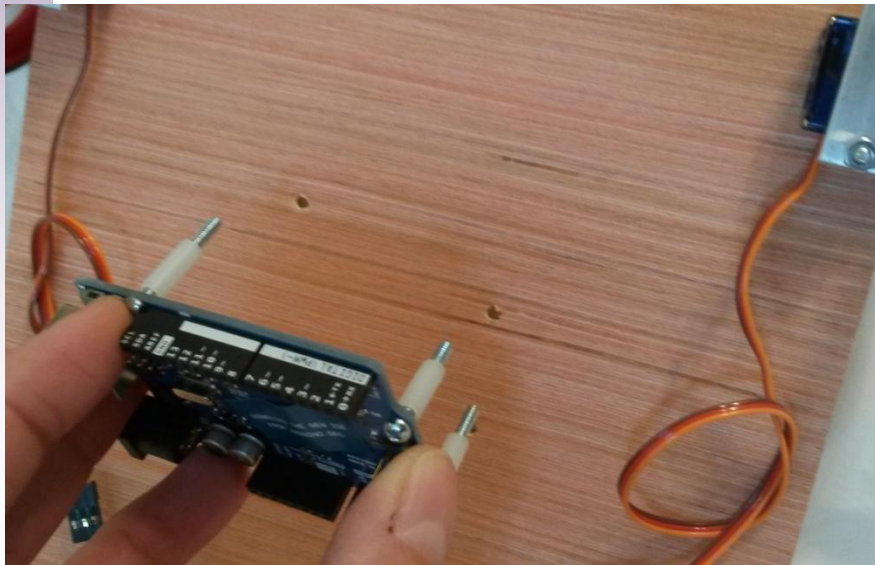
# Assembly – Step 3 (cont)

- Install all 4 screws
- Install 4 spacers
- Careful – parts may fall



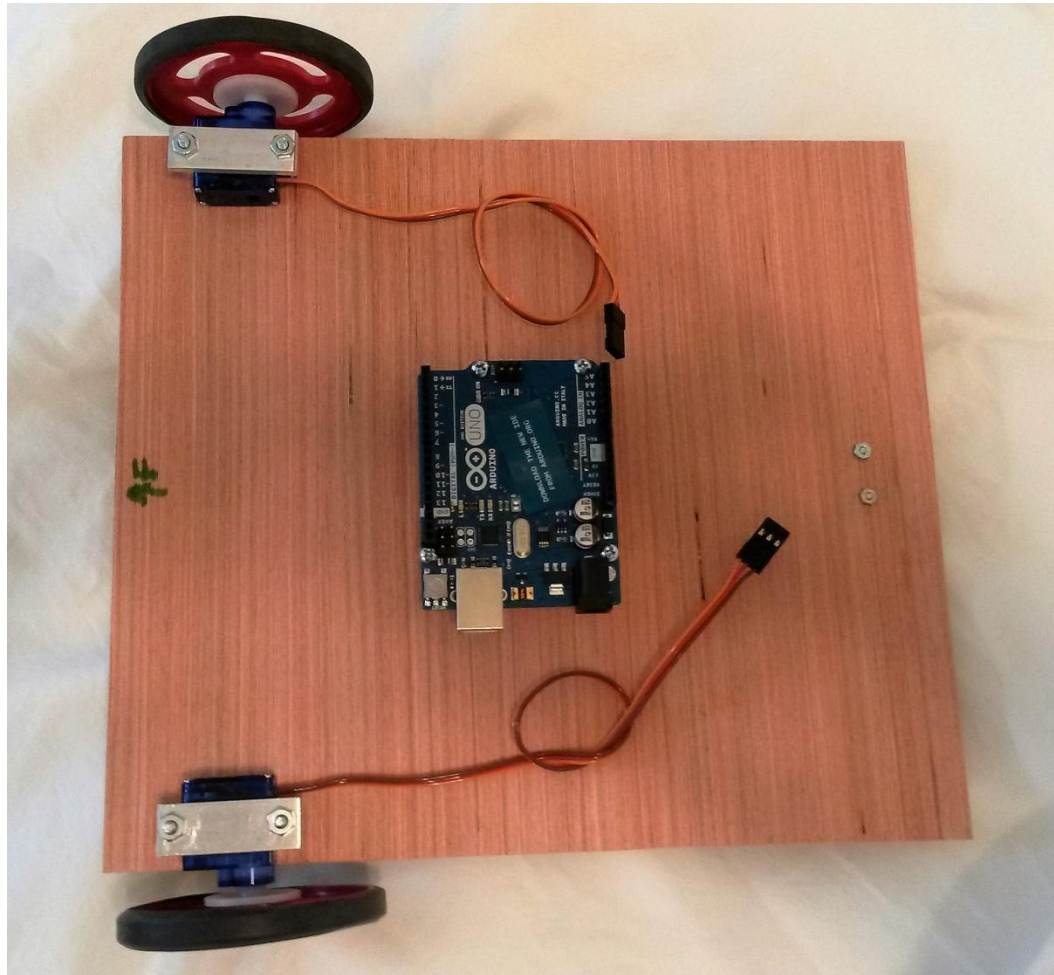
# Assembly – Step 3 (cont)

- Push screw through
- Install 4 nuts
  - Tighten gently – snugly
  - Must tighten flat screw from underneath



# Assembly – Step 3 - Done

- Assembly Looks like this....





# Assembly – Step 4

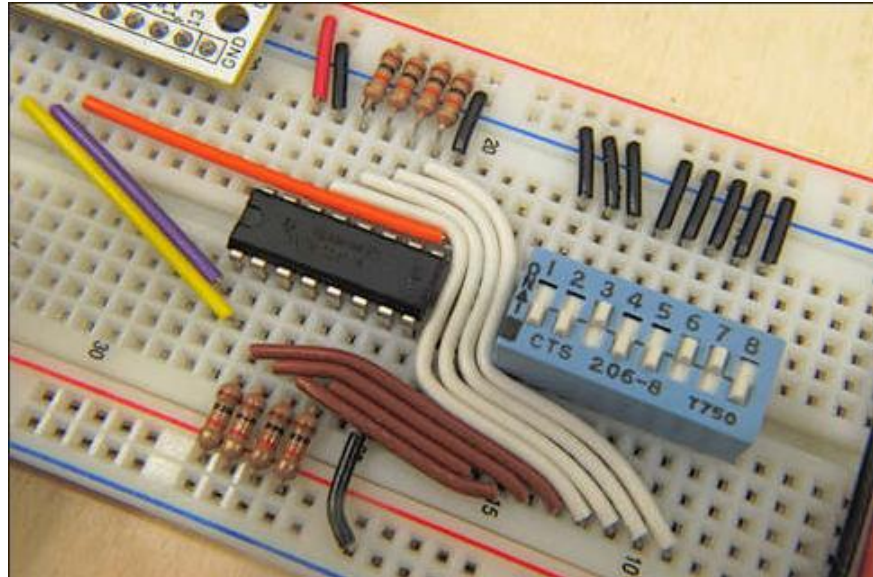
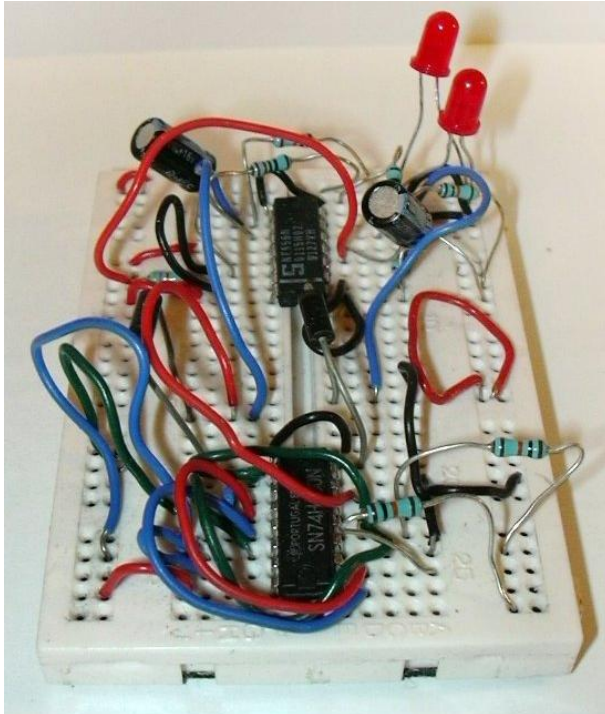
- Install Wiring Harness
- You will need:
  - Robot
  - Breadboard and jumpers





# Breadboard 101

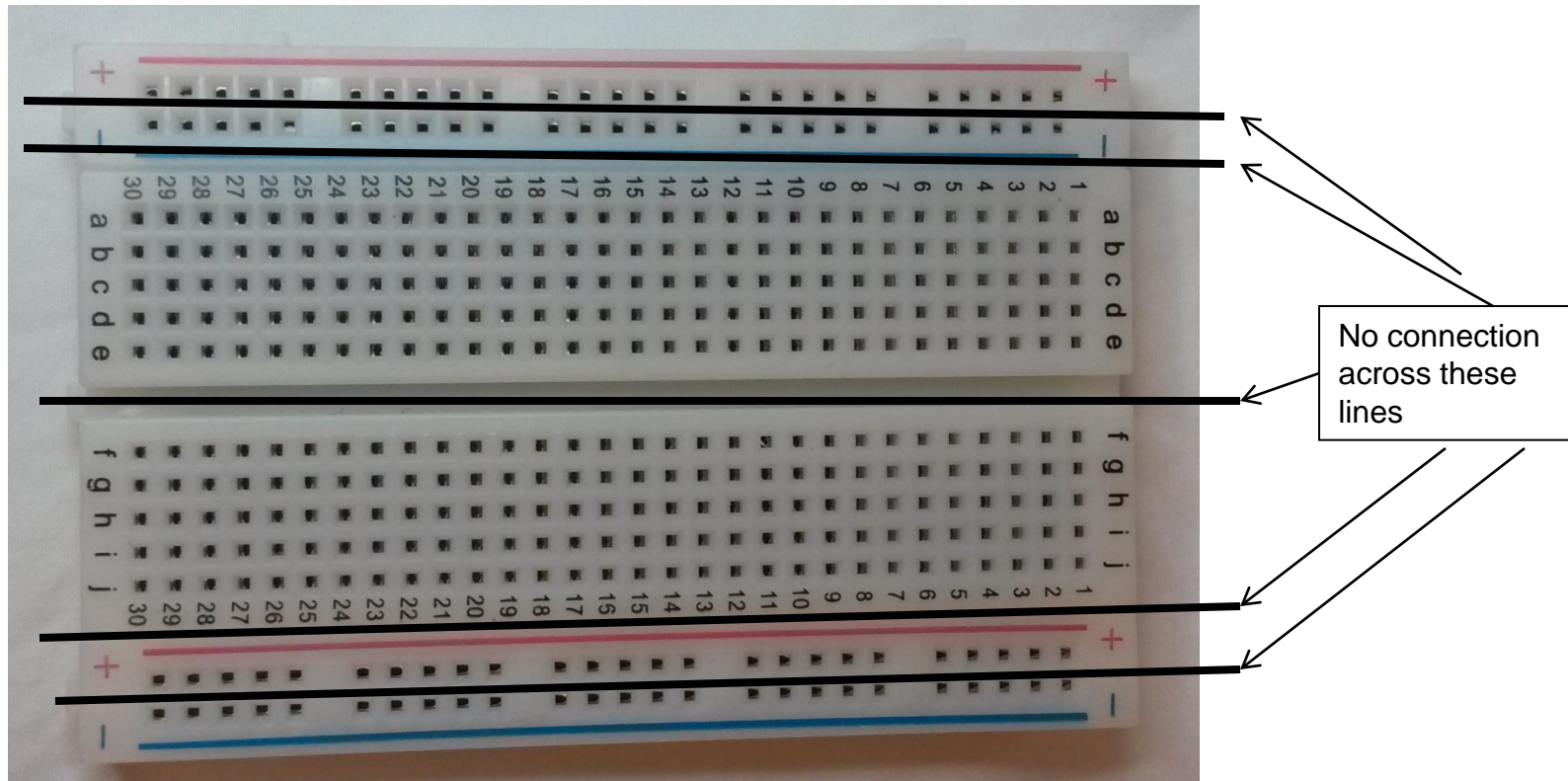
- Used to create quick prototypes
- Connect wires and devices without solder or connectors



<http://www.elec freaks.com/wp-content/uploads/2012/04/breadboard.jpg>

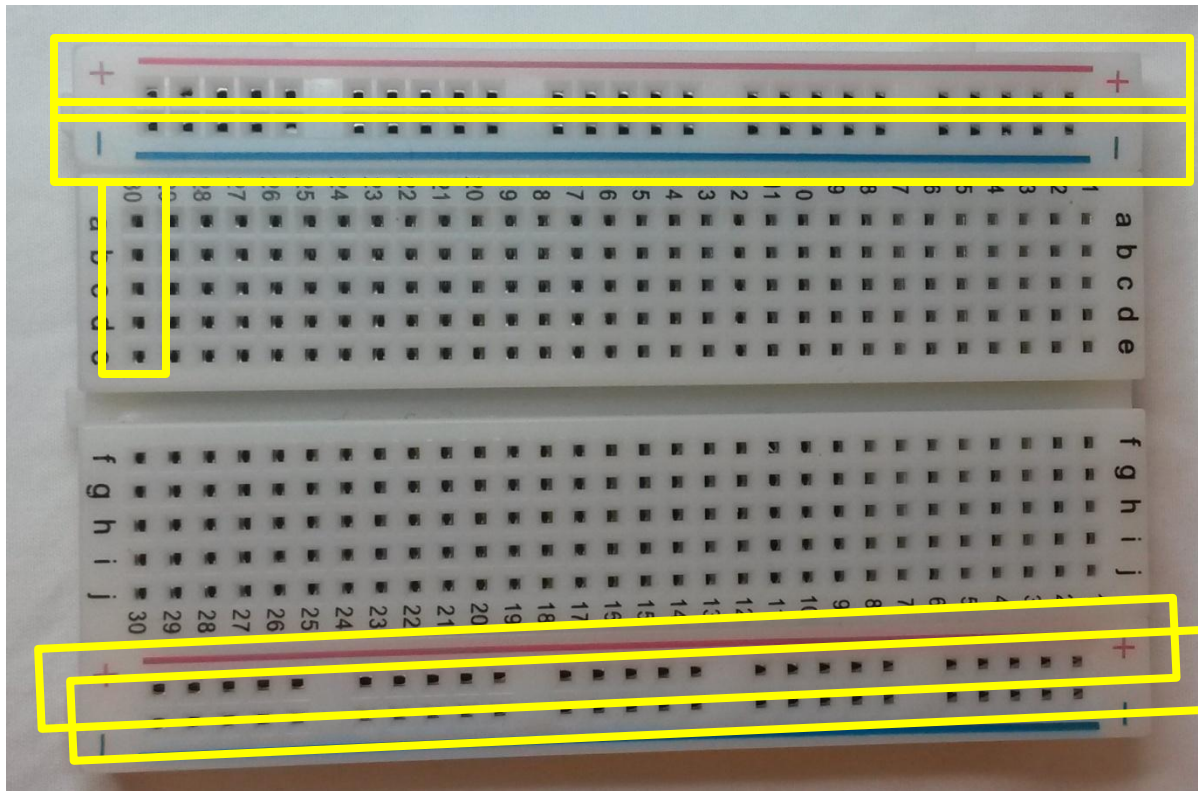
# Breadboard 101 (cont)

- Must understand connections
- Some areas are isolated



# Breadboard 101 (cont)

- Must understand connections
- Some areas are connected



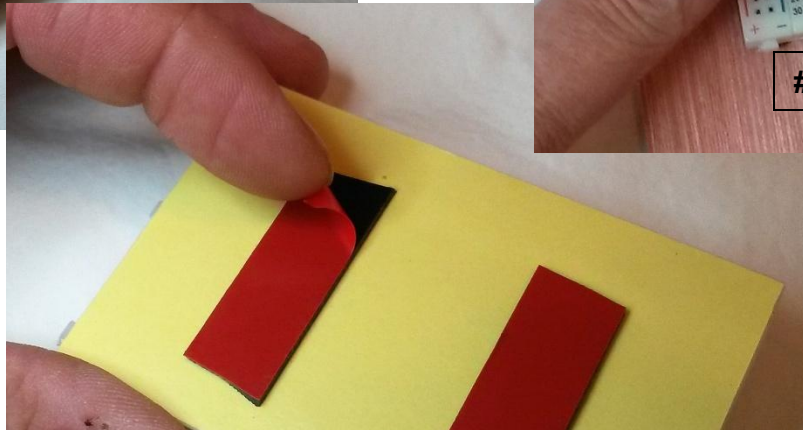
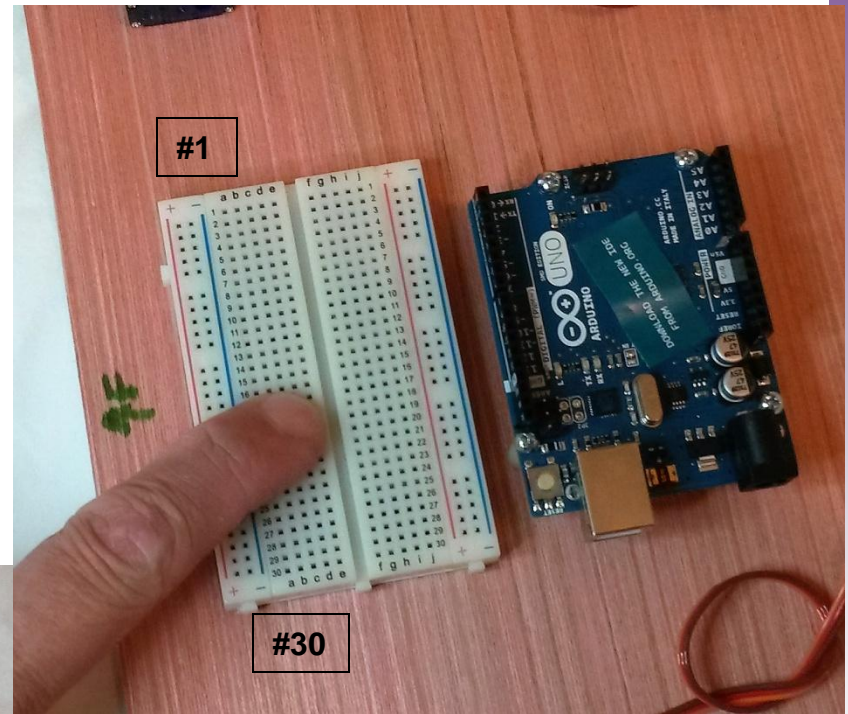
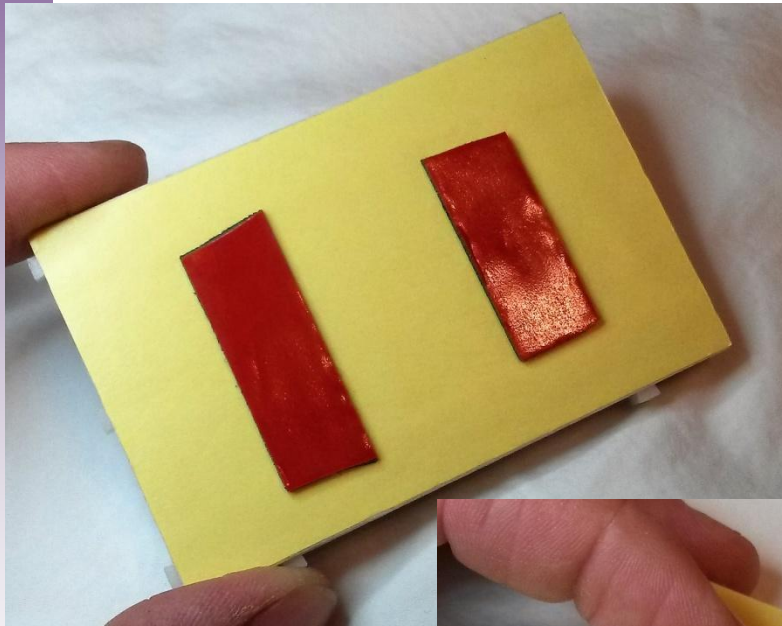
# Assembly – Step 4 (cont)

- Install Breadboard
- Need Breadboard, tape, scissors
  - Cut two pieces about  $\frac{3}{4}$ " to 1" long
  - Attach tape as shown
  - Peel off backing
  - SUPPORT CHASSIS to prevent damage to wheels – do not bear down on wheels
  - Attach board in front of Arduino
  - #1 to right - # 30 to left



# Assembly – Step 4 (cont)

- Install Breadboard

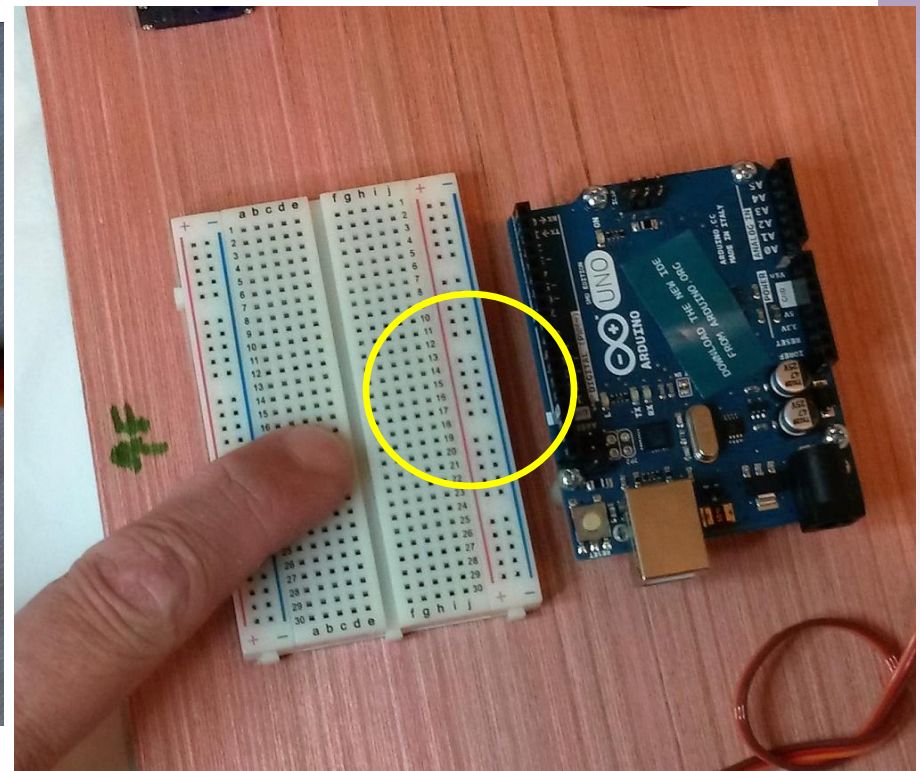
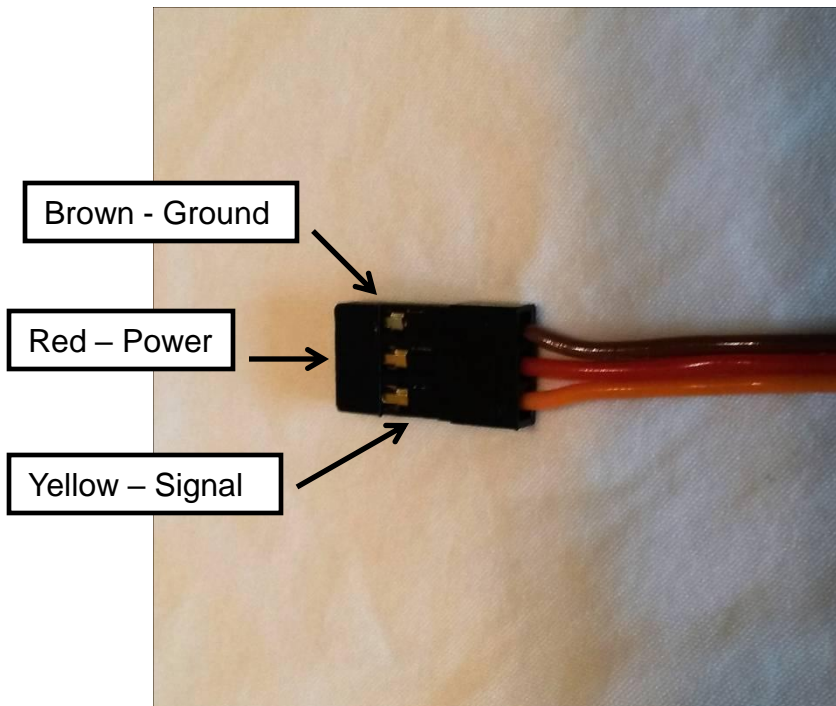


# Assembly – Step 4 (cont)

- Wire connection list – 8 wires
  - GND on arduino to -18 breadboard
  - 5V on arduino to +18 breadboard
  - Brown pin left servo to -17 breadboard
  - Brown pin right servo to -16 breadboard
  - Red pin left servo to +17 breadboard
  - Red pin right servo to +16 breadboard
  - Yellow pin left servo to arduino pin 10
  - Yellow pin right servo to arduino pin 9

# Assembly – Step 4 (cont)

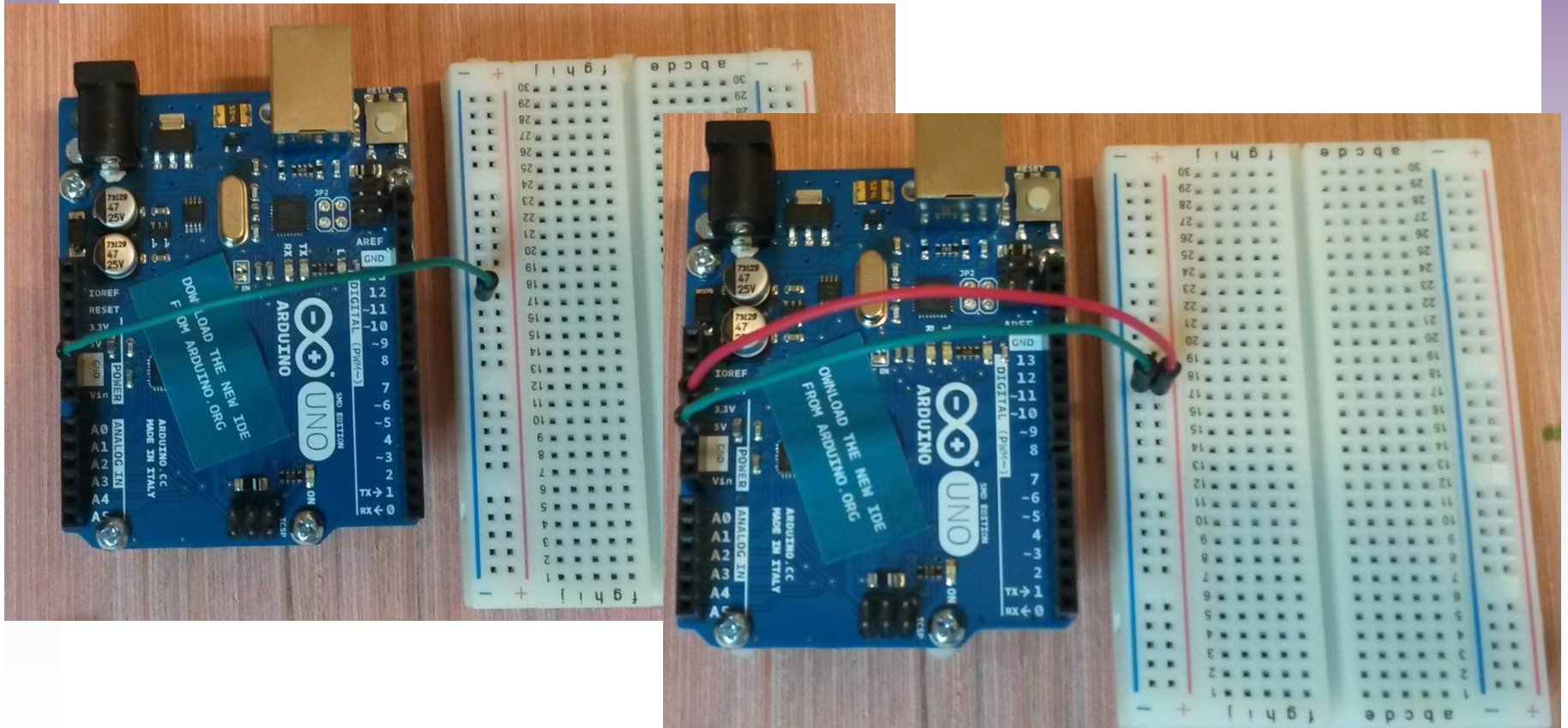
- Wire codes/references
  - Note wire colors on servo lead
  - Note pin location & number on breadboard





# Assembly – Step 4 (cont)

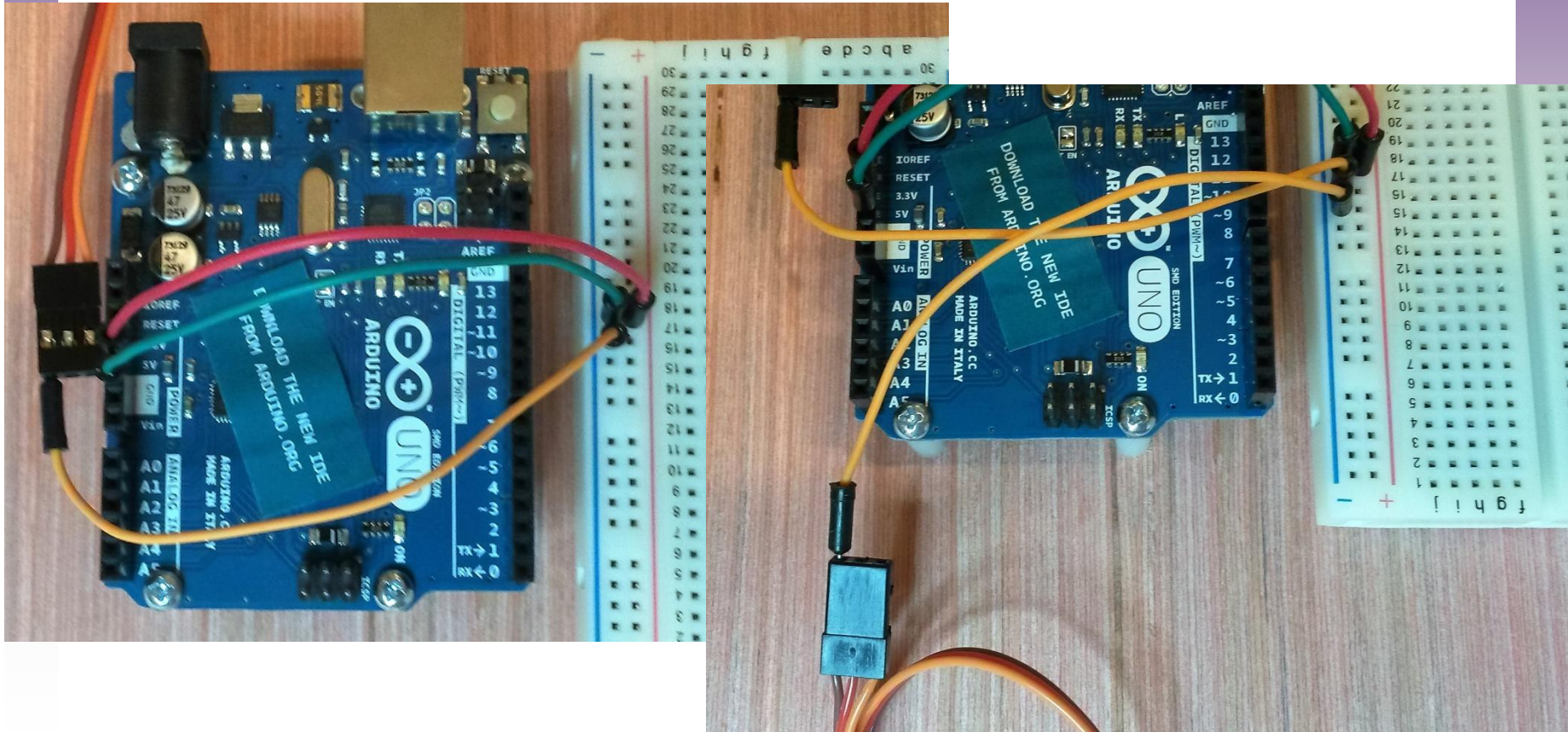
- GND on arduino to -18 breadboard
- 5V on arduino to +18 breadboard





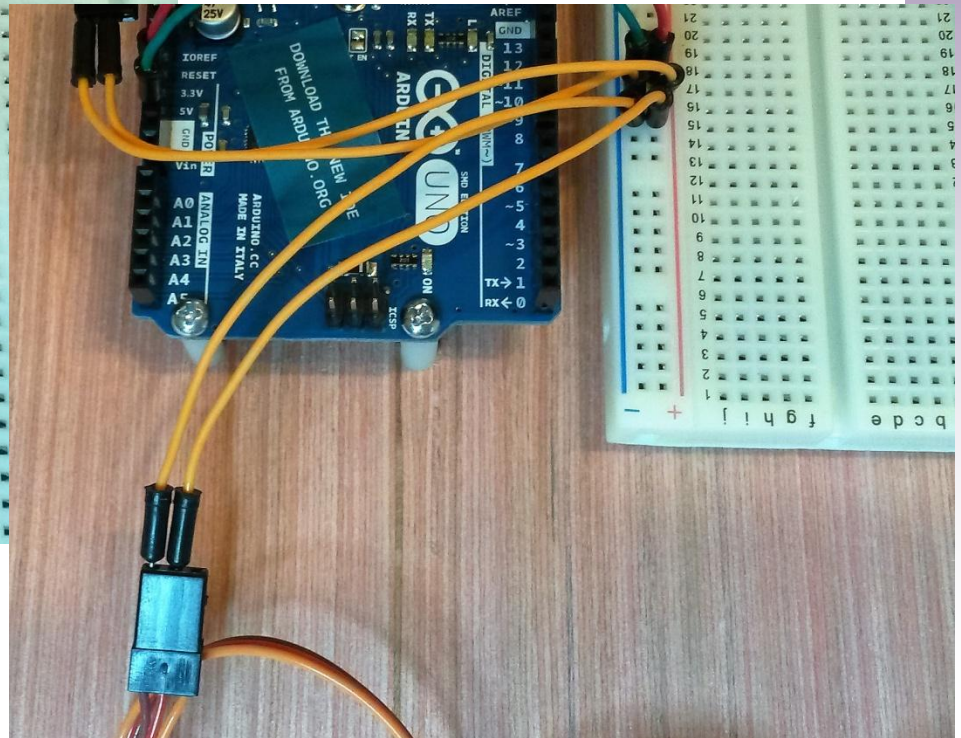
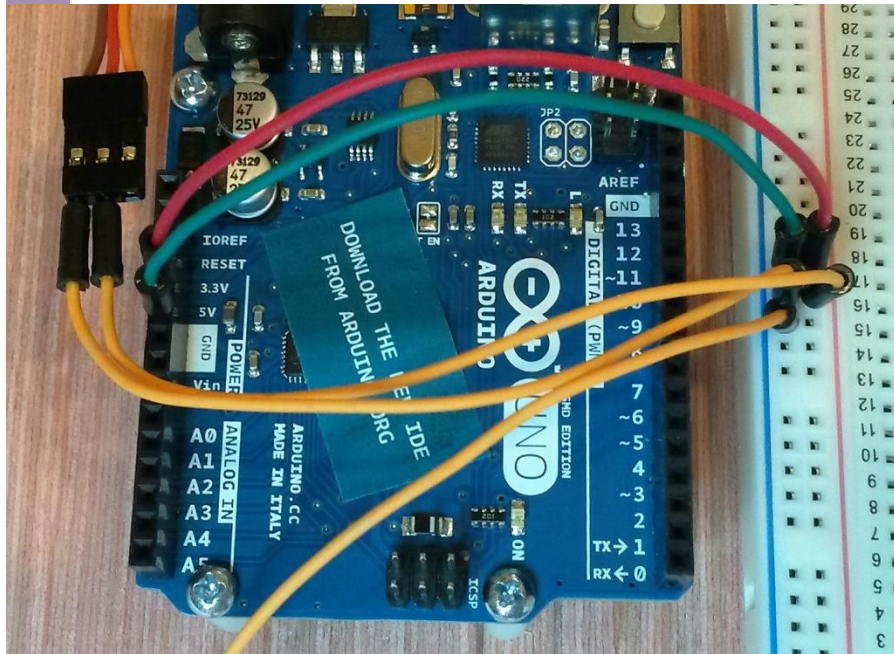
# Assembly – Step 4 (cont)

- Brown pin Left servo to -17 breadboard
- Brown pin Right servo to -16 breadboard



# Assembly – Step 4 (cont)

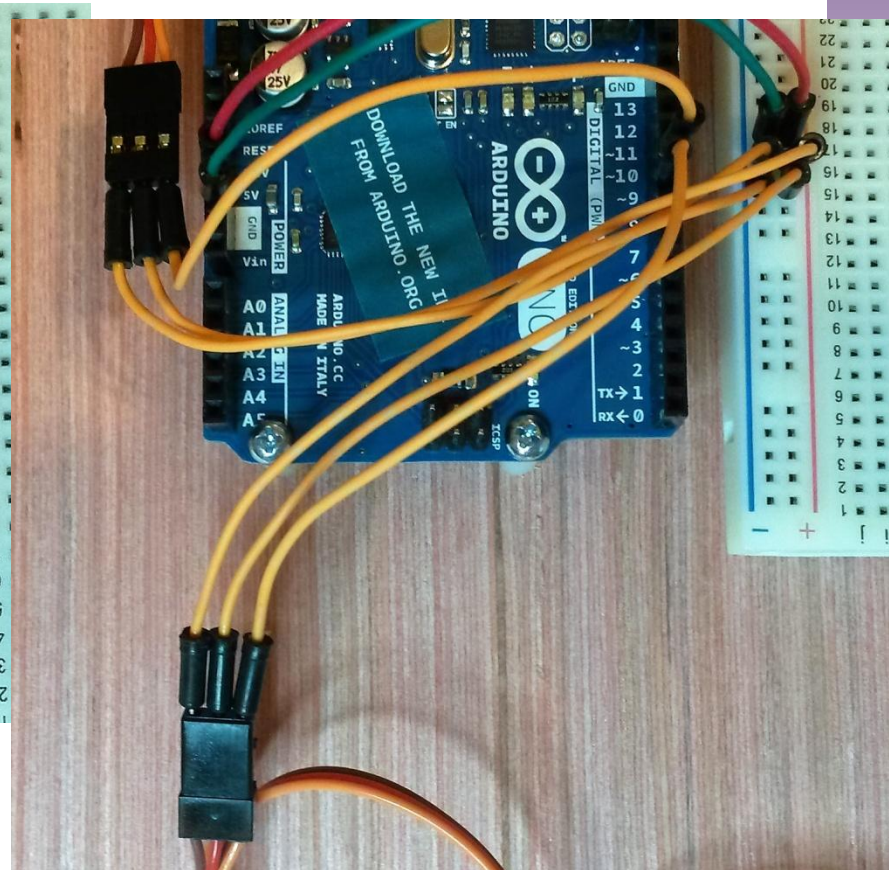
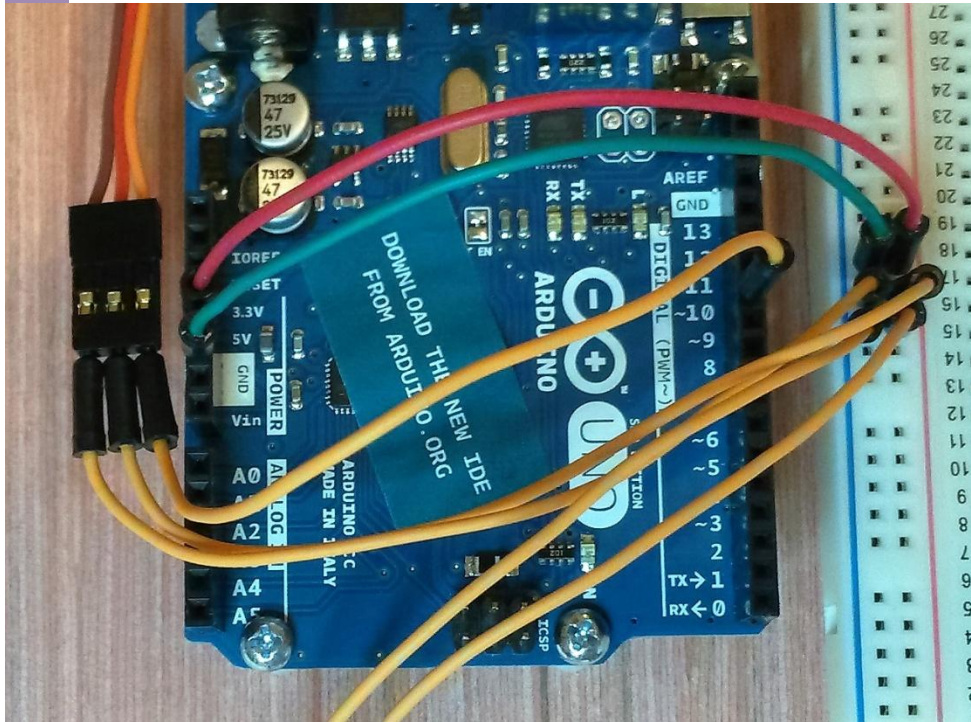
- Red pin Left servo to +17 breadboard
- Red pin Right servo to +16 breadboard





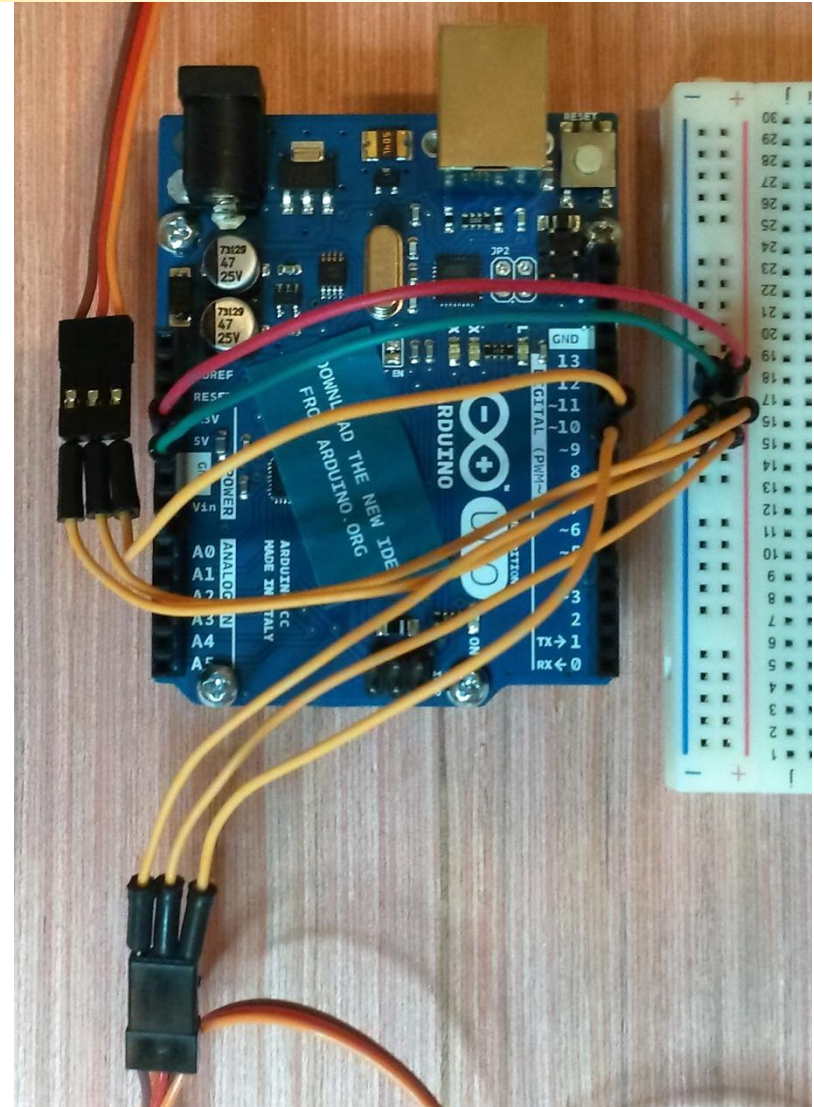
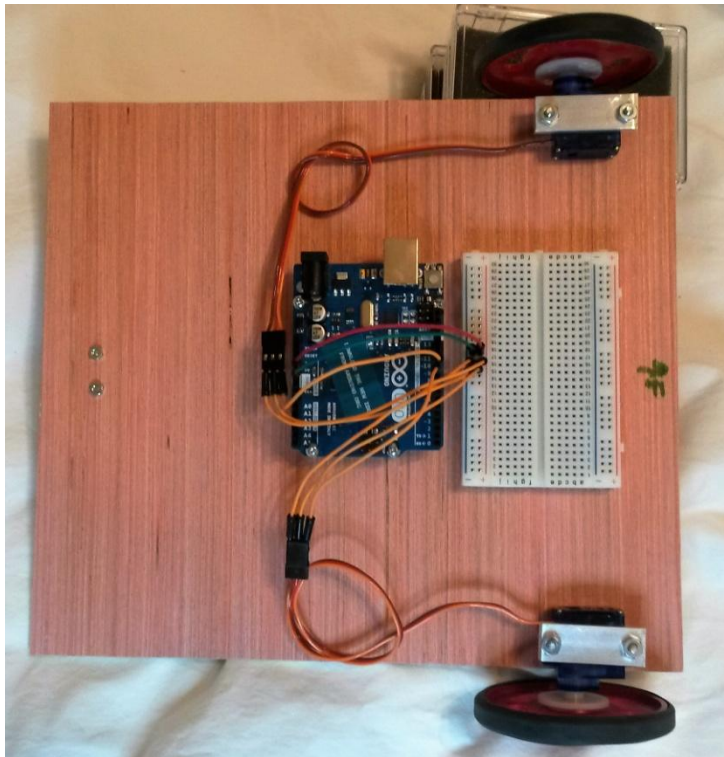
# Assembly – Step 4 (cont)

- Yellow pin Left servo to Arduino #10
- Yellow pin Right servo to Arduino #9



# Assembly – Step 4 - Done

- Wiring Complete
  - Check orientation!
  - Check wiring!





# Assembly – Step 5

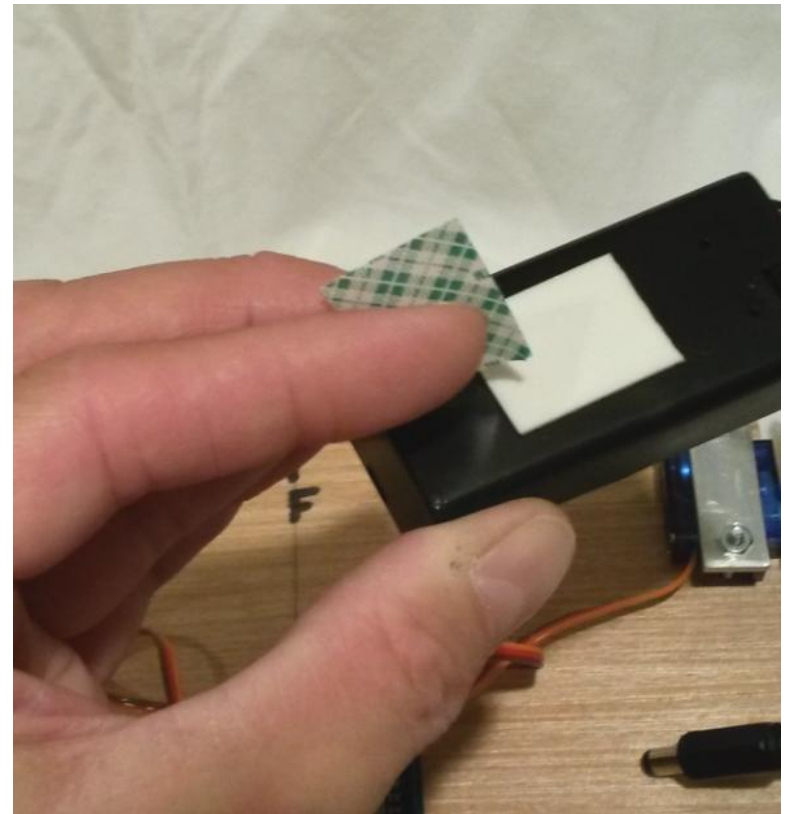
- Install Battery
- You will need:
  - Battery holder
  - Battery
  - Tape
    - ✓ 2-3 pieces





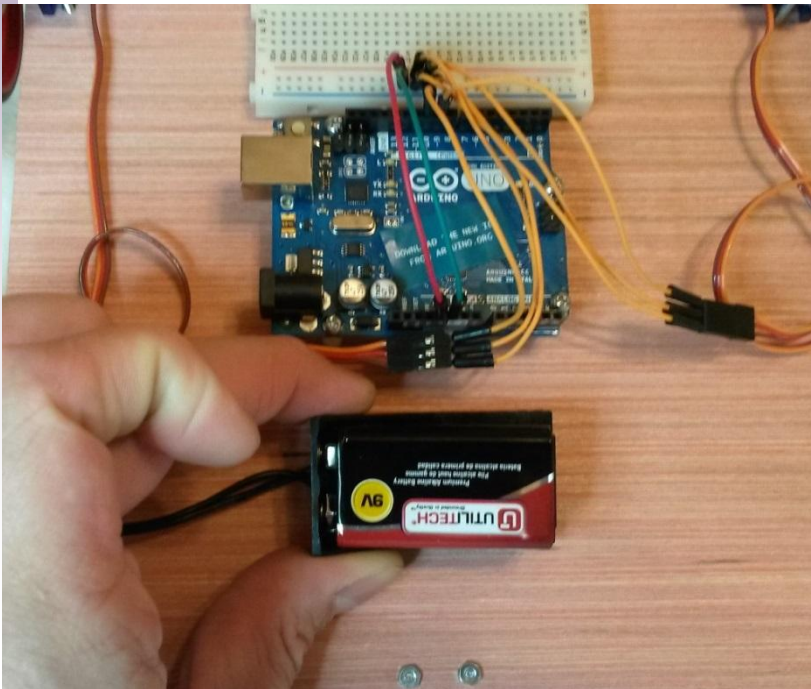
# Assembly – Step 5 (cont)

- Install battery in holder
- Add 2-3 layers of tape on back



# Assembly – Step 5 (cont)

- Place battery holder – support chassis
- **STOP!**
  - **Don't plug in! Check Wires! Wheels up!**
- Install/Remove connector to run robot



# Assembly – COMPLETE!

- Assembly is complete!
- The Robot should look like this.....

