



Faculty Hack: Jetstream2 in the Classroom

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Welcome!

Who is this for?

- Researchers and educators who need compute resources for their courses, workshops, or training events.

Agenda

- Brief intro to Jetstream2
- Overview of classroom use cases
- Demo of user interfaces & example use cases
- Features and Considerations
- Allocations
- Q&A

Quick poll

- Have you used JS2 before?

What is Jetstream2?

Jetstream2 is a flexible, user-friendly cloud computing environment designed for everyone - from researchers with minimal high-performance computing experience to software engineers looking for the latest in cloud-native approaches.

Jetstream2 is available to any US-based researcher or educator at no cost through support from the National Science Foundation (NSF)'s Advanced Cyberinfrastructure Coordination Ecosystem: Services & Support (ACCESS) program.



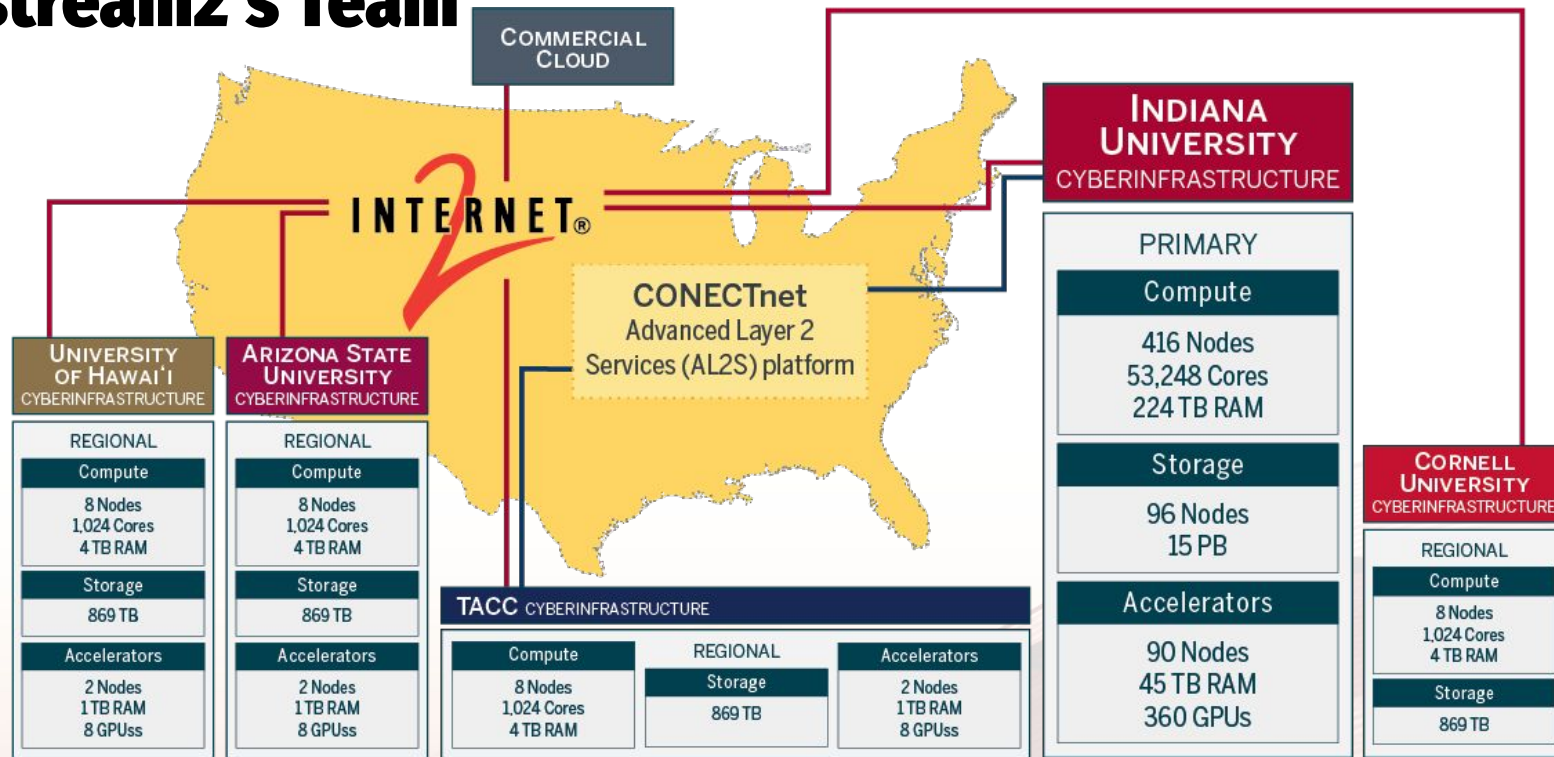
ACCESS

Advancing
Innovation



<http://jetstream-cloud.org/>
National Science Foundation
Award #ACI-2005506

Jetstream2's Team



Why use Jetstream2 for a course?

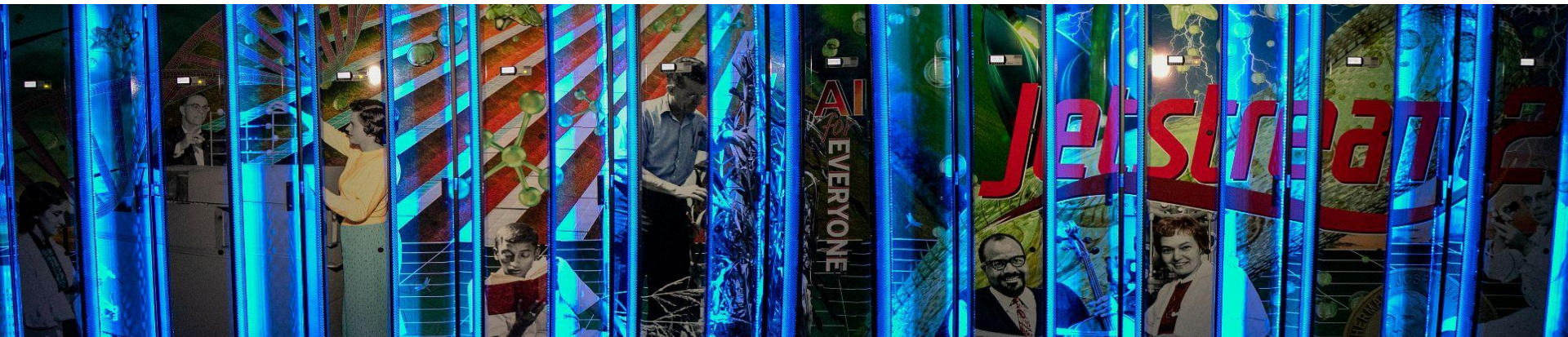
- **Batch launch virtual machines** for large amount of students
- **Full admin access** to install software and use instances how you want
- **On-demand resources**, no queues or runtime limits
- **Interactive computing environment** with graphical desktop
 - Great for students less familiar with command line
- **Full internet access with persistent IPs**, ideal for web hosting or gateways
- **Resources are available at no cost** thanks to our support from the NSF

Jetstream2 Instance Sizes

Full list of sizes and capabilities:

docs.jetstream-cloud.org/general/vmsizes

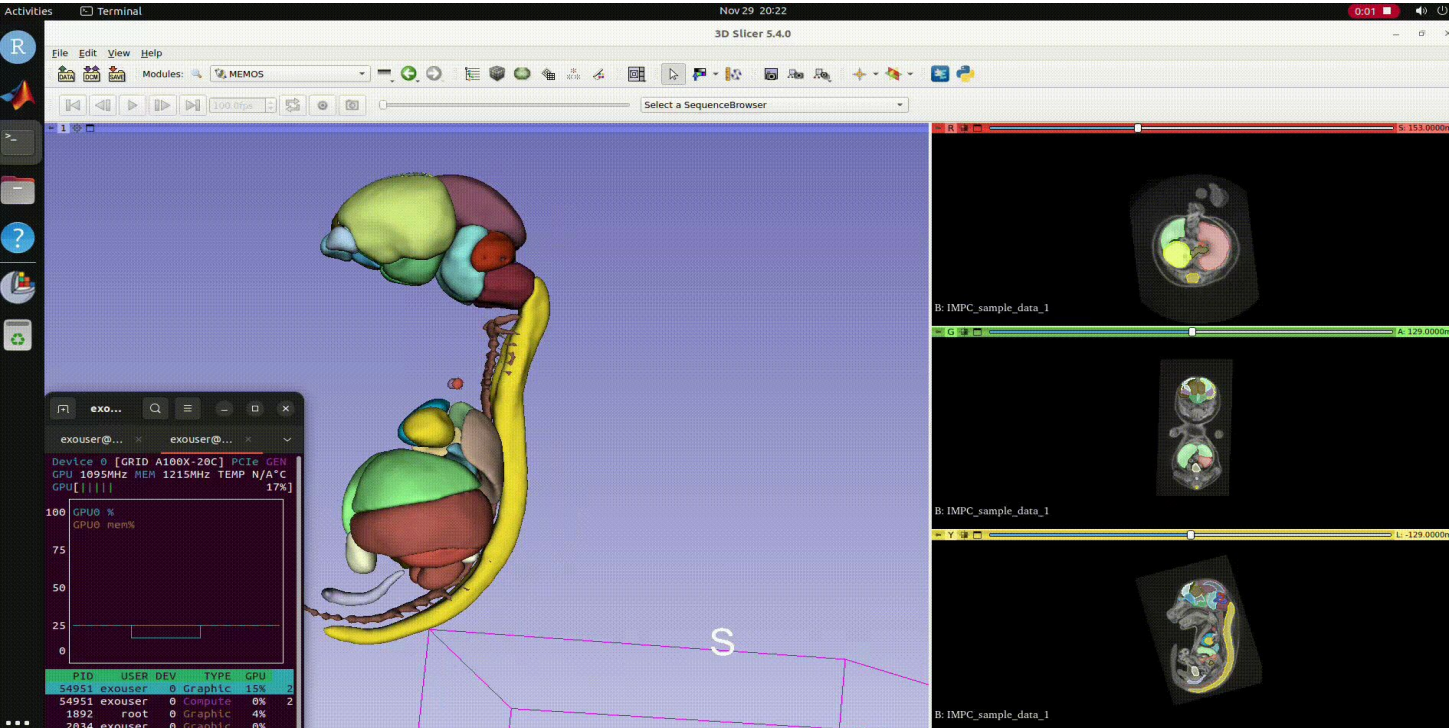
- **Four different resources:**
 - **CPU:** Up to 128 cores, 500 GB RAM
 - **Large Memory:** Up to 128 cores, 1000 GB RAM
 - **GPU:** Nvidia A100, up to 40GB GPU memory, 32 CPU cores, and 125 GB RAM, (L40S, H100, and multi-GPU A100 on request)
 - **Storage:** Default: 1 TB, more on request



Jetstream2 in the Classroom Use Cases

- **Reproducible Development Environment**
 - Individual virtual machines for practicing computer science techniques such as containerization, orchestration, and network security
- **ML, Data Analysis, & AI**
 - Give students on-demand access to powerful computing for high-performance analysis
 - Design, Implement, and evaluate ML methods with interactive environment
 - Teach modern AI methods using GPUs
- **Web Development & Hosting**
 - Persistent Public IPs with automatic DNS

Use Case: Virtual Desktop & GPU Accelerated Computing



3D Slicer

Free, open source software for visualization, processing, segmentation, registration, and analysis of medical, biomedical, and other 3D images and meshes; and planning and navigating image-guided procedures.

<https://www.slicer.org>

“MEMOS - Mouse Embryo Multi-Organ Segmentations: A 3D Slicer extension for automated segmentation of fetal mice using deep-learning” from <https://github.com/slicerMorph/slicerMEMOS>

Use Case: Easy to Launch JupyterHub

jupyterhub Home Token Admin

Search users

User Admin Server Last Activity

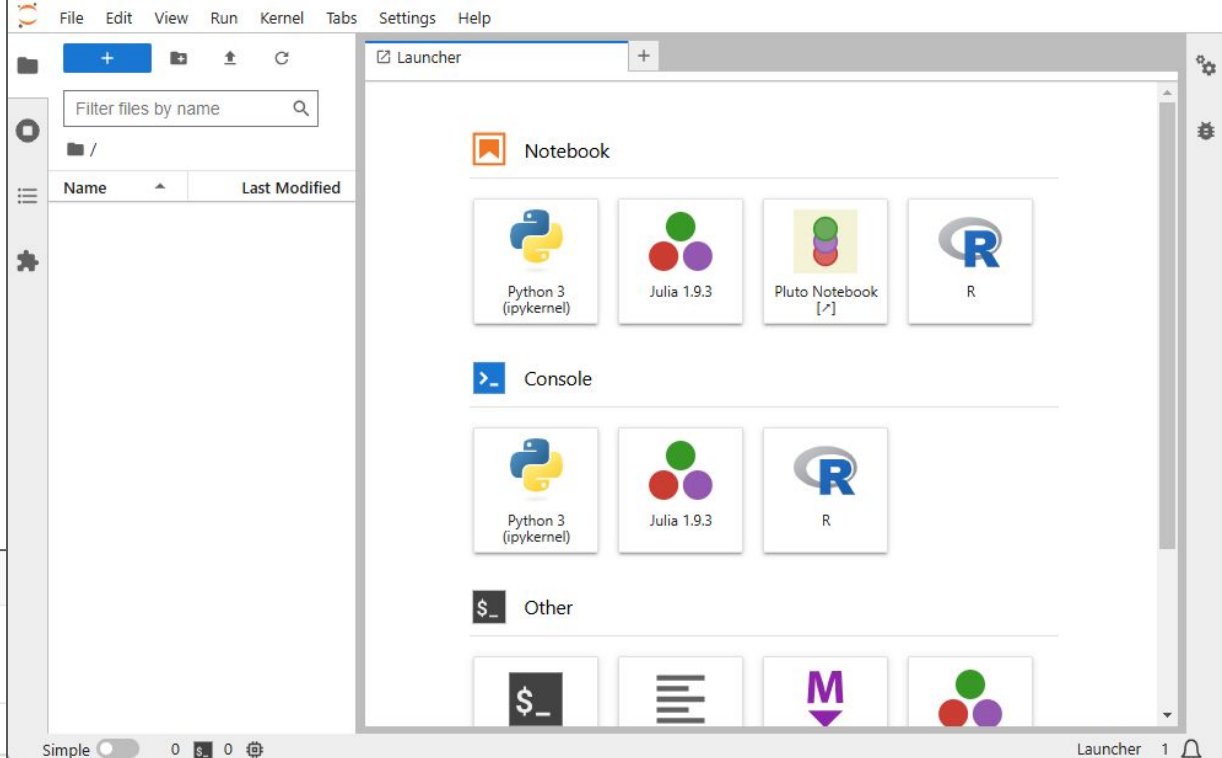
Add Users

Start All

Stop All

Shutdown Hub

djhavert	admin	57 seconds ago	Stop Server Access Server	Edit User
user1		Never	Start Server Spawn Page	Edit User
user2		Never	Start Server Spawn Page	Edit User
user3		Never	Start Server Spawn Page	Edit User



Jetstream2

Jetstream2

Joe's Classroom Experience



Using Jetstream2

More details on interfaces:
docs.jetstream-cloud.org/ui

- **Three interfaces**
 - **Exosphere:** Primary interface, most user friendly
 - **Horizon:** For advanced users, more tools, default Openstack dashboard
 - **CACAO:** For advanced users, useful for building clusters
- **Interface actions**
 - Create, shelve, and delete instances
 - Create and attach or remove storage volumes
 - Access your instance via Web Shell or Desktop (Exosphere only)
- **Command Line Interface**
 - For programmatic interaction

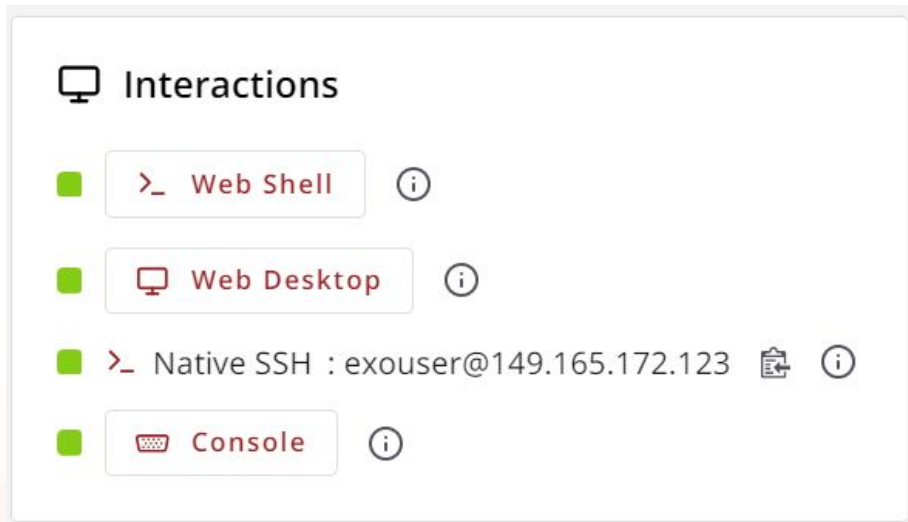
User Interfaces: Exosphere

- **User Friendly**

- Unfamiliar with cloud computing? Start here!
- Automates and abstracts complexity behind UI
- Create and share images with students and colleagues

- **Push Button Access to Instances**

- Immediate Shell and Virtual Desktop Access



User Interfaces: Horizon & CLI

- **Stable**
 - Developed and Maintained by Openstack
- **Versatile**
 - Supports all Openstack features
- **Not User Friendly**
 - Designed for those familiar with Cloud Computing
- **Programmatic**
 - Python based CLI tools

User Interfaces: CACAO

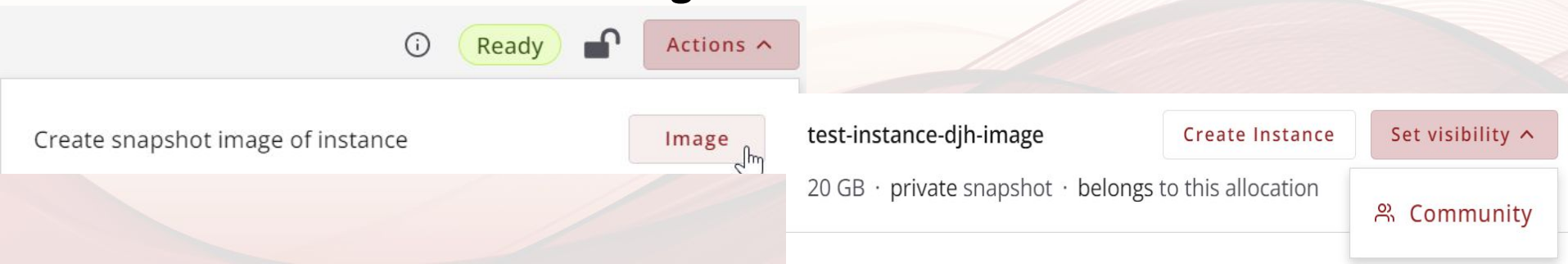
- **Templates for Advanced Provisioning**
 - Multi-VM launch for Workshops/Courses
 - Zero to JupyterHub
 - Kubernetes & Terraform
 - Magic Castle - virtual slurm cluster
- **Steeper Learning Curve**

Useful Features & Considerations

Images

More details on Images and Snapshots:
docs.jetstream-cloud.org/getting-started/snapshots/

- **What Are Images?**
 - Snapshot the state of an instance
 - Includes entire filesystem - software, configs, users, etc.
- **Why Use Images**
 - Can boot instances from an image
 - identical environments, no need to install software repeatedly
- **How to Create and Share Images**



Manila Shares

More details on Instance Management:
<https://docs.jetstream-cloud.org/general/manila/>

- **What is a Share?**
 - Network Storage Location that can be mounted to multiple instances
- **Why Use Manila?**
 - Shared read-only or read-write storage for entire class
 - Backend Network Filesystem (CephFS) managed by Jetstream2 Staff
- **Considerations**
 - Not designed for high-speed throughput or computation
 - Example workflow: transfer data from share before processing, then transfer results back to share.
 - Software that use lock-files are a no-go

Shelving & Unshelving

More details on Instance Management:
docs.jetstream-cloud.org/getting-started/instance-management/

- **What is Shelving?**
 - Moves your instance off the node - creates an image
- **Why Shelve Your Instances?**
 - Shelved instances do not consume SUs (credits)
- **How to Shelve/Unshelve?**

Shut down instance and offload it from compute host

Shelve



Restore shelved instance

Unshelve



For more on the software collection and storage:
docs.jetstream-cloud.org/general/software/
docs.jetstream-cloud.org/general/storage/

Misc Features and Tips

- **Software Collection**

- Mounted to every instance by default
- Matlab, R Studio, Anaconda/Miniforge, NVHPC, Apptainer

- **Object Storage**

- S3 compatible buckets

- **Extensive Documentation & Tutorials**

- Web Server - <https://docs.jetstream-cloud.org/general/webserver/>
- Kubernetes - <https://docs.jetstream-cloud.org/general/kubernetes/>
- Virtual Clusters - <https://docs.jetstream-cloud.org/general/virtualclusters/>

Security Considerations

- **Instances are fully open to the internet by default**
- **When should you be concerned?**
 - Old software can have security vulnerabilities
- **Security Groups**
 - Can block ports at the hypervisor level - traffic never reaches instance
- **Firewalls**
 - Blocks ports on the instance
- **Base Ubuntu firewall rules to build off of:**

```
ufw allow ssh
ufw allow 49528/tcp
ufw allow from any to 172.17.0.1 port 5901 proto tcp
ufw enable
```

Security Considerations

- **What happens if an instance is compromised?**
 - UIISO sends us a notice
 - Students will likely need to start from scratch
 - Nonzero amount of effort on instructors, students and JS2 staff to handle incidents
- **Best Practices**
 - Reach out to us prior to the course to ask any questions!
 - Consider providing a standard image with security measures and software environment in place
 - Enforce constraints on what can be done with the image
 - Enforce penalties for not sticking to the rules
 - Many are already putting these practices in place and are doing great!

Jetstream2

François shares set up experiences



Getting an Allocation

- **Consider Your Needs**

- Duration of Class
- Number of Students
- Instance Size per student
 - Consider computational needs - how many CPUs needed?
- GPUs
- 24/7 availability?
- Software Required

Getting an Allocation

Usage estimation calculator:
docs.jetstream-cloud.org/alloc/estimator

- **Calculate Usage**

- 1 CPU hour = 1 Credit
- GPUs receive a 2x multiplier

- **Determine Tier - Examples**

- **8 week course, 25 students, each receiving a VM with 4 CPUs**
 - ~ 135,000 Credits -> Explore
- **8 week course, 25 students, each requiring a large GPU (16 CPUs, 1/2 GPU)**
 - ~ 1,075,000 Credits -> Discover

Type	Credits
Explore	400,000
Discover	1,500,000
Accelerate	3,000,000
Maximize	Discretionary

Getting an Allocation

Step-by-step instructions and details:
allocations.access-ci.org/get-your-first-project

1. Create your ACCESS ID.

An ACCESS ID is necessary to request an allocation and to login to resources.

2. Select your project type based on your needs.

ACCESS offers four different project types to choose from.

Type	Credits
Explore	400,000
Discover	1,500,000
Accelerate	3,000,000
Maximize	Discretionary

3. Prepare and submit your allocation request.

Provide a project title, abstract, and a few other details, and you should hear back in 1-3 business days.

4. Receive and exchange your ACCESS credits.

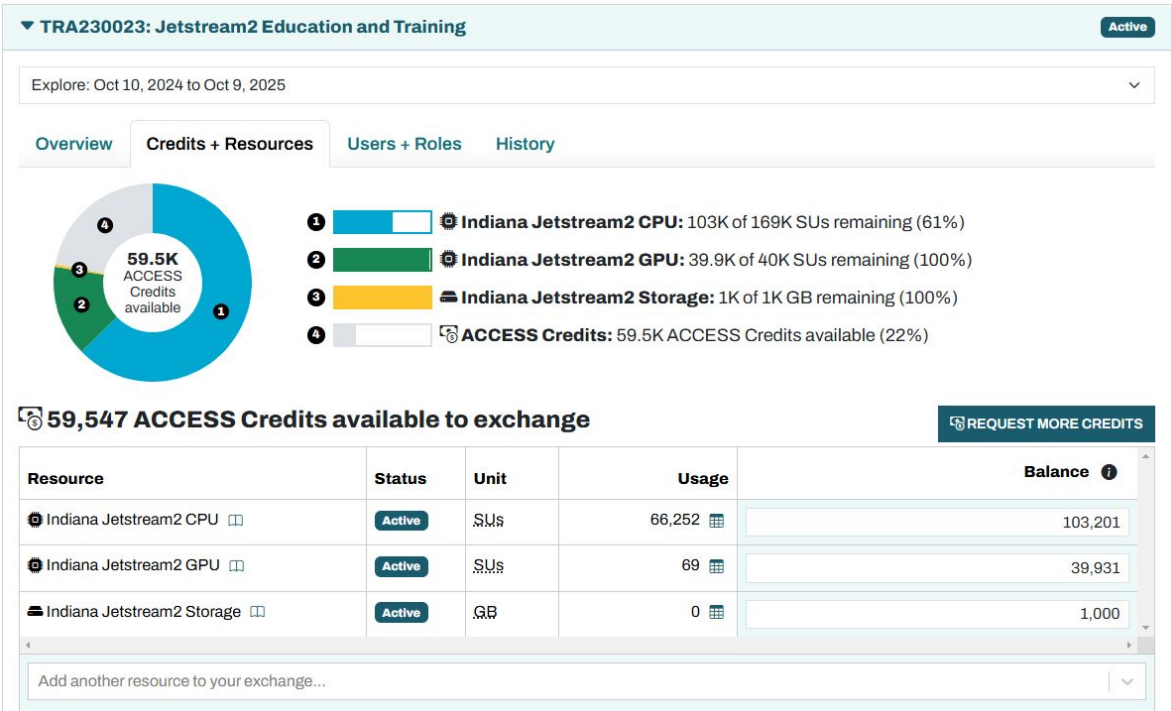
You'll receive a number of ACCESS credits that you will then apply toward computing resources.



Getting an Allocation

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Type	Credits
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Add Additional Instructors

- **Anyone with an ACCESS ID can be added to a project**
 - Getting an ACCESS ID is easy and comes at no cost!
 - Two roles: *User* and *Allocation Manager*
 - *User* get access to resources on allocation
 - *Allocation Manager* can manage users & credits on allocation
 - Done via the ACCESS allocations dashboard under “Users + Roles”

Overview

Credits + Resources

Users + Roles

History

Name	ACCESS Username	Role	All Resources	🇮🇳 Indiana Jetstream2 CPU	🇮🇳 Indiana Jetstream2 GPU	🇮🇳 Indiana Jetstream2 Storage
Havert..Daniel	dhavert	Allocati ▼	✓	✓	✓	✓
Pistorius..Julian	julianp	Allocati ▼	✓	✓	✓	✓
.Taylor..Jennifer	jtaylor1	Allocati ▼	✓	✓	✓	✓

Add Additional Instructors

Step-by-step instructions and details:
allocations.access-ci.org/how-to

▼ TRA230023: Jetstream2 Education and Training

Active

Explore: Oct 10, 2023 to Oct 9, 2024

▼

Overview

Credits + Resources

Users + Roles

History

Name	ACCESS Username	Role	All Resources	Indiana Jetstream2 CPU	Indiana Jetstream2 Storage
Taylor, Jennifer	jtaylor1	Allocati ▼	✓	✓	✓

nsmith1

▼

nsmith1 (Nicholas Smith, Indiana University, n**3@in*****edu)



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Add Additional Instructors

Step-by-step instructions and details:
allocations.access-ci.org/how-to

▼ TRA230023: Jetstream2 Education and Training

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Overview

Credits + Resources

Users + Roles

History

Name	ACCESS Username	Role	All Resources	Indiana Jetstream2 CPU	Indiana Jetstream2 Storage
Taylor, Jennifer	jtaylor1	Allocati ▼	☒	☒	☒
Smith, Nicholas	nsmith1	User ▼	☐	☐	☐

Add another user... ▼

RESET FORM

SAVE CHANGES



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Providing Access to Students

Either...

1. **Add Students as *Users* in Allocation**
 - **Gives Students**
2. **Give students access to only their instances**



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Adding Students to Allocation

Pros

- Easy and Free to add students
- More Freedom to Students
- Reduce instructor workload
- Students can utilize user-friendly interface to
 - Provision and manage their own instances
 - Access instances with a click of a button
- If students break instance, they can easily create a new one.

Cons

- More Freedom to Students
 - No fine-grained control over or restrictions for students

Use Cases

- Single or Multi-VM per Student
- Students learning about Cloud Infrastructure and Orchestration
- Long Course with large compute requirements
- Courses prioritizing installation & experimentation within instances

Give students access to only their VMs

Pros

- Students can't interfere with others' instances
- Provision a standard environment to students
- Easily create instances designed for multiple users
 - Shared resources but separate desktops & home directories

Cons

- Students can't create/shelve their own instances.
- If students break instances, can be time-consuming to troubleshoot or create new ones
- Administrative overhead for the course, including creation of additional course materials like a standard image and governance around it

Use Cases

- Multiple Students per instance
- Short courses or workshops
- Competitive environment with need for security between students/groups



Jetstream2 & Data Storage

More details on storage:

docs.jetstream-cloud.org/general/storage

- **Jetstream2 is NOT primarily a storage device**
 - Temporary location to stage data for analysis
 - Default 1TB storage (more can be requested)
- **Storage options**
 - **Volumes:** Default storage method
 - Attach to an instance to read and write your data from your programs
 - **Manila:** Shared file systems
 - Accessible by multiple instances and users
 - **Object Store:** “Bucket” to store large amounts of data without a filesystem
 - S3 compatible

Jetstream2 Trial Allocations

Jetstream2 Trial Allocation Portal
portal.jetstream-cloud.org

- **Test drive Jetstream2 before getting your own ACCESS allocation**
 - 1000 service units (SUs)
 - 1 m3.tiny or 1 m3.small virtual machine instance
 - 1 virtual machine backup snapshot per instance
 - 10 GB disk external storage volume
- **Sign up for a trial allocation**
 - Register for your ACCESS ID
 - Visit the Jetstream2 Trial Allocation Portal and select “enroll”
 - If using Exosphere, the allocation is named with your ACCESS username plus “JTA User”
 - If using Horizon, it is labeled with only your ACCESS username

Useful Resources

- **ACCESS user registration:** <https://operations.access-ci.org/identity/new-user>
- **ACCESS allocations portal:** <https://allocations.access-ci.org>
- **ACCESS Support:** <https://support.access-ci.org/open-a-ticket>
- **Jetstream2 Getting Started Guide:** <https://docs.jetstream-cloud.org/getting-started/overview>
- **Exosphere:** <https://jetstream2.exosphere.app/exosphere/home>
- **Jetstream2 website:** <https://jetstream-cloud.org>
- **Jetstream2 user documentation:** <https://docs.jetstream-cloud.org>

Connect With Us

- **Mailing list:** js2-users-l-subscribe@list.iu.edu
 - New users are automatically subscribed!
- **Community chat:** <https://matrix.to/#/#jetstream-cloud:matrix.org>
- **Support email:** help@jetstream-cloud.org
- **Office hours & events:** <https://jetstream-cloud.org/news-events/events.html>

A question for you!

What's **your** classroom use case?

The bottom half of the slide features a decorative background of overlapping, wavy lines in shades of light pink, peach, and pale blue, creating a soft, abstract landscape effect.

jetstream-cloud.org

help@jetstream-cloud.org

Zoom Office hours:

1 to 2 PM Central Tuesdays:

<https://jetstream-cloud.org/documentation-support/>