## How to Run

### Step 1:

1. download our legolas files from our github <https://github.com/AudreyVersteegen/Capstone-LEGOLAS>

(click on “code” -> “download zip”)

Download model from GitHub link (model\_10.pt) and put into “LEGOLAS/Scripts”

2. download anaconda from https://www.anaconda.com/products/individual

### Step 2:

We are create a python environment that uses python 3.12.3 because it is need to connect to the rpyc server

Launch anaconda prompt and type the following:

1. conda create -n python\_3.12.3 python=3.12.3 (type "y" when it asks to proceed) – Once done, don’t have to run anymore

2. conda activate python\_3.12.3

To switch out of the new environment type:  
conda deactivate

If you see (base) before filepath then you are back in your old environment.

You can type python --version to see that current version of python you have

3. python -m pip install ipykernel

So the above line is to make sure that the jupyter notebook uses the new environment instead of the old one. Once done, don’t have to run any more.

The following line of code adds the new python to jupyter (activate environment first):  
python -m ipykernel install --user --name python\_3.12.3-kernel

(Once done, don’t have to run any more)

### Step 3:

1. Open jupyter notebook

2. locate where the legolas files are and open "LegolasDemo.ipynb" under the "LEGOLAS Scripts" folder

3. on the top bar select "kernel" -> "change kernel" -> "python\_3.12.3-kernel"

The other kernel uses the old python

### Step 4:

In your anaconda prompt type the following commands:

Conda install -c conda-forge packagename

George says the above is better.

Then install using pip.

1. pip install opencv-python

2. pip install pyyaml

3. pip install rpyc=6.0.0

4. pip install matplotlib

5. pip install scipy

6. pip install torchvision

5/16/24 (old Python 3.11): ERROR: Cannot uninstall 'TBB'. It is a distutils installed project and thus we cannot accurately determine which files belong to it which would lead to only a partial uninstall.

7. pip install paramiko

8. pip install numpy

9. pip install sv\_ttk

5/16/24: in Python 3.12.3 environment, had to reinstall all packages. Why?

In old Legolas directory, set Jupyter notebook to Python 3.12.3 kernel. Can’t connect to server.

### Step 5:

1. make sure you are on the same network as the legolas

2. run the 2nd cell in the jupyter notebook

Before running anything with notebook, put the “Spot\_D.jpg” and the “testthecode.py” under “LEGOLAS Scripts” and then run “python testthecode.py” to install needed package and then ignore the error

3. after that's done run any of the cells to test the legolas

#### Note:

if you are to use manual.py instead of the jupyter notebook make sure that before you launch manual.py, you type in "conda activate python\_3.12.3" to use the environment we just setup

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5/17/24 Python environment on office laptop

<https://saturncloud.io/blog/how-to-create-a-conda-environment-based-on-a-yaml-file-a-guide-for-data-scientists/>

Laptop has two conda environments: base and python\_3.12.3

Base has a lot of packages installed including python 3.11.5

Environment python\_3.12.3 has 16 packages (one of them is python 3.12.3) but none of the are the ones needed for Legolas.

Pip install numpy #Numpy 1.26.4, see channel pypi (means used pip install)

If deactivate and then come back to this environment, numpy is still installed.

If signout, then come back in, numpy is still installed.

Pip install scipy #1.13.0

If restart laptop and come back in, numpy and scipy are still installed.

If disconnect ethernet, then connect houndnet, deactivate then come back in, still installed.

Disconnect houndnet, connect linksys, deactivate then com back in, still installed.

How does everything disappear????

Install everything. Conda list now shows many installed things – what are they and when did they come in?

Torch came in with torchvision.

Python manual.py works.

Python -m pip install ipykernel #now kernel starts in Jupyter

Under Testing OpenCV, top cell has error. Buildhat.exc.DeviceError: Port already used. If reset the rpyc server, then error disappears.

Under Testing OpenCV, second cell stage.move\_to\_cell(0,0) moves then takes snapshot. IndexError: list index out of range.

To run Stage.home(), must first run cell 3 and 4 to reset server and load\_from\_config.

Now try to run my original files.

Shut Pis off, exit out of anaconda. Come back in. All packages still there.

Edit utils.py because pi username was changed from pi to Greenleaf.

Use B&A’s manual.py

Python manual.py starts. Reset Server and Connect via IP work.

Connect via IP fails. Error “Cannot via config, check file integrity. Target machine actively refused it.

Use B&A’s manual.py.

Use final\_configBA.yaml (with edited line 33 about .txt)

Same error.

Exit manual.py. Come back in.

Connect via IP. Cannot connect to Pi1, tray again. No connection could be made because the target machine actively refused it.

Reset server – fine

Jupyter

Imported updated utils with new username

Now I can reset rpyc server (cell 2)!

Cell with config.yaml produces error.

5/18/24 **Run my original files**

Environment python\_3.12.3 exists. Switch to this environment.

All of the packages are still installed in python\_3.12.3!!!

Edit line 7 and line 49 of utils.py to say greenleaf instead of pi.

Use my manual.py, my core.py, my utils.py (sl. edited), my config.yaml

Jupyter works up to a point.

* Tested depo\_device. Can get TimeoutError. See Word document with error. Then stage.home() doesn’t work. Reset server in Jupyter or manual.py, then home works.
* It looks like “EOFError:stream has been closed” occurs when I reset rpyc servers in Jupyter at the beginning. Then manual.py does not work. Notes say that I shouldn’t close out of manual.py before opening Jupyter because there can be unexpected motor motions.

5/20/24

In python\_3.12.3 environment:

* Packages are still installed in python\_3.12.3 environment.
* Used conda env export > environment.yml Lists everything.
* I personally typed environment\_3.12.3.yml Lists what I think is important to know.
* Under C:\Users\mlowe\OneDrive - Loyola University Maryland\talks\CScapstone\_2024\_BrendanAudrey\Capstone\_Legolas
* Rpyc.classic.connect
  + Manual.py works, home works. If close out of manual.py, motor moves in unexpected manner. So keep manual.py open.
  + Jupyter. Manual.py closes automatically when rpyc servers are initialized.
  + Big issue: Jupyter runs fine for a while, then suddenly a cell does not run. Timeout error.
* Rpyc.connect
  + Cannot Connect via Config using my config2.yaml. Cannot via config, check file integrity. Error Messge: connect() missing 1 required positional argument:’port’
* Environment.yml comes from export of environment python\_3.12.3
* Environment\_3.12.yml shows what I pip-installed, resulting in environment.yml.
* Legolas\_2024 is clone of environment python\_3.12.3

In python base environment on yoga laptop under C:\Users\mlowe\OneDrive - Loyola University Maryland\Documents\Legolas:

* rpyc=5.3.1
* python=3.11.5
* pip uninstall rpyc to uninstall rpyc 5.3.1
* pip install rpyc results in rpyc=6.0.0
* python manual.py works. It looks like rpyc has to be the same version on Pi and PC.
* Conda list ipykernel shows that ipykernel=6.25.0 is already present
* Close manual.py. No weird motions of motors.
* TKinter errors are GUI errors associated with manual.py
* Jupyter. Switch to Python 3 kernel. Had to recalibrate syringe full up and full down. “Clean” exists but not “acid” and “base.”
* Big issue: Jupyter runs fine for a while, then suddenly a cell does not run. Timeout error.
* 5/21/24 I’m not sure but if motors cannot run properly (calib is wrong) or if “acid,” for example, is not defined, then cell cannot run properly and timeout error occurs. I hope this will stop when the entire system is initially calibrated.
* Be careful with partial calibration. I exported without doing a cell map and cell\_map.txt was wiped out. Copied old version to restore cell\_map.txt.

On raspberry Pi 7A:

* In auto\_rpyc\_server.sh: Nohup python /home/Greenleaf/git/rpyc/bin/rpyc\_classic.py –host 0.0.0.0&

I think it was set up to automatically run upon boot.

* Using ~/git/pip3 list | grep rpyc or grep buildhat:
  + rpyc=6.0.0
  + buildhat=0.7.0
  + To see OpenCV: sudo apt-cache show python3-opencv

5/21/24

On Surface Pro 6 (gray) -the one used at home to get Legolas working:

* python=3.7
* I typed environment\_3.7.yml. Under C:\Users\mlowe\OneDrive - Loyola University Maryland\Documents\Legolas
* Brought Surface Pro to Loyola and tried to run code in C:\Users\mlowe\OneDrive - Loyola University Maryland\Documents\Legolas. Python manual.py was unsuccessful. Error regarding file “<frozen importlib.\_bootstrap>” in \_find\_and\_load and in “<frozen importlib.\_bootstrap\_external>” in exec\_module, get\_code, get\_data.
* Unusable for Legolas at Loyola currently.

Talked with George Hall about Python environments. Better to clone an environment and test it keeping the original running until you know your tests are successful.

Cloned environment python\_3.12.3 and created environment Legolas\_2024 (Google search: managing environments). Activate environment. Then create Jupyter kernel.

Commands:

* conda create –name Legolas\_2024 –clone python\_3.12.3
* conda activate Legolas\_2024
* python -m ipykernel install --user --name Legolas\_2024-kernel

Legolas runs using environment Legolas\_2024.

Laptop has three conda environments: base and python\_3.12.3 and Legolas\_2024

I will work out of C:\Users\mlowe\OneDrive - Loyola University Maryland\Documents\Legolas

when using text file of cell locations

Rpyc.classic.connect vs rpyc.connect

From Brendan: In core.py our new version of the code does not use "rpyc.classic.connect" we use "rpyc.connect" instead.

Mary: In B&A’s core.py, line 28 uses rpyc.connect with port 18813. But lines 77 and 99 use rpyc.classic.connect. Puzzling. Where did 18813 come from?

From looking at rpyc documentation, it looks like 6.0.0 and 5.3.1 both allow rpyc.classic.connect. Peter thinks that these must have been rewritten in terms of the newer approach rpyc.connect. So I think that I can continue to use classic.connect in the code. Classic.connect uses 18812 as default for port.

<https://medium.com/swlh/setting-up-a-conda-environment-in-less-than-5-minutes-e64d8fc338e4>

**5/29/24 Adi – set up his Mac Airbook laptop**

Mac Airbook, OS Ventura 13.2.1

Install Anaconda

Can connect to Linksys. Needs password Legolas2000.

Terminal app

* ping successful
* ssh successful

Create environment for Legolas (python 3.11.7) called Legolas\_2024

* conda create --name Legolas\_2024 --clone base
* conda activate Legolas\_2024
* conda install torchvision
* conda install paramiko
* pip install rpyc==6.0.0
* pip install opencv-python
* pip install sv\_ttk
* python -m ipykernel install --user --name Legolas\_2024-kernel

Download Legolas code

* Brendan and Audrey: <https://github.com/AudreyVersteegen/Capstone-LEGOLAS>
  + Capstone-LEGOLAS-main
* Dr. Lowe: <https://github.com/mlowe308/Legolas_textCellLoc.git>
  + Legolas\_textCellLoc-main

Give permission to user to read and write to /Documents. Done via Settings. See Adi’s notes.

Test with Legolas

* python manual.py
* needed to edit location of cell\_map.txt

Things to work on: put thoughts on PPT slides

* Look at Audrey and Brendan’s work – start with report
* What is Anaconda, Jupyter, Spyder
* Editor
* Learn basic Linux commands
* Libraries: Opencv, pyyaml, rpyc, matplotlib, scipy, torchvision, paramiko, numpy, sv\_ttk
* Organize lab notes
* Gaussian processes: watch video, read Ch. 1
* Practice controlling robot

**5/30/24 Miller and Adi – set up Loyola PCs and Miller’s PC**

Loyola PC: username physics; password @ubn&w0rk

Install Anaconda and updated Navigator

ping 192.168.1.11

ssh [greenleaf@192.168.1.11](mailto:greenleaf@192.168.1.11) password: raspberry

python 3.11.7

Create environment for Legolas (python 3.11.7) called Legolas\_2024

* conda create --name Legolas\_2024 --clone base
  + a number of packages cannot be cloned, ex. Conda -24.5.0 -py311haa95532\_0
* conda activate Legolas\_2024
* conda install torchvision
* pip install rpyc==6.0.0
* pip install opencv-python
* pip install sv\_ttk
* pyyaml -already there
* matplotlib -already there
* scipy -already there
* paramiko -already there
* numpy -already there
* python -m ipykernel install --user --name Legolas\_2024-kernel

Download Github folders

On Loyola PC, placed on Desktop, 2 folders

Use IDE IntelliJ (used in CS212)

**5/30/24 Set up Dell PC at home**

conda create Legolas\_2024 python==3.11.7

* conda install torchvision
* conda install pyyaml
* conda install matplotlib
* conda install scipy
* conda install paramiko
* conda install numpy
* pip install rpyc==6.0.0
* pip install opencv-python
* pip install sv\_ttk
* python -m ipykernel install --user --name Legolas\_2024-kernel

**6/4/24 create environment python\_3.12.3 (Brendan and Audrey’s environment) on Loyola Desktop, Adi’s laptop, Miller’s laptop**

* conda install pyyaml
* conda install matplotlib
* conda install scipy
* conda install paramiko
* conda install numpy
* pip install rpyc==6.0.0
* pip install opencv-python
* pip install sv\_ttk
* pip install torchvision

ERROR – missing file

conda install urllib3 (pip install urllib3) didn’t work

**I tried this on Loyola Desktop PC:**

Comment out conn2 = rpyc.connect("192.168.1.12", 18813) in core.py

Connect to houndnet.

Alternatively you can place resnet50-0676ba61.pth in c:\users\mlowe\.cache\torch\hub\checkpoints\

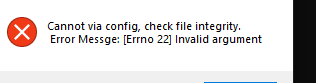
Edit final\_config.yaml to use correct path but path needs to be shorter.

Python manual.py

It gets the relevant file when connected to houndnet.

Then connect to linksys. Run manual.py. Reset servers. Works!

Final.config.yaml. Get error:



Solved the problem by shortening the path in final\_config.yaml

**6/5/24 Try to fix pytorch problem (zoom with Audrey) and pinpoint what is causing timeout error**

In python\_3.12.3 environment and BA’s directory:

For pytorch problem, see solution under 6/4/24.

------------------------------------------track down timeout error

python manual.py

Resetting servers does not cause timeout error.

Read config.yaml. Wait 2 min. Click home but little home window does not popup. Crash. No error in terminal.

Read config.yaml. Wait 105 sec. Click home but little home window does not popup. 24 sec later, there is timeout error in terminal.

Comment out conn2= rpyc.connect("192.168.1.12", 18813) command in core.py. Same timeout issue.

Run manual.py, reset servers, connect to config.yaml. Hit depo\_device, little window opens. Wait 100 sec. Try to go full down with syringe. Can’t move motor.

\*\*\*Problem occurs with config.yaml, not which motor is directed to move.\*\*\*

\*\*\*Problem occurs about 90 sec after config.yaml is read.\*\*\*

Connect monitor, keyboard, mouse to Pi 7A. Command: top

Screen keeps blanking out.

Python manual.py on laptop.

See process sshd on Pi.

After crash occurs, sshd is still running.

Wait, then sshd stops and timeout error appears on laptop

\*\*\*sshd is connected to timeout error.\*\*\*

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Comment out line 25: conn2= rpyc.connect("192.168.1.12", 18813) command in core.py. Same timeout issue.

Comment out lines 33, 34 in utils.py: find\_server\_cmd… and ssh\_stdin…Duplicates def find\_server\_pid(ssh)

Manual.py runs properly initially then crash, wait, timeoutError.

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Check wifi and ethernet connections on Raspberry Pi 7A.

Both seem to work.

Chrome does not work.

Install updates.

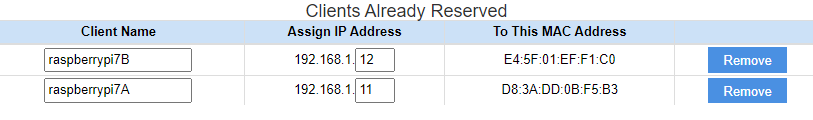
Need to unlock profile for chromium. Most likely it hadn’t been closed properly previously. Go to: /home/Greenleaf/.config/chromium/

Delete 3 files all starting with Singleton…

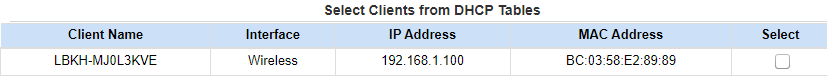
**6/6/24 Problem with router (not really)**

I cannot ping 192.168.1.11 but I can ping 192.168.1.12.

In <http://myrouter.local>, I see raspberrypi 7A and 7B with correct IP addresses



Also see:



On Pi 7A, discovered that I had turned off Wifi while trying to test whether I can get to the Internet by hooking up monitor, keyboard, and mouse yesterday.

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In manual.py > load\_config, print("stage, depo\_device, pH\_device, conn1, conn2:", stage, depo\_device, pH\_device, conn1, conn2)

stage, depo\_device, pH\_device, conn1, conn2: <core.Stage object at 0x000001C7037EFC90> <core.DepositionDevice object at 0x000001C700CFB710> <core.pHDevice object at 0x000001C70233EC50> <rpyc.core.protocol.Connection 'conn1' object at 0x000001C70243D3D0> <rpyc.core.protocol.Connection 'conn2' object at 0x000001C702891950>

In core.py > load\_from\_config: print("conn1:" , conn1)

print("r\_buildhat1:", r\_buildhat1)

conn1: <rpyc.core.protocol.Connection 'conn1' object at 0x00000157367AC850>

r\_buildhat1: <module 'buildhat' from '/home/greenleaf/.local/lib/python3.9/site-packages/buildhat/\_\_init\_\_.py'>

In core.py > connect\_pi1:

print("conn, r\_buildhat1, r\_serial1, r\_threading1, sensor\_X, motor\_Y, sensor\_Y, pH\_serial:", conn, r\_buildhat1, r\_serial1, r\_threading1, sensor\_X, motor\_Y, sensor\_Y, pH\_serial)

conn, r\_buildhat1, r\_serial1, r\_threading1, sensor\_X, motor\_Y, sensor\_Y, pH\_serial: <rpyc.core.protocol.Connection 'conn1' object at 0x00000244E2684A50> <module 'buildhat' from '/home/greenleaf/.local/lib/python3.9/site-packages/buildhat/\_\_init\_\_.py'> <module 'serial' from '/usr/lib/python3/dist-packages/serial/\_\_init\_\_.py'> <module 'threading' from '/usr/lib/python3.9/threading.py'> <buildhat.force.ForceSensor object at 0xf63c2be0> <buildhat.motors.Motor object at 0xf5928ee0> <buildhat.force.ForceSensor object at 0xf5928e98> Serial<id=0xf63c2c28, open=True>(port='/dev/ttyACM0', baudrate=9600, bytesize=8, parity='N', stopbits=1, timeout=None, xonxoff=False, rtscts=False, dsrdtr=False)

https://github.com/tomerfiliba-org/rpyc/issues/320

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Useful environment commands

<https://conda.io/projects/conda/en/latest/user-guide/tasks/manage-environments.html#activating-an-environment>

conda env list or conda info –-envs

conda list

conda list -n base scipy #replace scipy with name of package

conda activate python\_3.12.3 #python\_3.12.3 is name of environment

conda deactivate

conda env export > environment.yml

conda create --name Legolas\_2024 --clone python\_3.12.3 #clone environment

conda install torchvision

pip uninstall packagename