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Jetstream2: Accelerating science and engineering on-demand

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Jetstream2 Primary Investigator

NITRD MAGIC Subcommittee – 1 February 2023

Jetstream2

NSF Vision and Blueprint

U.S. National Science Foundation (NSF) envisions an **agile, integrated, robust, trustworthy and sustainable CI ecosystem that drives new thinking and transformative discoveries in all areas of S&E research and education.**

- View CI more holistically...
- Recognize and support the translational research continuum...
- Develop a strategy that balances innovations with stability and continuity...
- Work closely with the diverse S&E communities to tightly couple discovery and innovation...
- Achieve new levels of usability by easing the pathways for discovering, accessing, understanding, and utilizing powerful CI capabilities...

From: OAC Vision & Blueprint: Overview and Computational Ecosystem (Apr 2019)



What is “the” Jetstream(2)?

- NSF-funded production cloud environment
- Ease-of-use focus, rapid on-ramp to XSEDE/ACCESS
- **On-demand** interactive computing and persistent services for science gateways
- Enables configurable environments; **programmable cyberinfrastructure**

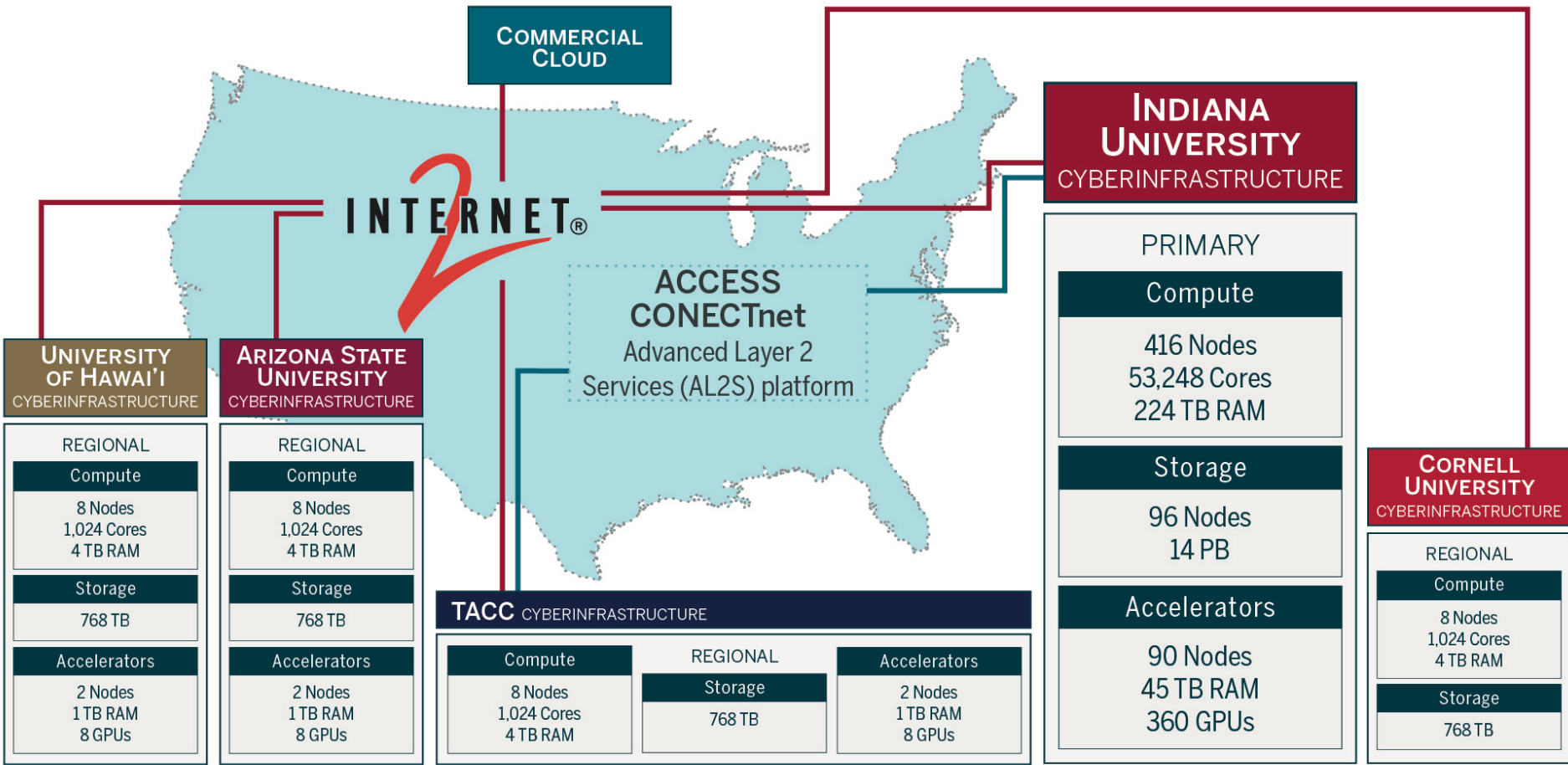
By Maria Morris: JS2 rear doors (lower) Banksy adaptation [non-commercial] (right)



Now with GPUs,
large-memory,
more faster PB!

Jetstream2





UNIVERSITY OF HAWAIIⁱ
CYBERINFRASTRUCTURE

REGIONAL
Compute
8 Nodes 1,024 Cores 4 TB RAM
Storage
768 TB
Accelerators
2 Nodes 1 TB RAM 8 GPUs

ARIZONA STATE UNIVERSITY
CYBERINFRASTRUCTURE

REGIONAL
Compute
8 Nodes 1,024 Cores 4 TB RAM
Storage
768 TB
Accelerators
2 Nodes 1 TB RAM 8 GPUs

TACC CYBERINFRASTRUCTURE

Compute	REGIONAL	Accelerators
8 Nodes 1,024 Cores 4 TB RAM	Storage	2 Nodes 1 TB RAM 8 GPUs
	768 TB	

INDIANA UNIVERSITY
CYBERINFRASTRUCTURE

PRIMARY
Compute
416 Nodes 53,248 Cores 224 TB RAM
Storage
96 Nodes 14 PB
Accelerators
90 Nodes 45 TB RAM 360 GPUs

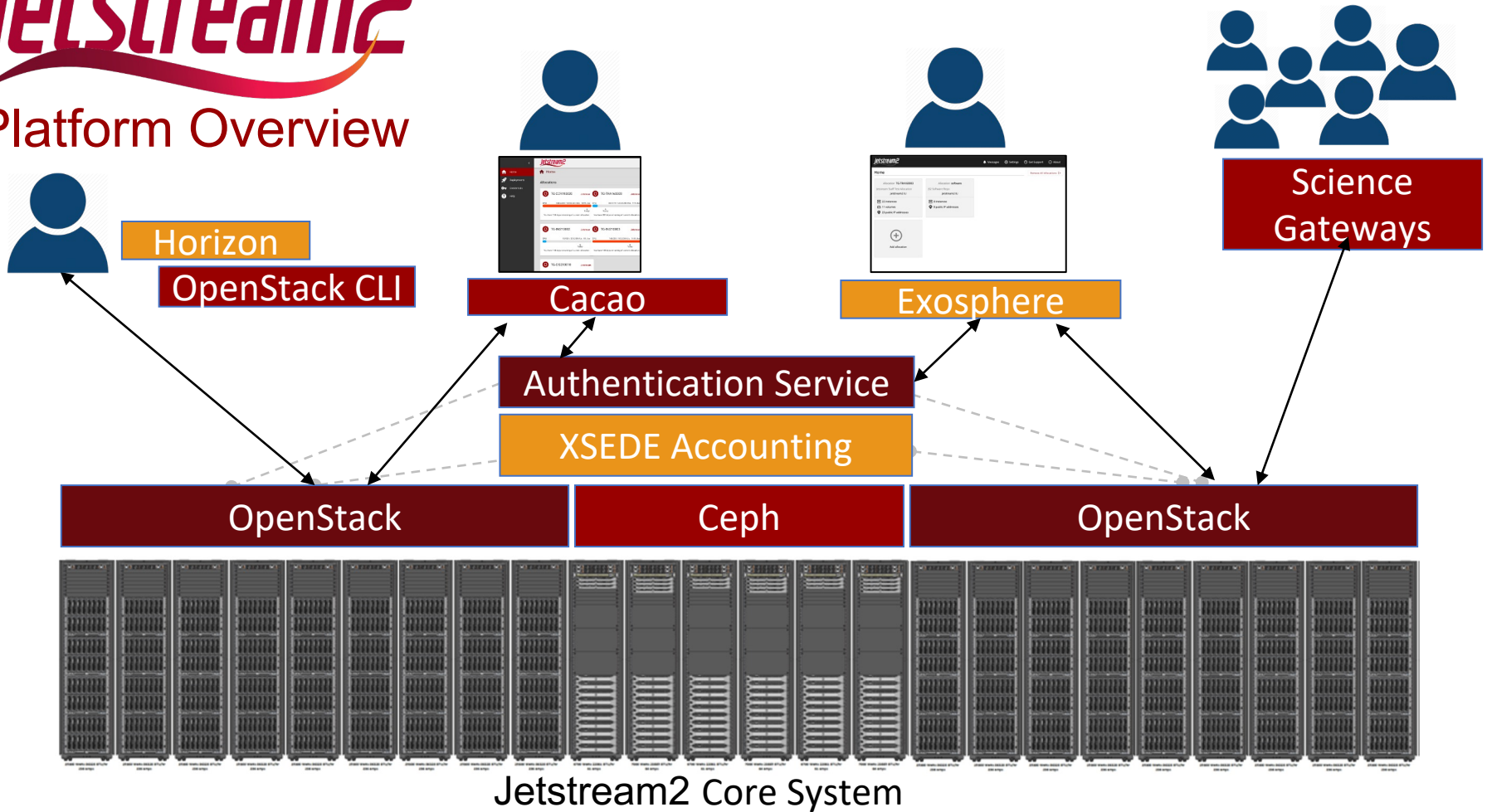
CORNELL UNIVERSITY
CYBERINFRASTRUCTURE

REGIONAL
Compute
8 Nodes 1,024 Cores 4 TB RAM
Storage
768 TB



Jetstream2

Platform Overview



Home > Project TG-CCR190024

iu.jetstream-cloud.org - TG-CCR190024

Remove Allocation Create

Instances

Instances used 11 of 25 total Cores used 26 of 132 total RAM used 100 of 388 GB

Select All

- Ready `formally_trusty_urchin`
- Shelved `optionally_certain_longhorn with GUI`
- Ready `wildly_united_mite`

Hiding 8 Instances created by other users

Show

Volumes

Volumes used 2 of 10 total Storage used 279 of 1,100 GB

Home > Project TG-CCR190024 > Instances > Instance formally_trusty_urchin

iu.jetstream-cloud.org - TG-CCR190024

Remove Allocation Create

Instance formally_trusty_urchin

Created 19 minutes ago / by user tg836338 / from image JS-API-Featured-CentOS8-Latest

Status **Ready**

UUID 2bc77f59-73bf-470f-95b6-51dc31d7577f

Flavor m1.small

SSH Public Key Name smart

IP addresses

Public IP Address 149.165.157.3 Unassign

IP Details

Volumes Attached

(none)

Attach volume

Interactions

- Web Shell
- Web Desktop
- Native SSH: exouser@149.165.157.3
- Console

Password

Try logging in with username "exouser" and the following password:

Show password

Actions

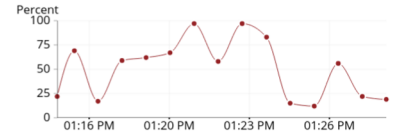
- Lock Prevent further instance actions until it is unlocked
- Suspend Save execution state to disk
- Shelve Shut down instance and offload it from compute host
- Image Create snapshot image of instance
- Reboot Restart instance
- Delete Destroy instance

Action History

Action	Time
create	19 minutes ago (2021-10-26 20:10:54 UTC)

System Resource Usage

CPU Usage



Memory Usage



Differences from Jetstream[1] GUI

- Co-exists with other OpenStack interfaces, other research clouds
- Much easier collaboration between users on same allocation
- Choose an operating system instead of browsing a list of images
- Multi-instance create and delete
- Volume-backed instances → large, persistent root disks
- Live instance load graphs (CPU, GPU, RAM, storage)
- Live instance resize
- Push-button virtual clusters with elastic scaling
- Reproducible workbenches with Binder-compatible repositories

CACAO

Home

Deployments

Credentials

Help

Home

Jetstream2 Alpha Release

Cloud Automation & Continuous Analysis Orchestration

Thank you for participating in the Jetstream2 Alpha release. Please use the following links to view known issues and submit any additional feedback as you use the application.

[VIEW KNOWN ISSUES](#) [SUBMIT FEEDBACK](#)

Allocations

Allocation ID	Project	CPU	GPU	Large Memory	Remaining
TRA220028	Jetstream2 Affiliated Development Projects	49,279 / 1,000,000 SUs 5% Used	12,083 / 1,000,000 SUs 1% Used	0 / 1,000,000 SUs 0% Used	You have 288 days remaining of current allocation.
TRA160003	Jetstream Staff Test Allocation	146,965 / 2,000,000 SUs 7% Used	95,323 / 2,000,000 SUs 5% Used	0 / 2,000,000 SUs 0% Used	You have 87 days remaining of current allocation.
CIS220046	Deep Learning Tutorial for Translational AI Center at Iowa State University	-	424,222 / 600,000 SUs 71% Used	-	You have 115 days remaining of current allocation.

Featured Learning

- Continuous Analysis 101
- Jetstream2 Basics
- Manage Resources

Deployments (1)

New Deployment

JETSTREAM 2 / BIO220047

Select a template that best describes what you want to do:

- simple launch of one or more vms
openstack-single-image
- launch a multi-vm zero-to-jupyterhub
jupyterhub
- launch a multi-vm kubernetes cluster (k3s)
single-image-k3s
- launch instances for a workshop
vm4workshop

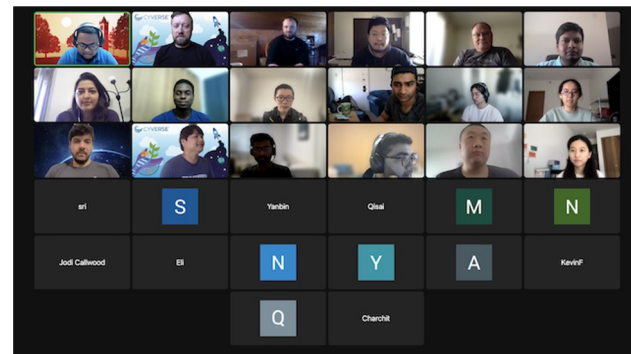
[GO](#)



<https://cacao.jetstream-cloud.org>

Deep dive into DL

- First-of-a-kind workshop to apply DL techniques to agricultural data sets in April 2022
- AIIRA, AI Institute for Resilient Agriculture, intends to distribute the digital twin built on JS2 for community re-use
- Allows community training and inference
- Provided via Terraform templates and customized UI through CACAO



...we were able to easily provide so many students with a GPU-enabled container so quickly. Normally, getting GPU resources on an HPC scheduler, like OnDemand, takes time, and the high demand for GPUs makes finding 40 or more unoccupied resources an impossibility.

– Tyson Swetnam, CyVerse Co-PI and workshop instructor



https://cyverse.org/deep_learning_workshop

Gateways use JS2 in several ways



Gateway web hosting



Datasets and
Database hosting



Gateway Security
Services

Integrated JupyterHub



Interactive
Computing



Elastic Virtual Clusters

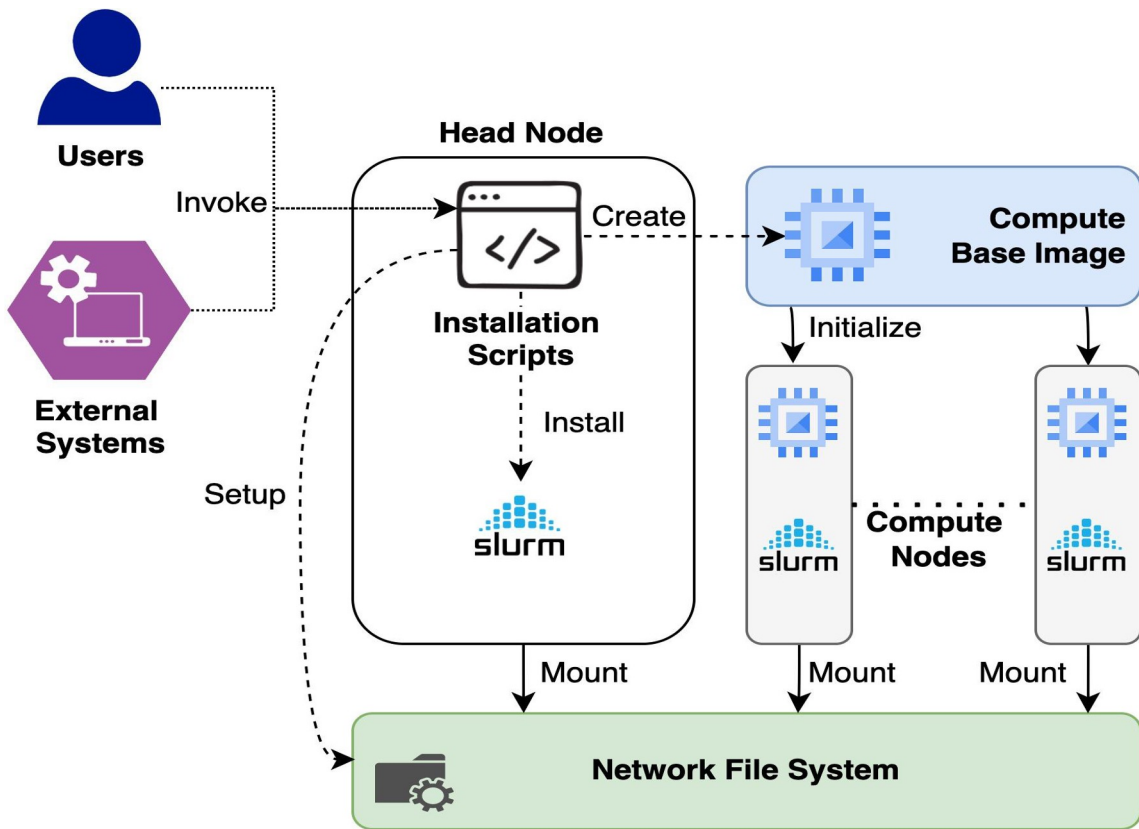


Elastic Virtual Clusters

- One Click OnDemand Cluster Augmenting the cloud Capabilities
 - Bundled lightweight HPC Stack, including SLURM.
 - Users deploy scientific software with complete OS control.
 - Dedicated and Responsive scheduler for rapid testing and development like workloads.
 - Mounted persistent storage.

Virtual Clusters Architecture

- All these steps are bundled into the Ansible orchestrion.
- The entire system is a single click invoked from Exosphere.



Early Operations Projects & Activity

- First PI invitations and projects added in February 2022
 - Remaining project migrations in May – July
- Retired Jetstream[1] in July/August 2022
- Full production in September 2022 after NSF approval
- Dec 2022: 357 projects and 1753 individuals (565 students)
- Approximately 900 unique people have created JS2 instances to date via Exosphere
- Includes multiple science gateways and education/training allocations



"Bike Exchange - 2009 IU Women's Little 500" by
Indiana Public Media
Flickr CC BY-NC 2.0

Production & Pilot

Vision for Jetstream2 is that it functions as a **production** system yet does not cede our **pilot** roots.

- Obsolescence vs Maturity & graceful aging
- Carry new lessons into the future

Imitation is the sincerest form of flattery

- Influenced design of many other systems
- Distinct utility, focus, and inclusion
- Reflecting on Why?



"Metamorphosis" by h.koppdelaney
Flickr CC BY-ND 2.0

Dynamic Connections

Importance of leveraging other projects

- XSEDE -> ACCESS
- Exosphere
- CyVerse – CACAO
- Globus
- Custos / CI Logon
- Open Source




Monterey Bay Aquarium – D. Y. Hancock

Operations highlights

- OpenStack upgrades x4 Wallaby -> Zed
- Shared storage availability (Manila)
- DNSaaS for instances (Designate)
- Only 17.2 hrs downtime (<0.2%) 4Q22
- 96.4% of instances started in <5 min
- Using CI/CD for image build pipeline
 - Weekly updates (vs periodic)
 - Allows more flavors (currently 7)
 - Allows reuse of our pipeline for others



**THE
HIGHLIGHTS**
UNA BANDA TRIBUTO A **BOB DYLAN**



DON'T BOO ME TOUR 2006
AGORA CAFE
C/ ORZAN, N. 27
JUEVES 20 JULIO - 23:00 H
www.thehighlights.es

"The Highlights" by Modesto del Río
Flickr CC BY 2.0

Developments to come

- LBaaS (load balancing)
- Secret storage
- Managed Kubernetes (via OpenStack)
- IPV6
- Addition of a new partner
- Continued/evolving outreach
- Increased Cacao use / features

Exosphere specific

- Shared storage integration
- GPU-accelerated desktops
- Education / workshop features



"Work in progress" by Alexander Baxevanis
Flickr CC BY 2.0

What's next?

- Midway into YR 1 operations
- Prepare for panel review (~March 2023)
- Integrate new partners
- Survey JS2 community
- Grow the community, focus on new tools and approaches
- Support hybrid science gateways
- Upgrade, share, and evolve



"Look Ahead!" by brenkee
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Acknowledgements

NSF Awards 1053575 & 1548562 (XSEDE), 1445604 (Jetstream) and 2005506 (Jetstream2)

This document was developed with support from the National Science Foundation. Any opinions, findings, conclusions, or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the NSF.

Special thanks to contributors & Jetstream2 partners

- Jeremy Fischer, J. Michael Lowe, Therese Miller, Maria Morris, Winona Snapp-Childs, George Turner, and Chris Martin.
- Vendors, particularly Dell and NVIDIA, also deserve recognition for their efforts

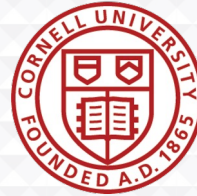


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<http://jetstream-cloud.org/>
National Science Foundation
Award #ACI-2005506