Day 06 CS570

Starting to program a Robot

Let's install some libraries… Start a new project called **First_ROMI**. Then go to the *View Menu > Tool Windows > Terminal.* Terminal is a place where you can give commands to the computer. In PyCharm, each project is contained within what is called a *Virtual Environment* which means that libraries are only accessible within that particular project. This is helpful because sometimes libraries have overlaps and interactions which are not good, and this allows you to control what libraries are part of any python project you are making.

On a mac, in terminal do the following commands one at a time:

```
python3 -m pip install robotpy
```

If you have another type of operating system please look at the instructions here.

We will need to initialize a robotpy project. This is done by the following command:

```
python3 -m robotpy init
```

Once this is done you have the code on your computer necessary to build our first ROMI robot code. We will start that next class…

Starting to code a Robot

Now that we have access to the `wpilib` libraries we can start to write code to make our robot move. Let's discuss a little bit about how that works. You will probably want to start the First-ROMI PyCharm Project that we started as that project hopefully has access to the libraries we need.

Writing the most basic Robot

Import a basic Robot class to subclass Start by creating a file in your project called `robot.py`. FRC robots all start with file called robot.py, and this is a default to help competitions work. In `robot.py` we will build a subclass of a robot class that is defined in wpilib called `TimedRobot`. To do this will need to put the following line at the top of the file:

```
from wpilib import TimedRobot
```

This allows use to reference `TimedRobot` by simply typing `TimedRobot`. There are times when you might have libraries that have classes of the same name, and then there could be confusion about which one you meant. In that case, you would want to do the following import:

```
import wpilib
```

And then when you want to use `TimedRobot` you would type `wpilib.TimedRobot`, this indicates that you want the `TimedRobot` class from the `wpilib` library.

Start to write out the subclass Add in the following lines:

```
from wpilib import TimedRobot

class MyRobot(TimedRobot):

   def robotInit(self):
        '''This method is called as the robot turns on and is often used to setup the
        joysticks and other presets.'''
         pass

    def robotPeriodic(self):
         '''This is called every cycle of the code. In general the code is loop
          through every .02 seconds.'''
         pass
    def autonomousInit(self):
        '''This is called once when the robot enters autonomous mode.'''
        pass

    def autonomousPeriodic(self):
        '''This is called every cycle while the robot is in autonomous.'''
        pass

    def teleopInit(self):
        '''This is called once at the start of Teleop.'''
        pass

    def teleopPeriodic(self):
        '''This is called once every cycle during Teleop'''
        pass

    ### There are other methods that you can overwrite for when the robot is
    # disabled, or when the robot is in Test mode.
```

This file and these methods are the main nerve center of the robot code. Good robot code doesn't have much in these methods, because we want to farm out the functionality to lots of different files so that they can worked on by several people independently.

A less than perfect robot

Let's continue to work only in this file for now, and then we will refactor our work to a different file and clean up our code.

Our goal is get the robot to drive. Here is the checklist of things that we need to address to get the ROMI to drive.

- Set up a **Controller** of some type. Take readings from the controller.
- Create a way to activate the motors
- Connect the information from the controllers to

Setting up the controller We will need an object to represent a joystick, the `wpilib` library already supplies one called `Joystick`. Let's import that class and make Joystick object and say the Joystick connects on port 0. A port is simply a place that you might plug something in to your computer.

At the top of the file alter the import to read:

```
from wpilib import TimedRobot, Joystick
```

And a little further down in the code alter `robotInit`, delete the word pass and add in the line about a controller.

```
    def robotInit(self):
        '''This method is called as the robot turns on and is often used to
        setup the joysticks and other presets.'''
        self.controller=Joystick(0)
```

Now we have a controller. To see what methods our controller can do you can see them here Because `Joystick` is a subclass of `GenericHID` (Human Interface Device) you can also access the methods here

Setting up the motors Now let's give this robot some motors. The motors we have aren't Spark motors, but they can be run by the same software, so let's create a left and right motor and indicate which input that they are attached to. According to the ROMI documentation the left motor is port 0, and the right is port 1 (the documentation is found here).

We are also going to use even more from the `wpilib` library. The library has a class that does all the work for a Differential Drive system. A Differential Drive system is where you have wheels on both sides that are independently set to speeds. This allows you to move forward and rotate. We won't need to code that we will just need to utilize the methods in the `wpilib` class.

Again we will edit the imports and the `robotInit` method.

```
from wpilib import TimedRobot, Joystick, Spark
from wpilib.drive import DifferentialDrive
```

```
    def robotInit(self):
        '''This method is called as the robot turns on and is often used to setup the joysticks and other p
        self.controller=Joystick(0)
        self.left_motor=Spark(0)
        self.right_motor=Spark(1)
        self.drivetrain = DifferentialDrive(self.left_motor, self.right_motor)
```

Connect the joystick to the motors This will happen in the teleop periodic for us. We will use methods that come with all the objects that we have brought in from `wpilib`.

```
    def teleopPeriodic(self):
        '''This is called once every cycle during Teleop'''
        forward=self.controller.getRawAxis(0)
        rotate=self.controller.getRawAxis(1)
        self.drivetrain.arcadeDrive(forward,rotate)
```

Make it runnable The ROMI runs in the simulator. So to make it run in reality we have to make a connection between the simulator and the ROMI. This is done by the following command:

```
os.environ["HALSIMWS_HOST"] = "10.0.0.2"
os.environ["HALSIMWS_PORT"] = "3300"
```

There are some more imports necessary for these commands. The `os` library is a standard python library that connects to the operating system, and we are going to need to import the wpilib library too. Your imports should now look like:

```
from wpilib import TimedRobot, Joystick, Spark
from wpilib.drive import DifferentialDrive
import os
import wpilib
```

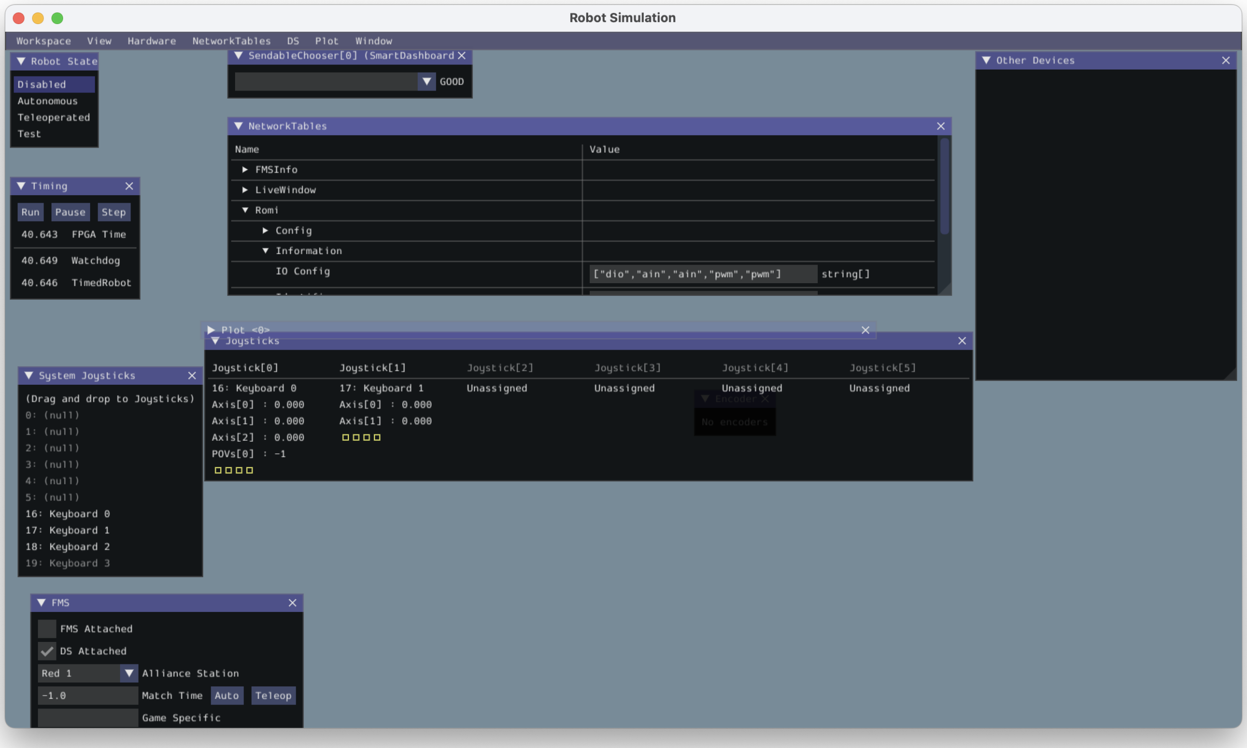
Running and operating your ROMI

Connect to the ROMI's wifi Turn on your ROMI by sliding the little switch on one side. Give a few minutes and then ROMI's wifi should be visible as one of the choices for your robot to connect to. You must connect your computer to the ROMI's wifi. The password for the ROMI's wifi is **WPILib2021!**.

Upload and start the simulator Now that you are connected to the ROMI you can upload and run your code. Open a terminal window *View > Tool Windows > Terminal*. In the terminal write:

```
python -m robotpy sim --ws-client
```

This should load the code you have written to the ROMI and start a window that looks like this



If there is nothing listed under **Joystick[0]** drag **Keyboard 1** over and drop in that area. Change the robot status to **Teleoperated** and you should be able to drive your ROMI with the *s* and *w* keys to go forward and back and the *a* and *d* to make it turn.

Homework

Watch this video about Object-Oriented Programming and answer the following questions.

- Describe some features of a robot that are likely to be abstracted away in the code that we write for a robot?
- Describe ways that encapsulation is helpful in writing robot code.
- Give an example of polymorphism in the robot code that we wrote today.

Next Steps

Test your ROMI code Get a partner and a ROMI and see if you can get a ROMI to move.

Show me your robot moving before you leave class today.

Refactor the Drivetrain While it is nice that the drivetrain is all within the robot.py file, it would be better if the drivetrain was in its own file. This will allow us to do more interesting things with the robot later.

So create a new file called `drivetrain.py` and move the drivetrain code into that file.

Then in the `robot.py` file import the drivetrain class and create an instance of the drivetrain class in the `robotInit` method.

Show me your code before you leave class today.