

Integrating HPC into STEM courses

Flex ID: 35057

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Presented by Equitable AI Alliance

nrp.ai

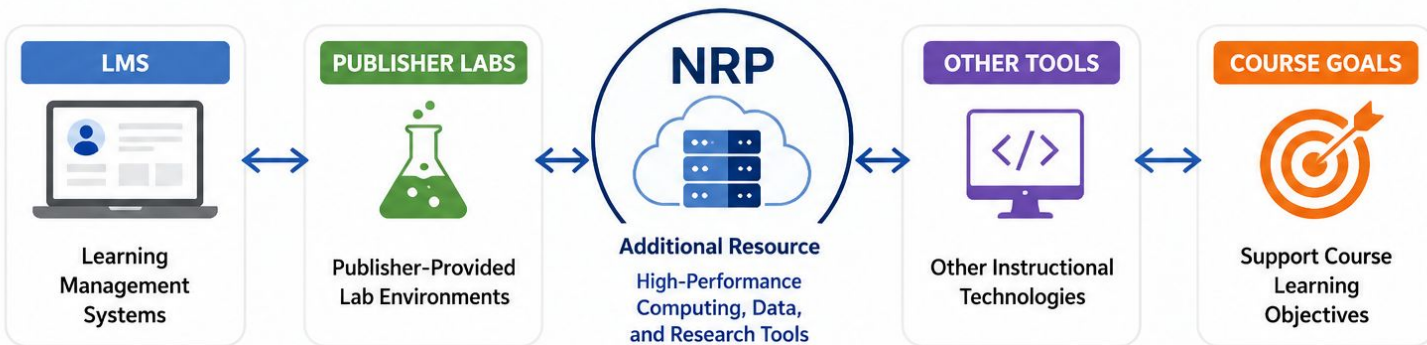
Expectations



The National Research Platform (NRP) is intended to serve as an **additional resource** for educators and researchers. It is designed to **complement**—**not replace**—existing learning management systems (LMSs), publisher-provided lab environments, or other instructional technologies.



Faculty should continue to use the tools and platforms that best support their course learning objectives.



NRP complements your existing tools to enhance teaching, learning, and research.

Educational Use Cases



Statistics with Python

Analyze data and build statistical models using Python libraries.



Scientific Computing

Run simulations, solve complex problems, and perform advanced computations.



Large Language Models

Access and experiment with frontier open-weight LLMs for teaching and research.



NRP supports multiple programming languages and computational environments.

Python is used in this workshop as an example.



Open the web browser and go to
<https://sdccd-jupyterhub.nrp-nautilus.io/>



In collaboration with
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FEDERATION

Consent to Attribute Release

JupyterHub requests access to the following information. If you do not approve this request, do not proceed.

- Your CILogon user identifier
- Your name
- Your email address
- Your username and affiliation from your identity provider

Consent to Attribute Release

Selected Identity Provider

San Diego Community College District ▼ ⓘ

☐ Remember this selection ⓘ

Log On

By logging on to this site, you agree to the [privacy policy](#).

Server Options

No need to use GPUs at
this point

GPU type

Any general

GPUs (max 4)

0

CPU Cores

2

Memory GB

4

Image



Stack Minimal



Stack R



Stack Scipy



Stack Tensorflow



Stack Datascience



Stack PRP



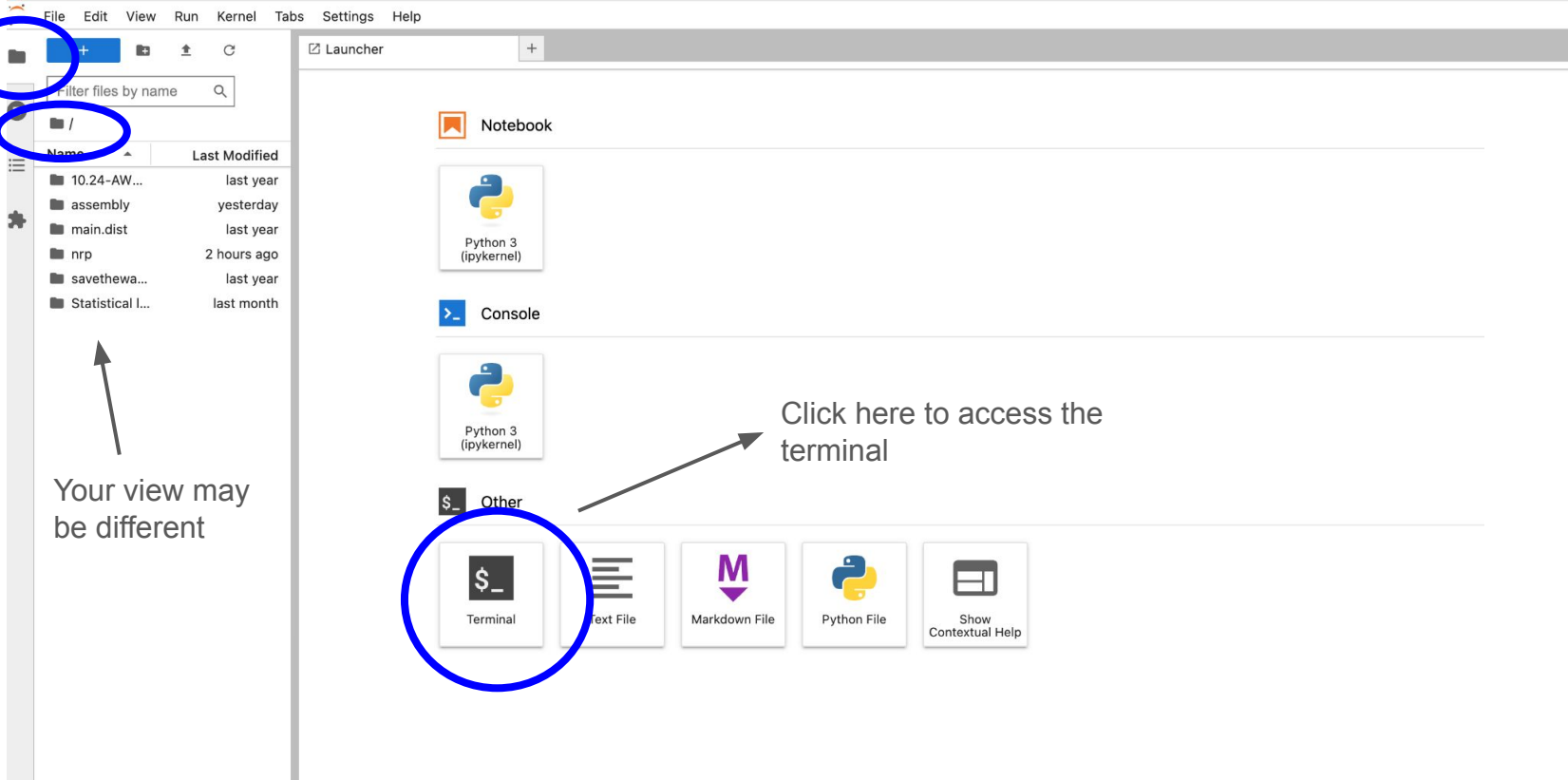
R Studio Server

Start

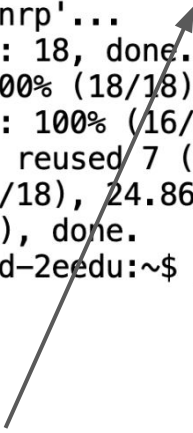
Shows
folder in
the side
panel

Current
directory
location

Your view may
be different



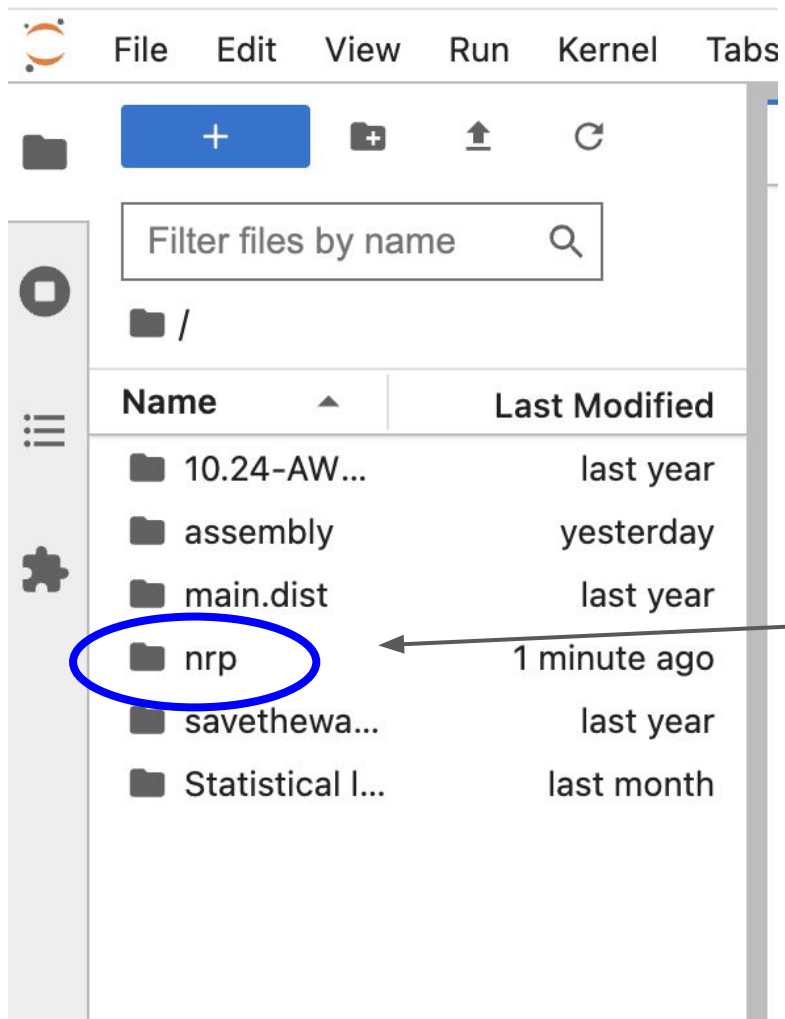
```
jovyan@jupyter-dkhan-40sdccd-2eedu:~$ git clone https://github.com/d-khan/nrp.git ~/nrp
Cloning into '/home/jovyan/nrp'...
remote: Enumerating objects: 18, done.
remote: Counting objects: 100% (18/18), done.
remote: Compressing objects: 100% (16/16), done.
remote: Total 18 (delta 2), reused 7 (delta 0), pack-reused 0 (from 0)
Receiving objects: 100% (18/18), 24.86 KiB | 410.00 KiB/s, done.
Resolving deltas: 100% (2/2), done.
jovyan@jupyter-dkhan-40sdccd-2eedu:~$
```



Write the following command at the terminal

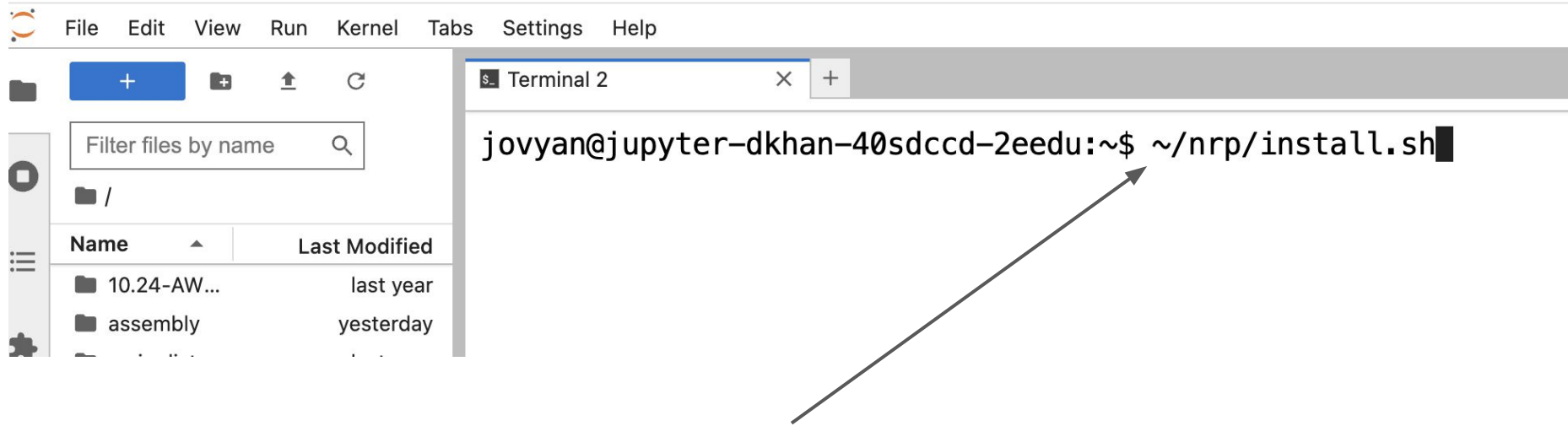
```
git clone https://github.com/d-khan/nrp.git ~/nrp
```

- Downloads a copy of the GitHub repository and saves it in a folder named **nrp** inside your home directory (~).
- **Why?** GitHub provides a convenient way for instructors to distribute course resources—such as notebooks, datasets, code, and instructions—to students.

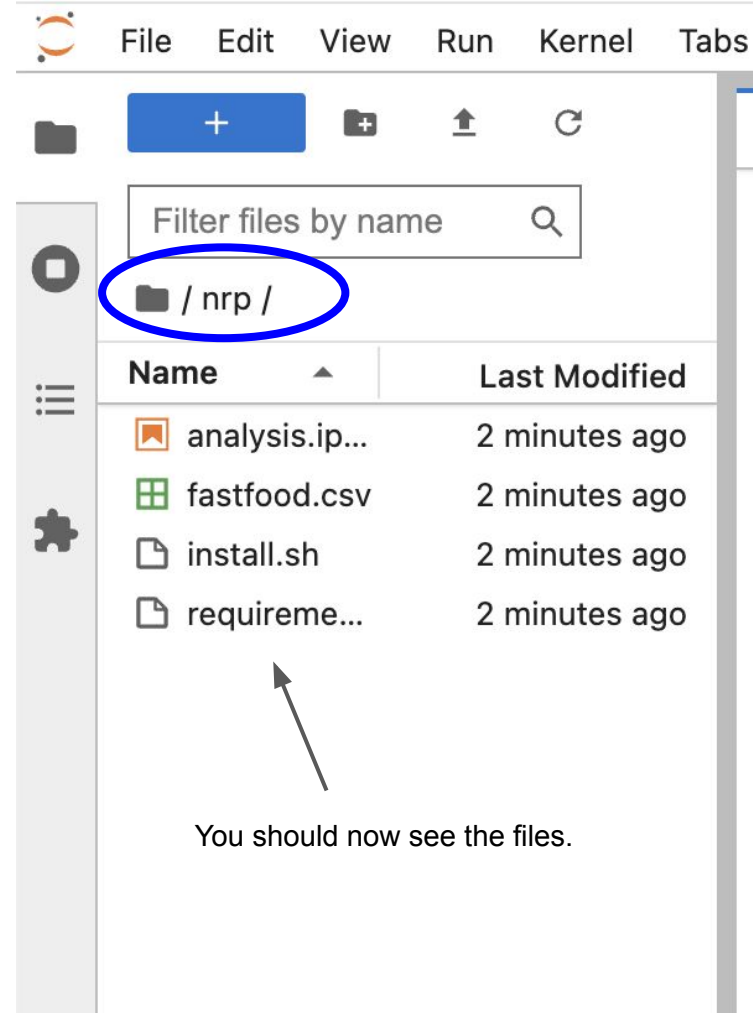
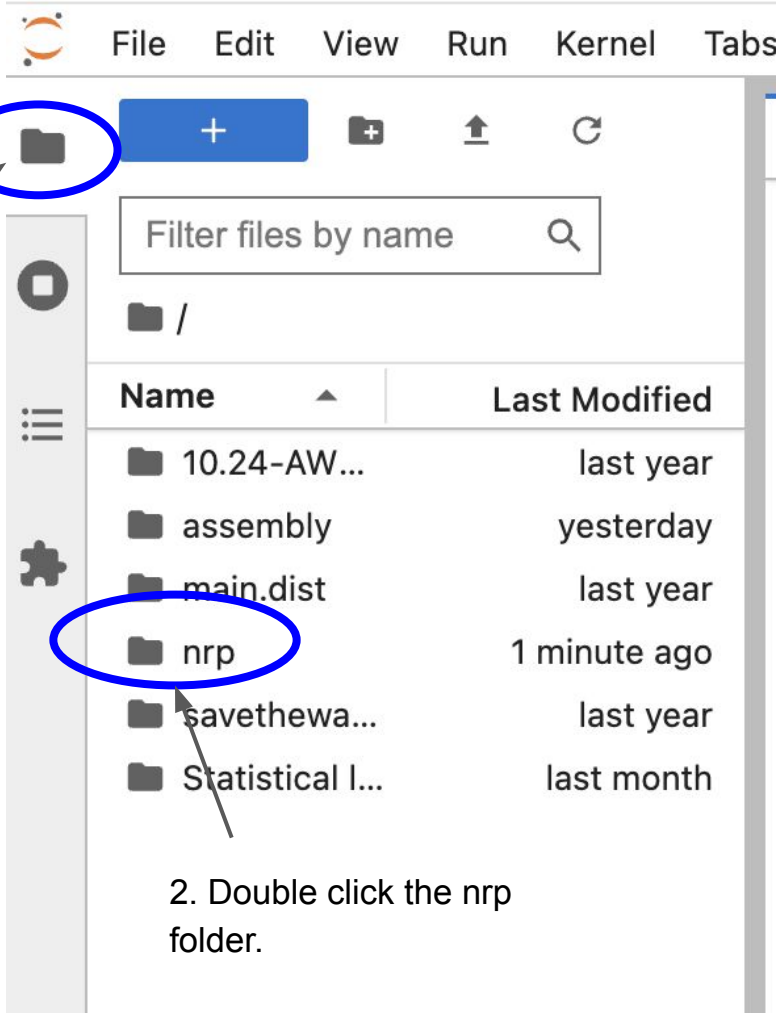


After successfully cloning the repository, you should now see the **nrp** folder.

After successfully cloning the repository, run the following command in the terminal:
`~/nrp/install.sh`



Installs the Python packages required to run the workshop activities.



File Edit View Run Kernel Tabs

+ + ↶ ↷

Filter files by name 🔍

/ nrp /

Name ▲	Last Modified
 analysis.ip...	2 minutes ago
 fastfood.csv	2 minutes ago
 install.sh	2 minutes ago
 requireme...	2 minutes ago

Double click the “analysis” file

Filter files by name

/ nrp /

Name	Last Modified
analysis.ip...	1 minute ago
fastfood.csv	9 hours ago
install.sh	9 hours ago
requireme...	9 hours ago

Do higher-calorie fast food items tend to contain more sodium?

```
[16]: import pandas as pd
import numpy as np
import plotly.express as px
import plotly.io as pio
pio.renderers.default = "notebook"
```

```
[23]: # Load the provided dataset
df = pd.read_csv("fastfood.csv")
```

```
[18]: df.info()
```

This is what you will see on the screen

When Two Galaxies Interact

As two galaxies approach each other, their **gravitational pull** changes the paths of their stars. The galaxies can become **distorted**, stars can be thrown into **new orbits**, and eventually the galaxies may **merge**.

1. Far Apart



Two galaxies are far apart and orbiting in space.

2. Approaching



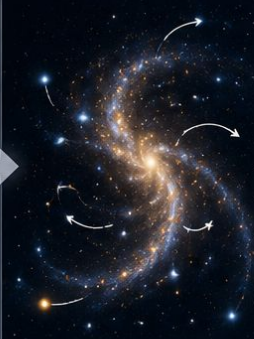
As they get closer, their gravity begins to influence each other.

3. Distorted



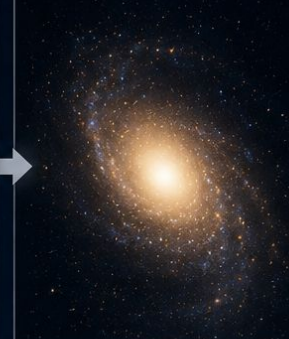
Their gravitational pull distorts the galaxies, stretching arms and pulling out streams of stars and gas.

4. New Orbits



Stars can be thrown into new orbits, some escaping into space, others captured by the other galaxy.

5. Merger



Eventually, the galaxies may merge to form a new, larger galaxy.



Most stars **do not collide** because galaxies are mostly empty space. The main effect of interaction is **gravity**.





5,000
stars

+

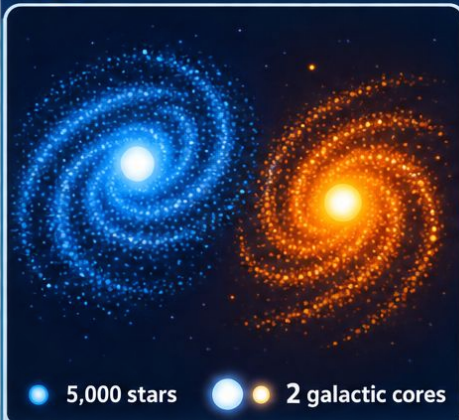


2 massive
galactic cores

=

5,002
simulated objects

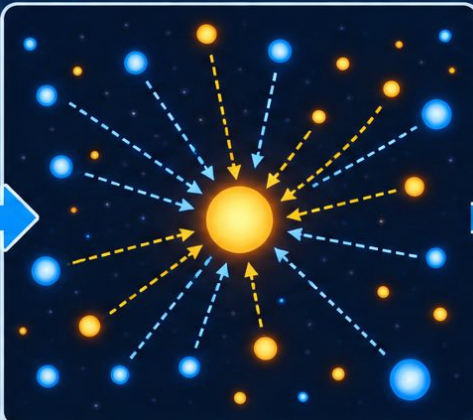
1 The Simulation



5,000 stars 2 galactic cores

The simulation contains
5,000 stars and
2 massive galactic cores.

2 Calculate Gravity

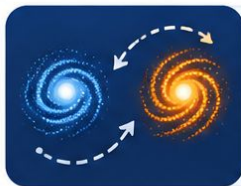


For each star or core,
the computer calculates
the **gravitational pull**
from all the other
simulated objects.

3 Update Motion



The simulation repeatedly
updates each object's
acceleration, velocity, and position.



$5,002 \times 5,001 \approx$ **25 million**
gravitational force contributions per time step



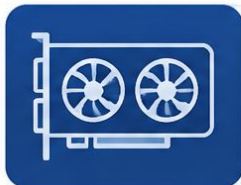
Computational complexity:
 $O(N^2)$ per time step



The simulation runs for **2,000** time steps,
recalculating gravity as everything moves



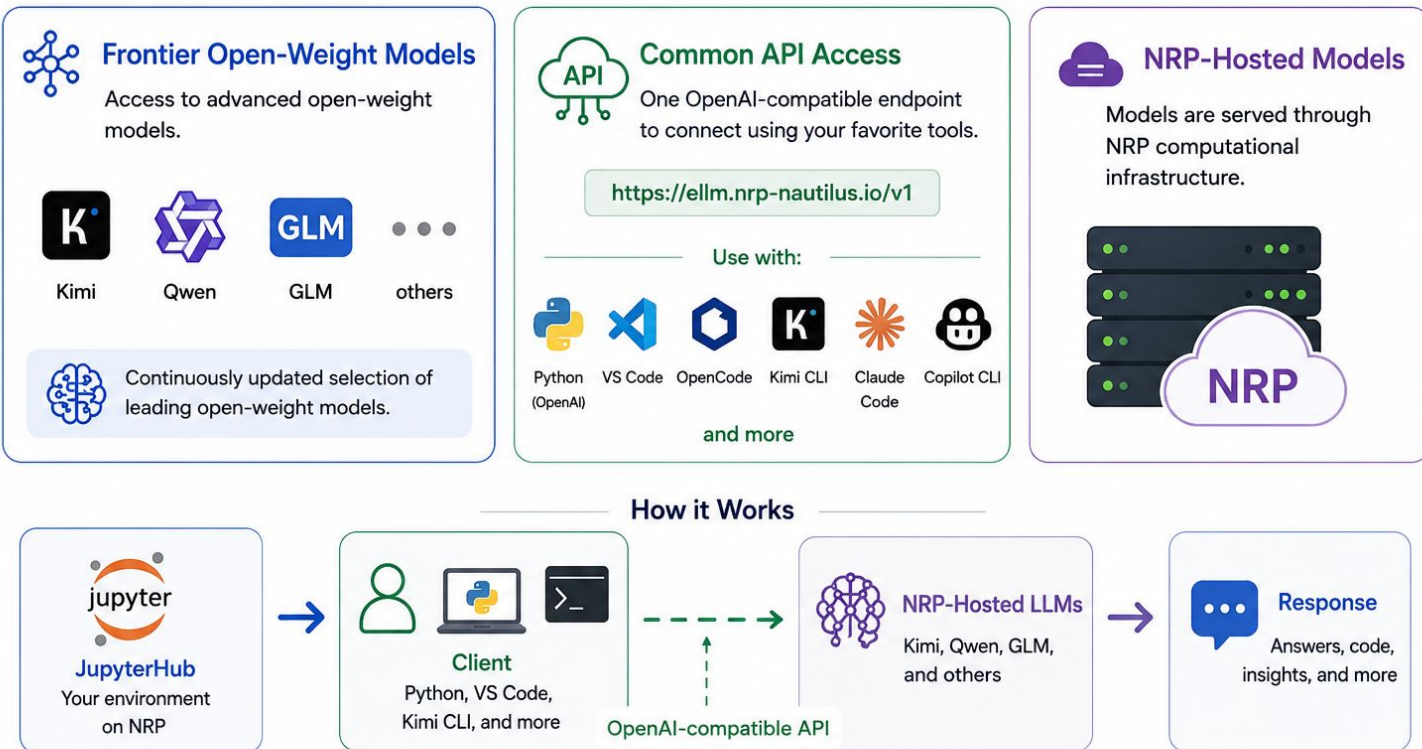
Total: $\approx$ **50 billion**
gravitational force contributions



GPUs can perform many of
these calculations **in parallel**

Accessing Open-Weight LLMs on NRP

NRP provides access to frontier open-weight LLMs through a common API.



One API. Many models. Many tools. Build more with NRP.

Learn more: nrp.ai/llms/

Get the LLM API Key

<https://nrp.ai/llmtoken/>

LLM API Keys

Create LLM API keys

You have no API keys yet. Create one to use LLMs.

Create new API key

Alias

llm

Group

nrp/sdccd/sdccd-codespace-users



Create new API key for general LLM API access

Generate a Chatbox configuration instead [Read more about Chatbox](#)

Save the key locally on your machine in a location where you can easily access it.

Do not share this key in any public location.

Go back to the terminal



Type: `mkdir ~/llm; cd ~/llm`



Type: `export OPENAI_API_KEY="paste your API key here; keep the quotation marks"`



The following step verifies that the API key works and can connect to the NRP endpoint.

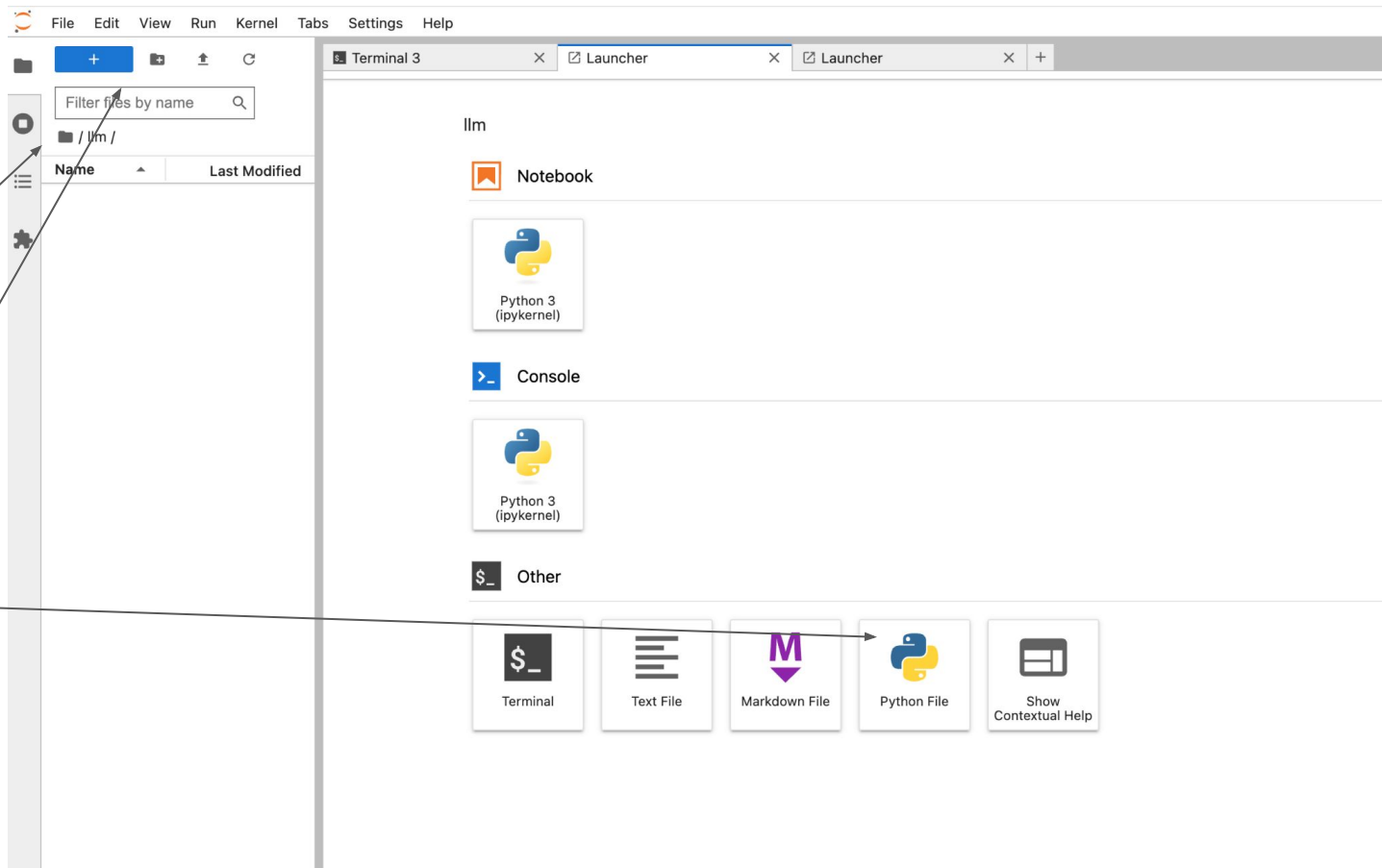
```
curl -s -H "Authorization: Bearer $OPENAI_API_KEY" \  
https://ellm.nrp-nautilus.io/v1/models | python3 -m json.tool
```

Copy and paste it on
the terminal

Install openAI

openai is a Python package used to connect to and interact with LLMs through an OpenAI-compatible API.

In the terminal, type: `pip install openai`



1. Click on the folder icon to display the side panel

2. Select llm folder

3. Click on the + sign and select Python file

Accessing an NRP LLM with Python

```
import os
from openai import OpenAI

client = OpenAI(
    api_key=os.environ.get("OPENAI_API_KEY"),
    base_url="https://ellm.nrp-nautilus.io/v1",
    timeout=30.0,
)

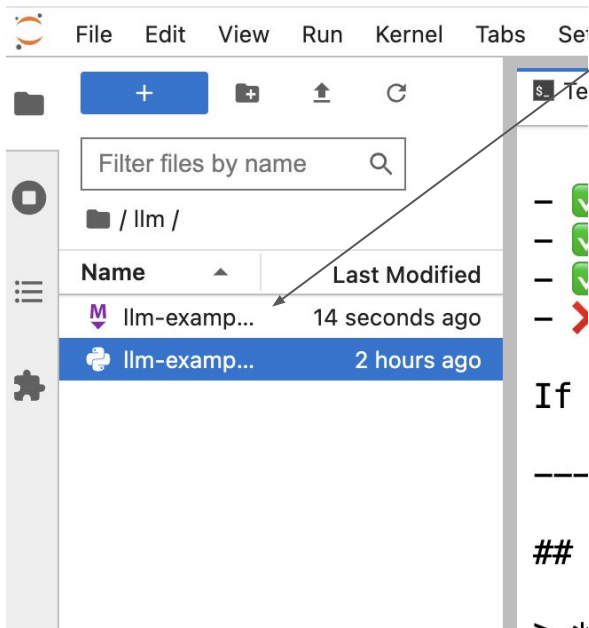
completion = client.chat.completions.create(
    model="gpt-oss",
    messages=[
        {"role": "system", "content": "You are a computer science professor."},
        {"role": "user", "content": "Explain machine learning to a first-year college student using an everyday analogy. Make formatting in markdown format"},
    ],
)

print(completion.choices[0].message.content)
```

Copy and paste this code in the python file you created earlier and rename the file ["llm-example.py"](#). Use right-click to rename the file

Run the code

```
python3 llm-example.py > llm-example.md
```



After a successful run, the markdown file is created. Right click on the file and open with “Markdown preview”

Flower identification - using qwen3-small (27B)

```
import os
from openai import OpenAI

client = OpenAI(
    api_key=os.environ.get("OPENAI_API_KEY"),
    base_url="https://ellm.nrp-nautilus.io/v1",
    timeout=120.0,
)

completion = client.chat.completions.create(
    model="qwen3-small",
    messages=[
        {
            "role": "system",
            "content": "You are an expert in plant and flower identification."
        },
        {
            "role": "user",
            "content": [
                {
                    "type": "text",
                    "text": "Identify the species of this flower. Explain how you identified it."
                },
                {
                    "type": "image_url",
                    "image_url": {
                        "url": "https://github.com/d-khan/llm/blob/main/flower.jpg?raw=true"
                    }
                }
            ]
        }
    ],
)

print(completion.choices[0].message.content)
```

Exercise

What is the name of the flower? _____

What is the common name of the flower? _____

Why NRP?



Equitable Access

Powerful computing without specialized hardware or software.



Easy Access

Only a browser and internet connection required.



Industry Skills

Python is widely used in STEM and valued by employers.



Reproducible Learning

Students can combine code, data, visualizations, and explanations in a single notebook.



Further support

- Areeluck Parnsoonthorn (For NRP accounts) aparnsoonthorn@sdccd.edu
- Danish Khan (NRP related tech queries) dkhan@sdccd.edu
- [Join Nautilus Support Chat](#)

Policies

[NRP Acceptable Use Policy \(AUP\)](#)

[Cluster Policies](#)