WEEKS 9/13-9/20

TELEOP

ROBO RAIDERS

SCARSDALE • 12331

Team Drive

Ask your TA to add you using your school email

ROBO RAIDERS
SCARSDALE · 12331

Discord

QR Code:

ROBO RAIDERS
SCARSDALE · 12331

Section 1: What is TeleOp?

ROBO RAIDERS
SCARSDALE · 12331

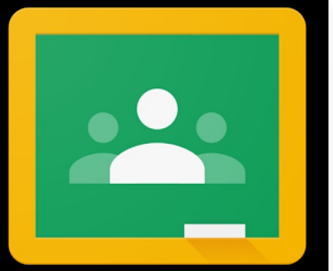
TeleOp Game Phase

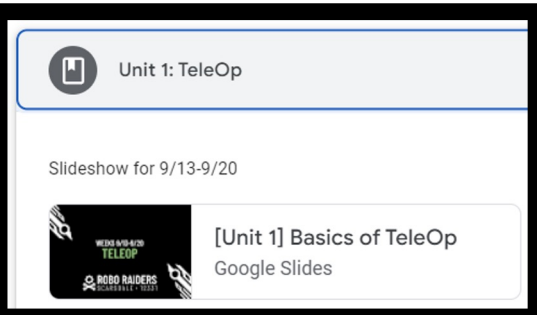
- Short for Teleoperation (remote control)
- 2 minutes

Video 3:18 - 4:41

ROBO RAIDERS
SCARSDALE · 12331

Section 2: Setting Up





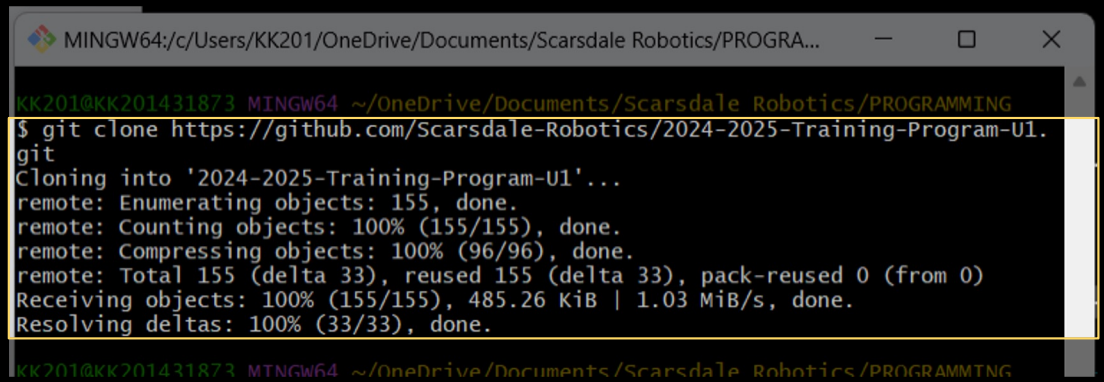
ROBO RAIDERS
SCARSDALE · 12331

GitHub Repo

- Clone the Unit 1 Repo:

```
git clone https://github.com/Scarsdale-Robotics/2024-2025-Training-Program-U1.git
```

*You can also get the HTTP link by going to https://github.com/Scarsdale-Robotics/2024-2025-Training-Program-U1 and clickin <> Code

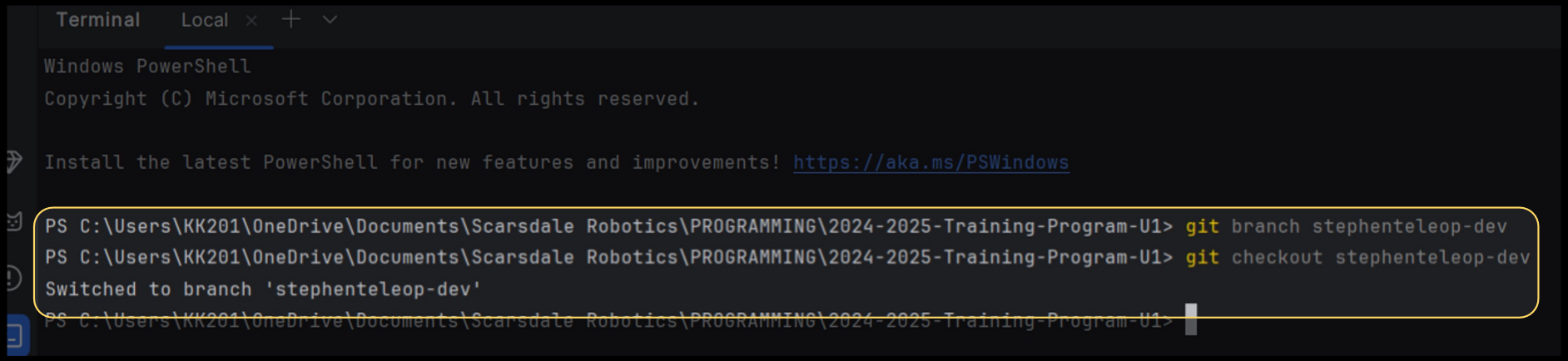


This was covered in the Unit 0 slides. Please review it if this is new to you!

ROBO RAIDERS
SCARSDALE · 12331

New Branch

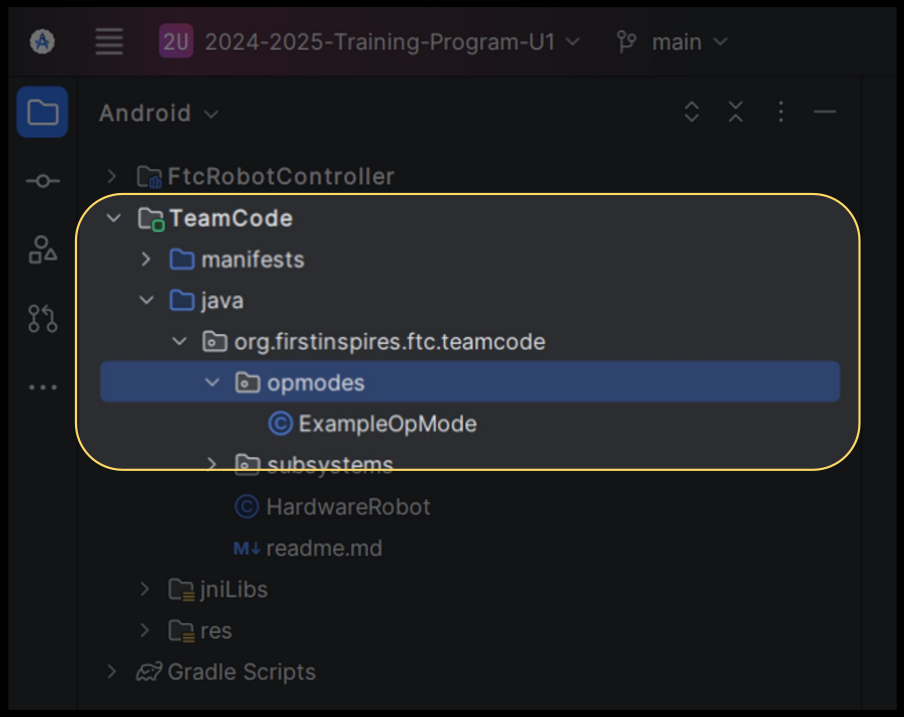
- Open it in Android Studio, wait for Gradle to build, and create a new branch called “[your name]teleop-dev”. Checkout the branch.



ROBO RAIDERS
SCARSDALE · 12331

File Tree

- Navigate from “TeamCode” to “opmodes”.



ROBO RAIDERS
SCARSDALE · 12331

Section 3: OpModes

ROBO RAIDERS
SCARSDALE · 12331

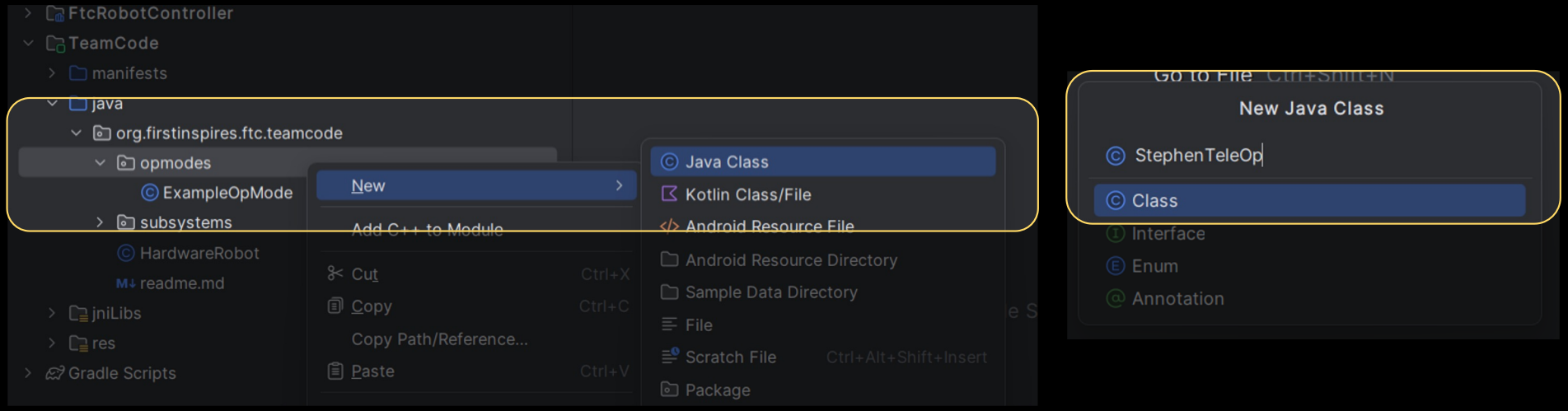
What is an OpMode?

- An Operational Mode (OpMode) is code that the robot can run.
- There are two main types of OpModes in FTC:
  - `OpMode`: Requires writing two methods.
  - **`LinearOpMode`**: You only need to write a `runOpMode()` method.
- Hence, we will be using **`LinearOpMode`** for simplicity sake.

ROBO RAIDERS
SCARSDALE · 12331

Let's Create an OpMode!

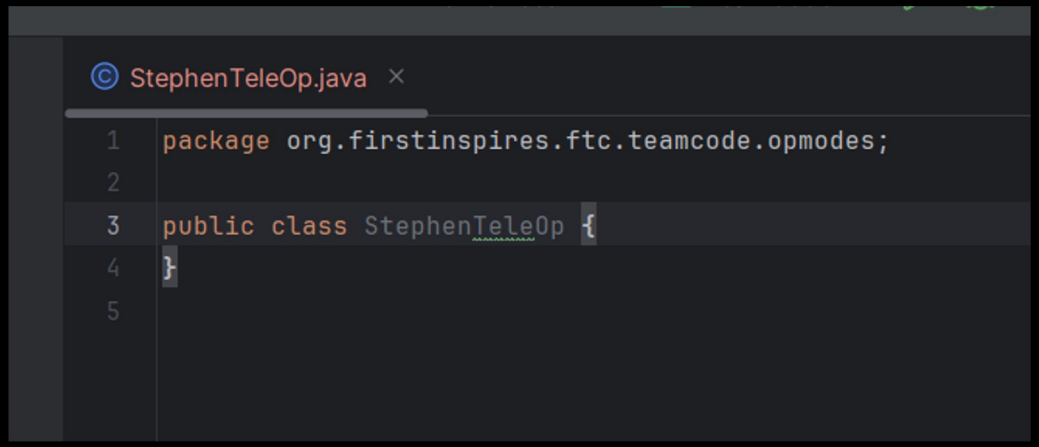
- Create a Java Class file in the "opmodes" folder called "*[your name]TeleOp*"



ROBO RAIDERS
SCARSDALE · 12331

Let's Create an OpMode!

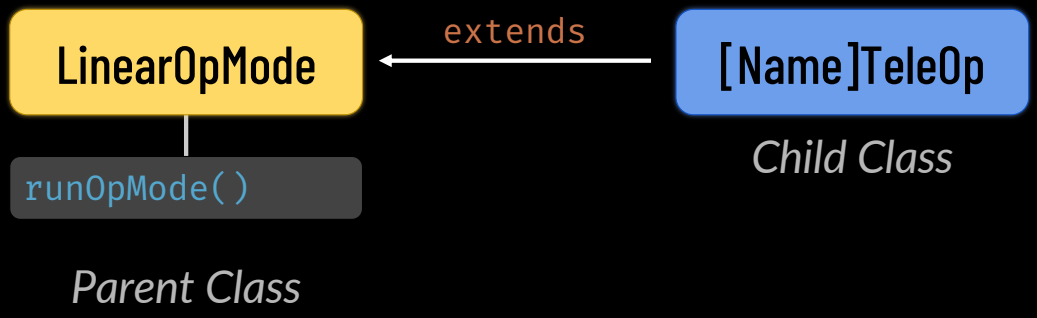
- You should see a *package statement* and a *class declaration*. If this is your first time using Java, the package statement should match the file's location and the class declaration should match the file's name.

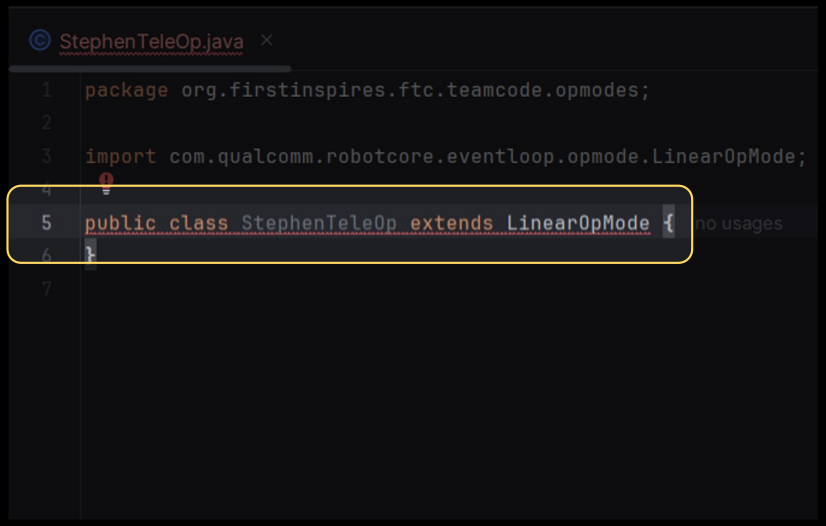


ROBO RAIDERS
SCARSDALE · 12331

Let's Create an OpMode!

- To make our class an OpMode, we have to *inherit* from a *parent class* called "LinearOpMode". In Java, the inheritance keyword is "`extends`".

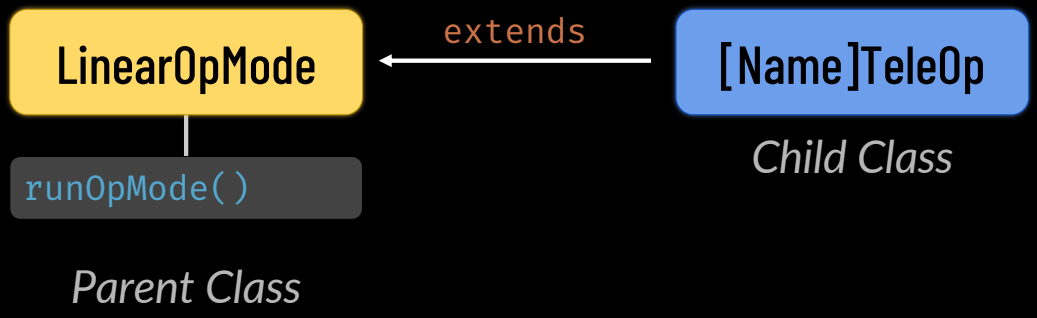


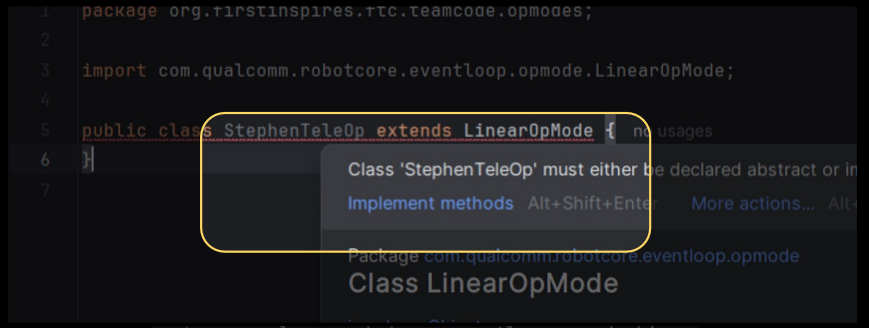


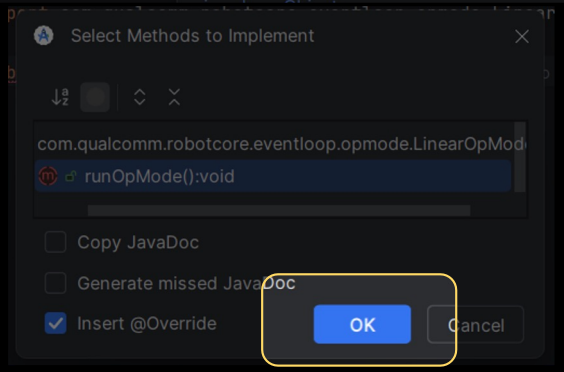
ROBO RAIDERS
SCARSDALE · 12331

Let's Create an OpMode!

- We haven't actually inherited anything yet. To inherit `runOpMode()`, hover over the red squiggle and press "Implement methods", then "OK".



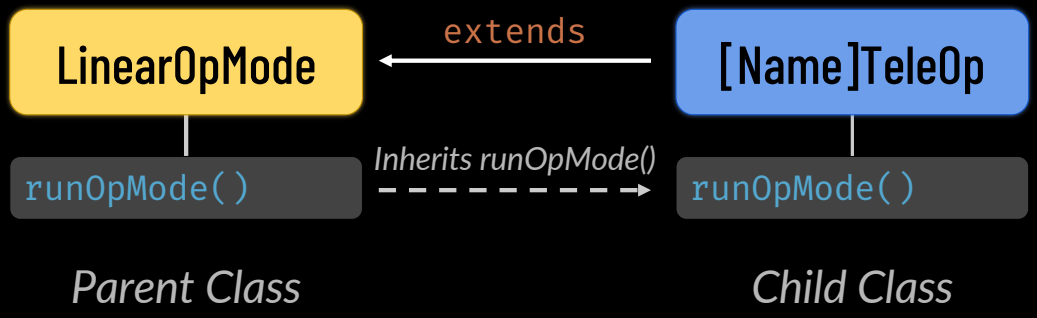




ROBO RAIDERS
SCARSDALE · 12331

Let's Create an OpMode!

- Even though we could've typed it, now we have a `runOpMode()` method!
- The `@Override` just means we're going to write our own code in `runOpMode()`.



StephenTeleOp.java

```
package org.firstinspires.ftc.teamcode.opmodes;

import com.qualcomm.robotcore.eventloop.opmode.LinearOpMode;

public class StephenTeleOp extends LinearOpMode {  no usages
    @Override
    public void runOpMode() throws InterruptedException {

    }
}
```

ROBO RAIDERS
SCARSDALE · 12331

Let's Create an OpMode!

- To finish up our OpMode skeleton, we'll add the `@Teleop` annotation above the class. This simply tells the robot that your file is a runnable TeleOp program.
- You can also set a program name with `@Teleop(name="[Name here]")`!

ROBO RAIDERS
SCARSDALE · 12331

The Code So Far

Registering and setting the name of our opmode

Inheriting from LinearOpMode

The inherited method which we will write our code in

StephenTeleOp.java

```
1   package org.firstinspires.ftc.teamcode.opmodes;
2
3   import com.qualcomm.robotcore.eventloop.opmode.LinearOpMode;
4   import com.qualcomm.robotcore.eventloop.opmode.TeleOp;
5
6   @TeleOp(name="Stephen's TeleOp")  no usages
7   public class StephenTeleOp extends LinearOpMode {
8       @Override
9       public void runOpMode() throws InterruptedException {
10
11      }
12  }
13
```

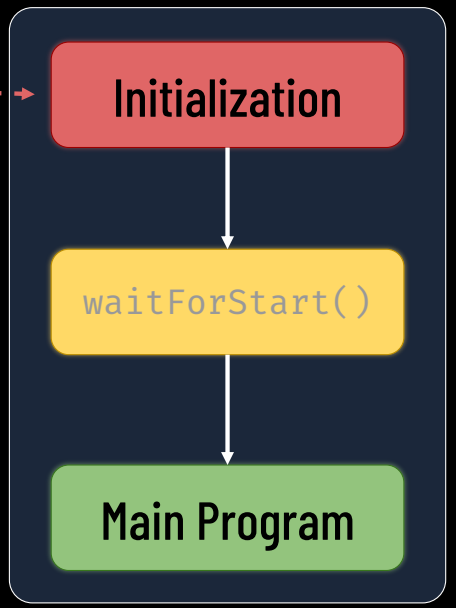
ROBO RAIDERS
SCARSDALE · 12331

Section 4: Initialization

ROBO RAIDERS
SCARSDALE · 12331

What is Initialization?

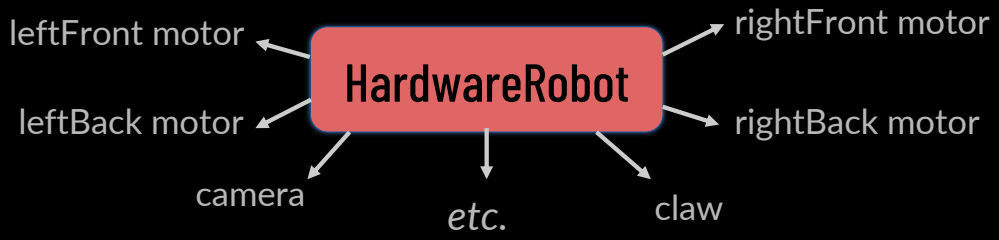
- Initialization is simply **what happens before hitting the Start button**.
- For example, a robot might need to:
  - Recognize and store its motors,
  - Turn on its camera,
  - Reset its internal timer,
  - etc.
- All of these are examples of code you might put in the initialization phase of your OpMode!

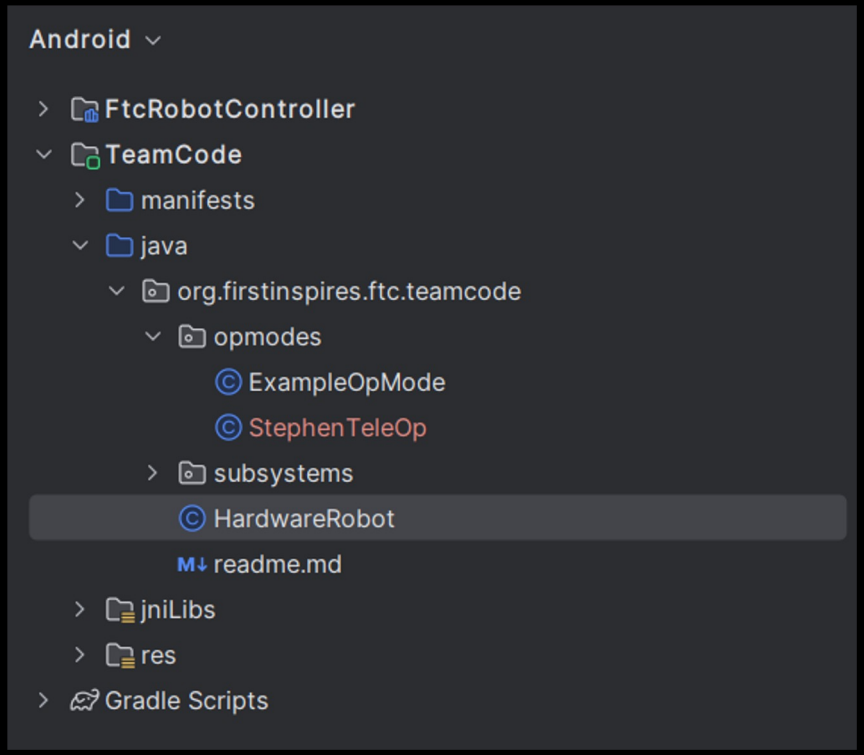


ROBO RAIDERS
SCARSDALE · 12331

Initializing HardwareRobot

- You might have noticed **HardwareRobot** in the file tree as you looked for the opmodes folder.
- This is a very nice initialization class that automatically reads in the robot config and stores its motors, servos, etc. into accessible objects.





ROBO RAIDERS
SCARSDALE · 12331

Initializing HardwareRobot

- To initialize HardwareRobot, we write:

StephenTeleOp.java

```
1   package org.firstinspires.ftc.teamcode.opmodes;
2
3   import com.qualcomm.robotcore.eventloop.opmode.LinearOpMode;
4   import com.qualcomm.robotcore.eventloop.opmode.TeleOp;
5   import org.firstinspires.ftc.teamcode.HardwareRobot;
6
7   @TeleOp(name="Stephen's TeleOp")  no usages
8   public class StephenTeleOp extends LinearOpMode {
9       @Override
10      public void runOpMode() throws InterruptedException {
11          // Initialization code.
12          HardwareRobot robot = new HardwareRobot(hardwareMap);
13
14      }
15  }
```

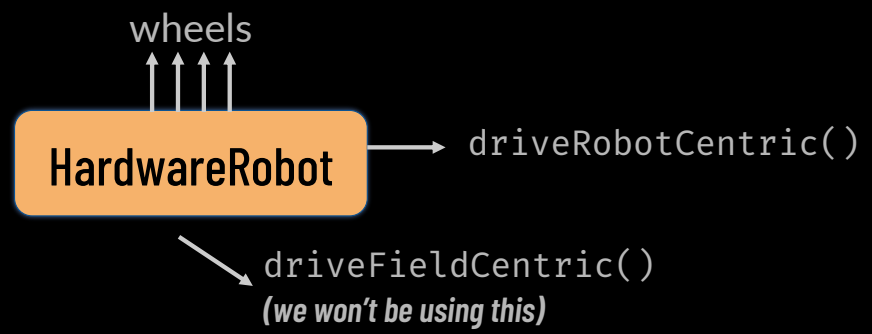
Passing in the hardwareMap to HardwareRobot's constructor

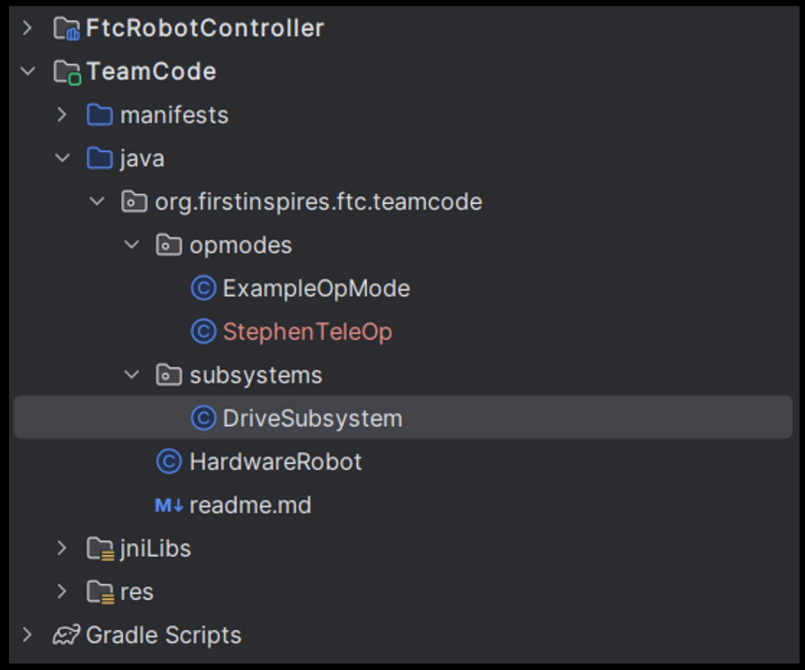
HardwareRobot's constructor method

ROBO RAIDERS
SCARSDALE · 12331

Initializing DriveSubsystem

- In the “subsystems” folder, you will see a file called DriveSubsystem.
- This initialization class contains the four wheel motors and methods to drive the wheels in any direction





ROBO RAIDERS
SCARSDALE · 12331

Initializing DriveSubsystem

- Let's write this to initialize DriveSubsystem:

Access each of the wheel motors from our HardwareRobot and pass them into the constructor!

DriveSubsystem's constructor method

StephenTeleOp.java

```
package org.firstinspires.ftc.teamcode.opmodes;

import com.qualcomm.robotcore.eventloop.opmode.LinearOpMode;
import com.qualcomm.robotcore.eventloop.opmode.TeleOp;
import org.firstinspires.ftc.teamcode.HardwareRobot;
import org.firstinspires.ftc.teamcode.subsystems.DriveSubsystem;

@TeleOp(name="Stephen's TeleOp")  no usages
public class StephenTeleOp extends LinearOpMode {
    @Override
    public void runOpMode() throws InterruptedException {
        // Initialization code.
        HardwareRobot robot = new HardwareRobot(hardwareMap);
        DriveSubsystem drive = new DriveSubsystem(
                robot.leftFront,
                robot.rightFront,
                robot.leftBack,
                robot.rightBack
        );
    }
}
```

ROBO RAIDERS
SCARSDALE · 12331

Adding WaitForStart

- Now that everything's initialized, we have to tell the code to wait until the Start button on the Driver Hub is pressed.

StephenTeleOp.java

```java
package org.firstinspires.ftc.teamcode.opmodes;

import com.qualcomm.robotcore.eventloop.opmode.LinearOpMode;
import com.qualcomm.robotcore.eventloop.opmode.TeleOp;
import org.firstinspires.ftc.teamcode.HardwareRobot;
import org.firstinspires.ftc.teamcode.subsystems.DriveSubsystem;

@TeleOp(name="Stephen's TeleOp")  no usages
public class StephenTeleOp extends LinearOpMode {
    @Override
    public void runOpMode() throws InterruptedException {
        // Initialization code.
        HardwareRobot robot = new HardwareRobot(hardwareMap);
        DriveSubsystem drive = new DriveSubsystem(
                robot.leftFront,
                robot.rightFront,
                robot.leftBack,
                robot.rightBack
        );

        waitForStart();

    }
}
```

ROBO RAIDERS
SCARSDALE · 12331

The Code So Far

Initialize HardwareRobot

Initialize DriveSubsystem

Wait until Start is pressed

StephenTeleOp.java

```
1   package org.firstinspires.ftc.teamcode.opmodes;
2
3   import ...
7
8   @TeleOp(name="Stephen's TeleOp")  no usages
9   public class StephenTeleOp extends LinearOpMode {
10      @Override
11      public void runOpMode() throws InterruptedException {
12          // Initialization code.
13          HardwareRobot robot = new HardwareRobot(hardwareMap);
14          DriveSubsystem drive = new DriveSubsystem(
15                  robot.leftFront,
16                  robot.rightFront,
17                  robot.leftBack,
18                  robot.rightBack
19          );
20
21          waitForStart();
22
23      }
24  }
25
```

ROBO RAIDERS
SCARSDALE · 12331

Section 5: The Main Loop

ROBO RAIDERS
SCARSDALE · 12331

While Loop

- After the Start button is pressed, we want to run code continuously. Let's use a "`while`" loop to do so.
- The loop only runs while condition within the parentheses, `opModeIsActive()`, is true. When Stop is pressed, the condition becomes false and the loop breaks

Let's add it to our code!

```
11    public void runOpMode() throws InterruptedException {
12        // Initialization code.
13        HardwareRobot robot = new HardwareRobot(hardwareMap);
14        DriveSubsystem drive = new DriveSubsystem(
15                robot.leftFront,
16                robot.rightFront,
17                robot.leftBack,
18                robot.rightBack
19        );
20
21        waitForStart();
22
23        while (opModeIsActive()) {
24            // Anything you write in here will loop until Stop is pressed.
25
26        }
27
28    }
29 }
```

ROBO RAIDERS
SCARSDALE · 12331

driveRobotCentric()

- As we discussed, the DriveSubsystem we initialized allows us to drive the wheels in any direction by using its `driveRobotCentric()` method.
- It takes 3 parameters: right power, forward power, and turn power. These inputs are *between -1 and 1*, with negative values representing the reverse direction.

Disclaimer: *Just an example, don't run this code on the robot!*

All of these different commands are being called within the same loop, so the robot will seize up!

```
23          while (opModeIsActive()) {
24              // Anything you write in here will loop until Stop is pressed.
25
26              // Set full power to the right.
27              drive.driveRobotCentric( right: 1,  forward: 0,  turn: 0);
28              // Set half power backward.
29              drive.driveRobotCentric( right: 0,  forward: -0.5,  turn: 0);
30              // Set quarter power turning clockwise.
31              drive.driveRobotCentric( right: 0,  forward: 0,  turn: 0.25);
32              // Set full power to the backward and left.
33              drive.driveRobotCentric( right: -1,  forward: -1,  turn: 0);
34              // This will get clamped to 1.
35              drive.driveRobotCentric( right: 2,  forward: 0,  turn: 0);
36
37          }
```

ROBO RAIDERS
SCARSDALE · 12331

The Code So Far

The main loop

StephenTeleOp.java

```java
package org.firstinspires.ftc.teamcode.opmodes;

import ...

@TeleOp(name="Stephen's TeleOp")  no usages
public class StephenTeleOp extends LinearOpMode {
    @Override
    public void runOpMode() throws InterruptedException {
        // Initialization code.
        HardwareRobot robot = new HardwareRobot(hardwareMap);
        DriveSubsystem drive = new DriveSubsystem(
                robot.leftFront,
                robot.rightFront,
                robot.leftBack,
                robot.rightBack
        );

        waitForStart();

        // Main loop.
        while (opModeIsActive()) {
            // Anything you write in here will loop until Stop is pressed.

            // We will do something with drive.driveRobotCentric()...

        }

    }
}
```

ROBO RAIDERS
SCARSDALE · 12331

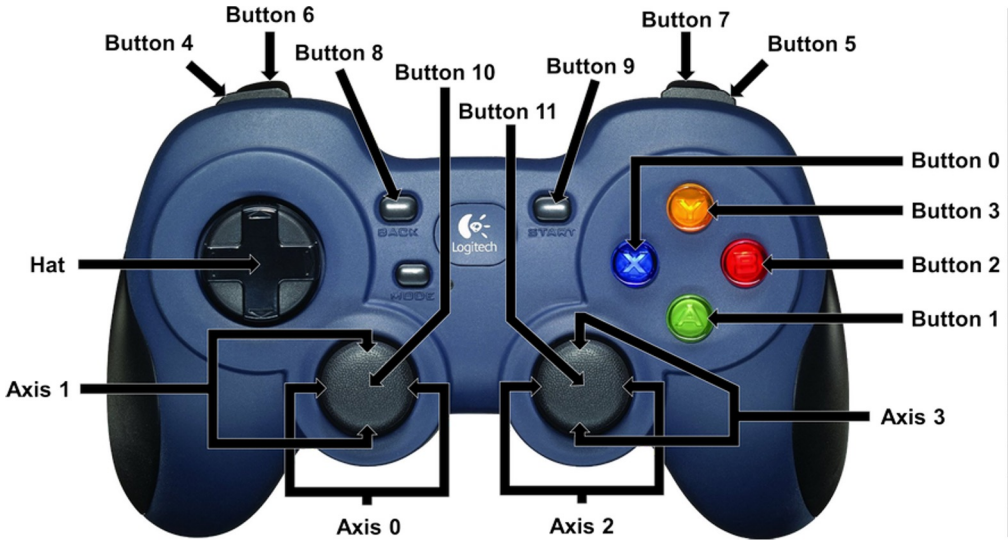
Section 6: The Gamepad

Controller Types

OR

ROBO RAIDERS
SCARSDALE · 12331

A Diagram I Took Off Google



Axis 0	Left Joystick X
Axis 1	Left Joystick Y (inv)
Axis 2	Right Joystick X
Axis 3	Right Joystick Y (inv)
Button 0	X
Button 1	A
Button 2	B
Button 3	Y
Button 4	Left Bumper
Button 5	Right Bumper
Button 6	Left Trigger
Button 7	Right Trigger
Button 8	Back
Button 9	Start
Button 10	Left Joystick (click)
Button 11	Right Joystick (click)
Hat	Directional Pad (X, Y)

Button Aliases

PS4	Xbox
circle	b
cross	a
triangle	y
square	x
share	back
options	start
ps	guide

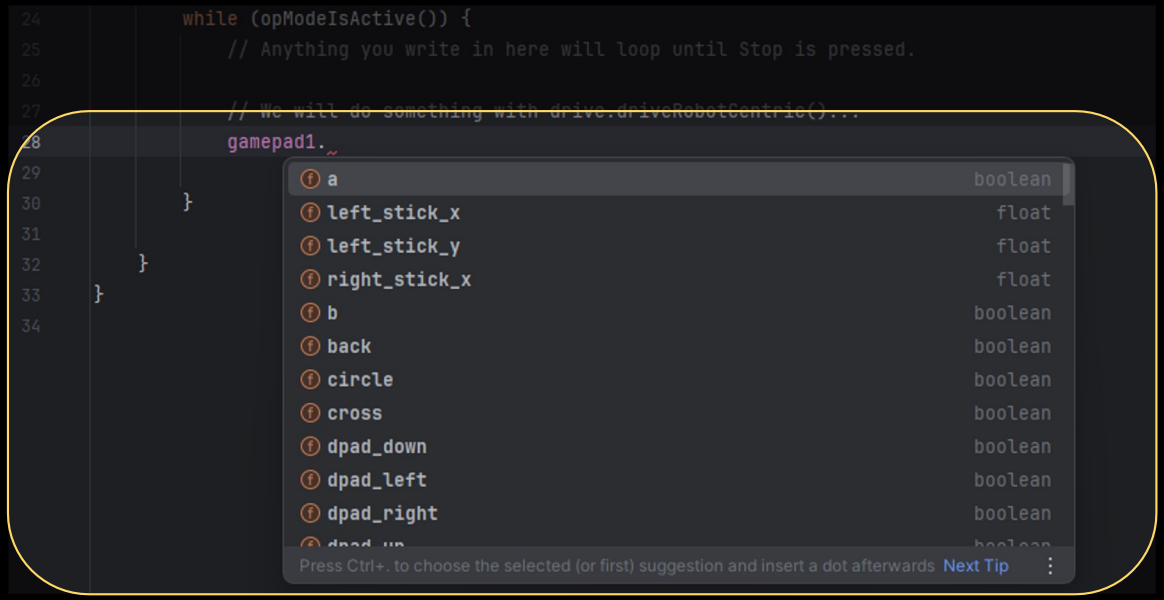
ROBO RAIDERS
SCARSDALE · 12331

https://gm0.org/en/latest/docs/software/tutorials/gamepad.html

Accessing Gamepad Buttons

- There are two gamepad objects, `gamepad1` and `gamepad2` (because the teleop phase requires two drivers). We will only use `gamepad1`.
- It's actually really easy! Type `gamepad1.` and see what appears:

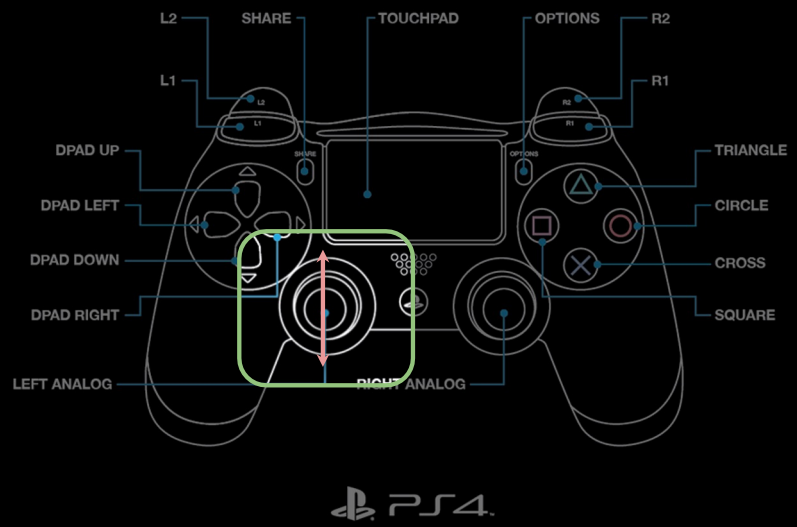
NOTE: *Joystick values are between -1 and 1.*



ROBO RAIDERS
SCARSDALE · 12331

Driving Sideways (Strafing)

- Let's map the Left Joystick X-axis to strafing left or right.

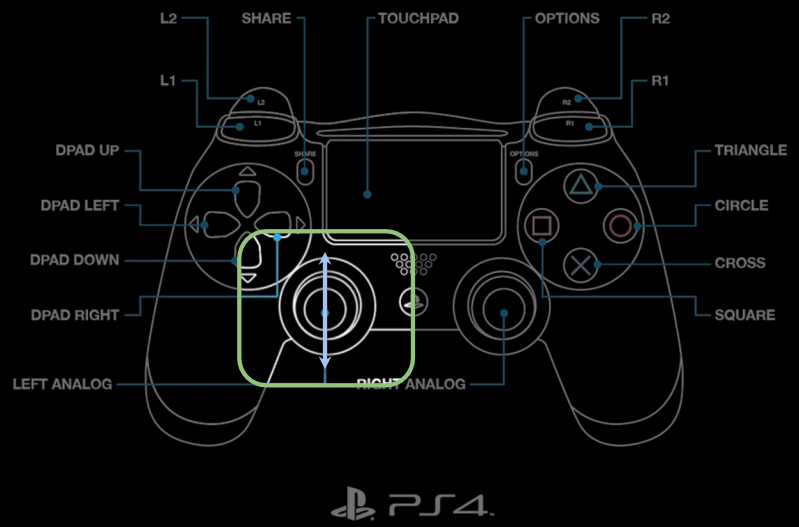



```
23          // Main loop.
24          while (opModeIsActive()) {
25              // Get the left joystick x position.
26              double strafe = gamepad1.left_stick_x;
27
28              // Drive using the joystick's position as the strafe power.
29              drive.driveRobotCentric(strafe, forward: 0, turn: 0);
30
31
32          }
```

ROBO RAIDERS
SCARSDALE · 12331

Driving Forward

- Similarly, let's map the Left Joystick Y-axis to driving forward or backward.



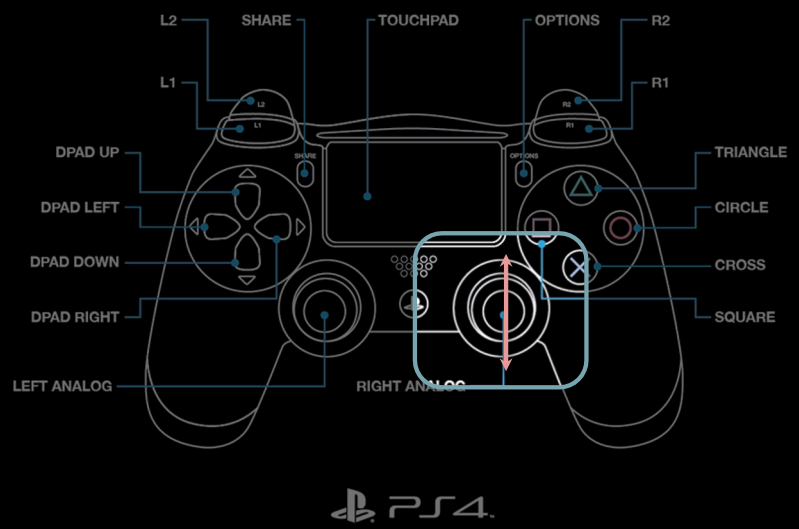

```java
// Main loop.
while (opModeIsActive()) {
    // Get the left joystick x position.
    double strafe = gamepad1.left_stick_x;
    // Get the inverted left joystick y position.
    double forward = -gamepad1.left_stick_y;

    // Drive using LJX as strafe power and LJY as forward power.
    drive.driveRobotCentric(strafe, forward, turn: 0);


}
```

NOTE: This axis is *inverted!!!*

ROBO RAIDERS
SCARSDALE · 12331

Turning

- Lastly, we'll map the Right Joystick X-axis to turning (positive = clockwise).




```java
// Main loop.
while (opModeIsActive()) {
    // Get the left joystick x position.
    double strafe = gamepad1.left_stick_x;
    // Get the inverted left joystick y position.
    double forward = -gamepad1.left_stick_y;
    // Get the right joystick x position.
    double turn = gamepad1.right_stick_x;

    // Drive using:
    //      Left Joystick X as strafe power
    //      Left Joystick Y as forward power
    //      Right Joystick X as turn power
    drive.driveRobotCentric(strafe, forward, turn);

}
```

ROBO RAIDERS
SCARSDALE · 12331

The Code So Far

Reading gamepad inputs

Set powers proportional to the position of the joysticks

StephenTeleOp.java

```java
package org.firstinspires.ftc.teamcode.opmodes;

import ...

@TeleOp(name="Stephen's TeleOp")  no usages
public class StephenTeleOp extends LinearOpMode {
    @Override
    public void runOpMode() throws InterruptedException {
        // Initialization code.
        HardwareRobot robot = new HardwareRobot(hardwareMap);
        DriveSubsystem drive = new DriveSubsystem(
                robot.leftFront,
                robot.rightFront,
                robot.leftBack,
                robot.rightBack
        );

        waitForStart();

        // Main loop.
        while (opModeIsActive()) {
            // Get the left joystick x position.
            double strafe = gamepad1.left_stick_x;
            // Get the inverted left joystick y position.
            double forward = -gamepad1.left_stick_y;
            // Get the right joystick x position.
            double turn = gamepad1.right_stick_x;

            // Drive using:
            //      Left Joystick X as strafe power
            //      Left Joystick Y as forward power
            //      Right Joystick X as turn power
            drive.driveRobotCentric(strafe, forward, turn);

        }

    }
}
```

ROBO RAIDERS
SCARSDALE · 12331

Other Driver Considerations

- To make it easier for the driver, you could possibly try:
  - Speed factor
  - Adding Fast and Slow modes
  - Modifying joystick sensitivity
  - Using the triggers to modify speed
  - etc.

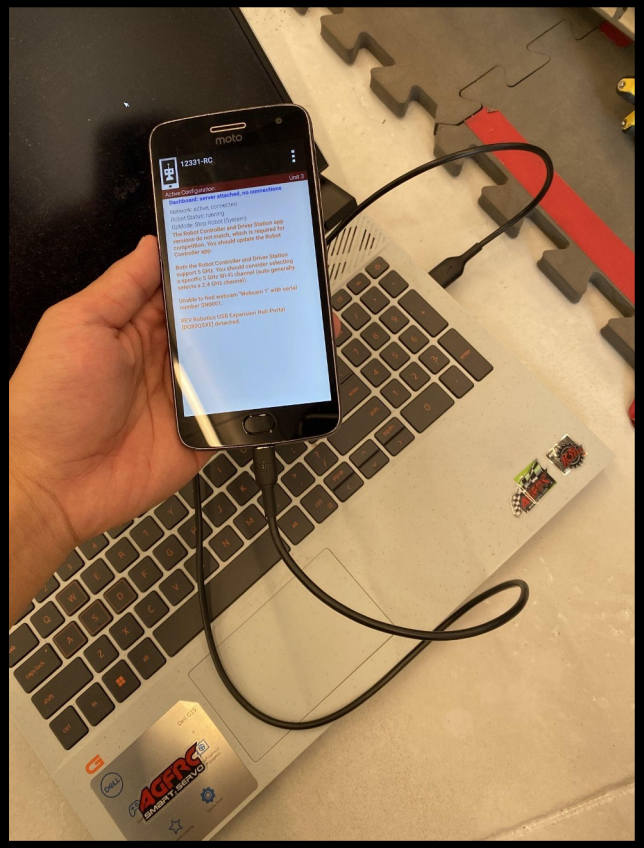
ROBO RAIDERS
SCARSDALE · 12331

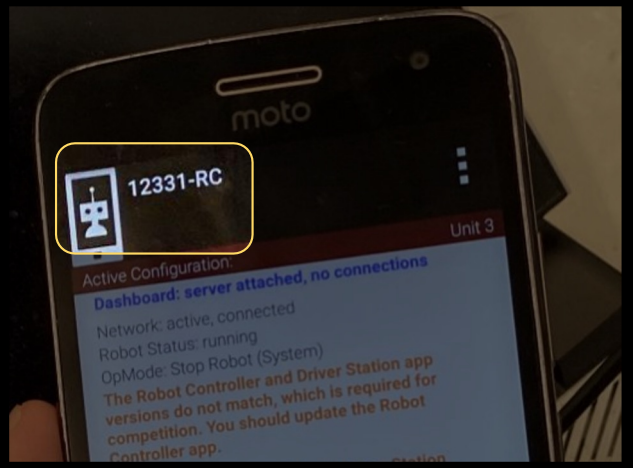
Section 7: Testing Your Code

ROBO RAIDERS
SCARSDALE · 12331

Connect Robot Controller

- Plug the 12331-RC phone into your computer.

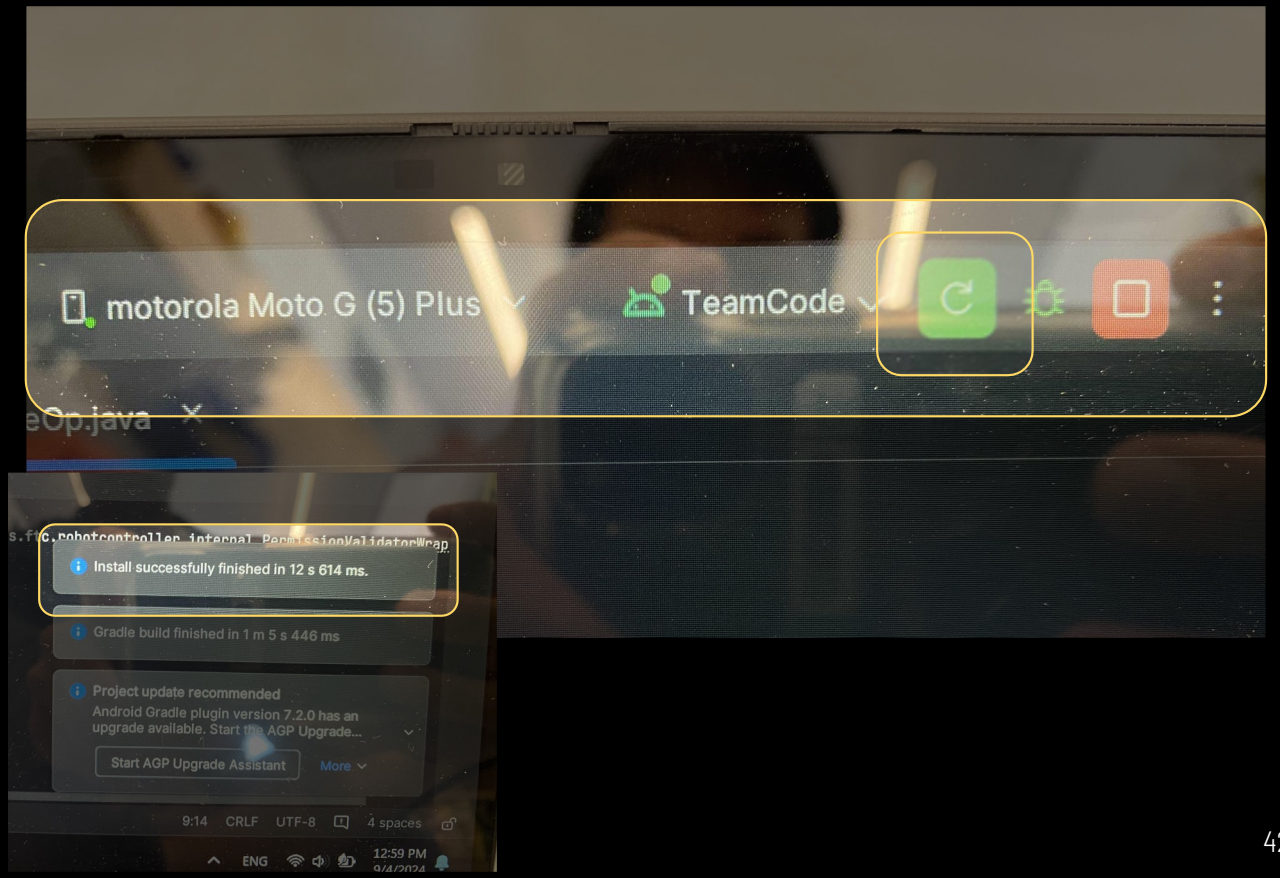




ROBO RAIDERS
SCARSDALE · 12331

Upload Code

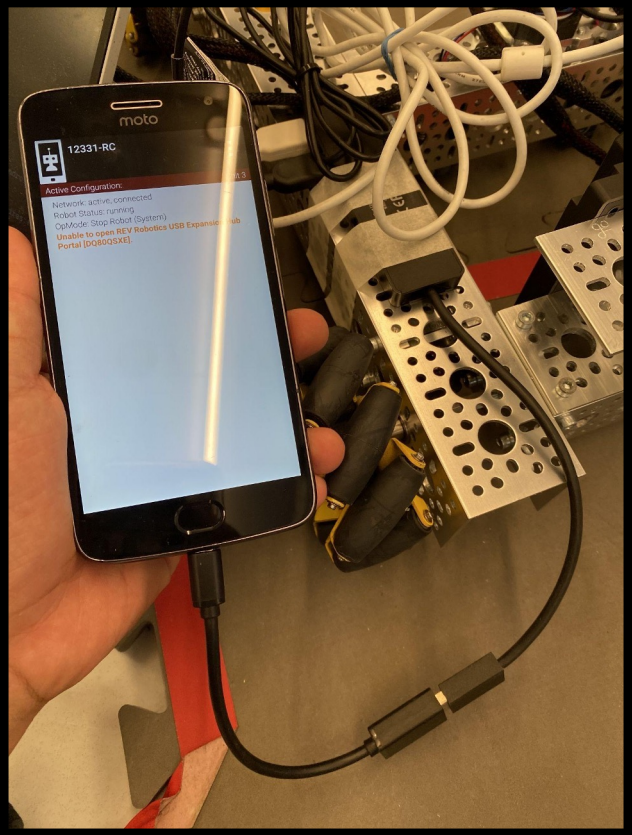
- Make sure the launch device says “motorola Moto G (5) Plus”.
- Click the green run button!
- Wait until “Install successfully finished”.

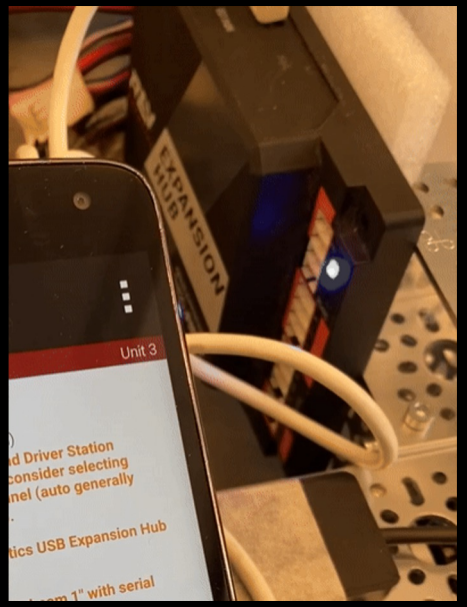


ROBO RAIDERS
SCARSDALE · 12331

Reconnect Robot Controller

- Plug 12331-RC back into the chassis.
- If the expansion hub flashes blue, unplug & replug the battery and phone.



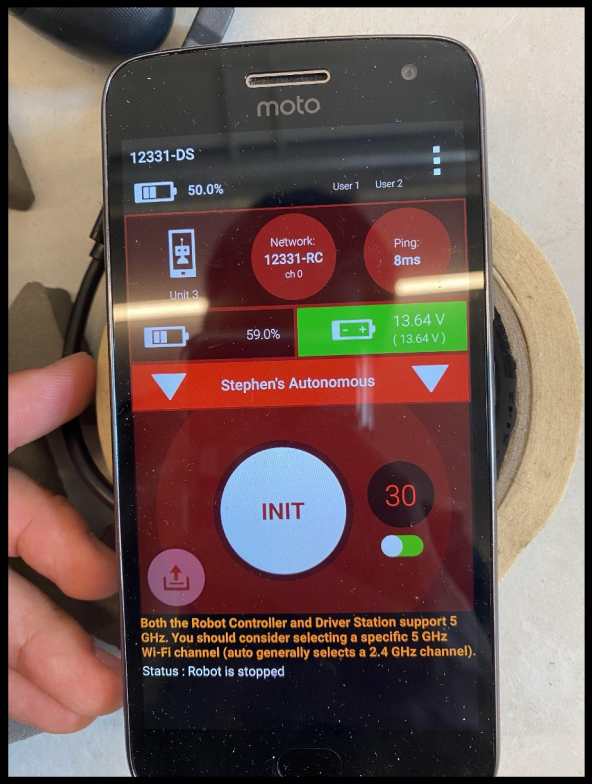


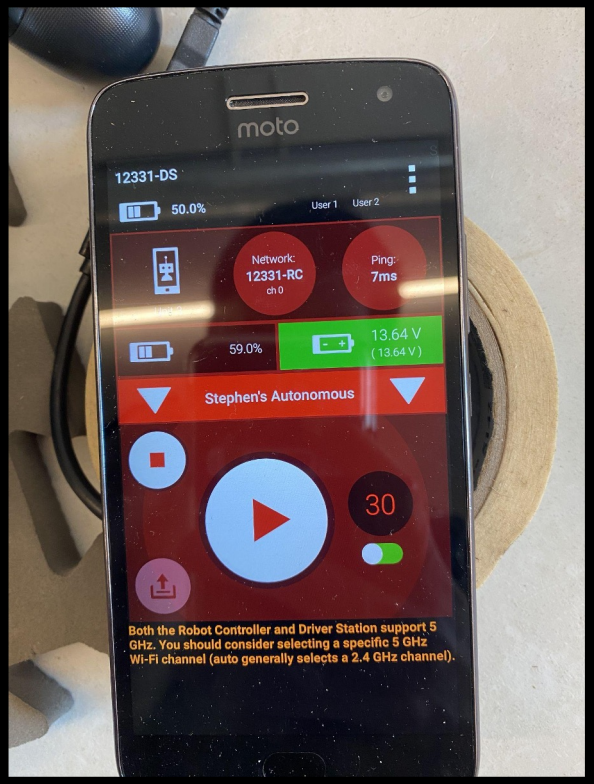
Not connected!

ROBO RAIDERS
SCARSDALE · 12331

Run On Driver Hub

- Open the dropdown on either side and select your OpMode.
- Click “INIT”, and then press Start!





ROBO RAIDERS
SCARSDALE · 12331