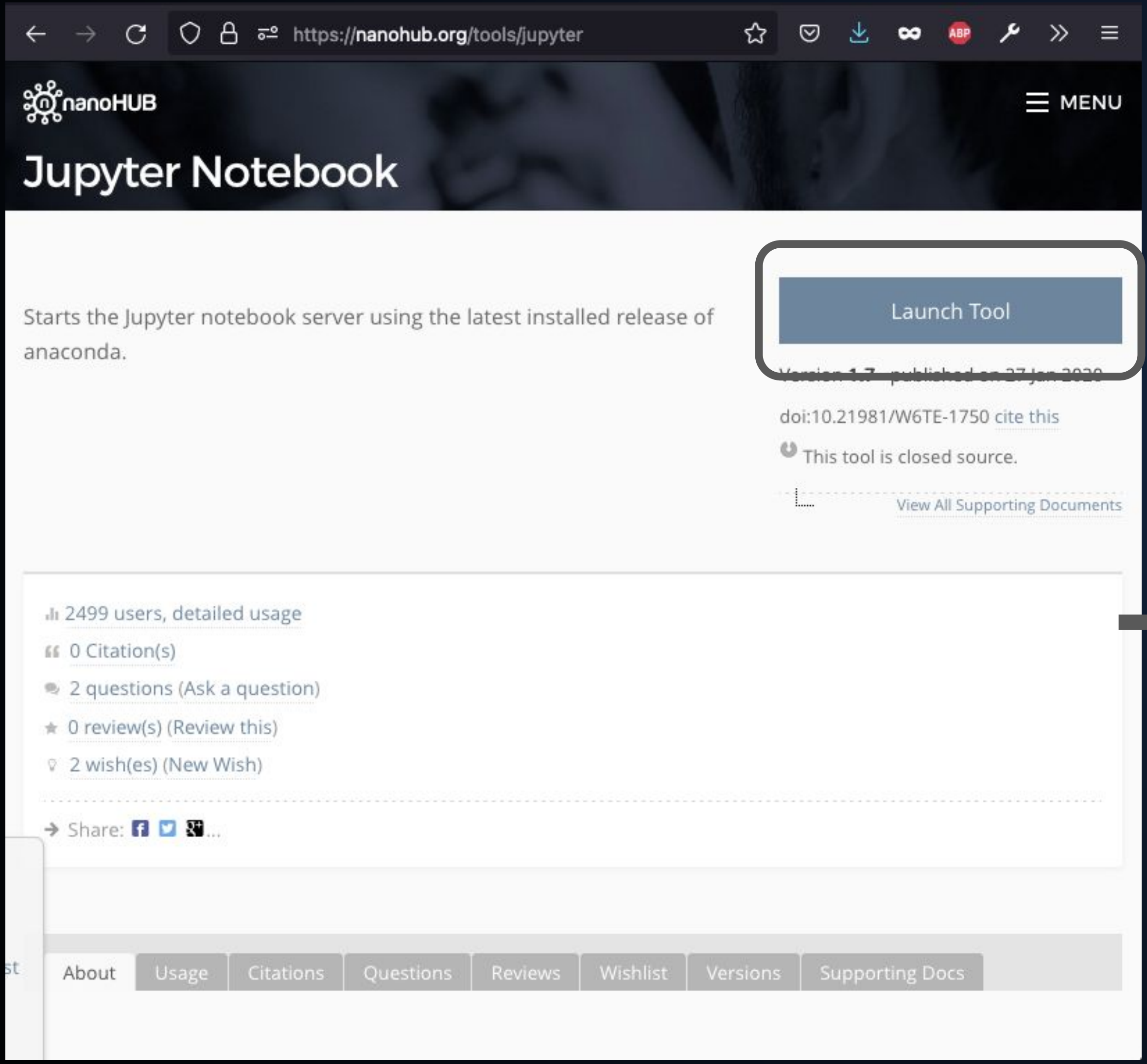
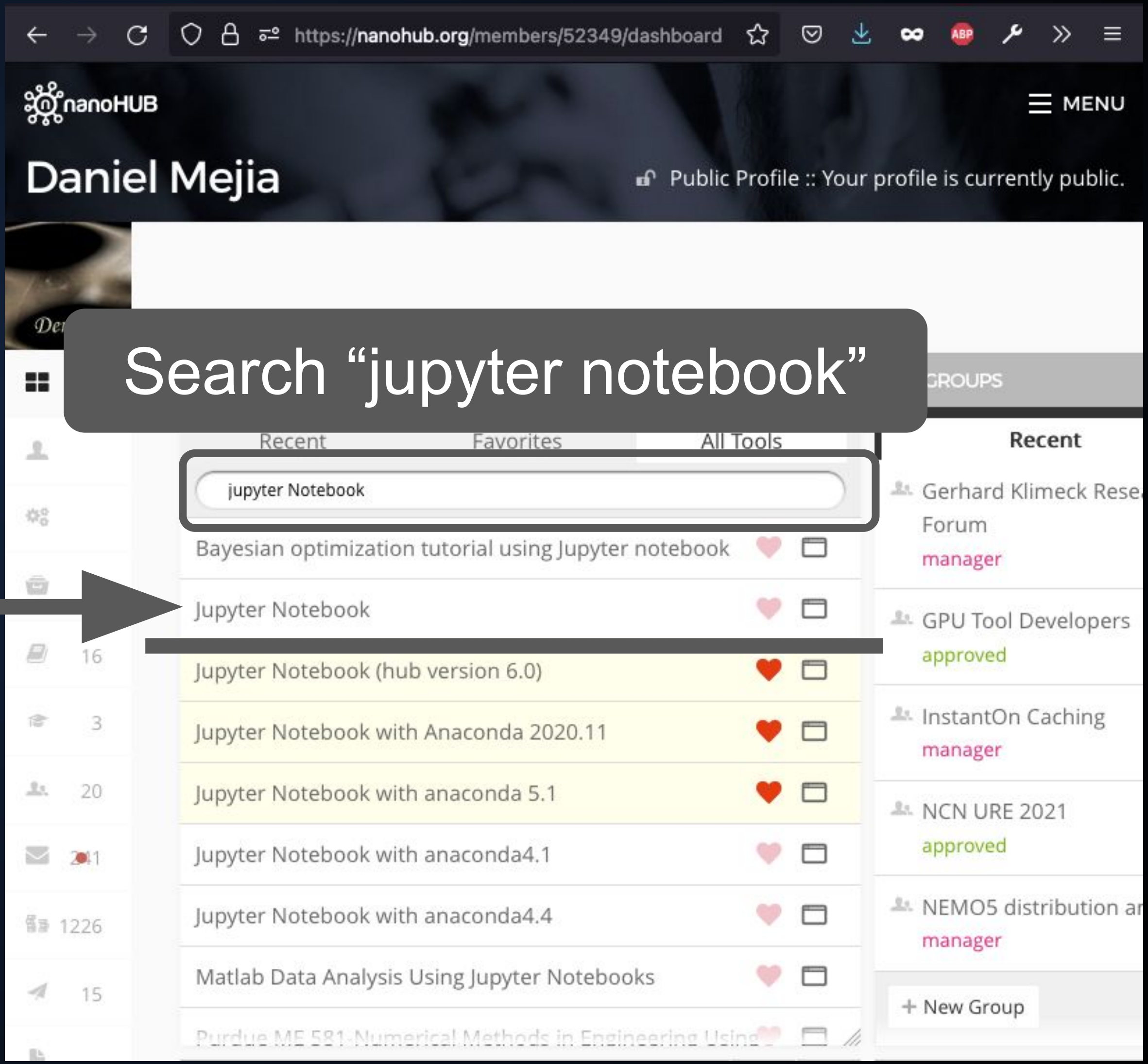
Create Sim2L - Pendulum Motion

https://nanohub.org/tools/jupyter



Dashboard



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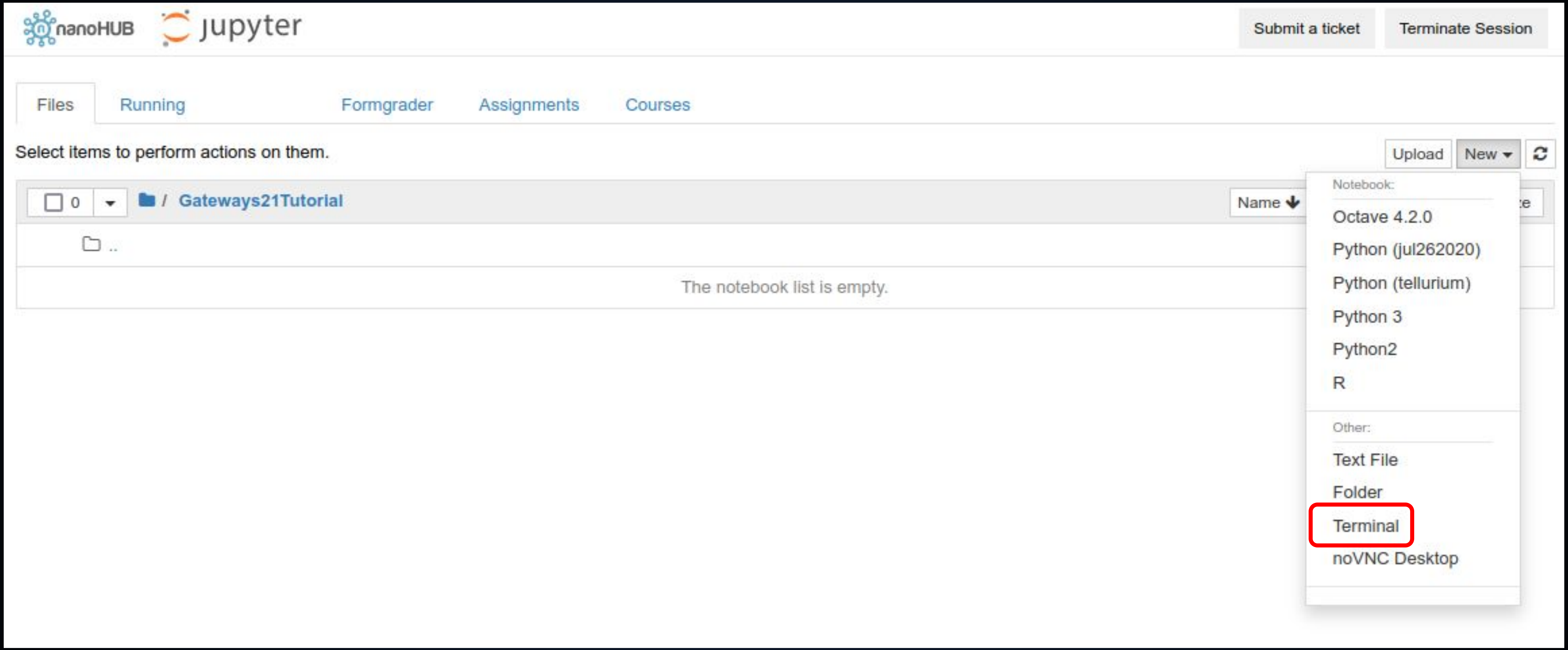

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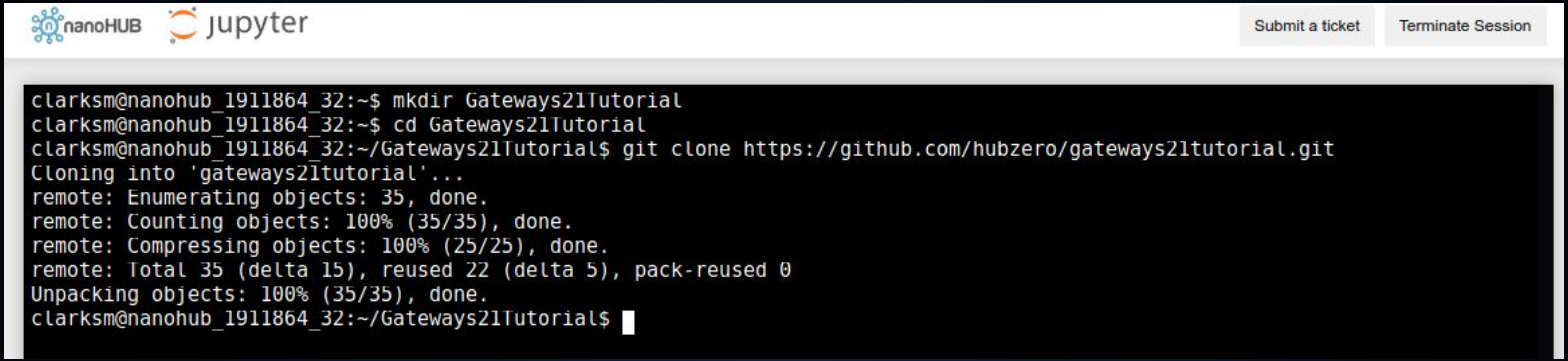

Create Sim2L - Pendulum Motion

Create Sim2L - Sim2L notebook

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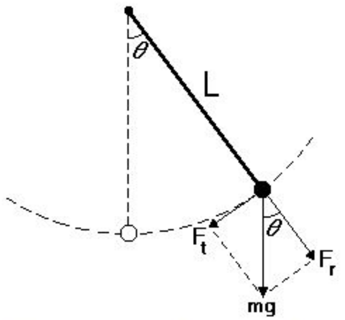
Problem Statement

Your assignment today is to write a Sim2L that solves a pair of ordinary differential equations describing the motion of a simple pedulum with damping applied.



The above diagram indicates the forces acting on a pendulum swinging from a fixed point. The equation describing the motion is:

$$\frac{d^2\theta}{dt^2} = -\frac{b}{m}\frac{d\theta}{dt} - \frac{g}{L}sin\theta$$

where:
θ - angle measured from vertical (radian)
t - time (time)
b - damping coeffient (mass-radian/time)
m - pedulum mass (mass)
g - gravitational constant (mass/time^2)
L - pendulum length (length)

The second order differential equation can be broken down into a pair of first order differential more suitable for numerical solution.

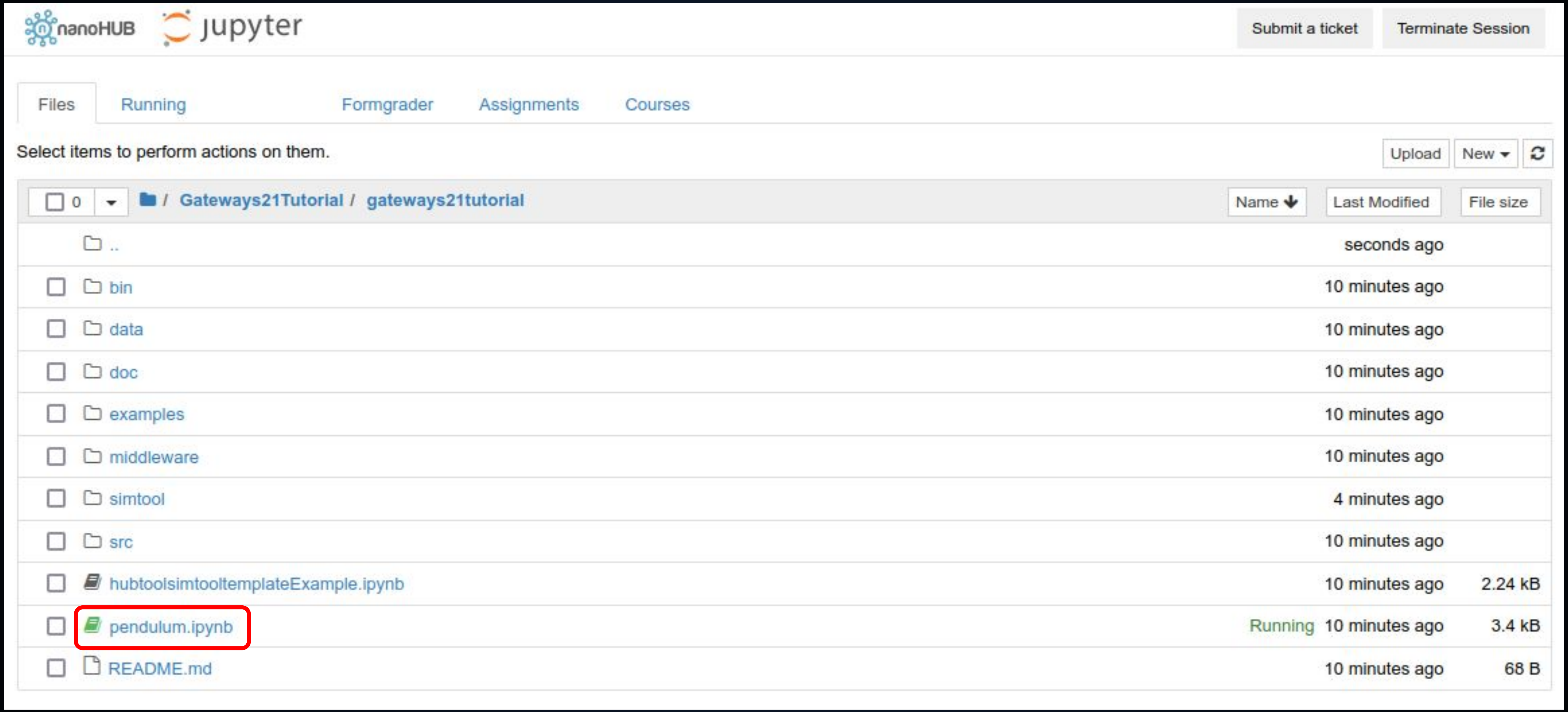
$$\frac{d\theta}{dt} = v$$

$$\frac{dv}{dt} = -\frac{g}{L}sin\theta - \frac{b}{m}v$$

where:
v - angular velocity (radian/time)

It is suggested that the *solve_ivp* method from scipy be used to compute the numerical solution. Details of the *solve_ivp* method can be found online. The Sim2L results should provide enough information to plot position and velocity as functions of time.

Create Sim2L - Sim2L notebook



Create Sim2L - workflow notebook

Standard Sim2L library imports

In [ ]:
```
from simtool import findSimTools,searchForSimTool
from simtool import getSimToolInputs,getSimToolOutputs,Run
```

Locate Sim2L

In [ ]:
```
simToolName = "XXX"
```

For the selected Sim2L retrieve and list input parameters

This will provide the full list of parameters including descriptions, default values, and units.

In [ ]:

For the selected Sim2L retrieve and list output parameters

This will provide the full list of result parameters to be expected when running the Sim2L.

In [ ]:

Assign input parameter values

All input parameters should have default values. If you want to run non-default values set them here.

In [ ]:

Run Sim2L

Run the Sim2L and report the summary. The summary will indicate if any problems occurred during the run.

In [ ]:
```
run = Run(simToolLocation,inputs)
run.getResultSummary()
```

Extract results

Extract any results from the run needed to plot position and velocity versus time plots.

In [ ]:

Plot results

Using the plot library of your choosing plot position and velocity versus time for the pendulum. If you are not familiar with any ploting libraries *matplotlib* is simple and easy to use for static non-interactive plots.

In [ ]:
```
import matplotlib.pyplot as plt
%matplotlib inline
```