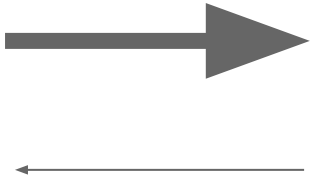
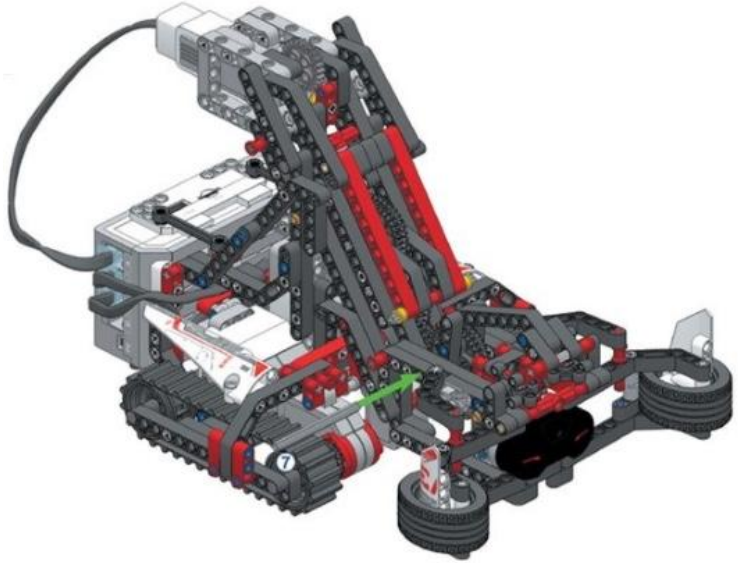
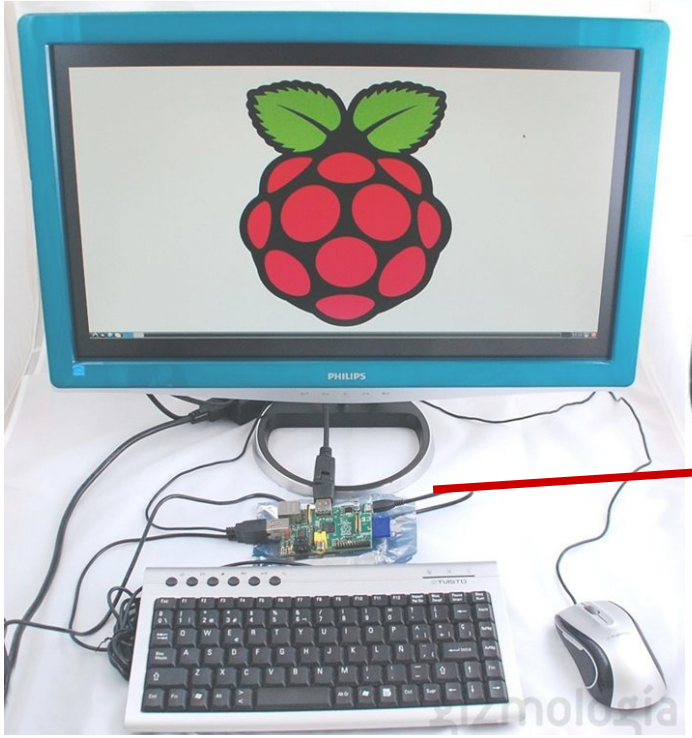
Connection from PyCharm to EV3

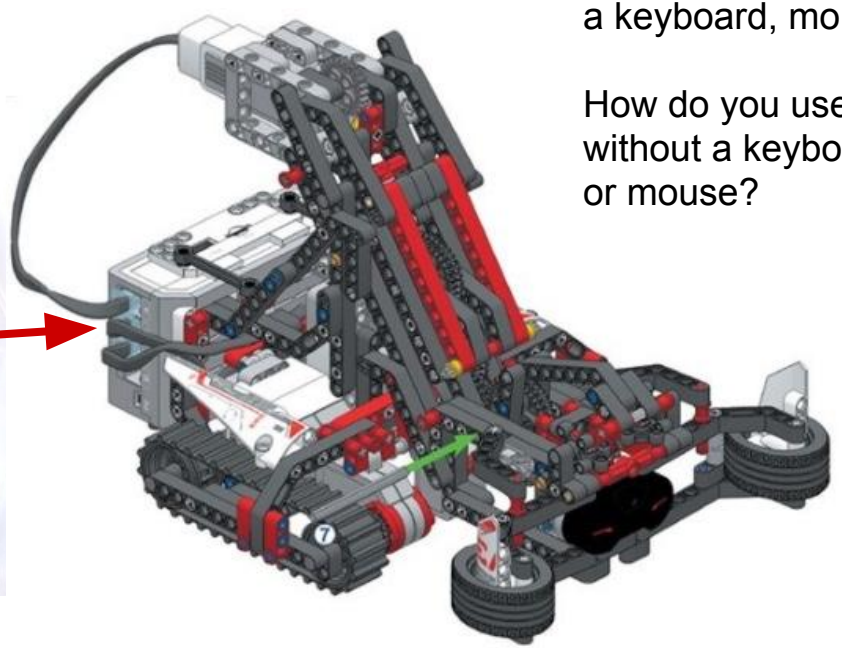




It’s a computer…

but without a monitor, keyboard, or mouse





Very similar to a Raspberry Pi, but lacks the ports to connect a keyboard, monitor, or mouse

How do you use a computer without a keyboard, monitor, or mouse?

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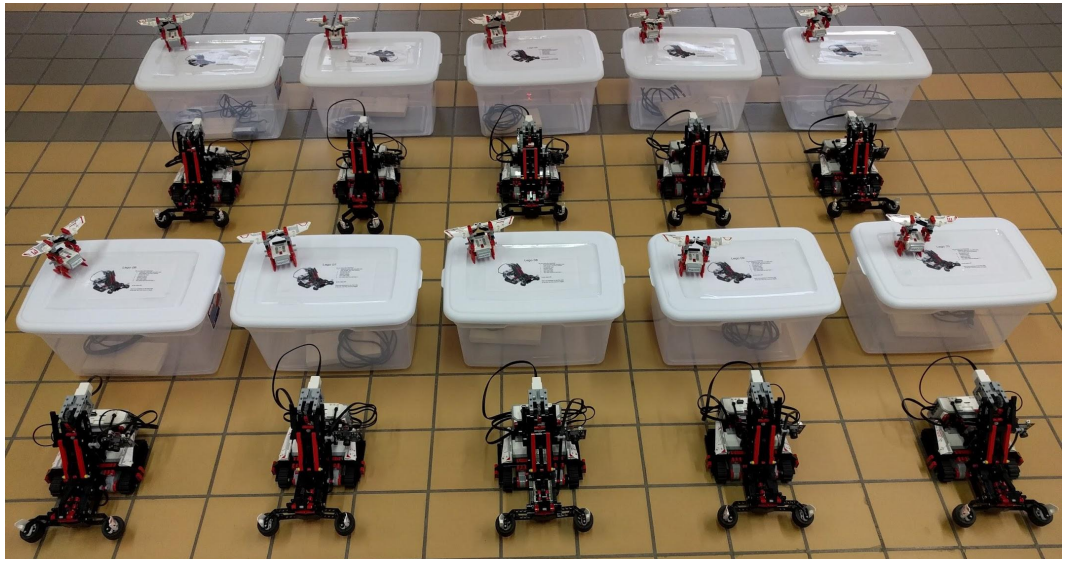
By the end of this unit you should be able to...

- ❏ Explain how PyCharm connects to ev3dev
- ❏ Upload programs to EV3
- ❏ Run programs on EV3
- ❏ Troubleshoot issues



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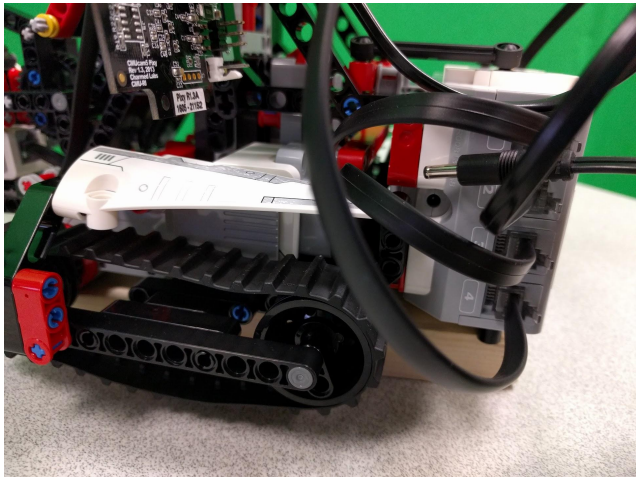
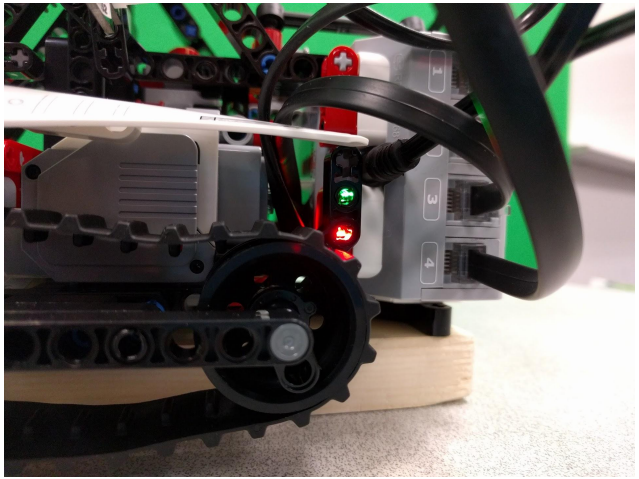
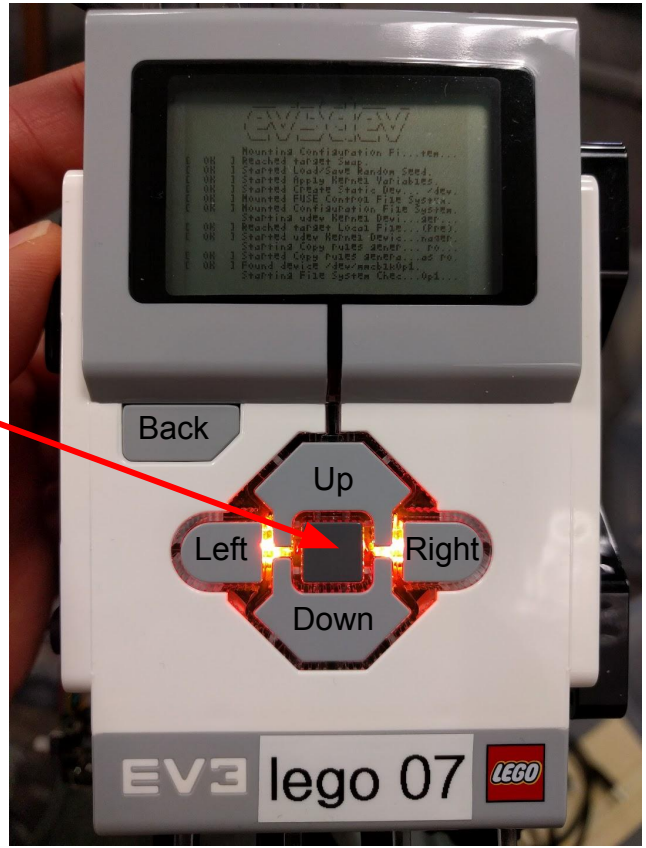
Reminder: Power is important

Plug in your robot to charge it every moment that you aren't driving around.





Button names



Power:

- Press ***Enter*** (hold for a moment) to turn on
- Hold ***Back*** to Power off or Reboot

Useful Trick (equivalent to Ctrl-Alt-Delete on a computer)

- If the brick is bricked (totally unresponsive), you can hold **Back and Enter** to do a hardware reboot (like Ctrl-Alt-Delete on Windows).
- Similar to pulling the battery out for a moment.

Connecting your robot to WiFi

Let's learn how to troubleshoot since you'll likely experience troubles at some point

You will connect to your robot via WiFi using Rose-Hulman's RHIT-OPEN network.

The robots should connect by default and you should never lose this network (yeah right!).

Let's practice a connect and disconnect from EV3 just in case. :)

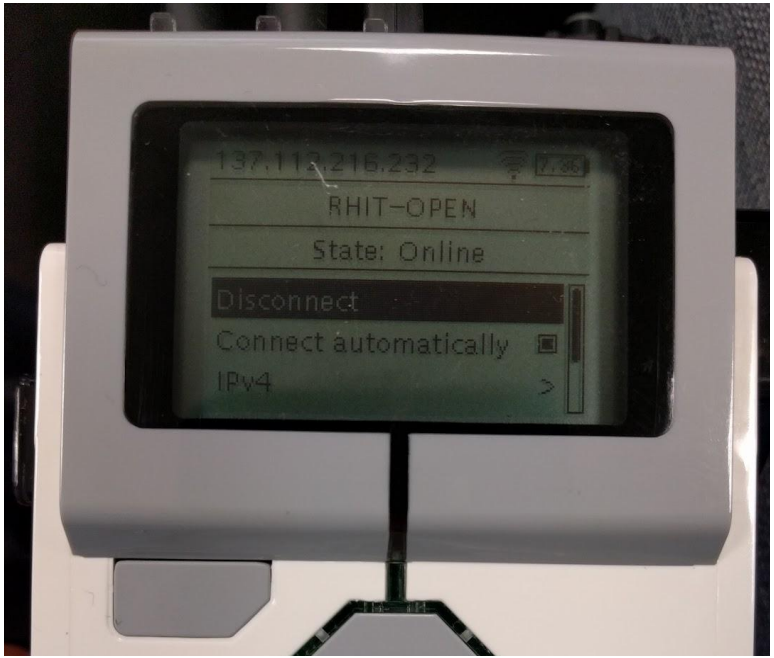
Make the following selections on the Brickman menu

Wireless and Networks

Wi-Fi

RHIT-OPEN

Network Connection



Things to notice:

- **State: Online** which is the best indicator of status
- IP address shown in the upper left (which is NOT the best indicator of your status, it doesn't always update)
- Battery level in the upper right > 7.0 volts.

Disconnect and reconnect

Select Disconnect

Watch the state change

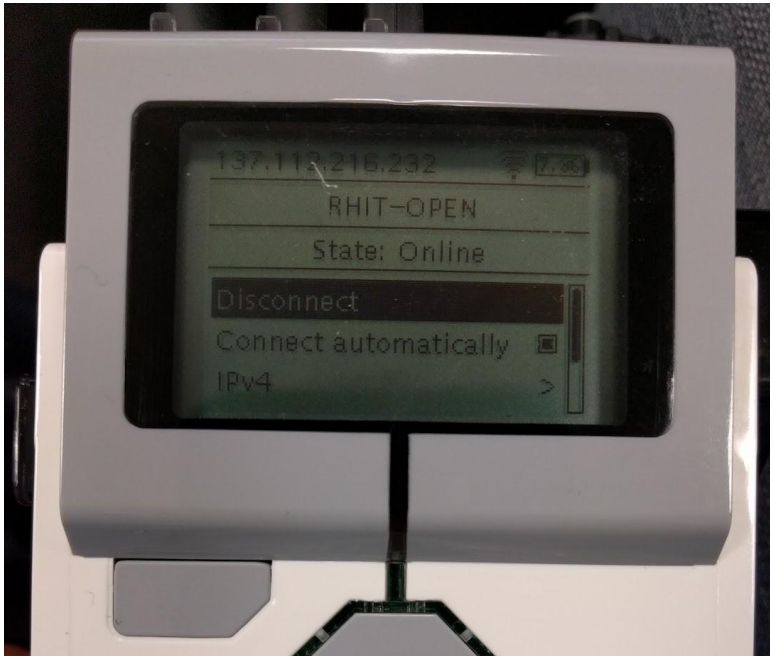
Watch the IP address go away

Select Connect

Says Associating, Configuring, then Online

Observation:

- It's fairly fast. This is a useful hammer to try to fix issues with the network.



Note, if your IP address ever starts with the value 192 that means you are NOT connected to RHIT-OPEN, I've seen that happen

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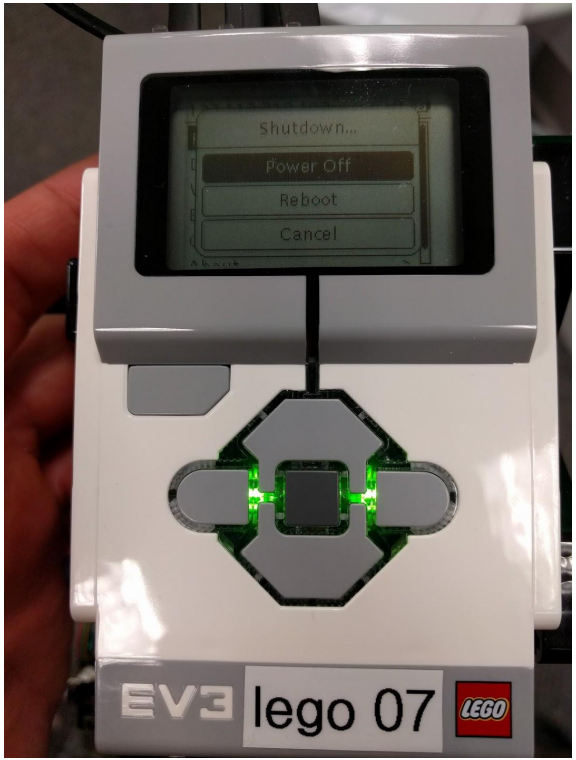
Next level of kicking: Reboot

If WiFi on and off isn't cutting it. Reboot can fix some issues

Takes about 2 minutes to power down then power back up.
Sometimes it's about your only option though.

Press and hold Back to see this menu.
Go ahead and kick off a reboot just to see how long it takes.
It's not super terrible. :)

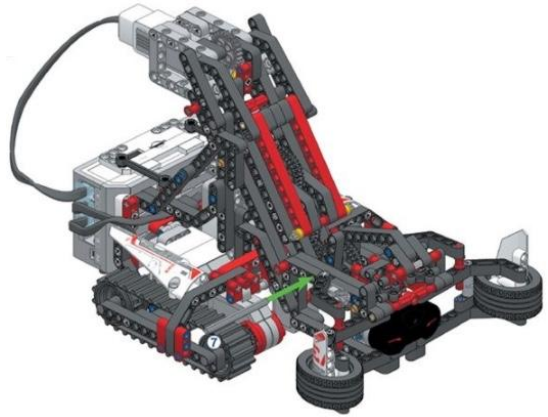
For no apparent reason, some days your robot will have trouble getting connected or lose the Rose-Hulman RHIT-OPEN WiFi. Hopefully the WiFi disconnect/reconnect will fix it. If not… Reboot.



Connecting from PyCharm to EV3

Fundamentally we need two things:

1. A way to transfer .py files that have been typed on our computer to the EV3
2. A way to run the programs on our EV3 and see the print statements on our computer



Starting code for this lesson

Some settings are project specific so make this project

Select the src folder of your project,

and do the usual right-click and

Mark Directory As ~ Sources Root

Transferring files to the EV3

Save on your computer, ship it over easily

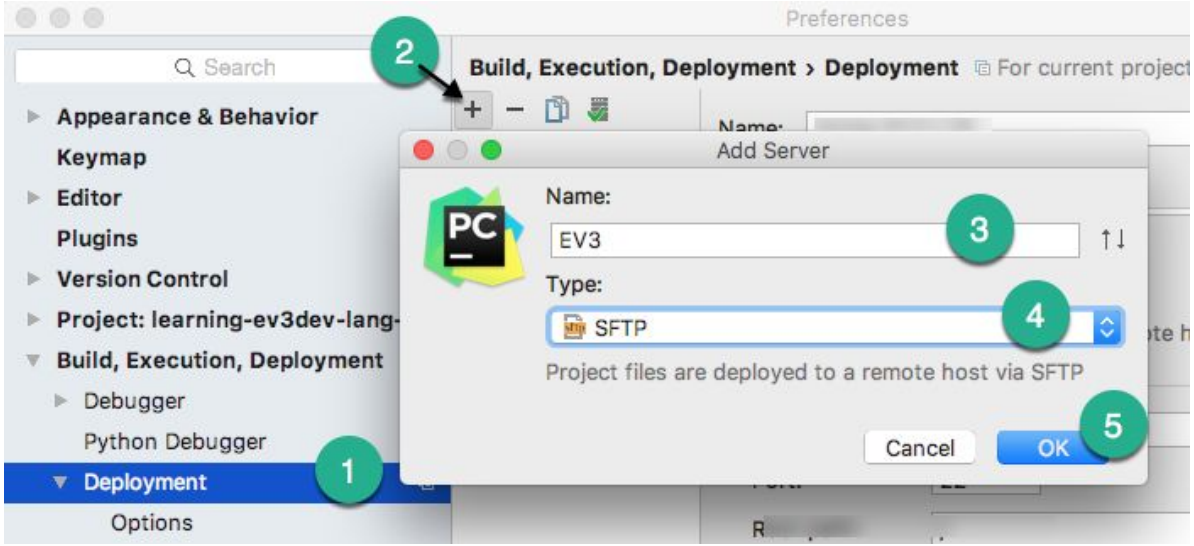
Open your project.

We will set up an SFTP connection from your computer to your robot to make file transfers trivially easy.

Adding a “Remote Server” to PyCharm

Within PyCharm choose File > Settings (on a Mac it’s PyCharm > Preferences)

- Expand Build, Execution, Deployment
- Click Deployment
- Click the + icon to add a new remote server, name it EV3
- Select SFTP and hit OK



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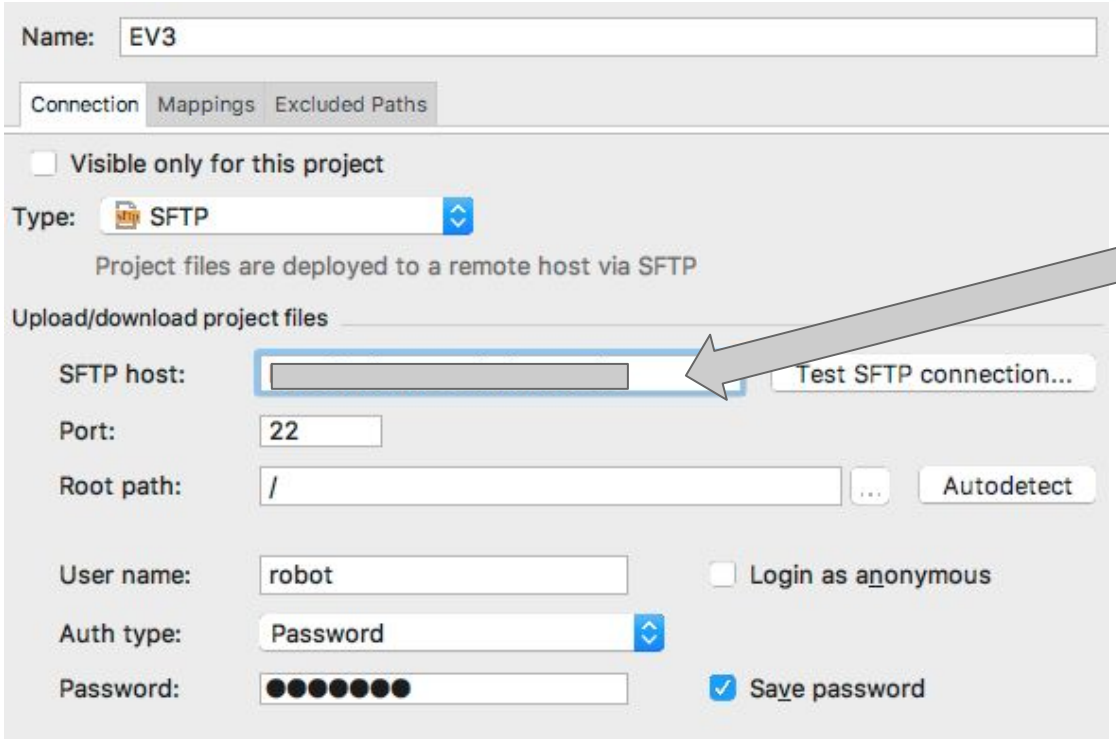
Setup these connection parameters

*Use **your IP address**, otherwise match the parameters shown*



Important settings to notice:

- SFTP host: **legoXX.wlan.rose-hulman.edu**

  (using 2 digits for your robot number) OR

  Use the **IP address that is displayed on your EV3 screen** (both should work)

- Port: 22 (don't change it)
- Root path: / (don't bother change it as we'll set the full path later)
- User name: **robot**
- Password: **C$$E120**
- Save password: Check the box
- **Un**check 'Visible only for this project' at the top (if needed)

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Click on the Mappings tab to set a deployment path

This part decides what folder your files go into on EV3

In the Mappings tab, check the button “Use this server as default”

Make the Local Path be this sessions src folder

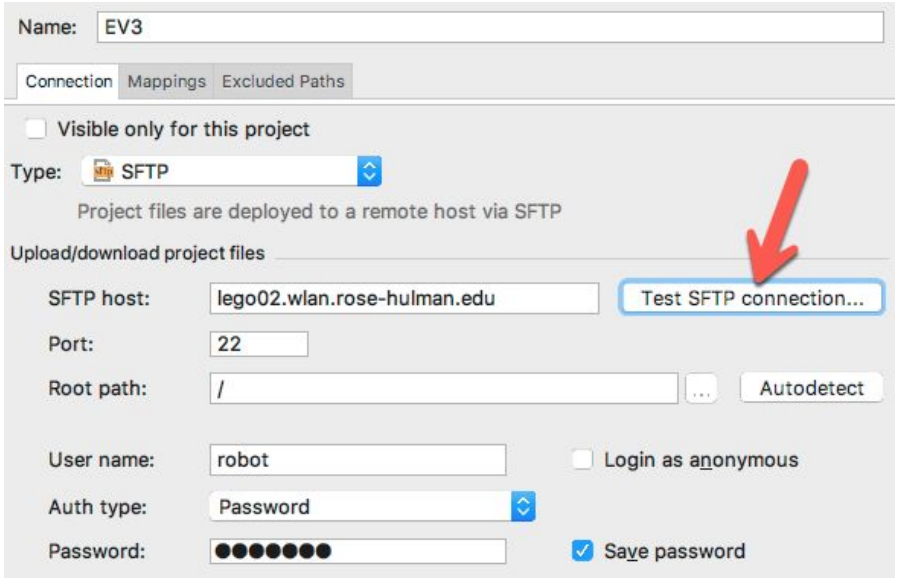
Set the server ‘EV3’ path to **`/home/robot/YOUR_NAME_NO_SPACES`**

for now. Note: later it will become /home/robot/csse120

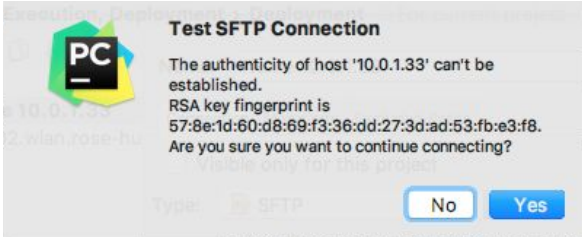
Test your connection

Networks are flaky, sorry. Every day you will start by Testing your connection.

Click this button. When it works a dialog will appear asking for approve. Say Yes.



This box is good!



If it fails check to make sure your EV3 says **Status: Online**
Then perform your Kick it skills!
(disconnect from WiFi then reconnect)

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Success versus Failure

If it works great! If not then what?

Start using your tool!

1. Disconnect… re-Connect
2. Try again
3. Reboot
4. Try again
5. Ask for help

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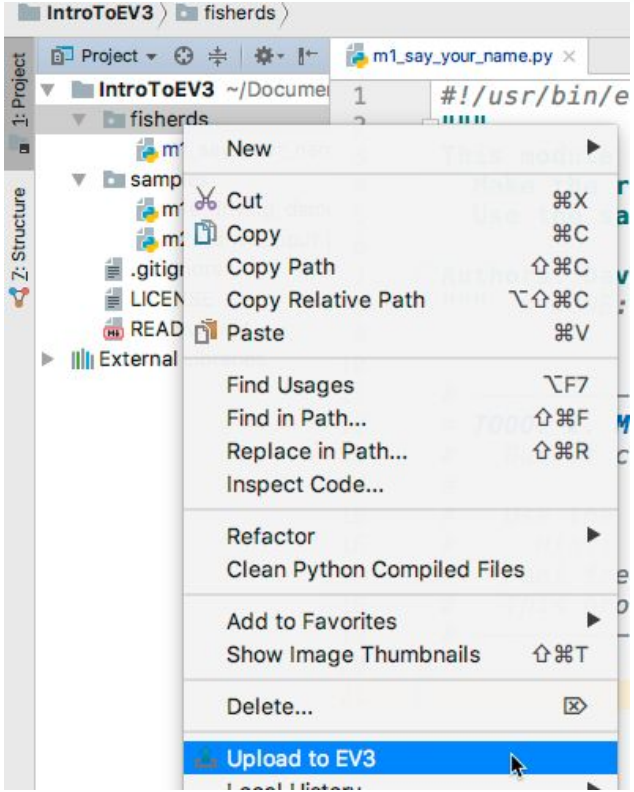
Push the your project to your robot

One person on your team should do this. Then the next person, just for practice.

Right click **the entire project**

Select ***Deployment ~ Upload to … EV3***

All the files in this project will get put into the /**`home/robot/`*`YOUR_NAME`*** folder.



Confirm with Brickman that your files are present

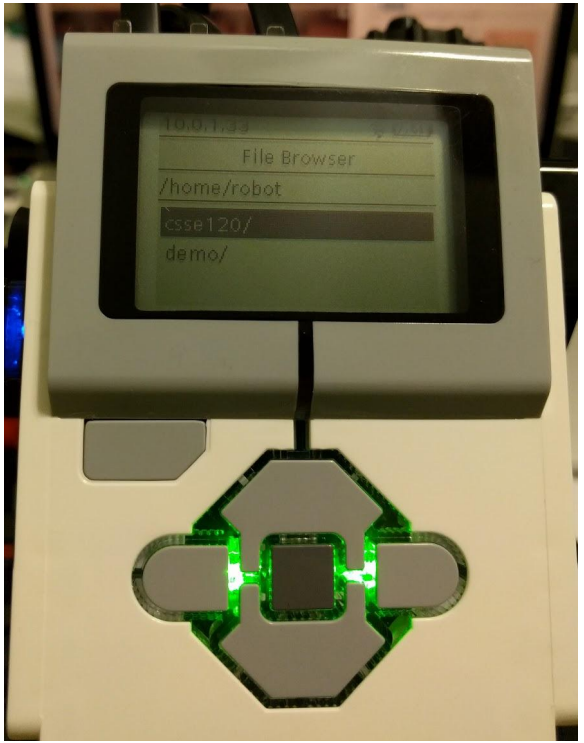
Go back to the top menu.

Select File Browser.

Notice that you have a YOUR_NAME folder that was not there a moment ago. You can click into it if you want but it's all there.

You will later use SSH to confirm files.

For now Brickman works though.



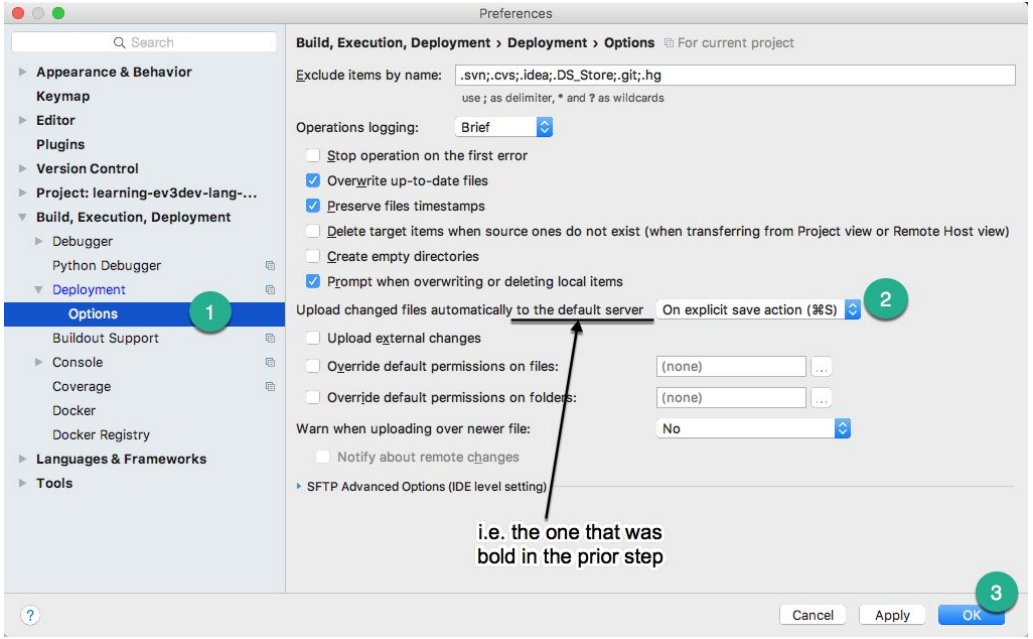
Let's setup automatic uploads

You want this on when you are connected to your robot, off otherwise

- Reopen the File > Settings
- Expand Build, Execution, Deployment
- Expand Deployment
- Select Options
- Select On explicit save action

Note this can be turned off anytime you are not connected to the robot (which is common). It's just nice that the file transfer happens automatically on save once this feature is setup.

To test just edit a file then hit save. There is a quick save



Running files

There are 2 ways to run files on your EV3

1. Mark the file as executable and run it via Brickman (like our ir_remote.py demo)
2. Make an SSH connection and type `python m1_myprogram.py`

We'll only use the second approach, you get to see console messages for errors etc.

Making an SSH connection

In CSSE132 you will use the command line a lot, but for now we'll keep it simple

An SSH connection (Secure SHell) is a command line tool.

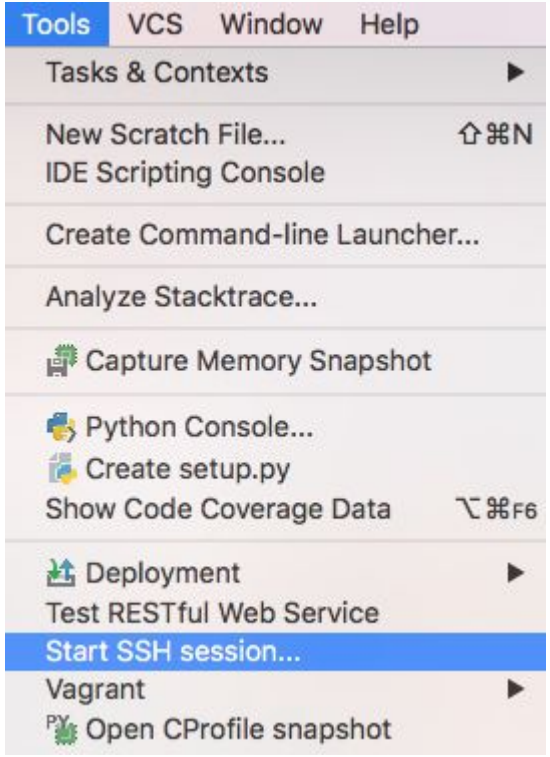
If you are a CS you will likely use the command line a lot in your life.

Common commands you'll use:

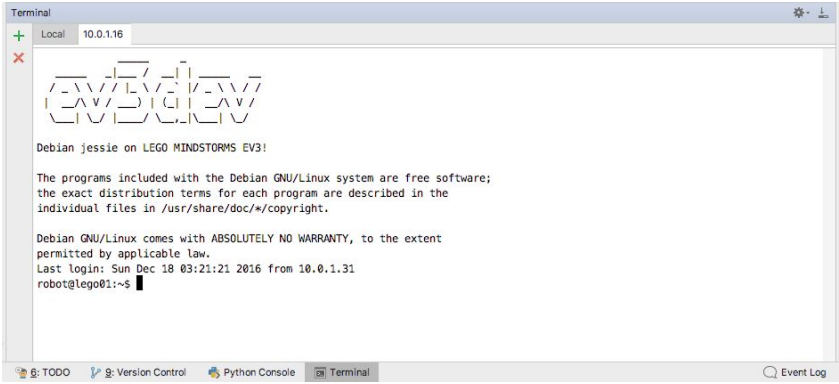
- `cd somefolder` to navigate into a folder.
- `cd ..` to navigate back one folder.
- `ls -lah` to list all the files in this directory with the -lah options, which help formatting.
- `python somefile.py` to run your program.
- `tab` to autocomplete a folder or file name, VERY handy. Always autocomplete!
- `Ctrl C` to manually kill a python script that is running, VERY handy.
- `up arrow` to quickly bring up prior commands (can be used repeatedly).

Open an SSH connection to your EV3

To start an SSH session just use the menu option Tools > Start SSH Session…



Select EV3
It already knows your password which is handy.



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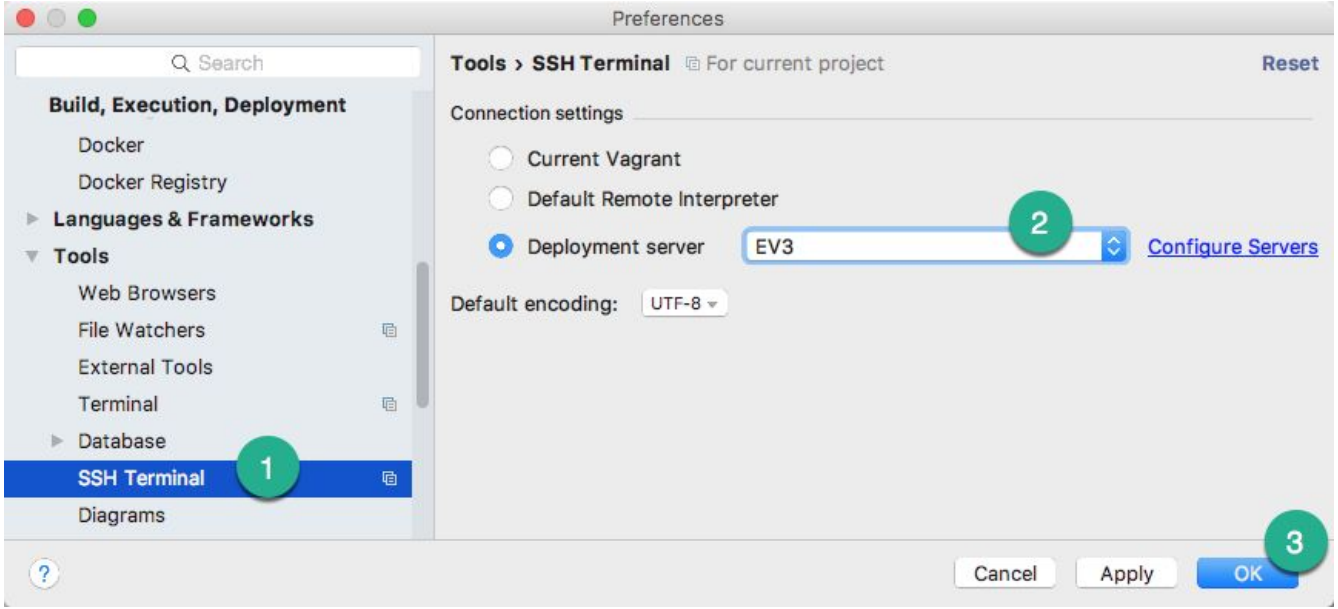
Optional optimization

You can even skip that selection step (saves 1 click!) by setting the default Deployment server

Choose *File* > *Settings*
Expand Tools - Select SSH Terminal
Change Deployment server from `Select server on every run` to `EV3`



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Trying out the SSH Terminal

Navigate around using `cd` and `ls -lah`

```
robot@lego02:~$ cd csse120
robot@lego02:~/csse120$ ls -lah
total 32K
drwxr-xr-x 5 robot robot 4.0K Jan  2 16:51 .
drwxr-xr-x 4 robot robot 4.0K Jan  2 16:52 ..
-rw-r--r-- 1 robot robot   11 Dec 22 01:45 .gitignore
-rw-r--r-- 1 robot robot 4.6K Dec 28 18:47 README.md
drwxr-xr-x 5 robot robot 4.0K Jan  2 16:51 examples
drwxr-xr-x 3 robot robot 4.0K Jan  2 16:51 libs
drwxr-xr-x 3 robot robot 4.0K Jan  2 16:51 sandbox
robot@lego02:~/csse120$
```

One person at a time try running a program from SSH

Navigate to `YOUR_NAME` folder

Type `python m0_run_this_on_ROBOT` (use tab to autocomplete as you type)

When you hit enter put your robot on the ground. It takes a few seconds (5-10) for the program to start running.

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Installing packages

In order for autocomplete to work we need some packages

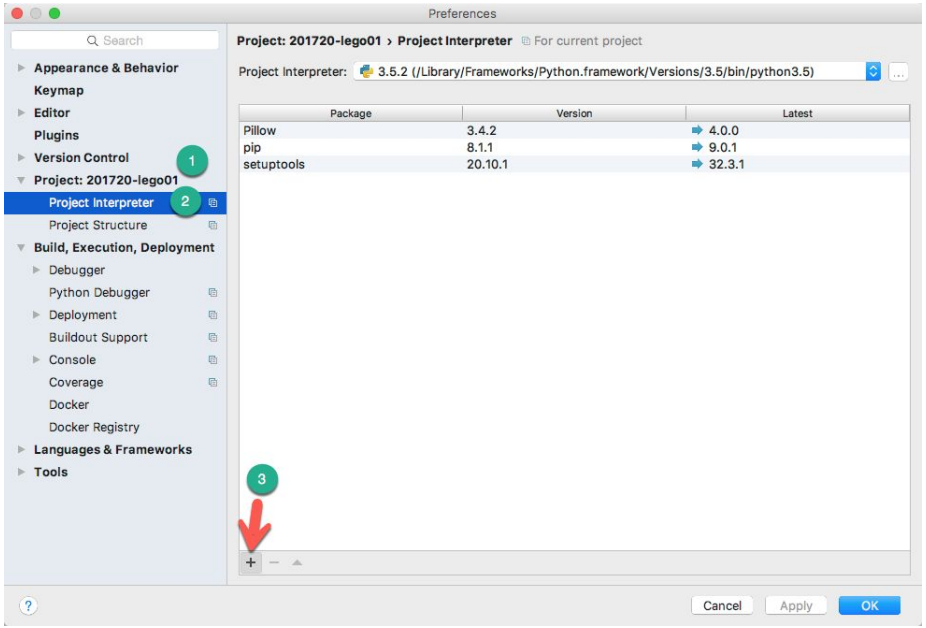
We'll need to install some 3rd party packages for our project:

- python-ev3dev
  - This package is already present on the EV3 robot, but you need it on your computer **to get autocomplete** to work. Interestingly it is not "used" by your computer, but it makes your development environment MUCH better.
- paho-mqtt
  - This Python library **must be on our computer for later** work. We'll use this tool to communicate using MQTT while the robot is running.

Installing python-ev3dev

Within PyCharm choose File > Settings

1. Expand Project: (your project name)
2. Select Project Interpreter
3. Click the + icon to add a new package



On Windows the + button is on the right not the bottom

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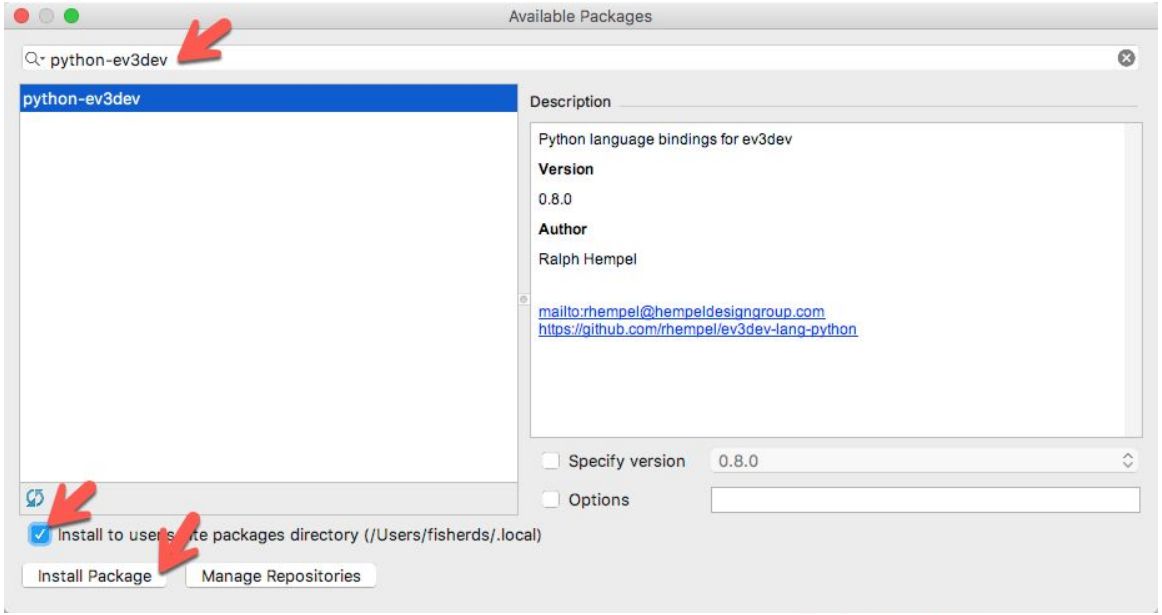
Installing the ev3dev package

*In the dialog that popped up do a search for **python-ev3dev***

This package is already present on the EV3 robot, but you need it on your computer to get autocomplete to work. Interestingly it is not “used” by your computer, but it makes your development environment MUCH better.

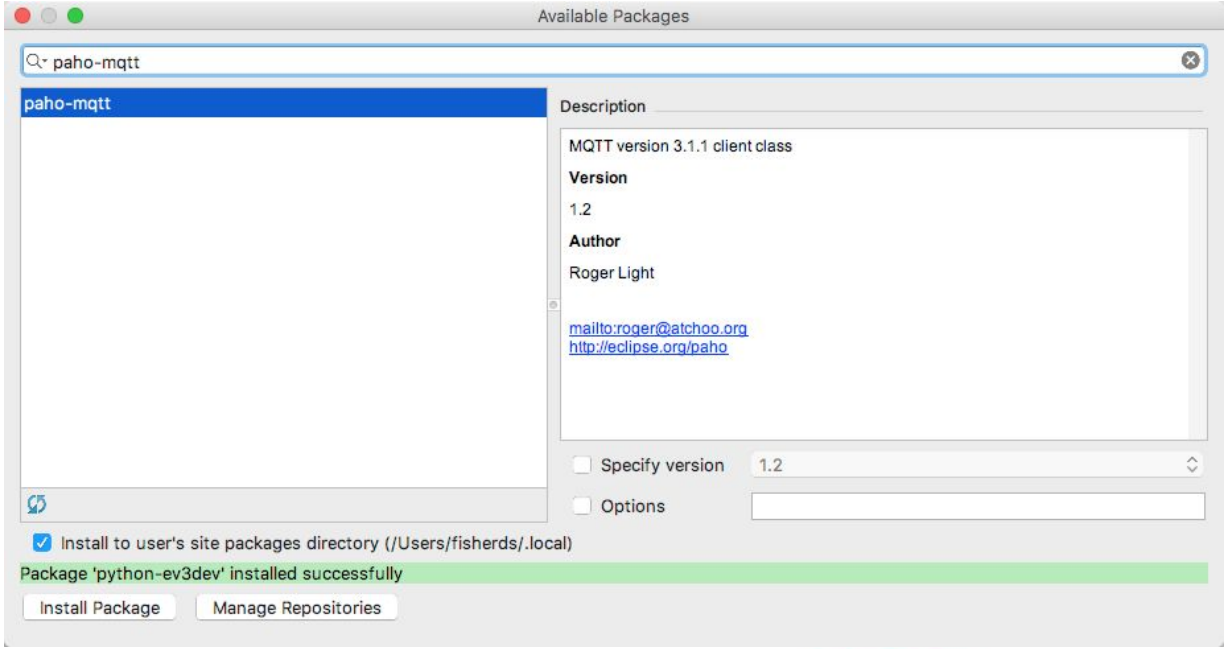
1. Search for **python-ev3dev**
2. Check the box to install to site packages
3. Click Install Package



After that installation do a search for *paho-mqtt*

This Python library must be on our computer for later work. We'll use this tool to communicate using MQTT while the robot is running.

1. Search for **paho-mqtt**
2. Check the box to install to site packages
3. Click Install Package



Summary: PyCharm is the best way to work with EV3

be thankful that JetBrains makes it free for you!

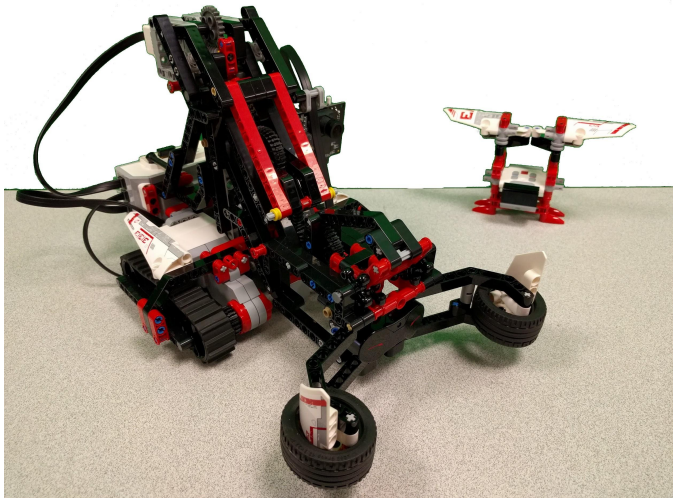
Warning! When you work with real hardware it is NOT like working with pixels on a computer screen.

Things go wrong periodically!

Robots lose their connections sometimes.

Things need a reset here and there.

Standard kick-it rules often apply.



Become an expert of your entire robot,

invest time into figuring out real world bugs.

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