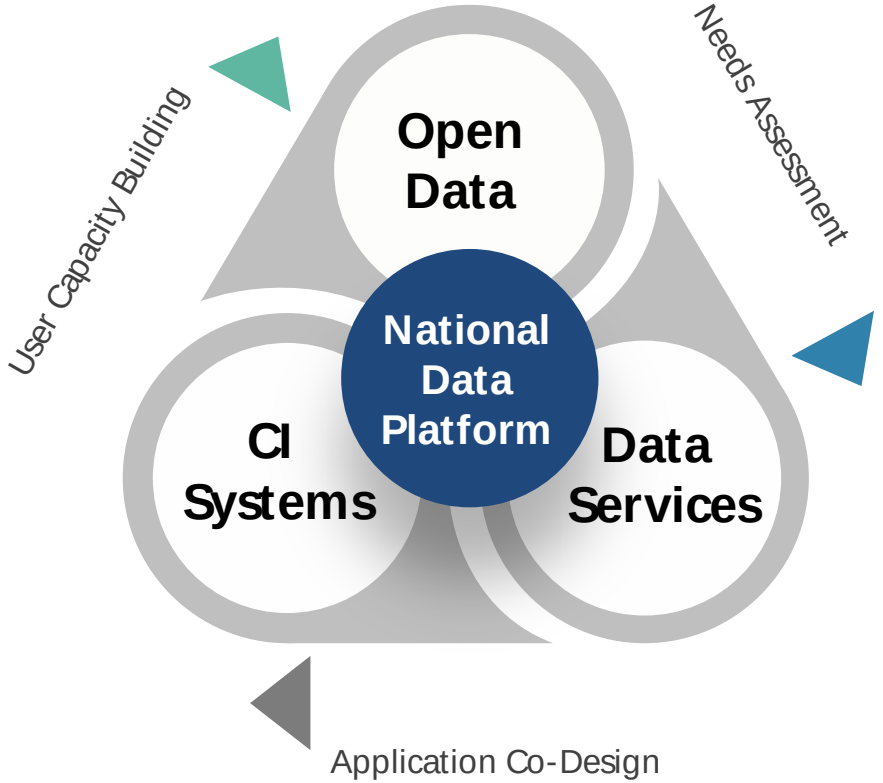
NATIONAL DATA PLATFORM

National Data Platform Pilot: Services for Equitable Open Access to Data

nationaldataplatform.org



National Data Platform is a federated and extensible data and service ecosystem to promote collaboration, innovation and equitable use of data on top of existing cyberinfrastructure capabilities.

NDP enables AI-integrated science workflows that foster discovery, decision-making, policy formation and societal impact related to wildfire, climate, earthquake and food security among others.

Link to the award abstract: https://www.nsf.gov/awardsearch/showAward?AWD_ID=2333609

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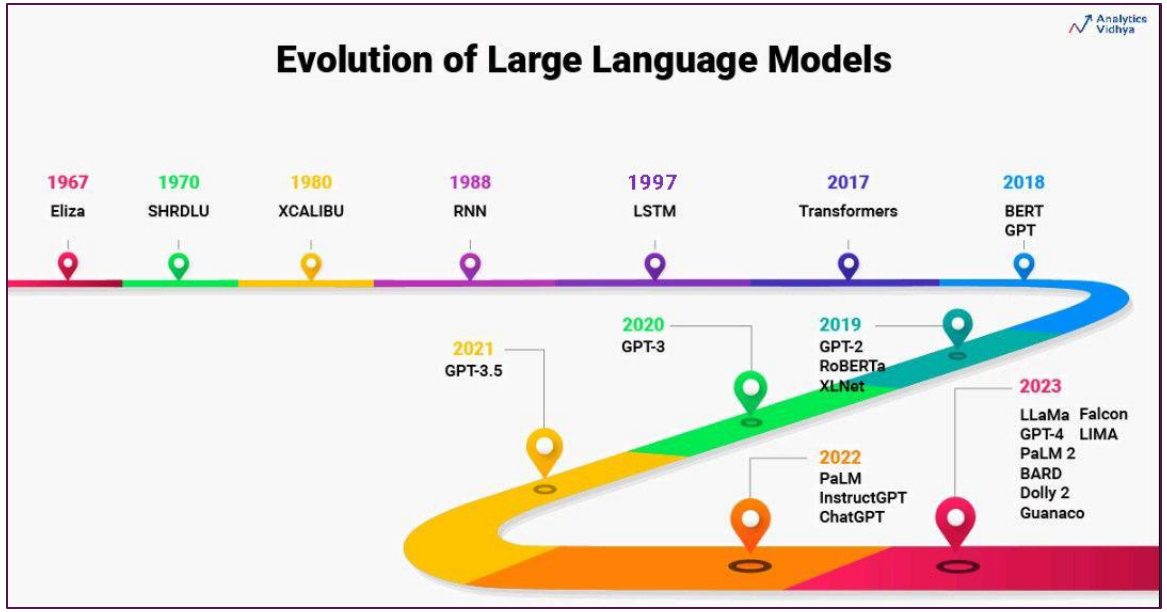
An NDP Service Example:
Generative AI and Large Language Models (LLM)

- Huge generative potential
- Ability to create human-like outputs
- Integration with complex models
- Libraries advanced technologies
  - e.g., GPT, Prompt Engineering, and vector storage
- Shortcomings on domain expertise
- Need domain-specific LLMs
  - with human-curated data and controlled knowledge



Source: https://www.analyticsvidhya.com/blog/2023/07/beginners-guide-to-build-large-language-models-from-scratch

"Generative AI helped workers avoid awful ideas, but it also led to more average ideas"

- Harvard Business Report (March – April 2024)

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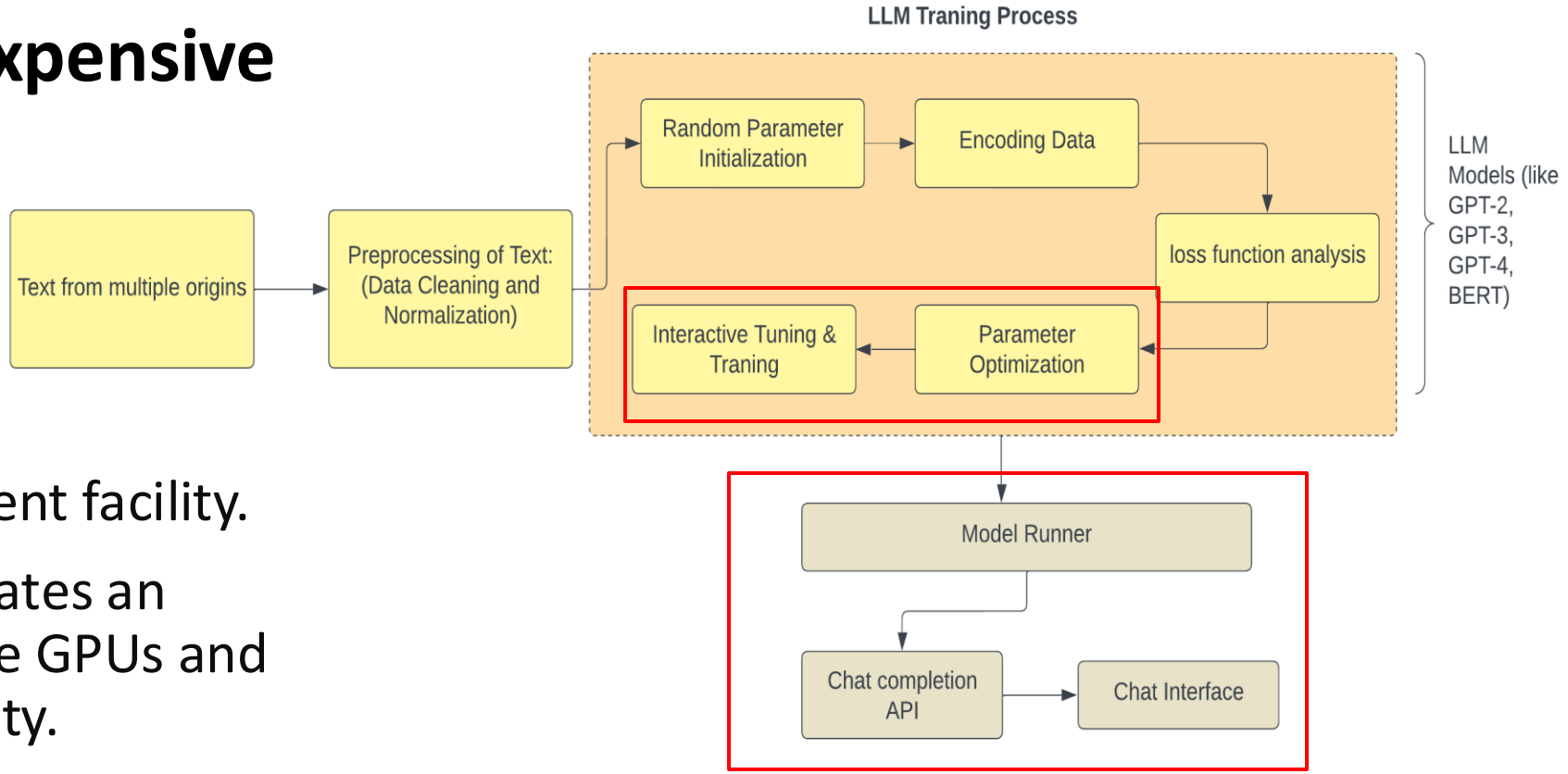
Accessing and Using LLMs is an Equity Issue

LLM Deployment is Expensive

- Even tuning an LLM can incur substantial costs, necessitating 4-5 AT100 GPUs, expansive nodes, and an equipped deployment facility.
- Operating an LLM necessitates an infrastructure with multiple GPUs and substantial memory capacity.



LLM Deployments

Commercial LLM

Pros:
- Ready to use
- Large knowledge base
- Low latency and distributed deployment
- Robust API with security

Cons:
- Lack of domain-specific knowledge
- High costs
- Information security and privacy concerns

Community LLM

Pros:
- Domain-specific knowledge
- Average latency
- Low costs
- Community-owned

Cons:
- Need infrastructure
- Dedicated tech and knowledge team
- Community volunteers to manage everything
- Privacy concerns

Private LLM

Pros:
- Usage mode is private access
- No knowledge control and security issues

Cons:
- Required hardware and software run models

NDP
LLM as a Service

- Tailored Model Selection
- Enhanced Data Control
- Privacy and Security
- Cost Efficiency
- OpenAI API and LangChain Support

LLM Client Service

- Use an existing model
- Add context with domain-specific documents

LLM Training Service

- Fine-tune an existing model to create a new model
- Use a larger corpus for training
- Deploy as a service

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NDP LLM as a Service

Alignment with NAIRR Objectives

- **Capacity** to support many users with a spectrum of backgrounds
- **Capabilities**
  - Ability to train *(and use)* resource-intensive AI models on CI resources
  - Ability to make use of a mix of computational resources
  - Option to select which resources to use through a range of mechanisms, including … optionally interactive “notebook”-like environments
  - A NAIRR system should include at least one large-scale machine-learning supercomputer capable of training 1 trillion-parameter models

In today’s tutorial we are using a model with **7B** parameters running on NRP

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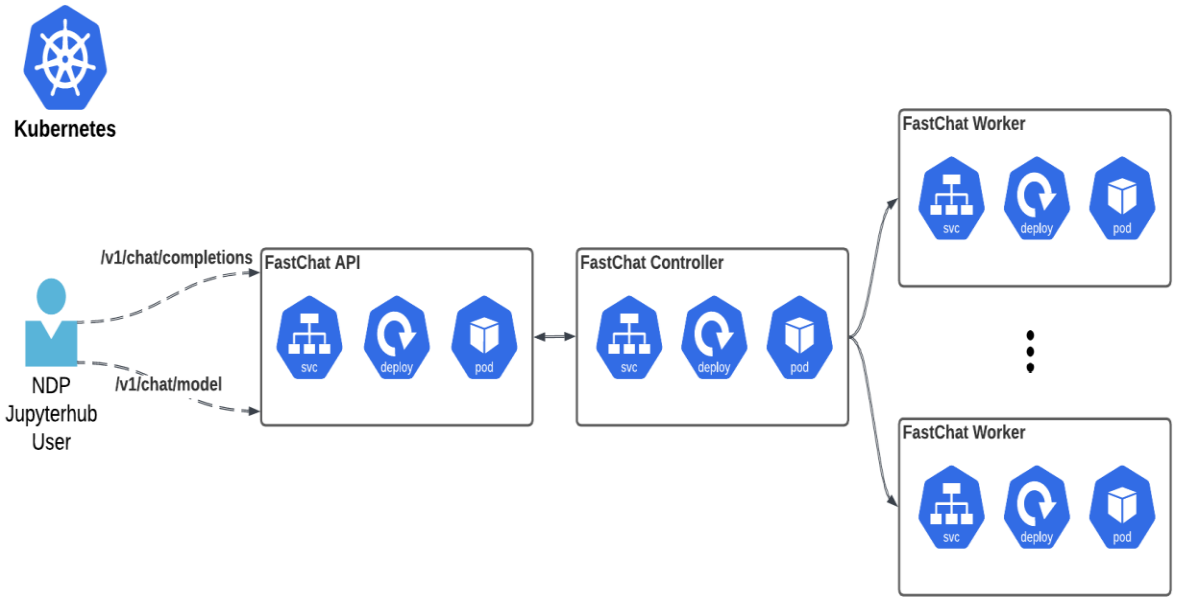
NDP LLM Deployment Architecture

- FastChat
  - Open source LLM execution library
  - Deployed on Nautilus
    - API Server
    - Controller
    - Worker (serves different or the same LLMs)
- Currently all workers are serving the following LLMs
  - eci-io/climategpt-7b,
  - ECarbenia/grimoiresigils
  - text-embedding-ada-002



NDP LLM-as-a-Service on NRP Tutorial

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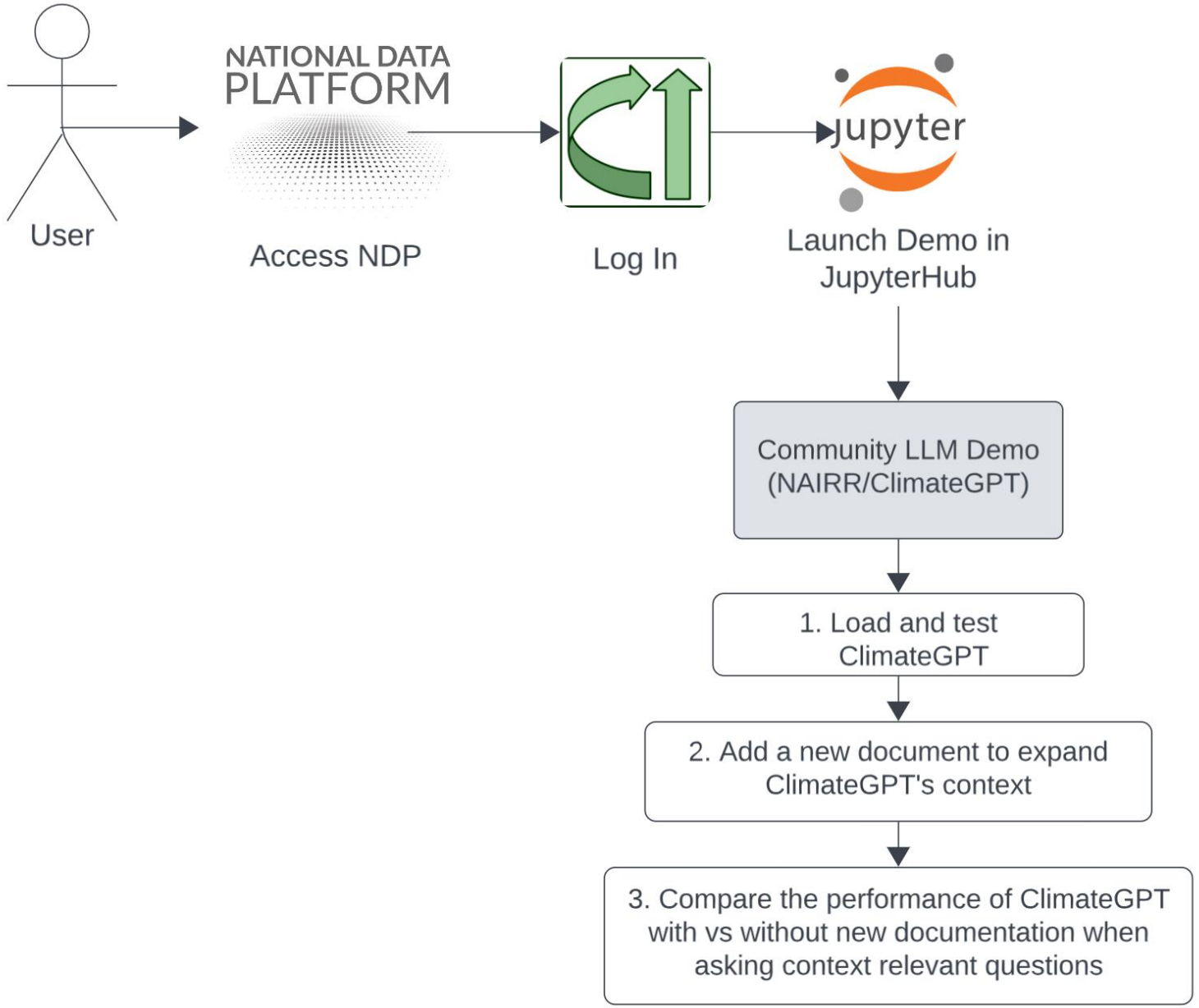
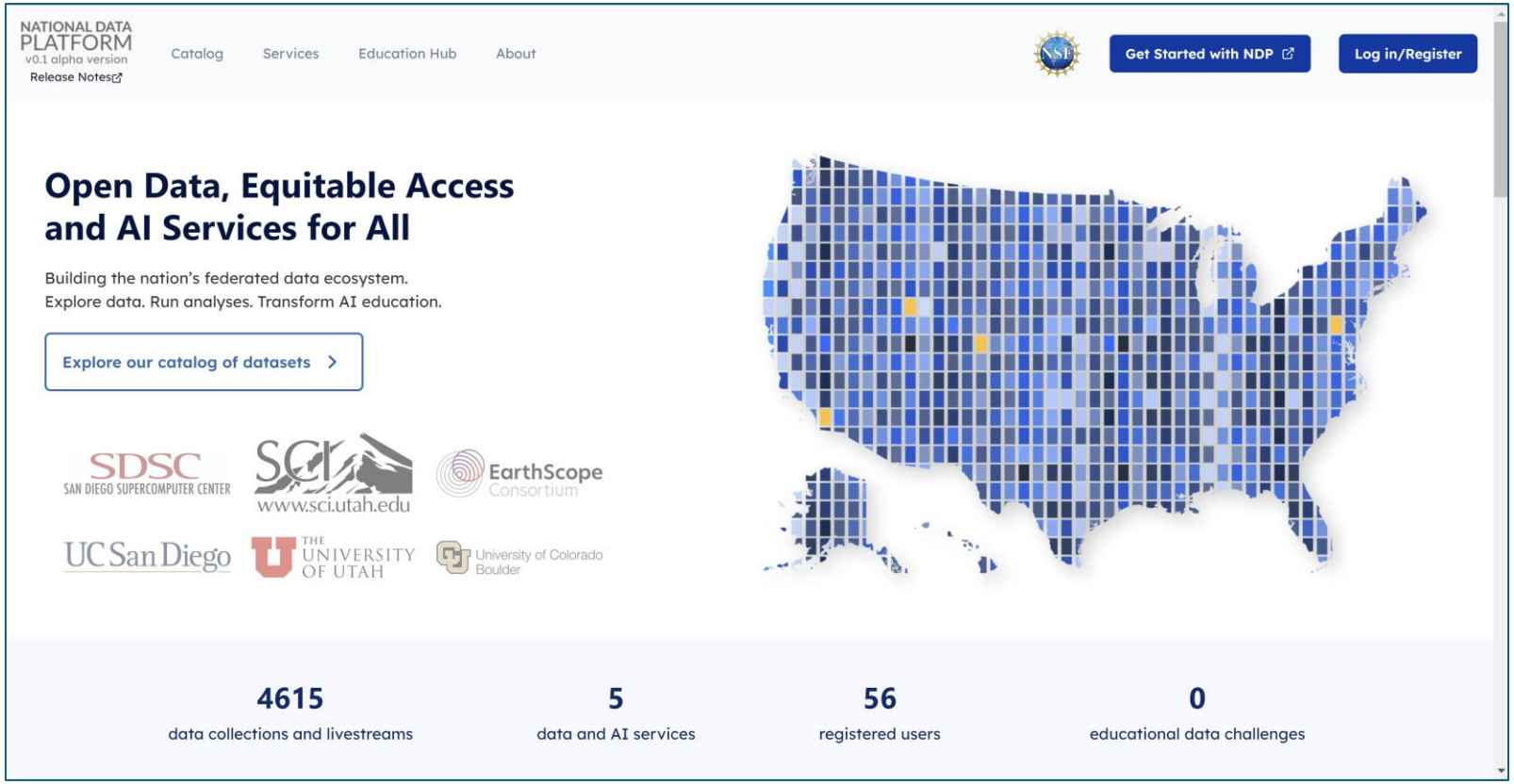
Tutorial Steps



Step 1: Go to nationaldataplatform.org



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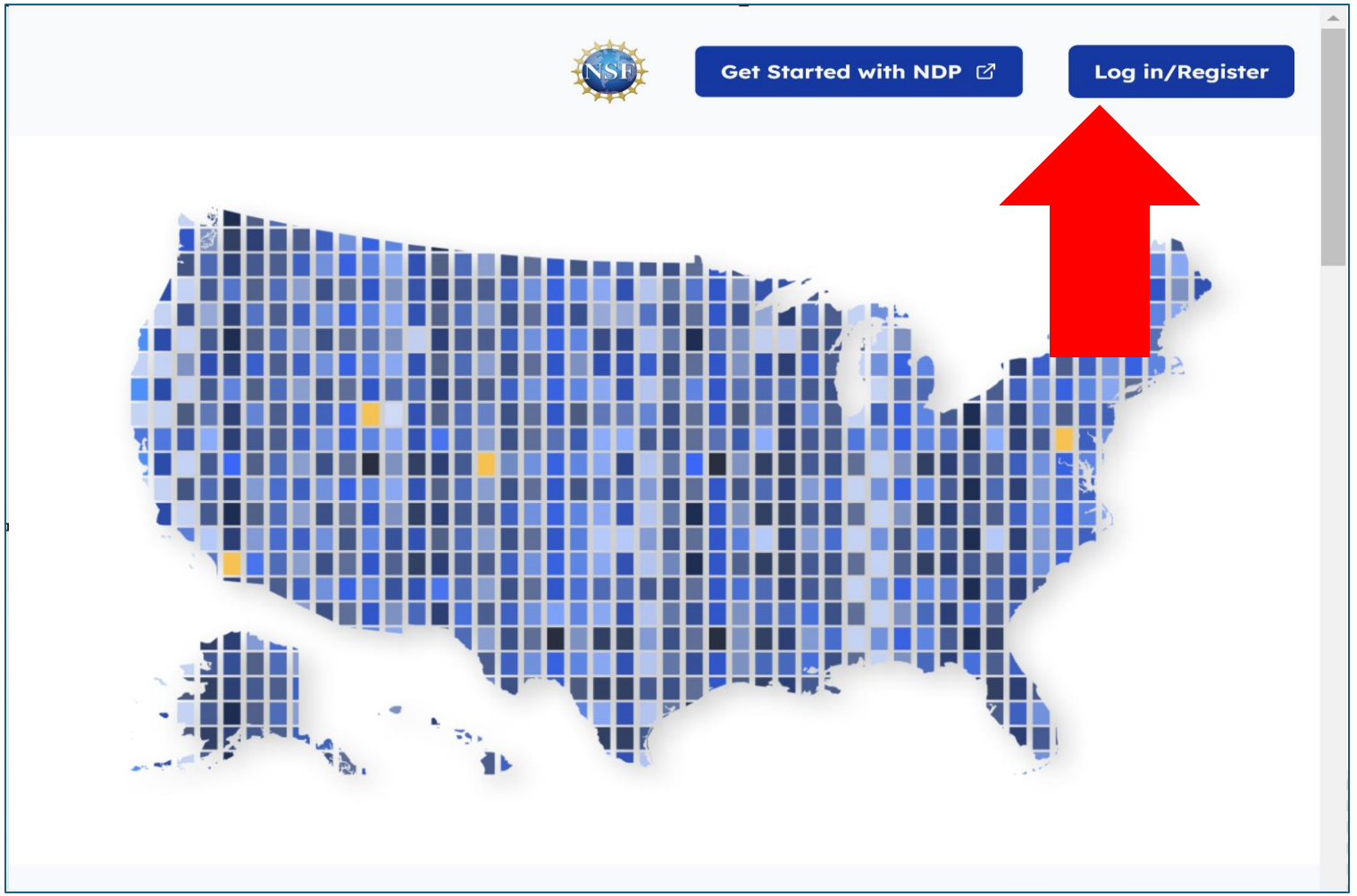
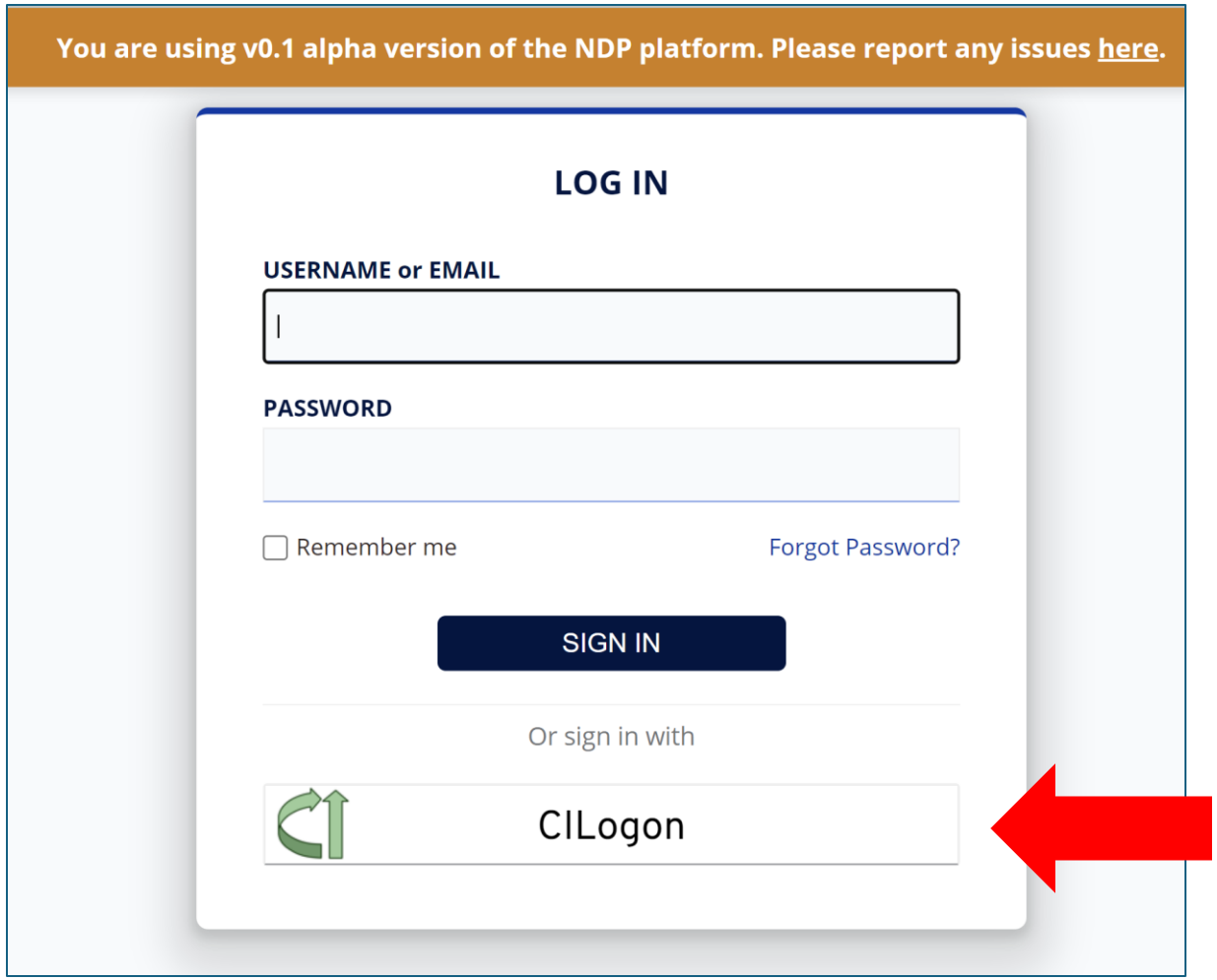
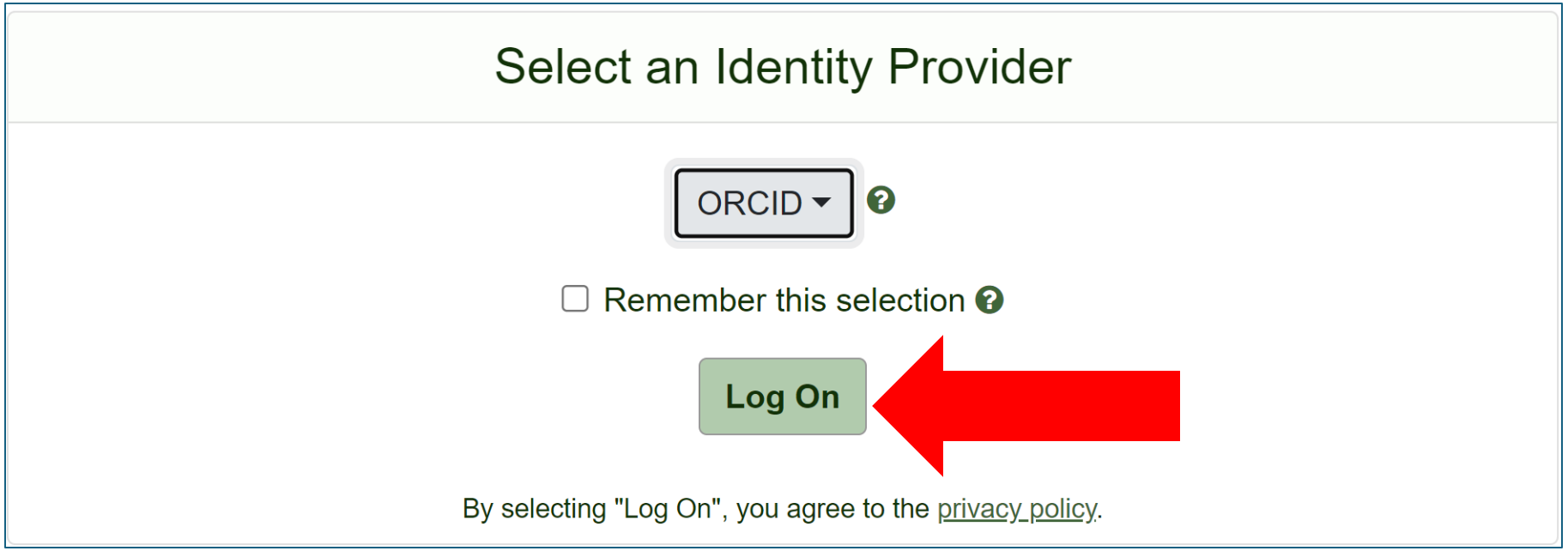
Step 2: Click on Log in/Register



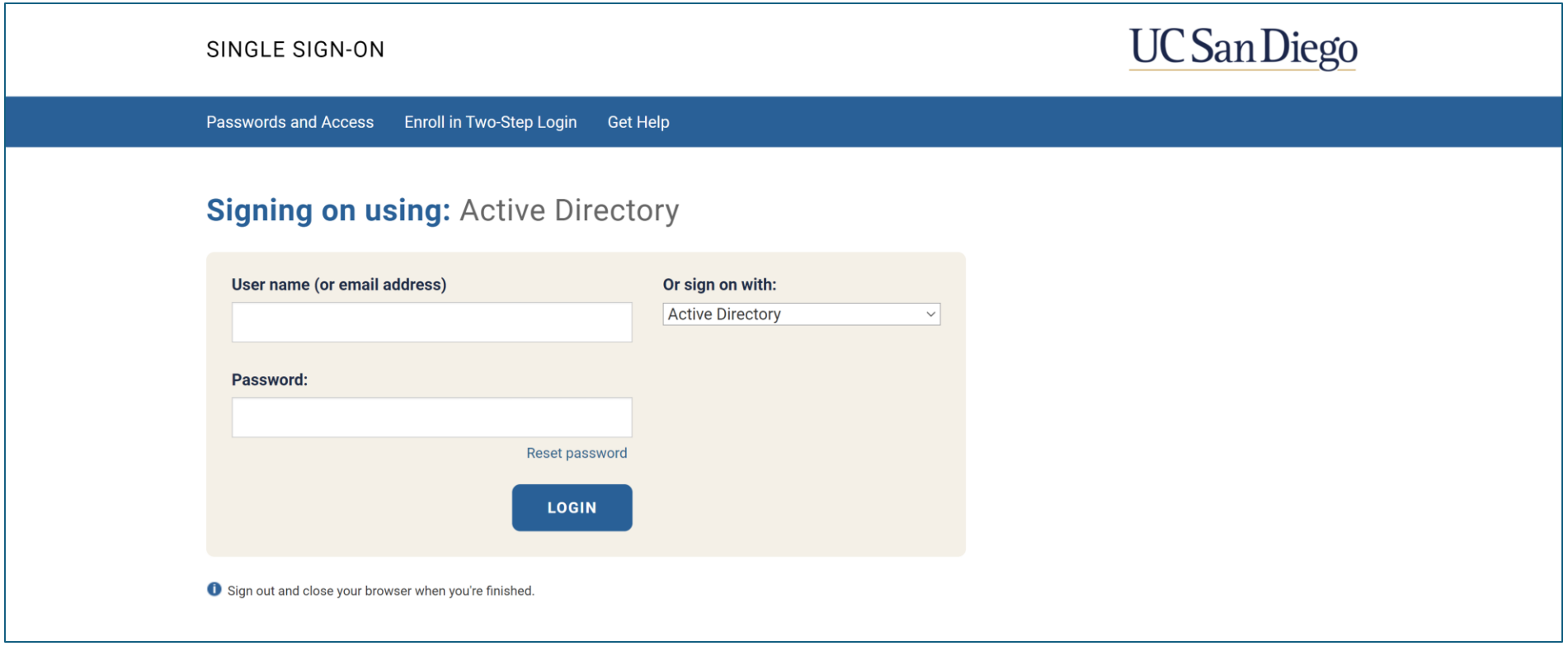
Step 3: Select CI Logon



Step 4: Click on the `Select an identity Provider` dropdown and search your institution. Click on `Log On`.



Step 5: Log in with your institutional credentials



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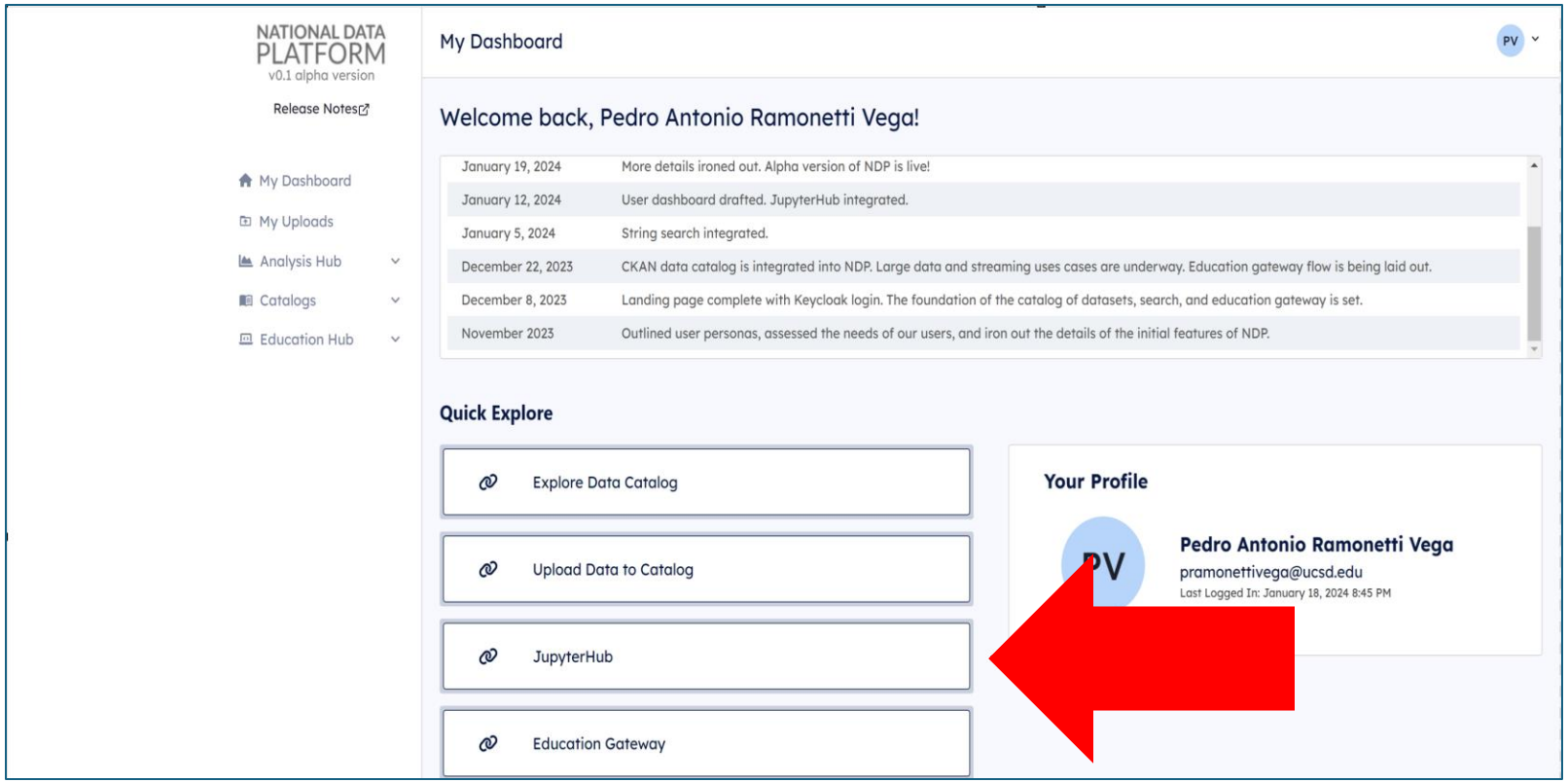
Step 6: In your dashboard, click on JupyterHub



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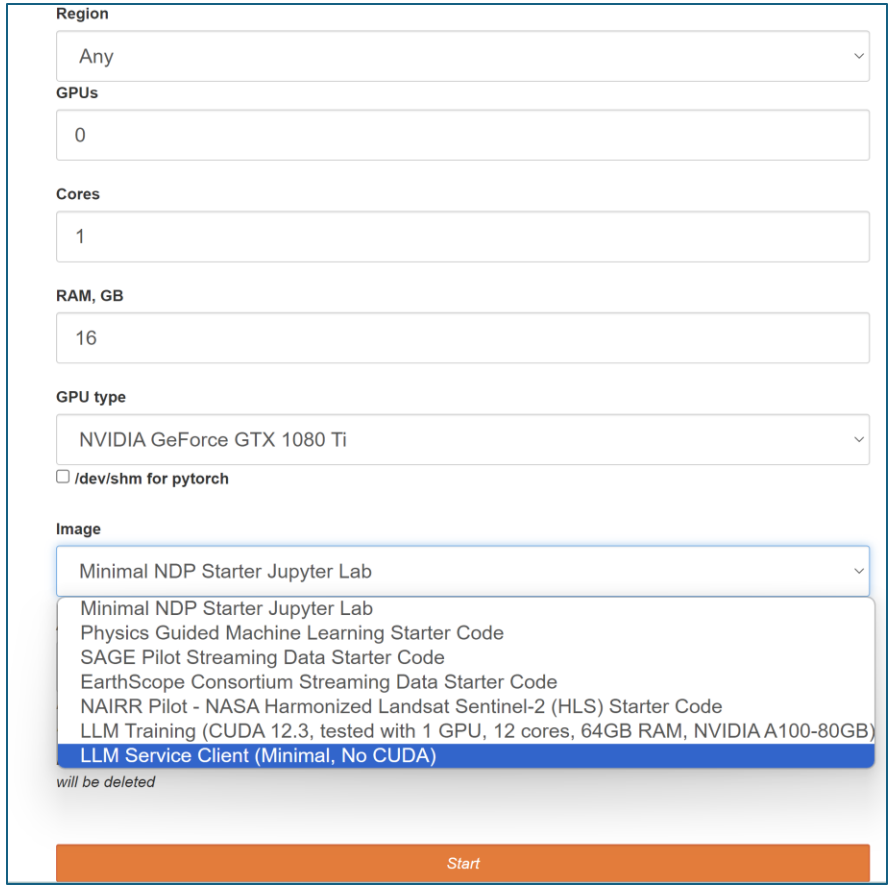
Step 7: Go to Image and select `LLM Service Client`. Click on `Start`.



Today's Demo Tutorial running on NRP/Nautilus

- **LLM Service Client:** Built for question and answer using pre-trained LLM model for ClimateGPT
  - Load any model and add your documents
- **LLM Training:** Built for customizing models for your domain
  - Update and fine-tune an existing model permanently for your domain using a large corpus of documents
  - Contact ndp@sdsc.edu for more information on training services

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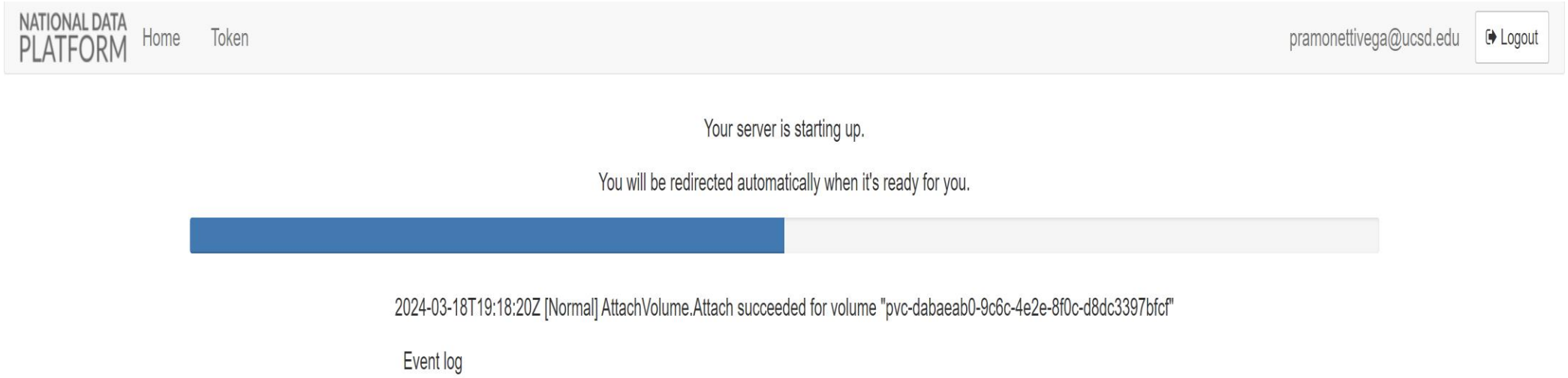
Step 8: Wait for the server to launch



It will take a couple of minutes.

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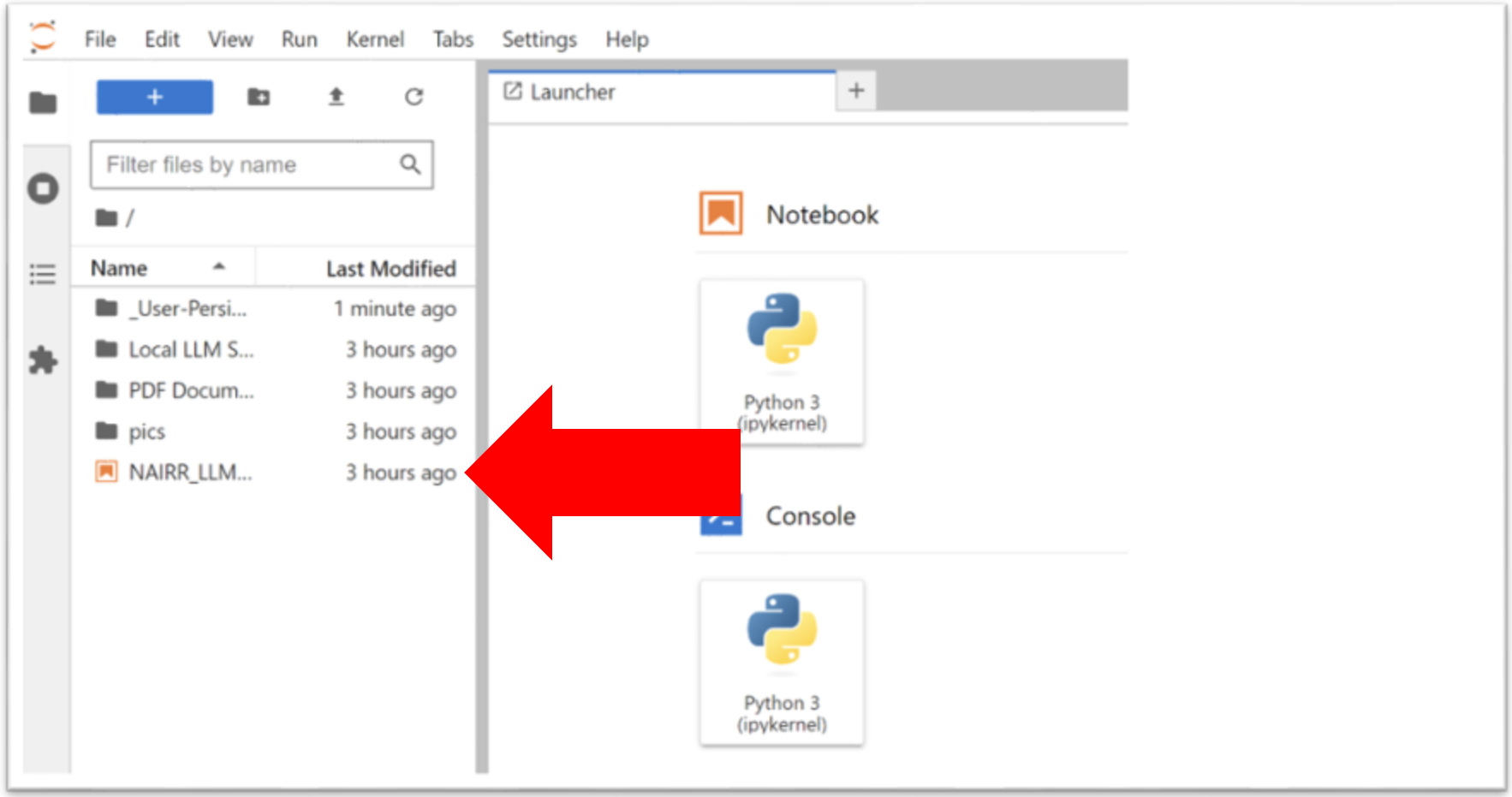
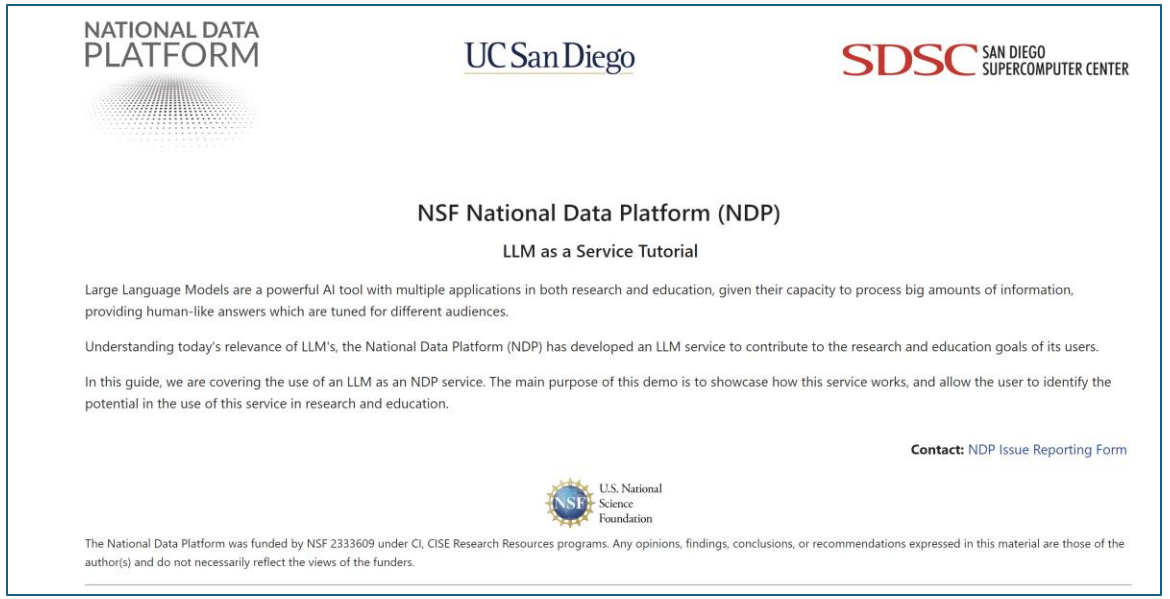
Step 9: Select `NAIRR_LLM_chat.ipynb`



Step 10: Hands On

Part 1: Explore Q&A using ClimateGPT

- Run cells under "A. Set Up"
  - Run using Shift+Enter on the cell
  - Functions built
    - make_query, run_conversation and save_conversation_to_file
- Run cells under "B. Running the conversation"
  - Use example questions or ask your own
  - Type ENTER after each question. DO NOT TYPE SHIFT+ENTER
  - Answer might take some time



Part 2: Add New Document and Compare Q&A Results

- Run cells under "C. Adding new context to ClimateGPT"
  - Loading the document can take up to a couple of minutes
  - Run queries and compare results

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3. Go to the next cell *POST*, and repeat the process. Now the model will provide an answer relying on the document.

PRE-Context

[6]:
```
# PRE - In this cell, we will ask the question without giving any context to ClimateGPT
conversation()
```

```
Question (q=quit, s=save previous answer):  What are NAIRR's goals with respect to human capital?

Answer: The North American Interfraternity Conference's (NAIRR) goals with respect to human capital are focused on promoting the growth and development of fraternity and sorority communities. Specifically, NA
IRR aims to:

1. Enhance leadership development: NAIRR provides educational programs, resources, and guidance to help fraternity and sorority members develop leadership skills and become effective leaders in their communit
ies.
2. Foster brotherhood and sisterhood: NAIRR supports the development of meaningful relationships among fraternity and sorority members through various programs and initiatives, aiming to cultivate a strong se
nse of brotherhood and sisterhood within these communities.
3. Promote diversity, equity, and inclusion: NAIRR recognizes the importance of creating a welcoming and inclusive environment for all members of fraternity and sorority communities. They work to support dive
rsity, equity, and inclusion efforts in these communities.
4. Improve risk management: NAIRR provides resources and guidance to help fraternity and sorority communities manage risks effectively, ensuring a safe and positive experience for members.
5. Support the overall success of fraternity and sorority communities: NAIRR aims to help fraternity and sorority communities thrive by providing resources, advocacy, and support to member organizations.

By focusing on these goals, NAIRR works to create well-rounded, engaged, and successful fraternity and sorority communities that benefit members and contribute positively to higher education and society as a
whole.
Question (q=quit, s=save previous answer):  q
```

Looking at the responses, we can confirm the model is given proper answers which are constructed taking the added document as context.

POST-Context

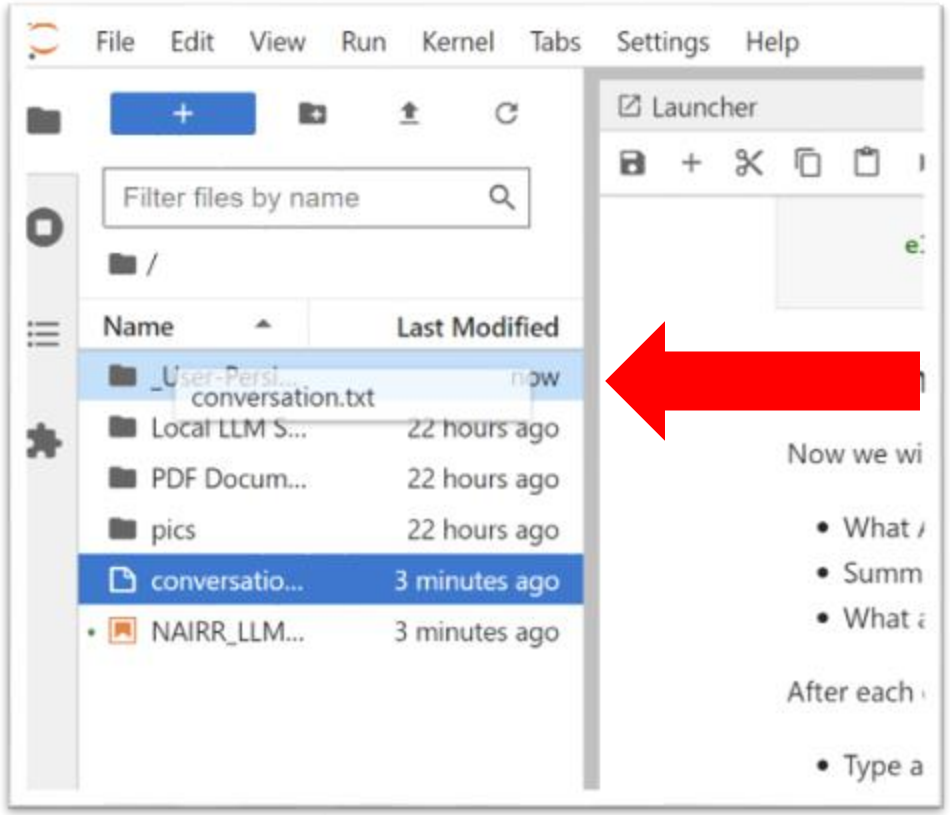
[*]:
```
# POST - We add True to indicate the model to make use of the new document
conversation(True)
```

```
Question (q=quit, s=save previous answer):  What are NAIRR's goals with respect to human capital?

Answer: The NAIRR aims to provide a comprehensive set of AI tools and resources for federal government use, and it recognizes the importance of human capital in the successful implementation and use of these
tools. The Operating Entity is responsible for ensuring that the NAIRR includes appropriate training and support materials for users, and for sharing responsibility with resource providers for providing this
training and support. The NAIRR also aims to incorporate lessons learned from its implementation and use to improve its governance, management, and operations over time.
Question (q=quit, s=save previous answer):
```

Screenshot of a pre-context and post-context response

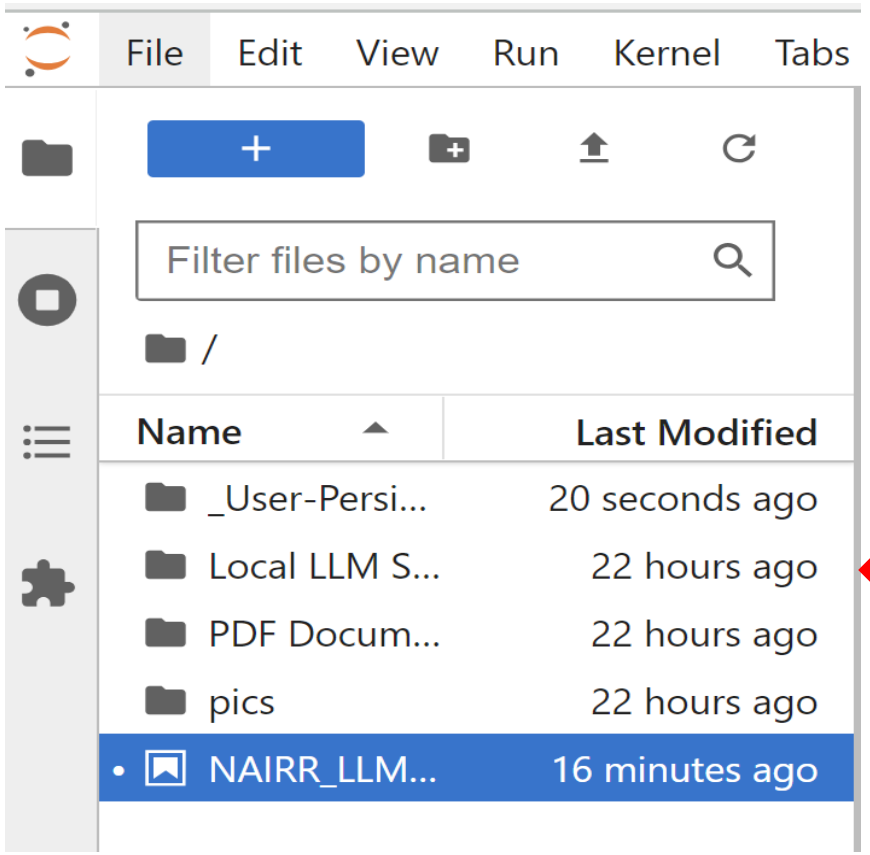
Step 11: Save your notebook and outputs



To save your notebook and or output, you can:

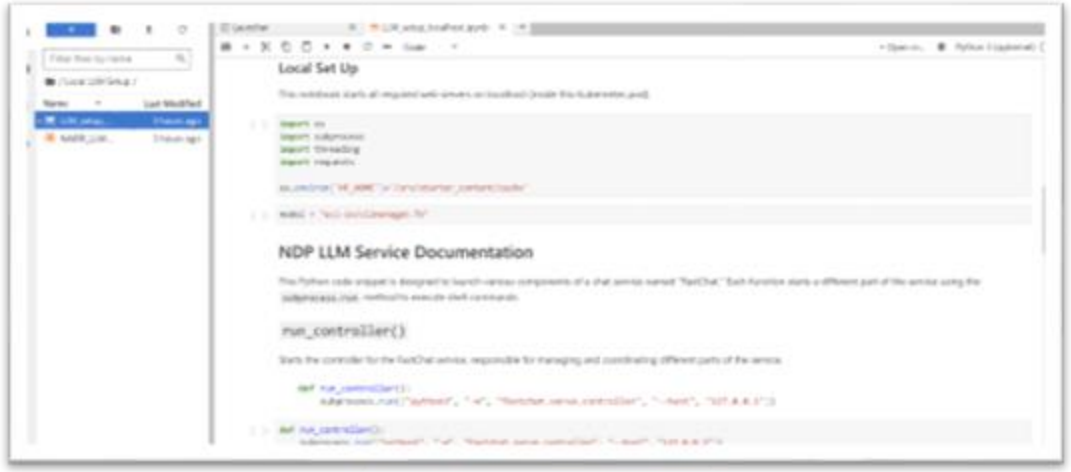
- Select the files and drag them into _User-Persistent-Storage_
- Copy-Paste the files into _User-Persistent-Storage_
- Download them locally

Local LLM: We provide the set-up code to host your own LLM within your server



To make this service work, it is necessary to reserve a server with at least one GPU instance.

Other NDP LLM Notebooks



LLM_setup_localhost.ipynb: This notebook allows users to start their own host API server, and to load their model from HuggingFace into their server.

NAIRR_LLM_chat_localhost.ipynb: The code explored today, which connects to the localhost server instead of Community's LLM server. Users can connect and start interacting with their model.

Contact ndp@sdsc.edu for support

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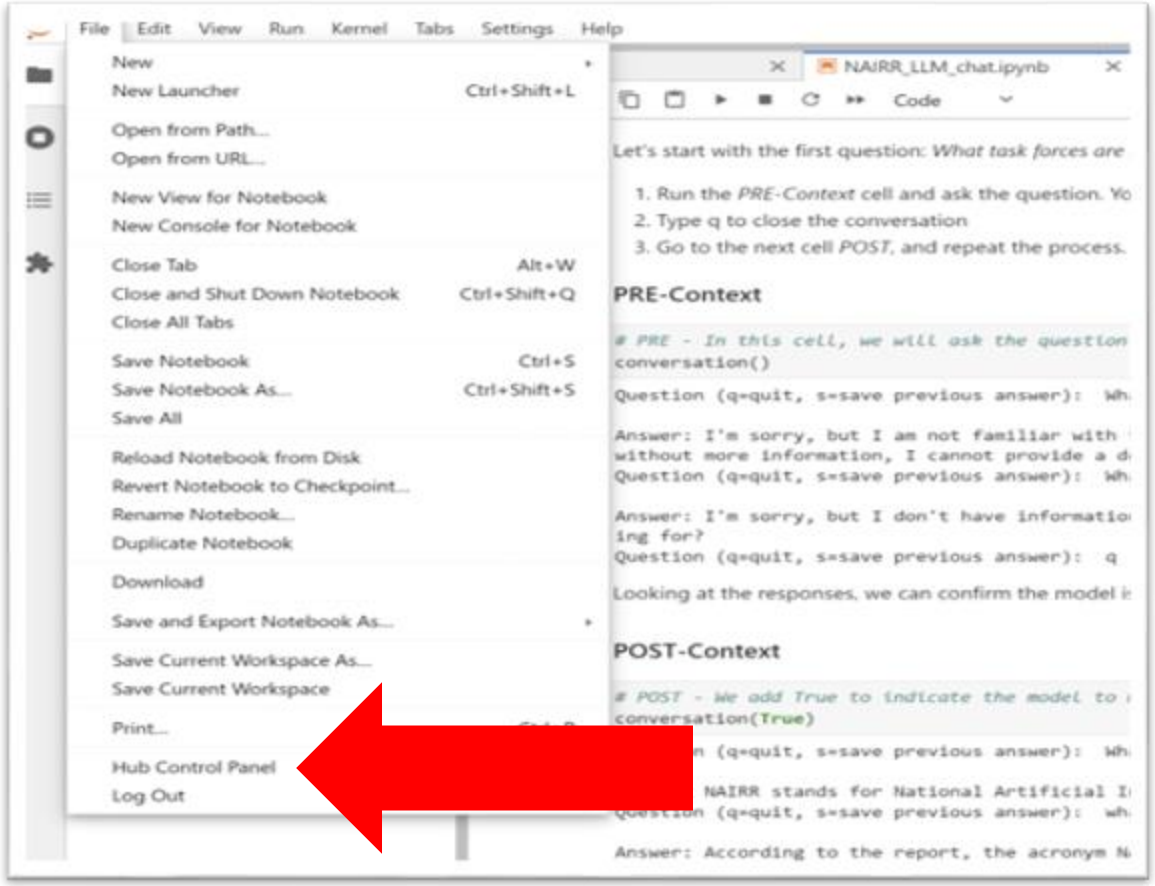
Step 12: Click on *File* and select *Hub Control Panel*



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Step 13. Stop your Server