

Navigating NERSC



New User Training
September 28, 2022

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User Engagement Group

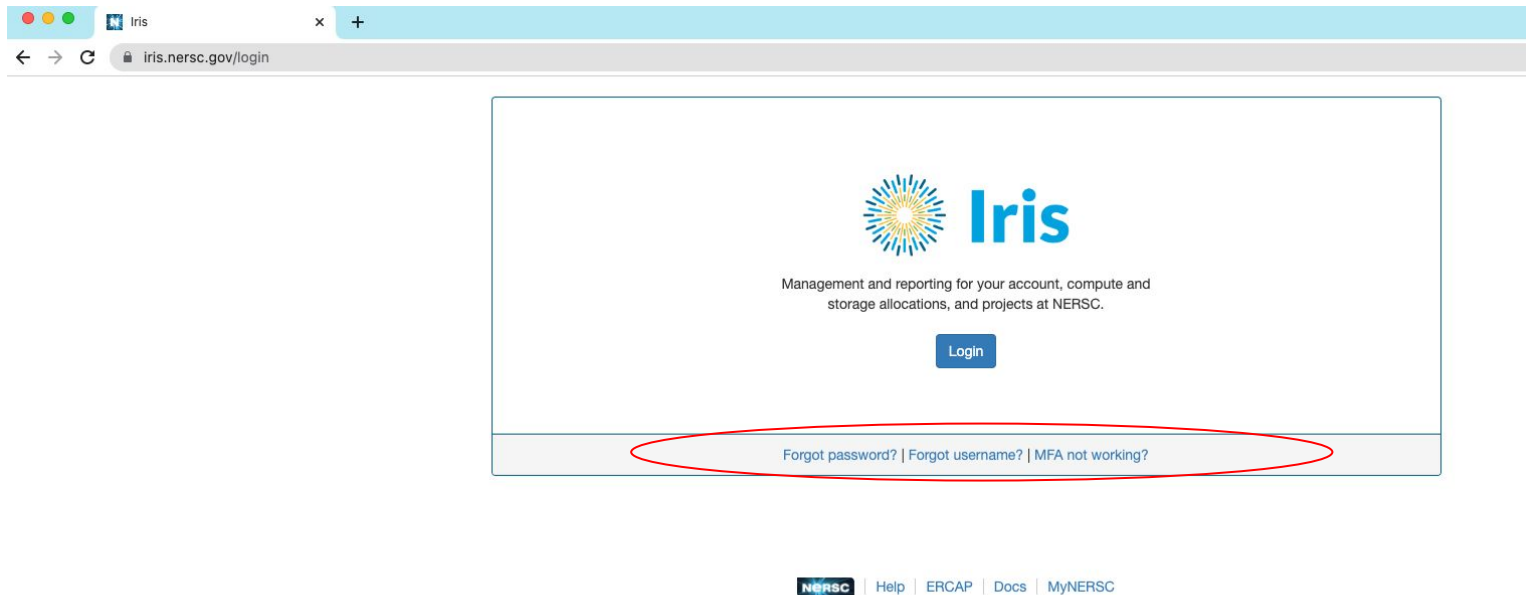
Agenda

- Navigating Iris (<https://iris.nersc.gov>)
- Submitting a User Ticket (<https://help.nersc.gov>)
- MyNERSC (<https://my.nersc.gov>)
- Connecting to Cori & Perlmutter
 - a. Connecting with SSH
 - b. <https://jupyter.nersc.gov> notebooks and terminals in your browser
 - c. NoMachine (<https://docs.nersc.gov/connect/nx/>) for GUI apps
- Navigating NERSC Home Page
- Navigating NERSC Documentation

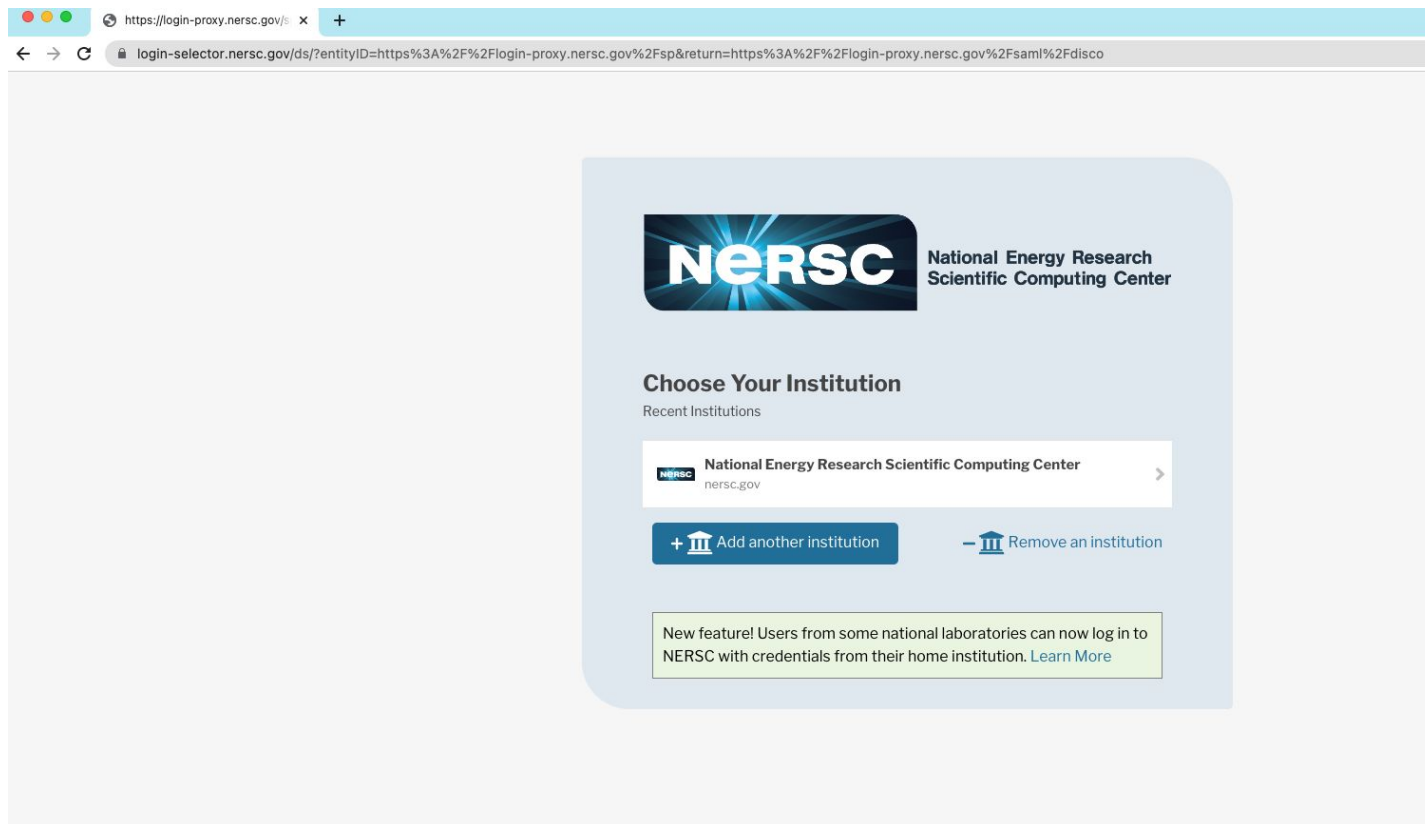
Navigating Iris



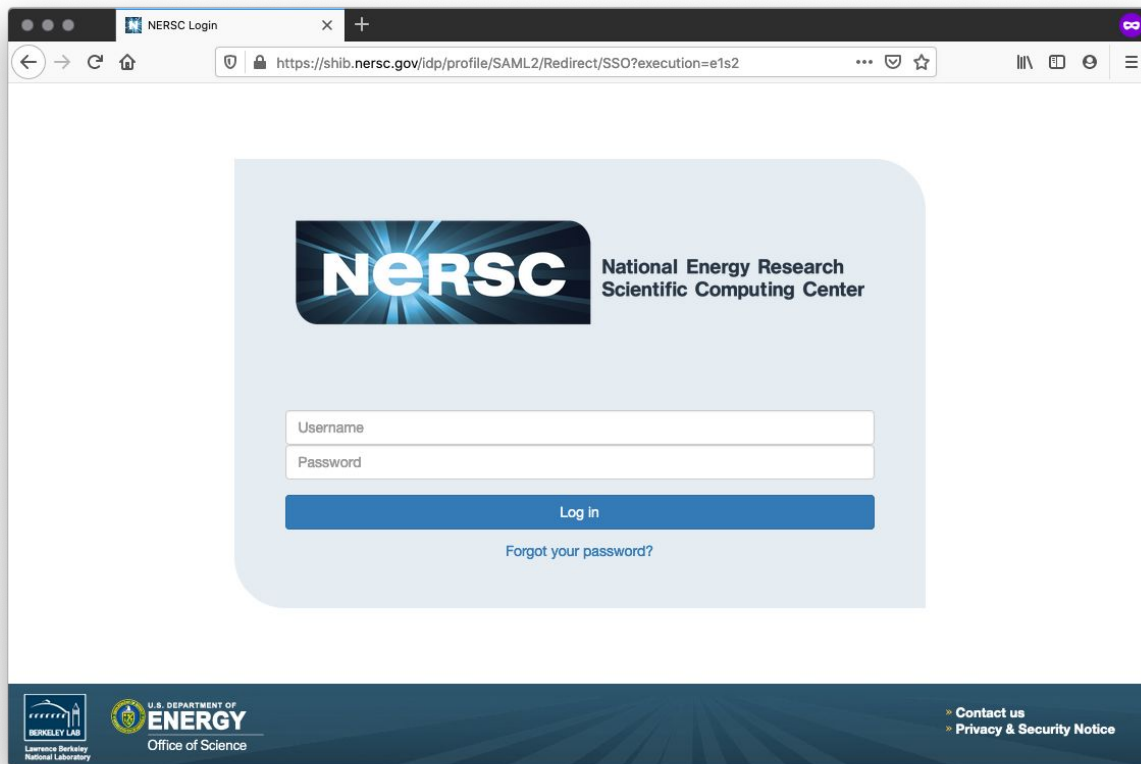
Iris (<https://iris.nersc.gov>) for Your Account



Iris (<https://iris.nersc.gov>) for Your Account



Iris (<https://iris.nersc.gov>) for Your Account

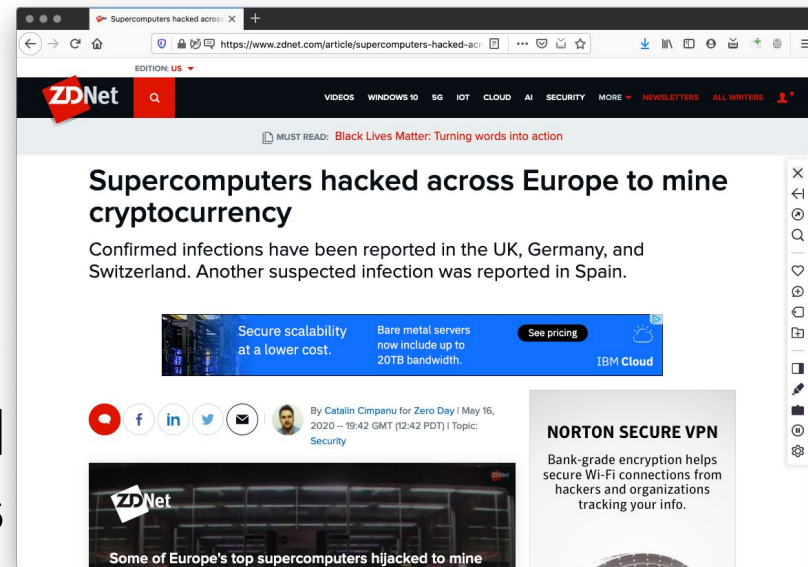


The screenshot shows a web browser window with the title "NERSC Login". The address bar displays the URL <https://shib.nersc.gov/idp/profile/SAML2/Redirect/SSO?execution=e1s2>. The main content area features the NERSC logo (National Energy Research Scientific Computing Center) and a login form with fields for "Username" and "Password", a "Log in" button, and a link for "Forgot your password?". The footer contains logos for Berkeley Lab, the U.S. Department of Energy Office of Science, and links for "Contact us" and "Privacy & Security Notice".

Multi-Factor Authentication (MFA)

Tip: you will use this a LOT

- Protects NERSC users from attacks like this →
- **Log into NERSC resources with your NERSC password plus a one-time code that is provided by an app**



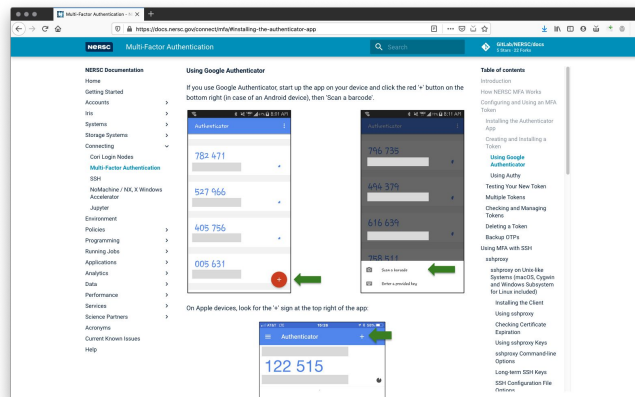
Setting Up MFA in Iris

- First install Google Authenticator on your smartphone (and/or Authy on your computer)

<https://play.google.com/store/apps/details?id=com.google.android.apps.authenticator2&hl=en>
<https://itunes.apple.com/us/app/google-authenticator/id388497605?mt=8>

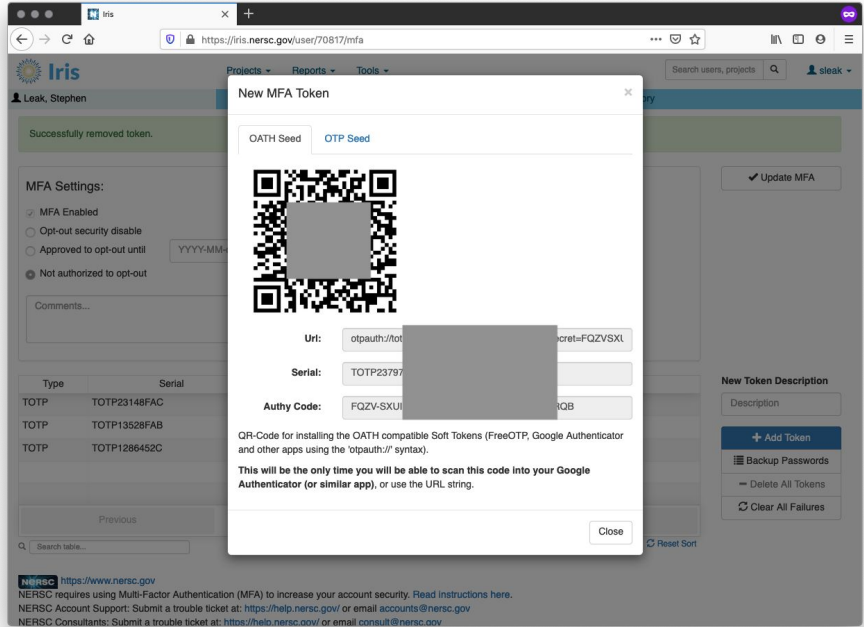
<https://authy.com>

Search "MFA" at
<https://docs.nersc.gov>



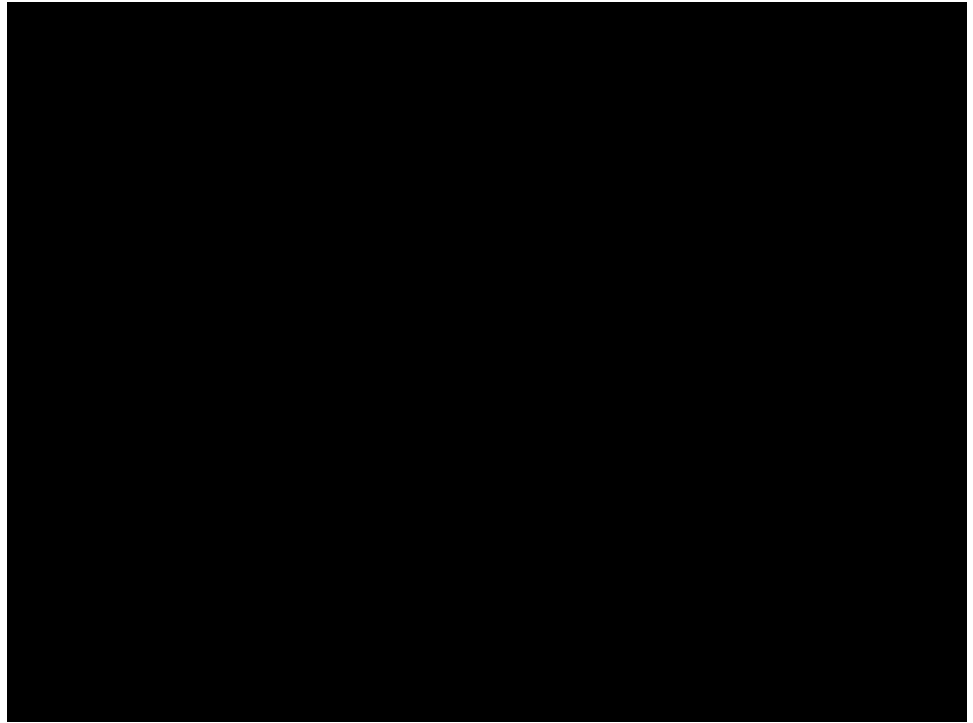
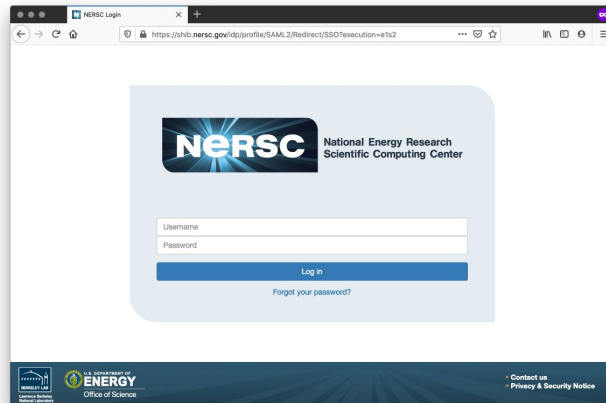
Setting Up MFA in Iris

- Click the "MFA" tab
- Click the "Add Token" button
- Scan the QR code with the Authenticator app (or, paste the Authy code into Authy)



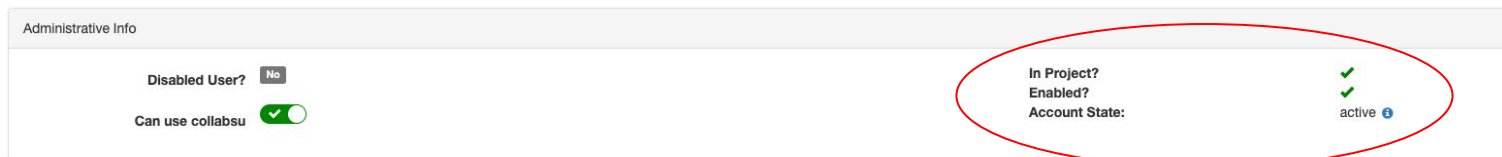
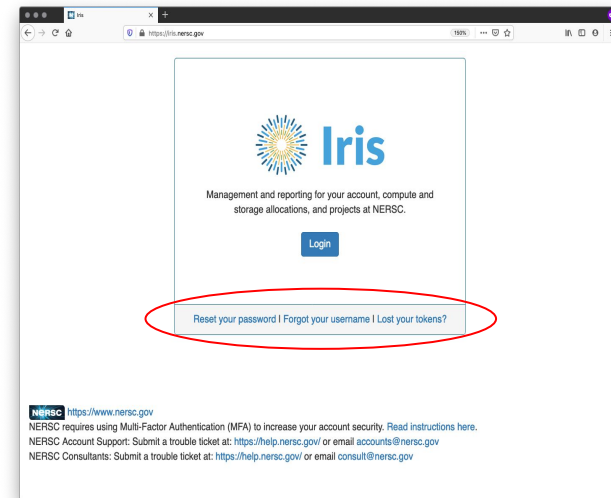
Logging in with MFA

After single-sign-on page you'll be asked for your one-time password (6 digits from app)



Troubleshooting Account Access

- I can't login to Iris
 - New account? It may not be approved yet (can take a few days)
 - Forgot password? Lost MFA tokens? Use the links on the Iris login page
- I can login to Iris, but not Cori or Perlmutter
 - Are you in a project? Check "Roles" tab



Navigating Iris - Menu Bar

The screenshot shows the Iris web application interface. The menu bar is located at the top and includes the following items: Projects, Reports, Tools, a red alert icon, Roles, Groups, MFA, Profile, and History. The Profile item is currently selected. Below the menu bar, the user's name 'Siddiqui, Shahzeb' is displayed on the left, and a search bar with the text 'Search users, projects' and a magnifying glass icon is on the right. The user's profile is shown as 'siddiq90'. The main content area is titled 'User Organization' and displays the following information:

Organization	Lawrence Berkeley National Laboratory - NERSC
Role	PROSTAFF
Org Type	NERSCOPS
Address	1 Cyclotron Road
City	Berkeley
State	CA
Province	
Postal Code	94720
Country	United States of America (US)
Website	www.nersc.gov
ROR ID	

Below the organization information, there is a link for 'All Organizations'. The menu bar also includes a 'Jobs' item, which is annotated with 'Job Details'. The 'Storage' item is annotated with 'Storage Details'. The 'Roles' item is annotated with 'NERSC Account Membership'. The 'Groups' item is annotated with 'Unix Group Membership'. The 'MFA' item is annotated with 'MFA Token'. The 'Profile' item is annotated with 'Profile Information'. The 'History' item is annotated with 'Audit Log'. The 'CPU' item is annotated with 'CPU Account Membership'. The 'GPU' item is annotated with 'GPU Account Membership'.

Navigating Iris - Finding Account Details

Siddiqui, Shahzeb

CPUGPUJobsStorage**Roles**GroupsMFAProfileHistory

Iris Role:

consultant

Update Iris Role

Project Roles:

Project	Description	Role	Accounts	Group	Created	Updated
m3503	ECP Software Integration and Cl E...	pi	m3503 (DOE) m3503_g (DOE)	✓	2022-01-19 09:29	2022-01-19 09:29
nstaff	NERSC Staff Accounts	user	nstaff (DOE) nstaff_g (DOE)	✓	2020-04-22 06:53	2022-01-05 04:21

PreviousPage 1 of 15 rowsNext

Search table... .csvOptions

m3503

CPUGPUJobsStorageRoles**Details**History

Add Image

Click image to edit

Project funding

Allocation Pool: DOE Allocation Pool
Allocation Type: DOE Mission Science
Office: Advanced Scientific Computing Research
Program: Advanced Scientific Computing Research
Science Category: Computer Science : General
Slurm Category:

ERCAP project details

Organization: Lawrence Berkeley National Laboratory - NERSC, US
DOE Sensitive Identifiers:
Compute requested in ERCAP: 2.5 K hours
GPU requested in ERCAP: 1.0 K hours
HPSS requested in ERCAP: 1.0 TB
CFS storage available: 20.0 TB
CFS files available: 20.0 M
CFS max projectdirs: 10
Funded by DOE Office of Science? Y
Request # ERCAP0021376

Project owners

pi: Siddiqui, Shahzeb
shahzebsiddiqui@lbl.gov
pi proxy: Palmer, Erik
epalmer@lbl.gov
pi proxy: Cook, Justin
jsccook@lbl.gov

Allocation transfer report

Navigating Iris - Changing User Shell

Server Logins

Ldap Tree	Home Directory	Login Shell	Username	GID	Group	Actions
alvarez	/global/homes/s/siddiq90	/bin/bash	siddiq90	92503	siddiq90	Edit Delete Search
cori	/global/homes/s/siddiq90	/bin/zsh	siddiq90	92503	siddiq90	Edit Delete Search
datatran	/global/homes/s/siddiq90	/bin/zsh	siddiq90	92503	siddiq90	Edit Delete Search
gerty	/global/homes/s/siddiq90	/bin/zsh	siddiq90	92503	siddiq90	Edit Delete Search
hpss	/home/s/siddiq90	/bin/bash	siddiq90	92503	siddiq90	Edit Delete Search
muller	/global/homes/s/siddiq90	/bin/zsh	siddiq90	92503	siddiq90	Edit Delete Search
nim-ldap	/home/s/siddiq90	/bin/bash	siddiq90	92503	siddiq90	Edit Delete Search
nx	/global/homes/s/siddiq90	/bin/zsh	siddiq90	92503	siddiq90	Edit Delete Search
perimutter	/global/homes/s/siddiq90	/bin/bash	siddiq90	92503	siddiq90	Edit Delete Search
server	/home/s/siddiq90	/bin/bash	siddiq90	92503	siddiq90	Edit Delete Search

Previous Page 1 of 2 10 rows Next

Search table... .csv Options

Add a new Server Login

Server

Home Directory

Login Shell

Username

GID

Group Name

/bin/bash

/bin/csh

/bin/tcsh

/bin/ksh

/bin/sh

✓ /bin/zsh

siddiq90


92503


siddiq90

Save Changes

Cancel







Navigating Iris - Adding User to Account




Projects ▾ Reports ▾ Tools ▾ 


m3503


CPU GPU Jobs Storage Roles Groups Details History

User	Username	User Email	Organization	Account State	Role	Accounts	Group	Created	Updated
 Siddiqui, Shahzeb	siddiq90	shahzebsiddiqui@lbl...	 Lawrence Berkeley...	active	pi	m3503 (DOE) m3503_g (DO)	✓	2022-01-19 09:29	2022-01-19 09:29
 Cook, Justin	jscook	jscook@lbl.gov	 Lawrence Berkeley...	active	pi_proxy	m3503 (DOE) m3503_g (DO)	✓	2022-07-22 08:00	2022-08-29 11:26
 Palmer, Erik	epalmer	epalmer@lbl.gov	 Lawrence Berkeley...	active	pi_proxy	m3503 (DOE) m3503_g (DO)	✓	2022-07-22 07:59	2022-08-29 11:26


+ Add User

 From Last Year

 Update All

 Accounts...

Remove User

Add a user to Project  m3503

Use this form to add an **active** NERSC user to this project. To add a **new** or **deactivated** user, please [invite them](#) instead.

Select a user

Please select a valid user.

Role

user

You can either grant this user a number of node hours they cannot exceed, or a percentage of the project's compute allocation. The latter takes precedence in case they're both specified.

CPU allocation

Allocated Hours

0

% of Project's Hours

100

GPU allocation

Allocated Hours

0

% of Project's Hours

100


Please specify what is the max percent of the project's HPSS allocation that can come from this user.

% of HPSS Storage


100

Save Changes


Cancel



15



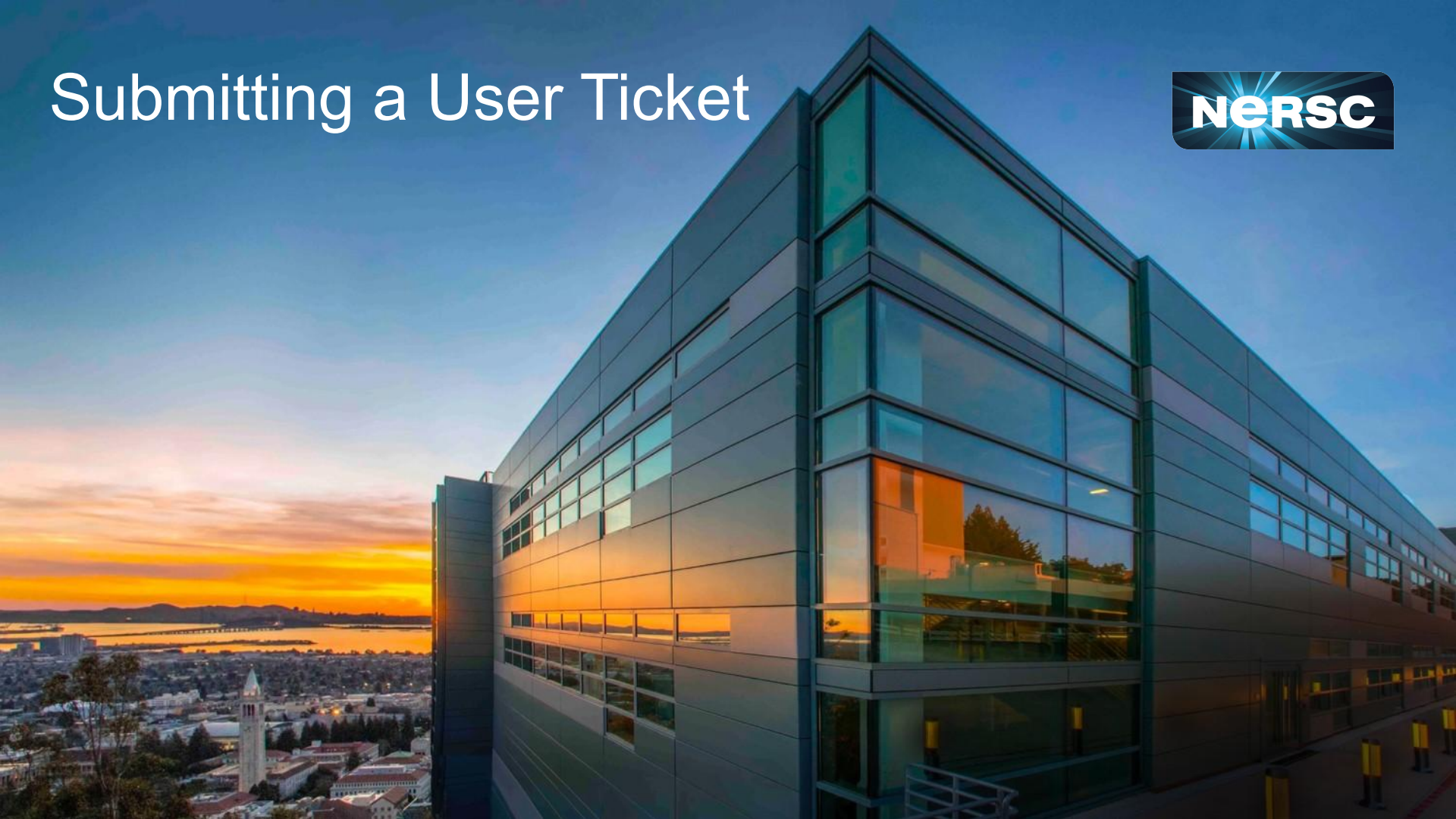
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U.S. DEPARTMENT OF
ENERGY

Office of
Science

Submitting a User Ticket



NERSC Help Portal: <https://help.nersc.gov/>

← → ↺ nersc.servicenowservices.com/sp/ 🔍 🏠 ☆ ⚙️ 🗪 🔴 Update ⓘ

0 Perlmutter Job Submissions


Project allocation on Perlmutter CPU-only node jobs use (#SBATCH -A mXXXX); for the Perlmutter GPU node jobs you must use the _g accounts (#SBATCH -A mXXXX_g).

NERSC

🔗 Classic View 🗒️ NERSC Homepage 👤 Shahzeb Siddiqui


NERSC Help Portal

Search Incidents and Requests 🔍




Documentation

Technical documentation for users, including examples



Open Ticket

Contact NERSC support to report a problem



Open Request

Quota increases, reservations, databases, etc.

Service Announcements

No upcoming maintenances in the next two weeks

My Recent Incidents

[Sijle account do not deactivate](#)
INC0189995 • Closed • 43 ago

Useful Links

[Password Reset](#)
[Book Consulting appointment](#)
[NERSC Status Page](#)
[NERSC Users Slack](#)
[ERCAP](#)
[IRIS](#)

My Watchlist Open Incidents

[BerkeleyGW openrun not normal](#)
INC0177349 • 10mo ago • User Updated • Tang, Hong (tang2017)

[disk quota](#)
INC0190580 • 3h ago • Awaiting User Info • Pucka, James (jpsral)

[Quantum chemistry programs on Perlmutter](#)
INC0190578 • 8d ago • Awaiting User Info • Greenman, Loren (lorenz)

My Projects' Open Incidents

[Compute Reservation Request](#)
INC0190600 • 13d ago • Active-Expectations Set • Ross, Hannah (hross)

[Unable to login to NERSC systems](#)
INC0190549 • 34d ago • Awaiting User Info • Bhalachandra, Sridutt (sriduttb)

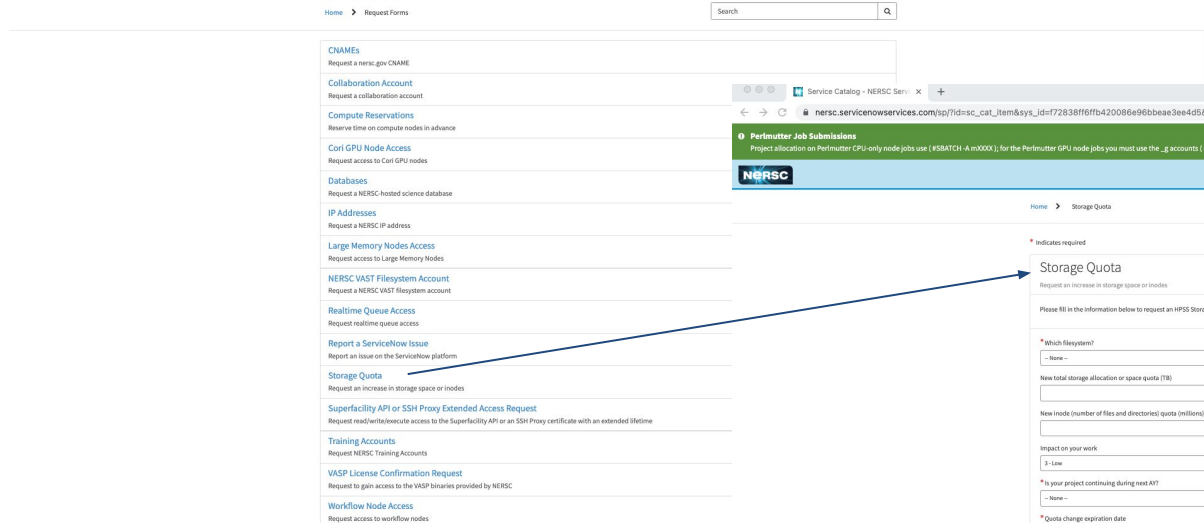
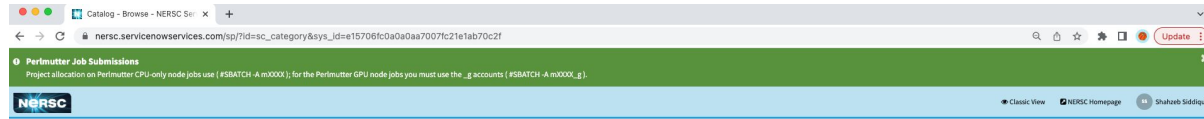
[Degraded Performance on Perlmutter nid001532](#)
INC0190552 • 13d ago • New • Bhalachandra, Sridutt (sriduttb)

[Compute Reservation Request](#)
INC0185551 • 4mo ago • Active • Blaschke, Johannes (jblaschke)

[DGEMM performance issues with Perlmutter Nodes nid003069 and nid003177](#)
INC0170970 • 7mo ago • Awaiting Vendor • Bhalachandra, Sridutt (sriduttb)

[HPSS Allocations](#)
INC0180078 • 8mo ago • User Updated • Nugent, Peter (pugent)

Request Forms



Home > Storage Quota

Search Catalog

Storage Quota

Request an increase in storage space or inodes.

Please fill in the information below to request an NPSS Storage Allocation or disk quota change.

* Indicates required

* Which filesystem?

None

New total storage allocation or space quota (TB)

New inode (number of files and directories) quota (millions)

Impact on your work

Low

* Is your project continuing during next AIT?

None

* Quota change expiration date

* Reason for this request

Submit

Required information

Which filesystem? Is your project continuing during next AIT? Quota change expiration date Reason for this request

How to file a Good Ticket

- NERSC receive thousands of user support tickets every year and we strive to resolve tickets in timely manner.
- In order for us to troubleshoot your user request, we need **as much information** in ticket to best understand the problem and find a solution.

How to File a Good Ticket 📌

NERSC Consultants handle thousands of support requests per year. In order to ensure efficient timely resolution of issues include **as much of the following as possible** when making a request

- error messages
- jobids
- location of relevant files
 - input/output
 - job scripts
 - source code
 - executables
- output of `module list`
- any steps you have tried
- steps to reproduce

Please copy and paste any text directly into the ticket and only include screenshots as attachments when the graphical output is the subject of the support request.

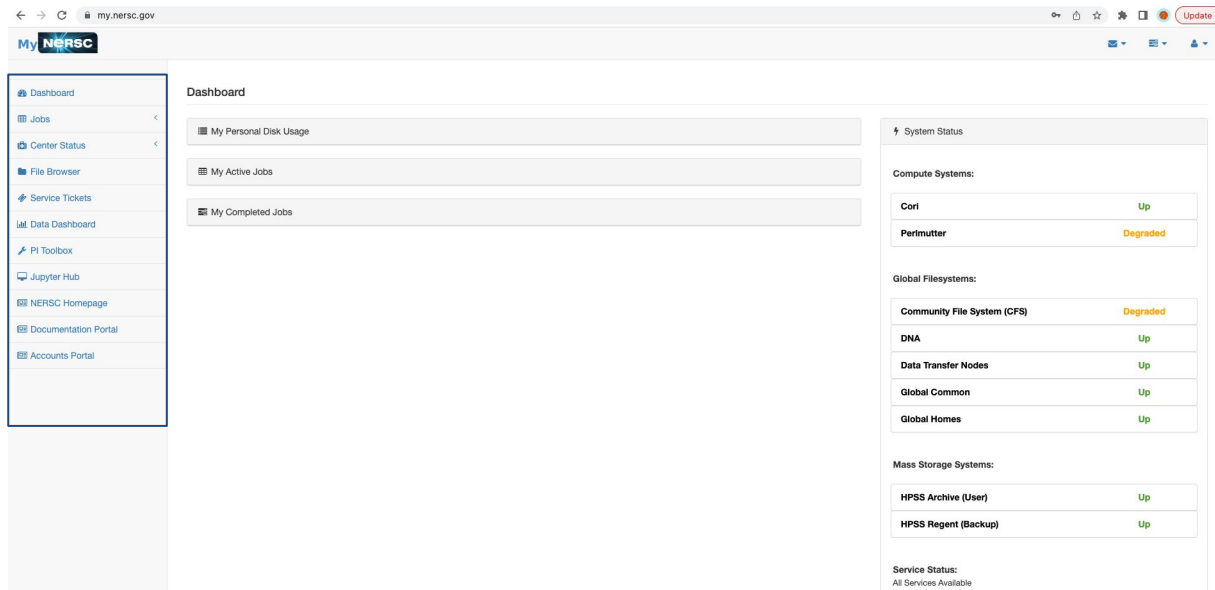
<https://docs.nersc.gov/getting-started/#how-to-file-a-good-ticket>

MyNERSC



<https://my.nersc.gov>

If you only remember **one** URL, <https://my.nersc.gov> will get you everywhere NERSC



The screenshot shows the My NERSC dashboard in a web browser. The browser's address bar displays 'my.nersc.gov'. The dashboard features a left-hand navigation menu with links to Dashboard, Jobs, Center Status, File Browser, Service Tickets, Data Dashboard, PI Toolbox, Jupyter Hub, NERSC Homepage, Documentation Portal, and Accounts Portal. The main content area is titled 'Dashboard' and includes sections for 'My Personal Disk Usage', 'My Active Jobs', and 'My Completed Jobs'. On the right side, there is a 'System Status' section with a table of system health:

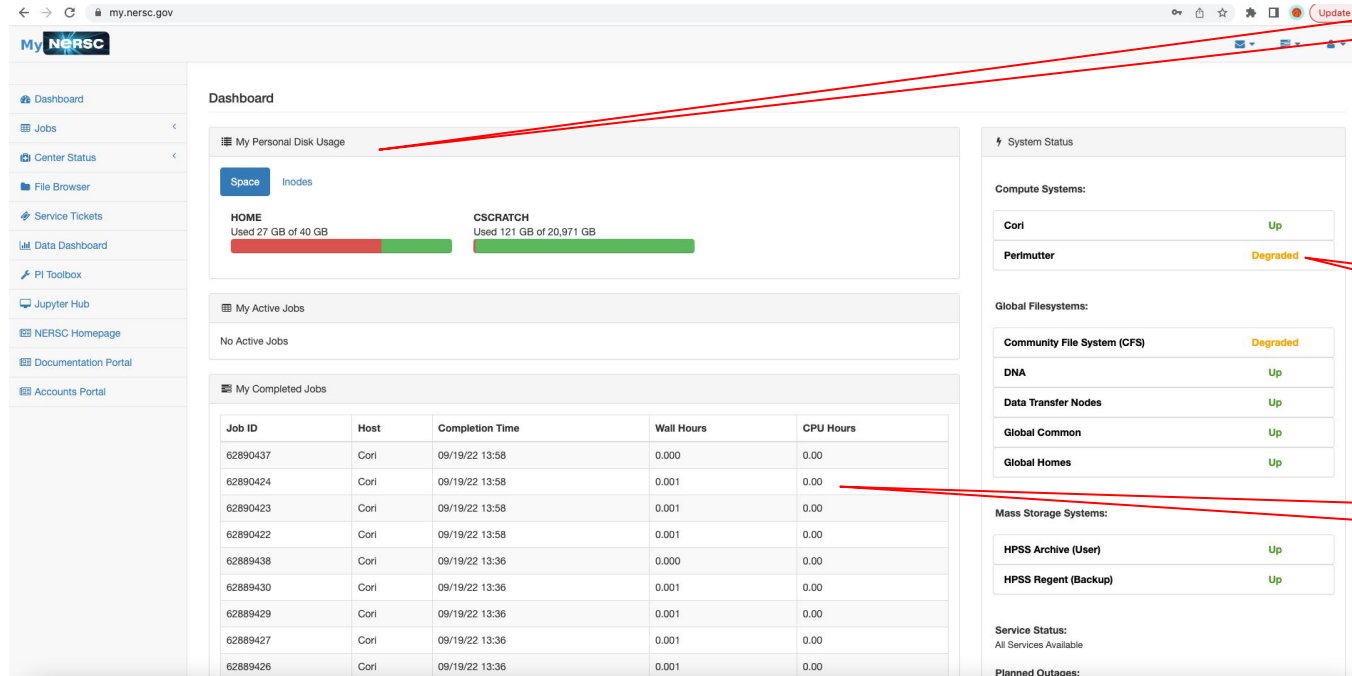
Compute Systems:	
Cori	Up
Perimutter	Degraded

Global Filesystems:	
Community File System (CFS)	Degraded
DNA	Up
Data Transfer Nodes	Up
Global Common	Up
Global Homes	Up

Mass Storage Systems:	
HPSS Archive (User)	Up
HPSS Regent (Backup)	Up

At the bottom of the system status section, it states 'Service Status: All Services Available'.

<https://my.nersc.gov>



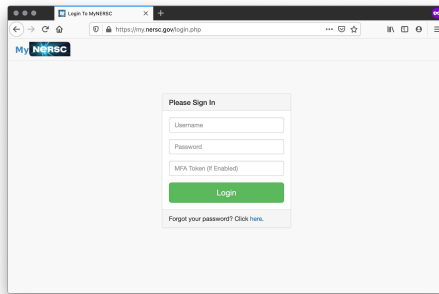
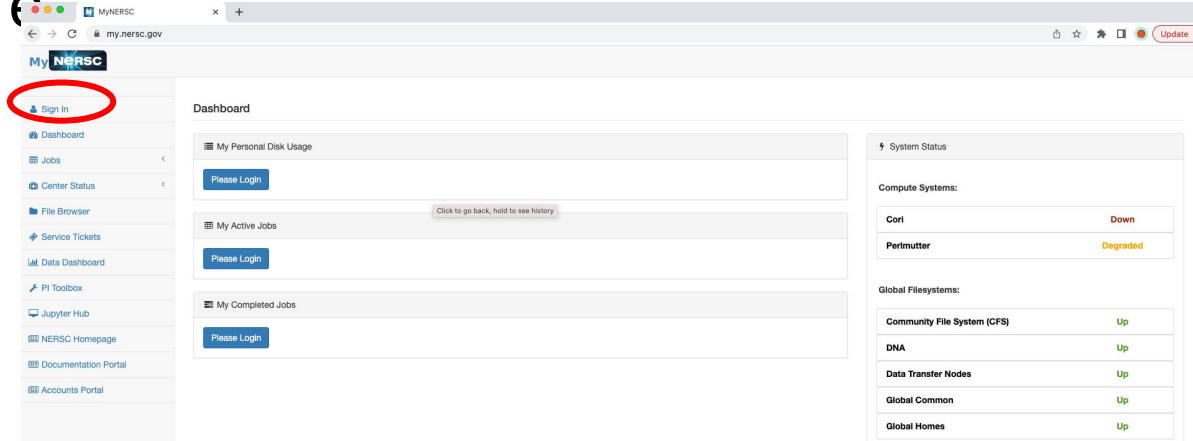
my disk quota

Perlmutter Status

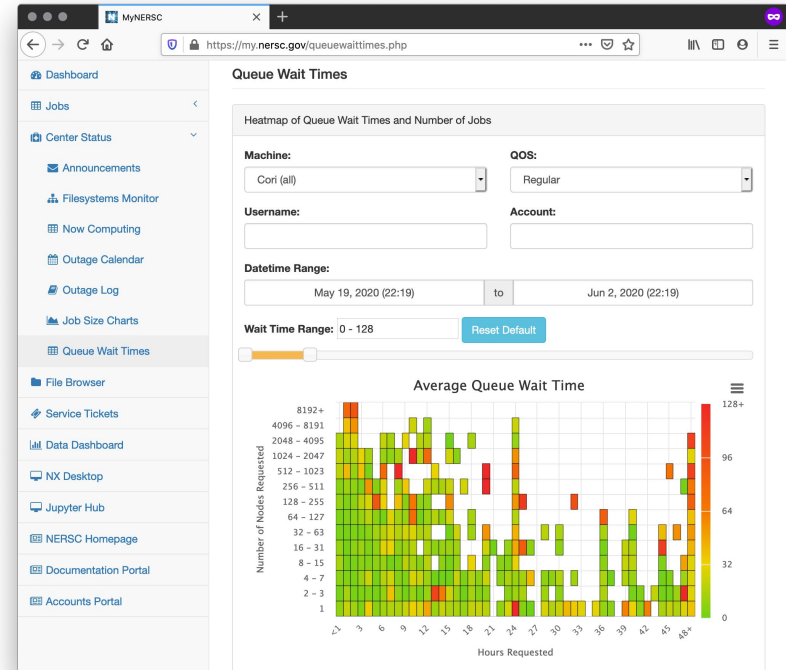
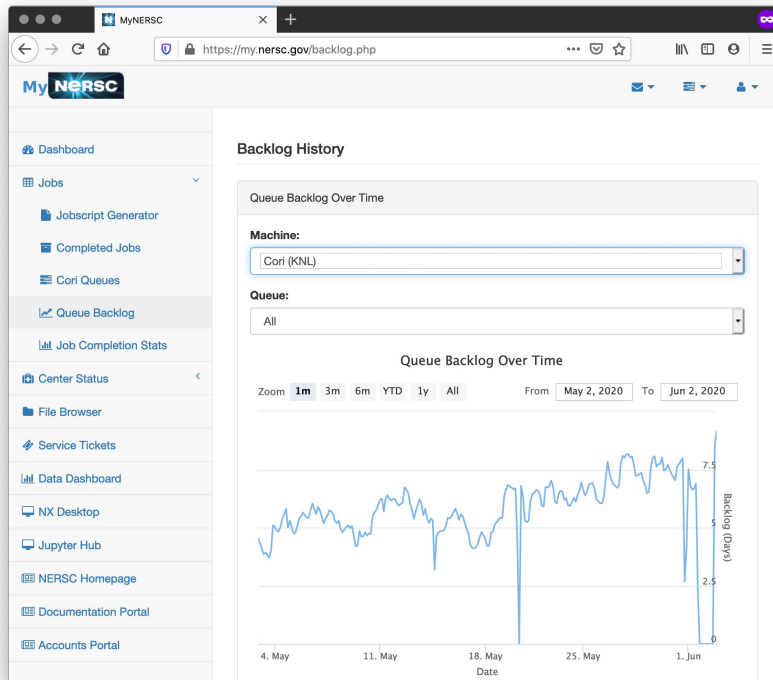
my jobs

<https://my.nersc.gov>

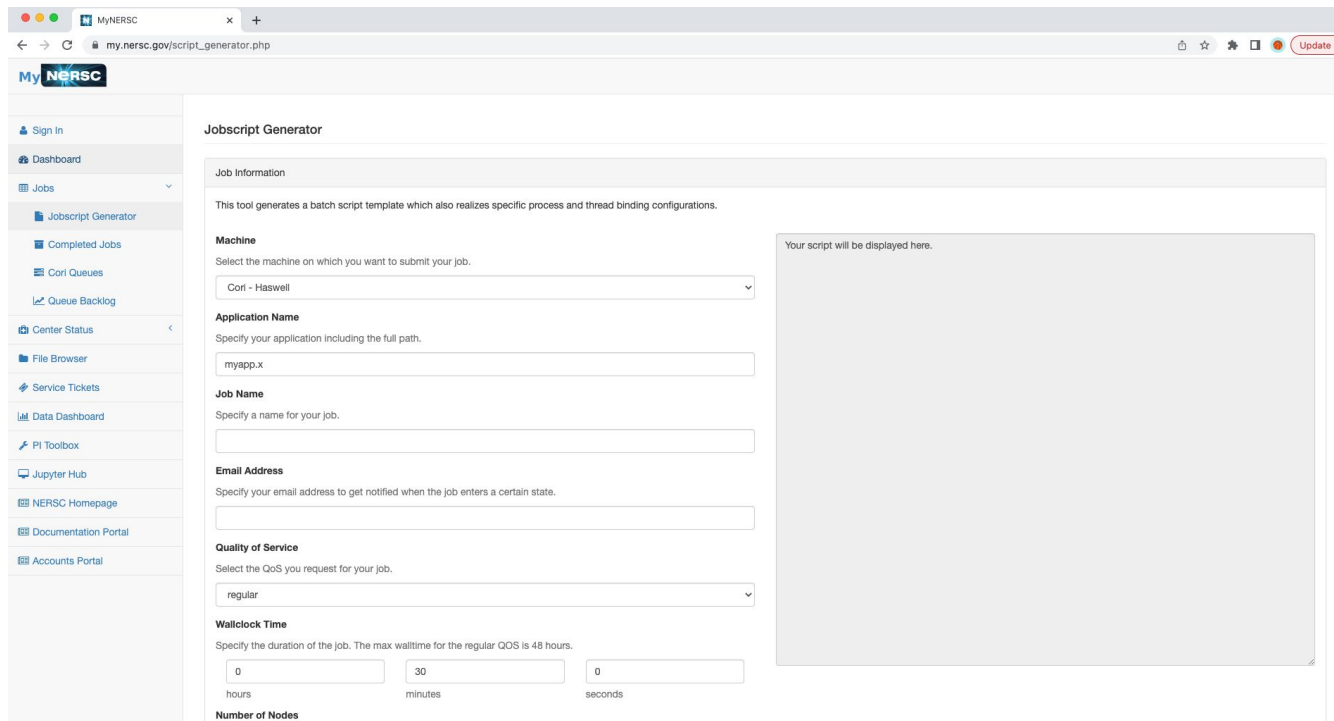
Most things require
login (also MFA)



<https://my.nersc.gov>



Jobscript Generator



The screenshot shows a web browser window with the URL `my.nersc.gov/script_generator.php`. The page has a sidebar on the left with navigation links: Sign In, Dashboard, Jobs (expanded), Jobscript Generator (selected), Completed Jobs, Cori Queues, Queue Backlog, Center Status, File Browser, Service Tickets, Data Dashboard, PI Toolbox, Jupyter Hub, NERSC Homepage, Documentation Portal, and Accounts Portal. The main content area is titled "Jobscript Generator" and contains a "Job Information" section. This section includes a description: "This tool generates a batch script template which also realizes specific process and thread binding configurations." Below this are several form fields: "Machine" (a dropdown menu showing "Cori - Haswell"), "Application Name" (a text input field containing "myapp.x"), "Job Name" (a text input field), "Email Address" (a text input field), "Quality of Service" (a dropdown menu showing "regular"), and "Wallclock Time" (three input fields for hours, minutes, and seconds, with values 0, 30, and 0 respectively). To the right of these fields is a large gray box labeled "Your script will be displayed here."

Connecting to NERSC Systems



Connecting with SSH

"The traditional method"

- For those comfortable working in a terminal, ssh from your local terminal is the most flexible and powerful working environment

You will need a terminal program!

- Mac: terminal (built-in) or "iTerm2" (<https://www.iterm2.com/>)
- Windows: PuTTY (<https://www.putty.org/>), MobaXterm (<https://mobaxterm.mobatek.net/>) or XWin32 or Git BASH
- Linux: Your own favorite :)
- Chromebook: crosh (developer mode) or Crostini (Linux-in-a-container) or SSH App

Connecting to NERSC systems

Connect to NERSC Computational Systems

Please make sure you have configured [Multi-Factor Authentication \(MFA\)](#) prior to login.

To access Perlmutter via `ssh` you can do the following:

```
ssh <user>@perlmutt-p1.nersc.gov
```

or

```
ssh <user>@saul-p1.nersc.gov
```

Similarly, you can access Cori with

```
ssh <user>@cori.nersc.gov
```

Connecting with SSH

```
ssh -l siddiq90 -Y perlmutter-p1.nersc.gov
The authenticity of host 'perlmutter-p1.nersc.gov (128.55.126.9)' can't be established.
RSA key fingerprint is SHA256:Db9s2Fa4J3qx7An5oIMgUqUAdK7UWJGTPGoIKD44+Gs.
Are you sure you want to continue connecting (yes/no/[fingerprint])?
```

This means your laptop doesn't recognize the computer. The first time you log in, this is expected. But if your laptop **should** recognize Perlmutter, it's a red flag

docs.nersc.gov/connect/#key-fingerprints

NERSC Connecting to NERSC

Search

GitLab/NERSC/docs

NERSC Documentation

- Home
- Getting Started
- Tutorials
- Accounts
- Iris
- Systems
- Storage Systems
- Connecting
- Multi-Factor Authentication
- Federated Identity
- NoMachine / NX, X Windows Accelerator

Key fingerprints

NERSC may occasionally update the host keys on the major systems. Check here to confirm the current fingerprints.

Perlmutter

```
4096 SHA256:Db9s2Fa4J3qx7An5oIMgUqUAdK7UWJGTPGoIKD44+Gs perlmutter-p1.nersc.gov (RSA)
```

Cori

```
4096 SHA256:35yiNFengwzHCHFrPGWJrJBCCqERqLt0VSR36s1DaPc cori.nersc.gov (RSA)
256 SHA256:Y0ycBUgqcXq5Zi045oG8JKNo9sek07n0C1Xo0MpQZtc cori.nersc.gov (ECDSA)
256 SHA256:/bLLKa0JDmbElrot7lvVlf+CQC3tFC+e9CkCCObtS+o cori.nersc.gov (ED25519)
```

Table of contents

- Login Nodes
- Connect to NERSC
- Computational Systems
- X11 Forwarding
- SSH
- Connecting with SSH
- Password-less logins and transfers
- SSH certificate authority
- Key fingerprints**
- Perlmutter
- Cori

AB

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ENERGY

Office of
Science

Connecting with SSH

When you ssh in, you'll see a prompt like:

Password + OTP:

Enter your (iris) password, then the 6 digits from Authenticator, with no spaces etc between eg **Pa\$\$w0rd!123456**

Nothing will appear at prompt as you type! (this is normal)
If you only get "Password: (no "+ OTP)", your account may not be ready yet

```
~ ssh -l siddiq90 -Y perlmutter-p1.nersc.gov
Warning: Permanently added the RSA host key for IP address '128.55.126.12' to the list of known hosts.
*****
NOTICE TO USERS

Lawrence Berkeley National Laboratory operates this computer system under
contract to the U.S. Department of Energy. This computer system is the
property of the United States Government and is for authorized use only.
Users (authorized or unauthorized) have no explicit or implicit
expectation of privacy.

Any or all uses of this system and all files on this system may be
intercepted, monitored, recorded, copied, audited, inspected, and disclosed
to authorized site, Department of Energy, and law enforcement personnel,
as well as authorized officials of other agencies, both domestic and foreign.
By using this system, the user consents to such interception, monitoring,
recording, copying, auditing, inspection, and disclosure at the discretion
of authorized site or Department of Energy personnel.

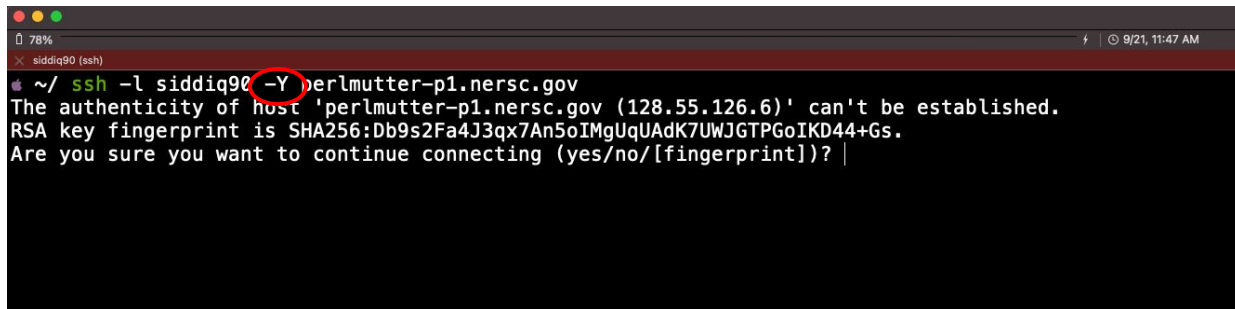
Unauthorized or improper use of this system may result in administrative
disciplinary action and civil and criminal penalties. By continuing to use
this system you indicate your awareness of and consent to these terms and
conditions of use. LOG OFF IMMEDIATELY if you do not agree to the conditions
stated in this warning.

*****

Login connection to host x3116c0s17b0n0:
Password + OTP:  
```

SSH Options

Wait, what was that "-Y" ?



A terminal window with a dark background and light text. The title bar shows '78%' and 'siddiq90 (ssh)'. The command prompt is '~/. ssh -l siddiq90 -Y perlmutter-p1.nersc.gov'. The output text reads: 'The authenticity of host 'perlmutter-p1.nersc.gov (128.55.126.6)' can't be established. RSA key fingerprint is SHA256:Db9s2Fa4J3qx7An5oIMgUqUAdK7UWJGTPGoIKD44+Gs. Are you sure you want to continue connecting (yes/no/[fingerprint])? |'. The '-Y' in the command is circled in red.

"ssh -Y" (or "ssh -X")

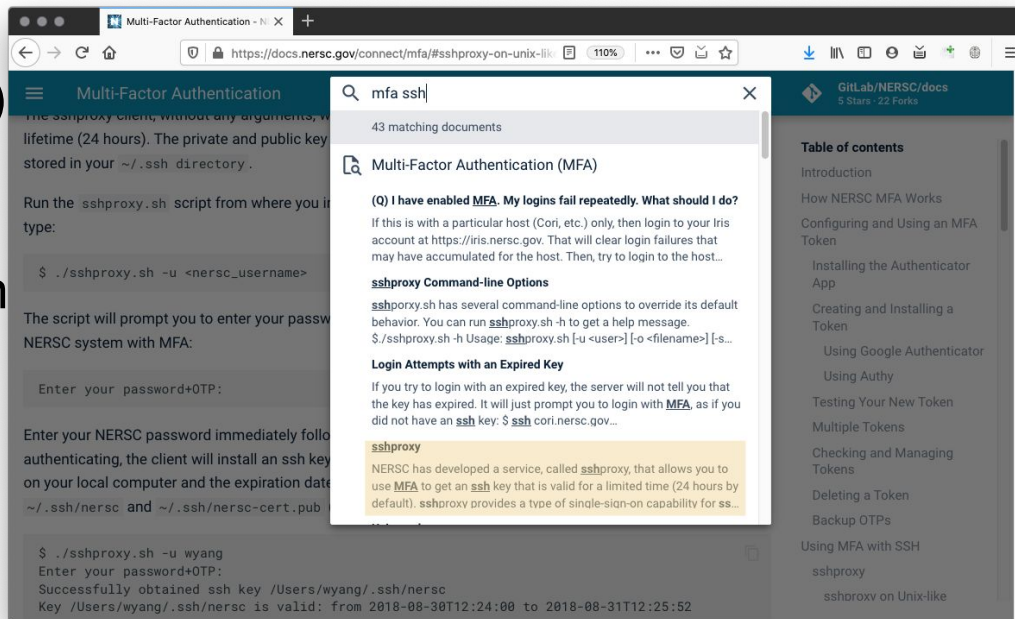
allow X (ie, GUI) programs to display on your local monitor.

- You need an X-server (<https://www.xquartz.org/> for Mac or <http://x.cygwin.com/> for Windows)
- Can be very slow - alternatives coming up!

sshproxy

- Tired of repeatedly typing password + OTP?

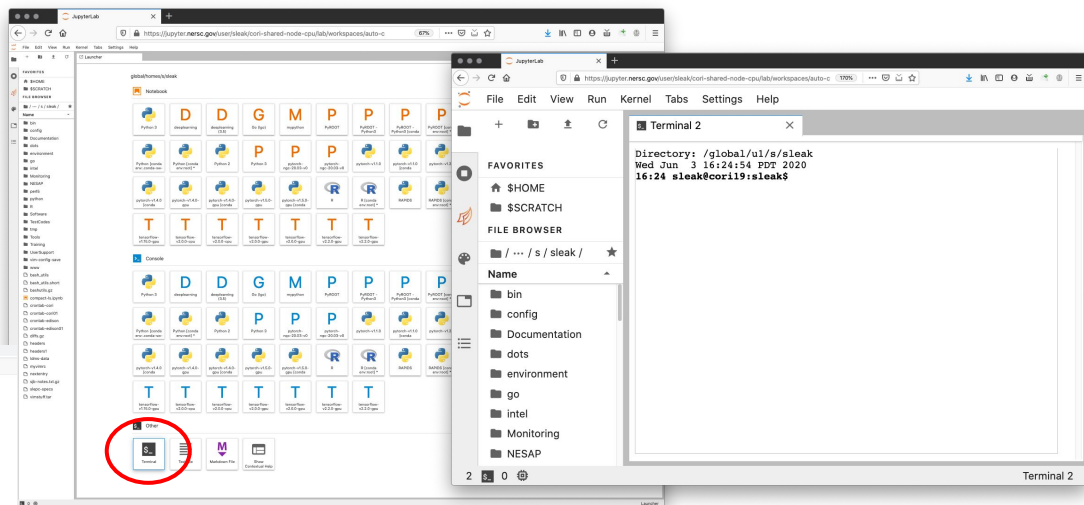
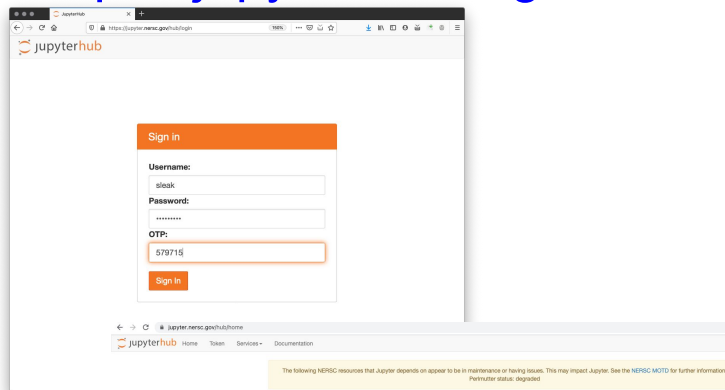
- **sshproxy.sh** creates a short-term (24 hours) certificate
- Run **sshproxy.sh** once, then you can ssh to NERSC systems for the next 24 hours before being asked for password+OTP again



- Search "MFA SSH" at <https://docs.nersc.gov>

Jupyter

You can access NERSC systems from any web browser, via <https://jupyter.nersc.gov>



Running GUI Apps

GUI apps eg Matlab, DDT
(debugging), Nsight (performance)
can be painfully slow over a network

Why is this, and how can we fix it?

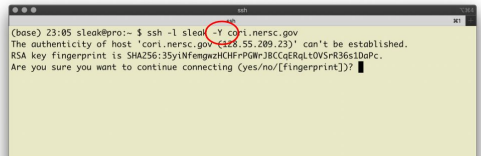
SSH Options

Wait, what was
that "-Y" ?

"ssh -Y" (or "ssh -X")

allow X (ie, GUI) programs on Cori to display on your local monitor.

- You need an X-server (<https://www.xquartz.org/> for Mac or <http://x.cygwin.com/> for Windows)
- **Can be very slow** - alternatives coming up!



24



NoMachine

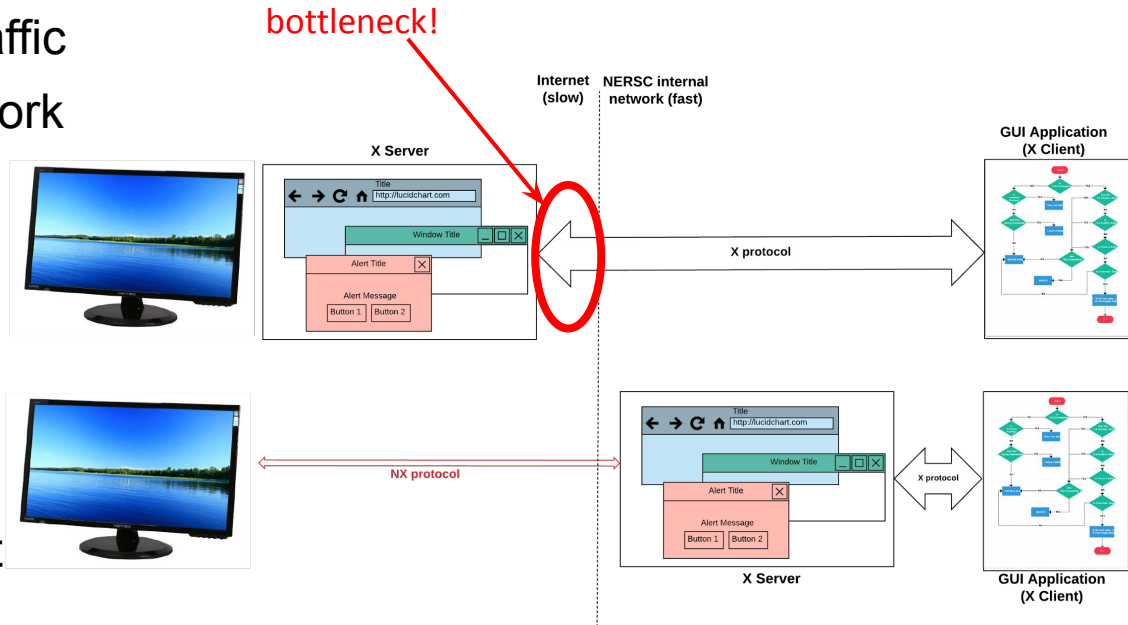


NoMachine: Accelerated X

X protocol makes a lot of traffic

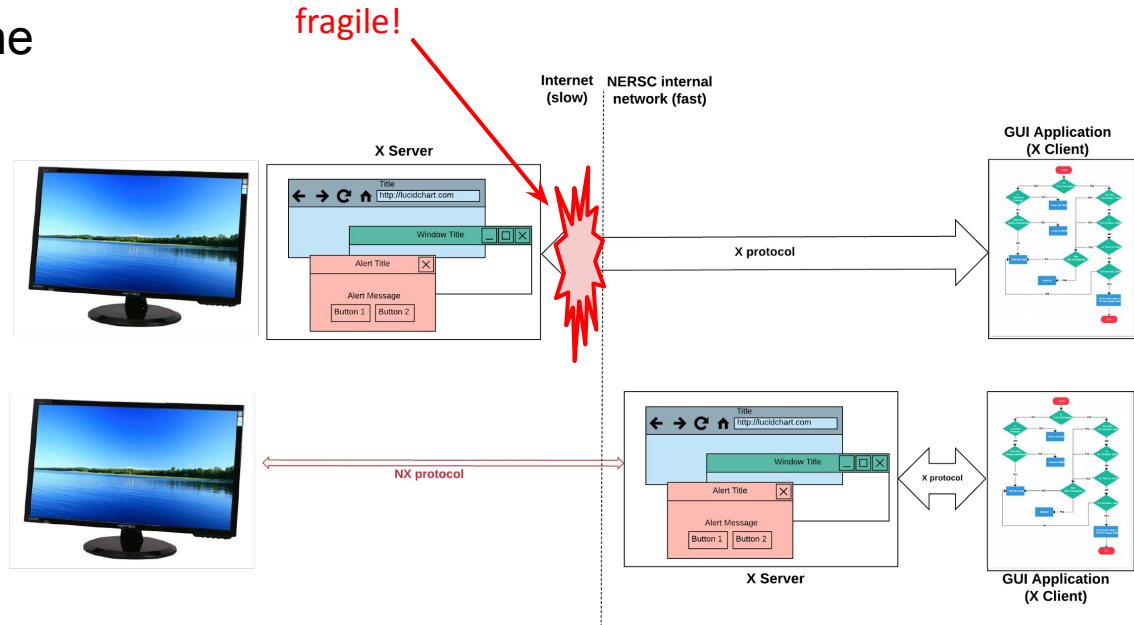
- OK over the (fast) network internal to NERSC
- Not OK over the (slow) internet

NoMachine runs **inside** NERSC, and sends less data over the (slow) internet



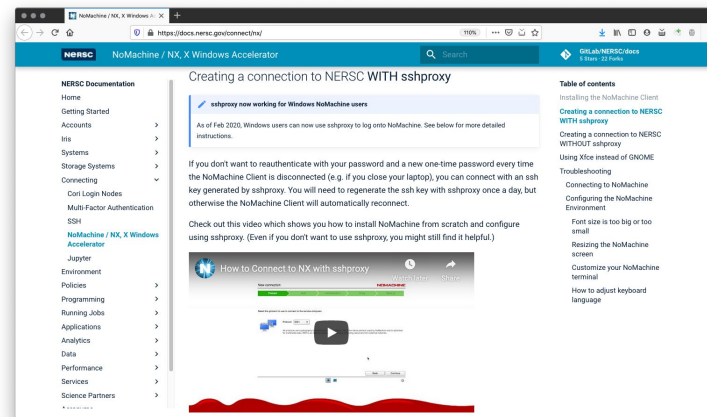
NoMachine: Accelerated X

NoMachine also removes the weakest link, so broken connections don't kill your application

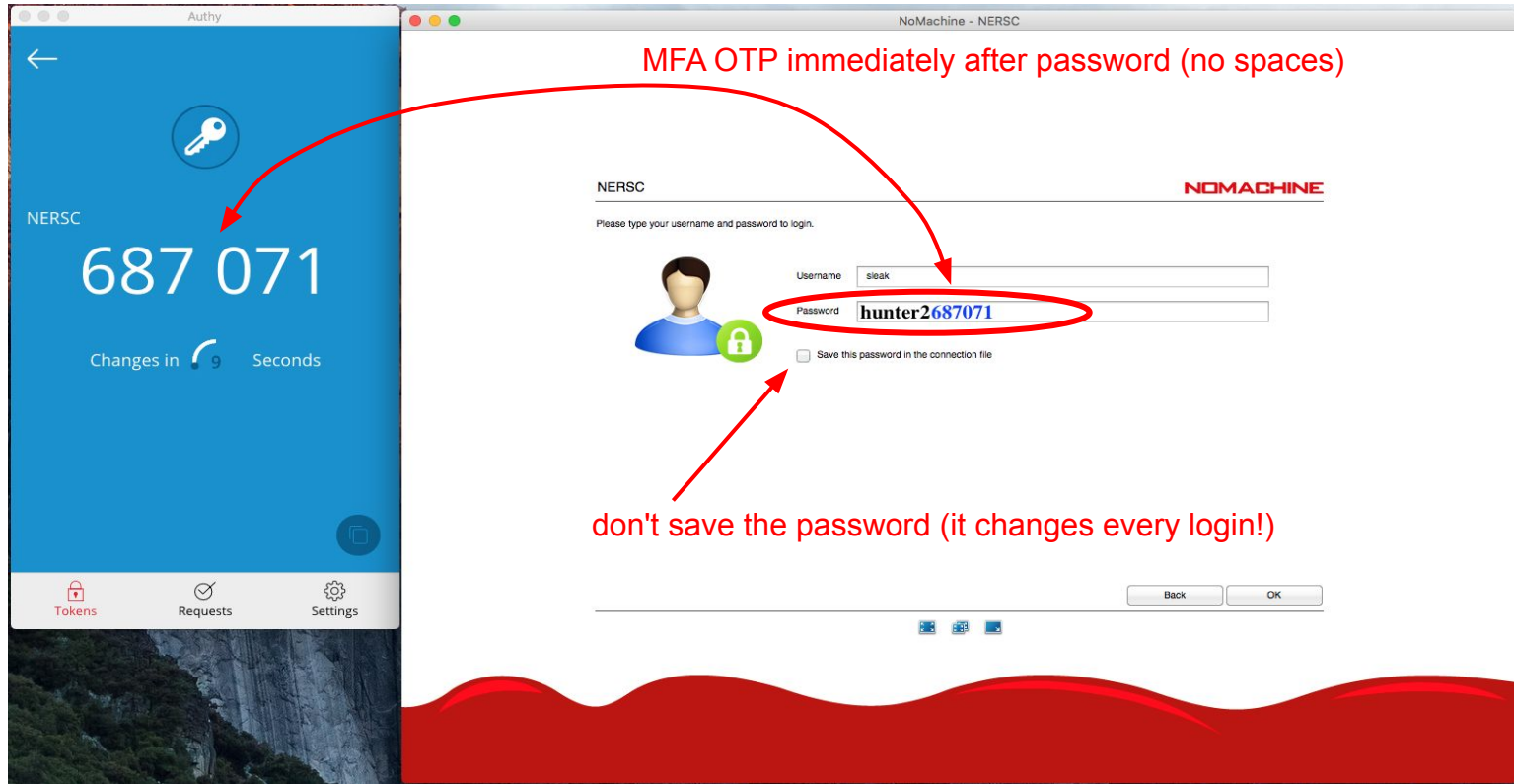


How to Set It Up

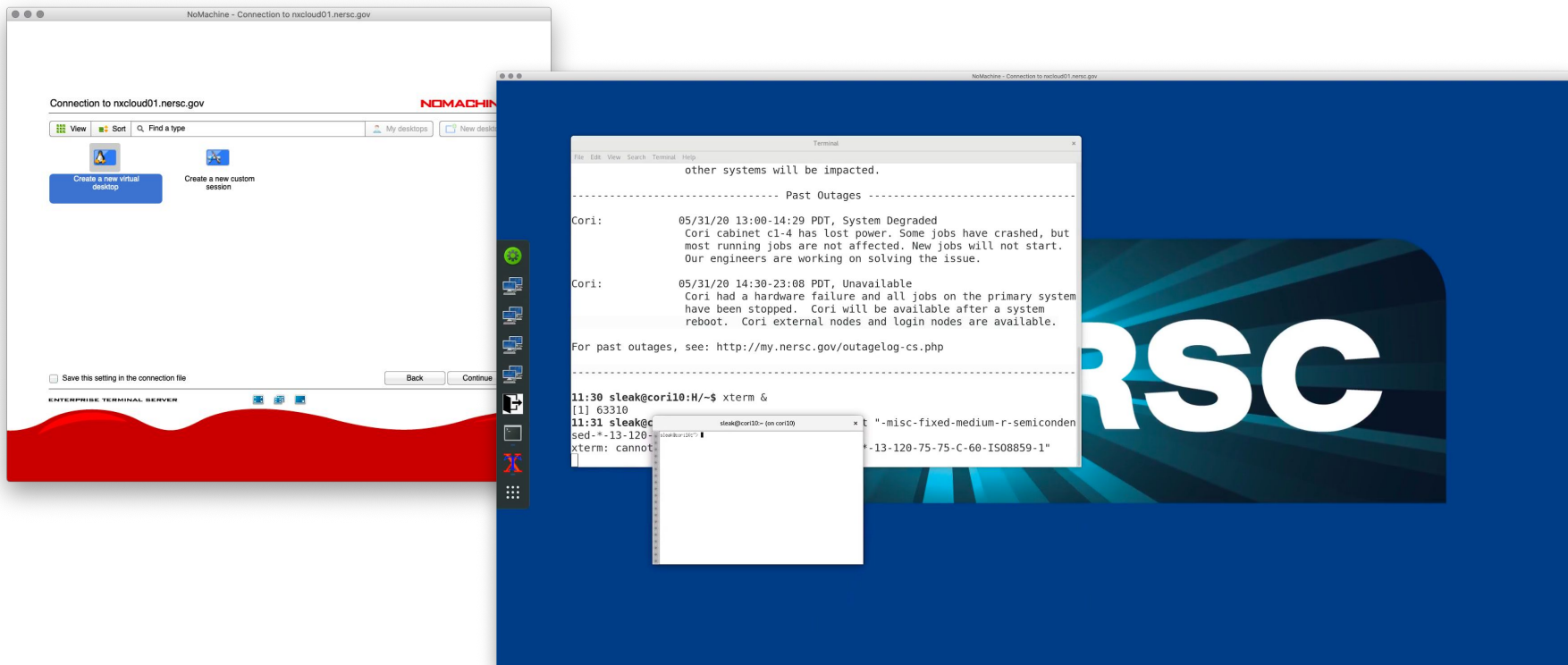
- <https://docs.nersc.gov/connect/nx/> has detailed instructions
 - Download the client
(<https://www.nomachine.com/download-enterprise#NoMachine-Enterprise-Client>)
(Make sure to get the **client**, not the server or workstation)
 - Setup a connection (can optionally use the key you generated with `sshproxy.sh`)



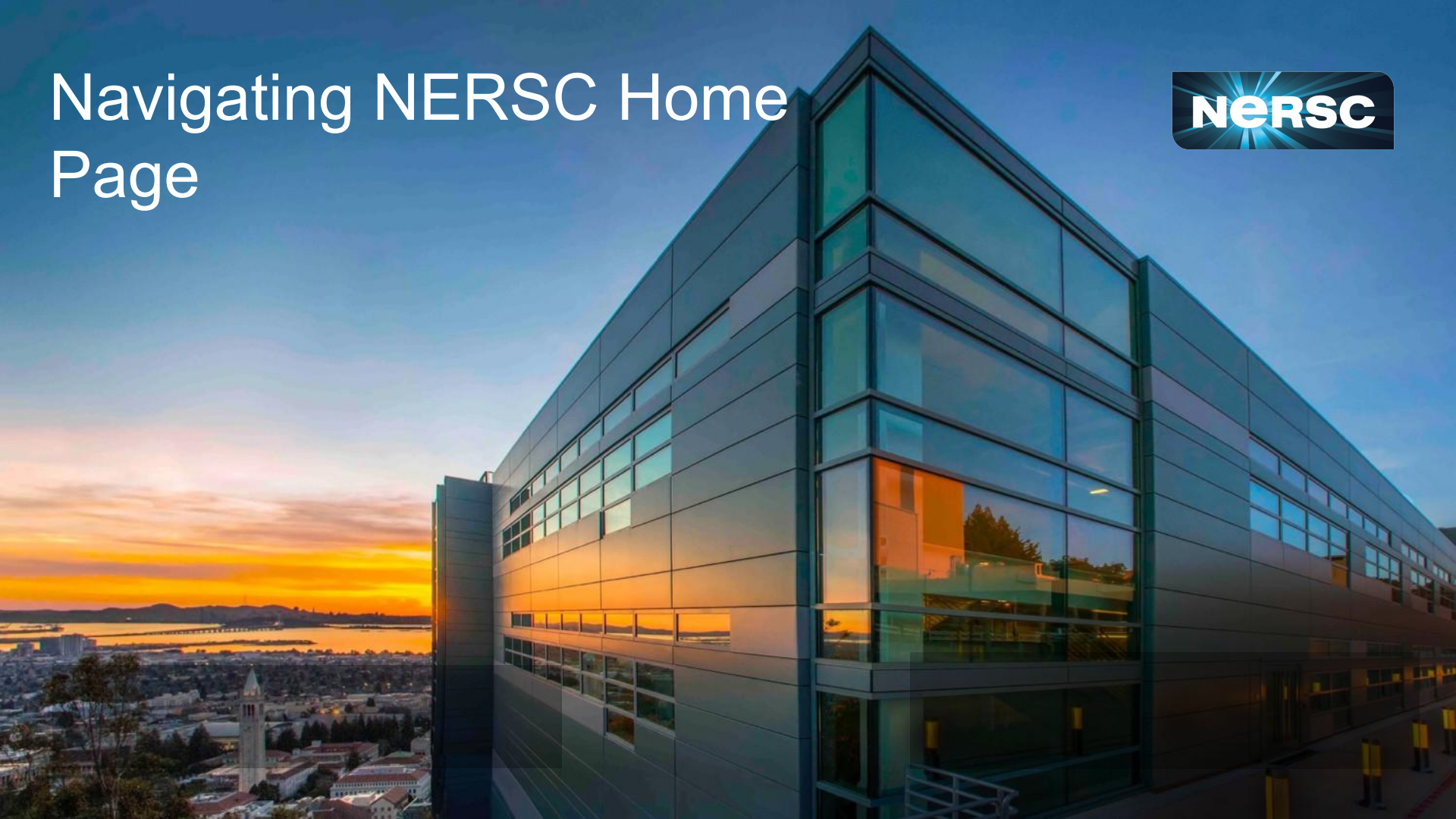
NoMachine without sshproxy



NoMachine



Navigating NERSC Home Page



Navigating www.nersc.gov (NERSC Training)

NERSC

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Training Events

Home > For Users > Training & Tutorials > Training Events

NERSC TRAINING EVENTS

See also the [NERSC Events Calendar](#).

DATA DAY 2022, OCTOBER 26-27

October 26, 2022

AbstractNERSC is rebooting its data-centric training, Data Day, as a hybrid two-day event on October talks, tutorials, and hands on hacking designed to get you up and running with the latest and greatest in scientific computing on Perlmutter. This event is geared towards HPC users of all experience levels, but intermediate and advanced topics which will help data workloads run performantly at scale on Perlmutter. [Read More >](#)

VISIT AT OLCF, OCTOBER 13, 2022

October 13, 2022

AbstractVisit is an interactive, parallel analysis and visualization tool for scientific data. Users can visualize offload visualization using a Python script to analyze data ranging in scale from small projects to large computing simulations. Users can generate visualizations, animate them through time, manipulate their operators and mathematical expressions, and save the resulting images and animations. Owing to its complexity, Visit is a hybrid two-day event on October 13, 2022. [Read More >](#)

2022 ALCF SIMULATION, DATA, AND LEARNING WORKSHOP, OCTOBER 4

October 4, 2022

AbstractThe ALCF's Simulation, Data, and Learning Workshop is designed to help researchers improve productivity of simulation, data science, and machine learning applications on ALCF systems. The attendee ALCF's new Polaris system, an HPE Apollo Gen10+ machine equipped with NVIDIA A100 Tensor Core processors. Workshop participants will have the opportunity to: Use Polaris to get a head start on prep systems Work... [Read More >](#)

TOTALVIEW TUTORIAL, SEPTEMBER 29, 2022

September 29, 2022

Note: Due to uncertainty regarding Perlmutter system's availability, we move this training to Thursday, September 15. NERSC is hosting a training event on TotalView on Thursday, September 29, 2022. TotalView is a parallel debugger for complex C, C++, Fortran, and CUDA applications. Perlmutter, NERSC's supercomputer, is a heterogeneous system comprising both CPUs and GPUs. This makes it challenging errors in user codes that... [Read More >](#)

NEW USER TRAINING: SEPTEMBER 28, 2022

September 28, 2022

NERSC is hosting a one-day training event for new users on Wednesday, September 28, 2022. The goal is to provide users new to NERSC with the basics on our computational systems; accounts and allocations; programming environment; running jobs, tools, and best practices; and data ecosystem. The training will be focused on Perlmutter. Current Cori users who have not started migrating your applications to Perlmutter are encouraged to attend selected presentations on using Perlmutter.

Home > For Users > Training & Tutorials > Training Events > New User Training: Sept 28, 2022

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This event will be presented online only using Zoom. Please see below for remote connection information.

AGENDA

Time (PDT)	Topic	Presenters
9:00 am	Welcome and Introduction to NERSC	Rebecca Hartman-Baker
9:30 am	Accounts & Allocations	Clayton Bagwell
9:50 am	Navigating NERSC	Shahzeb Siddiqui
10:15 am	Break	
10:35 am	Programming Environment and Compilation	Erik Palmer
11:05 am	Running Jobs	Muazz Awan
11:45 am	Profiling Tools	Neil Mehta
12:05 pm	Debugging Tools	Justin Cook
12:20 pm	Lunch break (on your own)	
1:10 pm	Workflows at NERSC	Bill Arndt
1:30 pm	Data Storage & Sharing Best Practices	Lisa Gerhardt
1:50 pm	I/O Best Practices	Alberto Chiussolo
2:10 pm	Break	
2:30 pm	Python at NERSC	Daniel Margala
2:50 pm	Jupyter at NERSC	Rollin Thomas
3:10 pm	Shifter	Laurie Stephey
3:30 pm	Deep Learning	Peter Harrington
3:50 pm	Q&A	
4:00 pm	End	

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4:00 pm	End	

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Navigating www.nersc.gov (NERSC Events)

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- » Monthly NUG Webinars
- » Scheduled System Outages
- » NERSC Training
- » Deep Learning for Science
- » NERSC Data Seminars

Home » Events » NERSC Events Calendar

NERSC EVENTS

NUG 2022

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- Scheduled System Outages
- NERSC Training
- Deep Learning for Science
- NERSC Data Seminars

NERSC Training & Events

Today [←](#) [→](#) **September 21** [Print](#)

Sun	Mon	Tue	Wed	Thu	Fri	Sat
28	29	30	1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	Oct 1	

Events shown in time zone: Pacific Time - Los Angeles [+ Google Calendar](#)

NERSC Training & Events

Today [←](#) [→](#) **Wednesday, September 21** [Print](#)

Thursday, September 22

9:00am Training: Perftools and Reveal

Tuesday, September 27

10:00am VASP User Hands-on Training

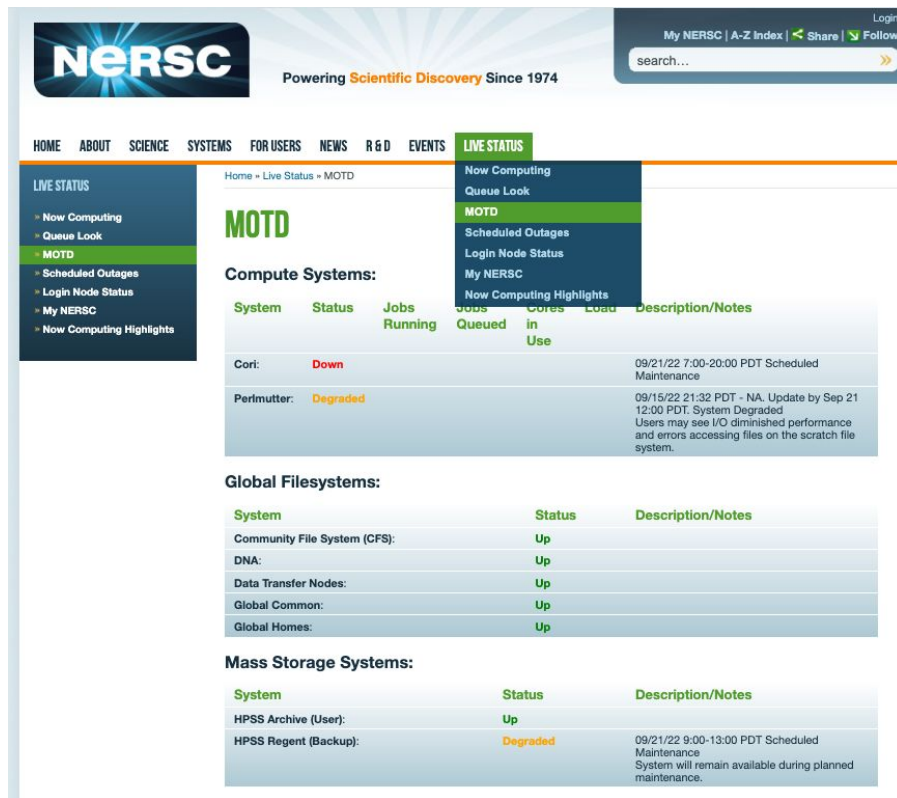
Wednesday, September 28

9:00am New User Training

Thursday, September 29



Navigating www.nersc.gov (MOTD)



The screenshot shows the NERSC website with the MOTD (Message of the Day) page. The page features a navigation bar with links to HOME, ABOUT, SCIENCE, SYSTEMS, FOR USERS, NEWS, R & D, EVENTS, and LIVE STATUS. A search bar is located in the top right corner. The main content area is divided into three sections: Compute Systems, Global Filesystems, and Mass Storage Systems.

Compute Systems:

System	Status	Jobs Running	Queued	Cores in Use	Description/Notes
Cori:	Down				09/21/22 7:00-20:00 PDT Scheduled Maintenance
Perlmutter:	Degraded				09/15/22 21:32 PDT - NA. Update by Sep 21 12:00 PDT. System Degraded. Users may see I/O diminished performance and errors accessing files on the scratch file system.

Global Filesystems:

System	Status	Description/Notes
Community File System (CFS):	Up	
DNA:	Up	
Data Transfer Nodes:	Up	
Global Common:	Up	
Global Homes:	Up	

Mass Storage Systems:

System	Status	Description/Notes
HPSS Archive (User):	Up	
HPSS Regent (Backup):	Degraded	09/21/22 9:00-13:00 PDT Scheduled Maintenance. System will remain available during planned maintenance.

Navigating www.nersc.gov (Scheduled System Outages)

The screenshot displays the NERSC (National Energy Research Supercomputing Center) website. The header features the NERSC logo and the tagline "Powering Scientific Discovery Since 1974". Navigation links include HOME, ABOUT, SCIENCE, SYSTEMS, FOR USERS, NEWS, R & D, EVENTS, and LIVE STATUS. A search bar is located in the top right corner.

The main content area is titled "NERSC SCHEDULED SYSTEM OUTAGES". It includes a sidebar with a list of events: NUG 2022, NERSC Events Calendar, CS Seminars Calendar, Monthly NUG Webinars, Scheduled System Outages (highlighted), NERSC Training, Deep Learning for Science, and NERSC Data Seminars. The main content area shows a calendar view for "Wednesday, September 21" through "Friday, November 18". The calendar lists various scheduled maintenance events, such as "Cori Scheduled Maintenance" and "HPSS Regent (Backup) Scheduled Maintenance". A "Print" button and a "Week" button are visible. At the bottom, there is a "Google Calendar" link and a note: "Events shown in time zone: Pacific Time - Los Angeles".

Footer information includes the U.S. Department of Energy logo, the Office of Science logo, and contact information: "Contact Us", "Privacy and Security Notice", "Directory", and "Computing Sciences Area". The text "Last edited: 2018-05-02 15:38:06" is also present.

Navigating www.nersc.gov (NERSC User Slack)

The screenshot shows the NERSC website with the 'FOR USERS' section selected in the navigation menu. The page title is 'NERSC USERS GROUP (NUG)'. The main content area describes the NERSC Users' Group, NUG, which welcomes participation from all NERSC users. It provides advice and feedback to NERSC on the current state and future delivery of NERSC resources and services. NUG promotes the effective use of the high performance computing facilities at NERSC by sharing information about experiences in using the facility, suggesting new research and technology directions in scientific computing, and voicing user concerns. NUG members converse with NERSC and DOE through monthly teleconferences, NUG email lists, and yearly face-to-face meetings. NERSC holds annual face-to-face meetings. A section titled 'Monthly NUG Webinars' states that this page lists the NERSC User Group (NUG) monthly user telecons and webinars, with a 'Read More' link. Another section titled 'NUG Annual Meetings' states that NUG holds annual meetings. The annual meetings usually consist of one "business day" and one to three days of High Performance Computing training, with a 'Read More' link. A section titled 'SIG Experimental Facility Users' states that NUG is sponsoring a Special Interest Group (SIG) within the NERSC User Group for Experimental Facility Users, with a 'Read More' link. A section titled 'NUG Executive Committee (NUGEX)' states that NUGEX is the voice of the user community to NERSC and DOE. While all NUG events are open to all NERSC users, NUGEX members regularly participate in the monthly teleconferences and the annual face-to-face meeting. NUGEX is consulted on many NERSC policy issues, e.g., batch configurations, disk quotas, services and training offerings. Members of NUGEX also participate in their officer's NERSC Requirements Reviews of High Performance Computing and Storage. There are three representatives from each office and three members-at-large, with a 'Read More' link. A section titled 'NUGEX Positions - Now accepting nominations' states that they are currently seeking volunteers and nominations for NUGEX - if you would like to participate, or to nominate a potential NUGEX member, please fill in and submit the form at <https://forms.gle/KL3dHSPD6WkV777>. The Executive Committee (NUGEX) of the NERSC User's Group (NUG) is a group of NERSC users who oversee NUG activities for the benefit of NERSC's user community of over 8,000 researchers across all scientific domains of the DOE Office of Science. NUGEX will meet regularly (up to 1...), with a 'Read More' link.

The screenshot shows the NERSC website with the 'MONTHLY NUG WEBINARS' section selected in the navigation menu. The page title is 'MONTHLY NUG WEBINARS'. The main content area states that NUG holds monthly teleconferences with NERSC, usually on the second Thursday of the month, from 11:00 to 12:00 Pacific Time. All NERSC users, regardless of experience or sophistication, are welcome and encouraged to attend. Connection details are sent monthly via email to all NERSC users. NUG teleconferences are on the [Events Calendar](#). A section titled 'NUG Meeting September 15, 2022' states that the meeting is on September 15, 2022, at 11:00 PST. The Monthly NUG Meeting is a regular opportunity for our users to show off what they've done, for NERSC to get feedback from users, and for users to exchange ideas. Zoom: <https://btl.zoom.us/j/285479463> (full connection details below). We'll also use the NERSC Users Slack #webinars channel for discussion before, during and after the meeting. Update: The video recording is now available at <https://youtu.be/7MTXpJtgv0>, and the slides are attached... [Read More](#). A section titled 'NUG Meeting August 18, 2022' states that the meeting is on August 18, 2022, at 11:00 PST. Update: the recording is at <https://youtu.be/7AYB3uZqEw>, and the slides are attached below. The Monthly NUG Meeting is a regular opportunity for our users to show off what they've done, for NERSC to get feedback from users, and for users to exchange ideas. Zoom: <https://btl.zoom.us/j/285479463> (full connection details below). We'll also use the NERSC Users Slack #webinars channel for discussion before, during and after the meeting. Add to... [Read More](#). A section titled 'NUG Meeting July 21, 2022' states that the meeting is on July 21, 2022, at 11:00 PST. The Monthly NUG Meeting is a regular opportunity for our users to show off what they've done, for NERSC to get feedback from users, and for users to exchange ideas. Zoom: <https://btl.zoom.us/j/285479463> (full connection details below). We'll also use the NERSC Users Slack #webinars channel for discussion before, during and after the meeting. Update: The recording is available at <https://youtu.be/n6V7C17Ww> and slides are attached below. Add to... [Read More](#). A section titled 'NUG Meeting June 16, 2022' states that the meeting is on June 16, 2022, at 11:00 PST. The Monthly NUG Meeting is a regular opportunity for our users to show off what they've done, for NERSC to get feedback from users, and for users to exchange ideas. Zoom: <https://btl.zoom.us/j/285479463> (full connection details below). We'll also use the NERSC Users Slack #webinars channel for discussion before, during and after the meeting. Update: Recording is now available at <https://youtu.be/k7atKPtgc> and slides are attached below. Add to... [Read More](#).



Navigating www.nersc.gov (User Announcement)

The screenshot shows the NERSC website interface. At the top, there's a header with the NERSC logo, the tagline "Powering Scientific Discovery Since 1974", and a search bar. Below the header is a navigation menu with links for HOME, ABOUT, SCIENCE, SYSTEMS, FOR USERS, NEWS, R & D, EVENTS, and LIVE STATUS. The "NEWS" section is highlighted, and a sub-menu on the left lists "News", "Publications & Reports", "Journal Covers", "Galleries", "Podcasts", "User Announcements", "Email Lists", and "Staff Blogs". The "User Announcements" link is selected, leading to a page titled "Email Announcements". This page has a sidebar with a "Year: 2022" dropdown and a "Select List:" section with buttons for various systems like "all", "users", "mpp", "edison", "cori", "jgi", "pdfs", "nug", "managers", "hopper", "carver", "bassi", "davinci", "franklin", "jacquard", "pvp", "euclid", and "seaborg". The main content area displays a table of announcements for 2022, with columns for #, Subject, Date, and Author. The table lists several announcements, including "NERSC Weekly Email, Week of September 19, 2022", "NERSC & HPE Engineers Working on Perlmutter Scratch Performance Issues", "ERCAP Office Hours -- happening now through 4pm (Pacific)", "Scratch becoming available on Perlmutter, not at full performance or reliability yet", "NUG Monthly Meeting tomorrow, Thursday 11am PT - How to file a good ticket", "NERSC Weekly Email, Week of September 12, 2022", "Perlmutter Scratch Maintenance Ongoing; Perlmutter Charming Postponed", and "NUG Monthly Meeting tomorrow, Thursday 11am PT - How to file a good ticket".

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ANNOUNCEMENTS

Email Announcements

Year: 2022

Select Year:

2022 2021 2020 2019 2018 2017 2016 2015 2014 2013

Select List:

all users mpp edison cori jgi pdfs nug managers

Refined Systems:

hopper carver bassi davinci franklin jacquard pvp euclid seaborg

Search Announcements Body and Title

Search

Show 25 entries

#	Subject	Date	Author
0	[Users] NERSC Weekly Email, Week of September 19, 2022	2022-09-19 16:17:16	Rebecca Hartman-Baker <rhartmanbaker_at_lbl.gov>
1	[Users] NERSC & HPE Engineers Working on Perlmutter Scratch Performance Issues	2022-09-16 15:11:56	Rebecca Hartman-Baker <rhartmanbaker_at_lbl.gov>
2	[Users] ERCAP Office Hours -- happening now through 4pm (Pacific)	2022-09-15 13:40:35	Rebecca Hartman-Baker <rhartmanbaker_at_lbl.gov>
3	[Users] Scratch becoming available on Perlmutter, not at full performance or reliability yet	2022-09-15 09:42:45	Stephen Leak <nersc-consulting_at_lbl.gov>
4	[Users] NUG Monthly Meeting tomorrow, Thursday 11am PT - How to file a good ticket	2022-09-14 15:39:22	Stephen Leak <nersc-consulting_at_lbl.gov>
5	[Users] NERSC Weekly Email, Week of September 12, 2022	2022-09-12 16:57:31	Rebecca Hartman-Baker <rhartmanbaker_at_lbl.gov>
6	[Users] Perlmutter Scratch Maintenance Ongoing; Perlmutter Charming Postponed	2022-09-08 13:03:40	Rebecca Hartman-Baker <rhartmanbaker_at_lbl.gov>
7	[Users] NUG Monthly Meeting tomorrow, Thursday 11am PT - How to file a good ticket	2022-09-07 11:53:59	Rebecca Hartman-Baker <rhartmanbaker_at_lbl.gov>

NERSC Weekly Podcast

NERSC 2020 in Review and Looking Forward: Sudip Dossangh Interview
JANUARY 18, 2021

NERSC Software Support Policy: Steve Leak Interview
AUGUST 10, 2020

NERSC Power Upgrade: David Topoleski Interview
JULY 6, 2020

Dynamic Farn: Norm Bourassa Interview
JUNE 8, 2020

GPU Hackathons: Kevin Gott Interview
MAY 11, 2020

The RAPIDS Library: Nick Becker Interview
FEBRUARY 24, 2020

How Slurm Works: Chris Samuel Interview
FEBRUARY 10, 2020

IO Middlewares: Quincey Kozio Interview
JANUARY 27, 2020

NERSC 2019 in Review and Looking Forward: Sudip Dossangh Interview
JANUARY 13, 2020

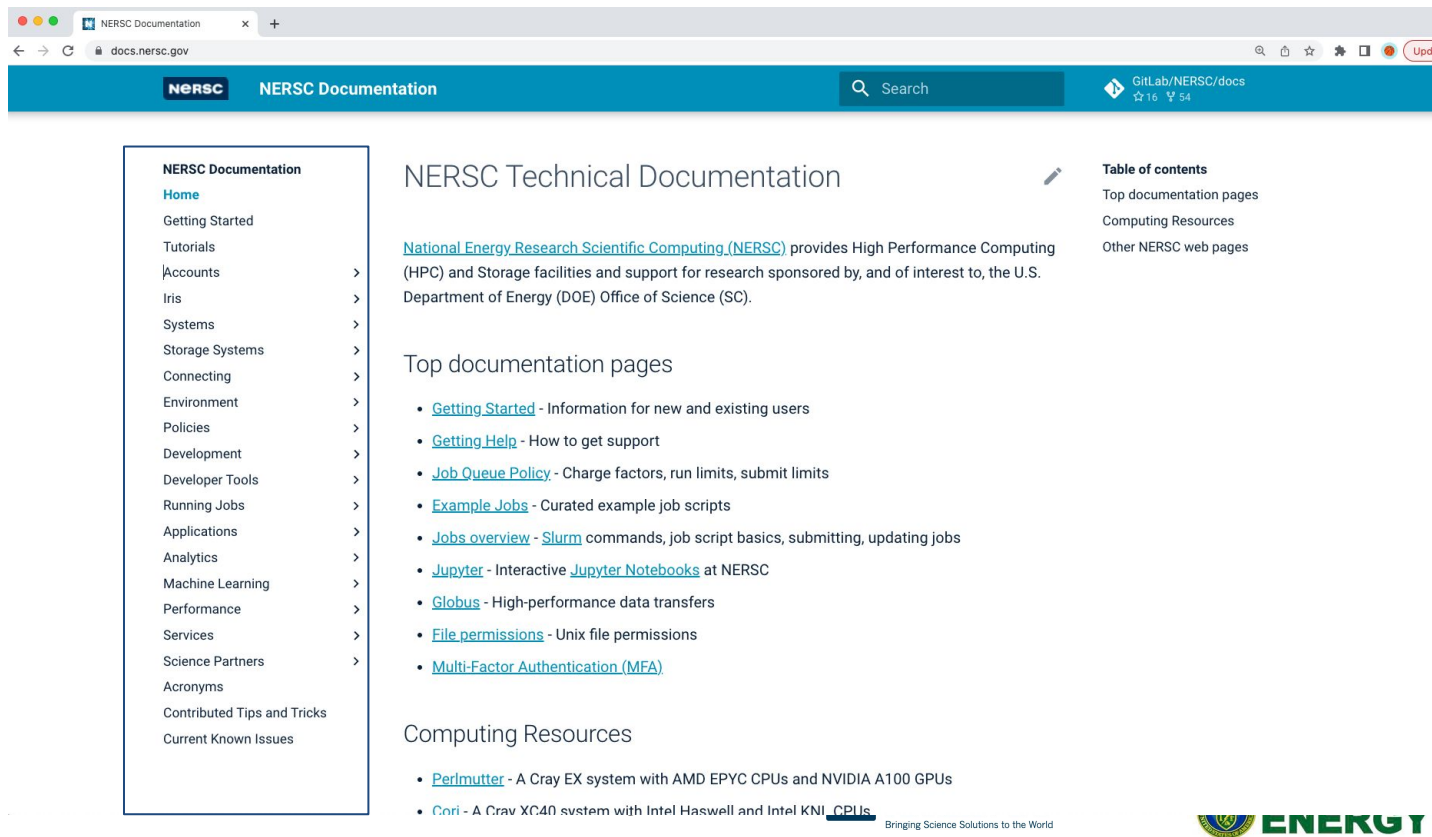
File System: Kristy Rouse, Greg Butler, and Emma Interview
OCT 9, 2019

Announcements

Navigating NERSC User Documentation



NERSC Documentation - Main Page



The screenshot shows the NERSC Documentation main page in a web browser. The browser's address bar shows 'docs.nersc.gov'. The page has a blue header with the NERSC logo and 'NERSC Documentation' text. A search bar is on the right. The main content area is divided into three columns. The left column is a sidebar with a list of links. The middle column has a heading 'NERSC Technical Documentation' followed by a paragraph about NERSC and a list of 'Top documentation pages'. The right column has a 'Table of contents' section with links to 'Top documentation pages', 'Computing Resources', and 'Other NERSC web pages'. At the bottom, there is a 'Computing Resources' section with links to 'Perlmutter' and 'Cori'. The footer includes the NERSC logo, the 'ENERGY' logo, and the 'Office of Science' logo.

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- Current Known Issues

NERSC Technical Documentation

[National Energy Research Scientific Computing \(NERSC\)](#) provides High Performance Computing (HPC) and Storage facilities and support for research sponsored by, and of interest to, the U.S. Department of Energy (DOE) Office of Science (SC).

Top documentation pages

- [Getting Started](#) - Information for new and existing users
- [Getting Help](#) - How to get support
- [Job Queue Policy](#) - Charge factors, run limits, submit limits
- [Example Jobs](#) - Curated example job scripts
- [Jobs overview](#) - [Slurm](#) commands, job script basics, submitting, updating jobs
- [Jupyter](#) - Interactive [Jupyter Notebooks](#) at NERSC
- [Globus](#) - High-performance data transfers
- [File permissions](#) - Unix file permissions
- [Multi-Factor Authentication \(MFA\)](#)

Computing Resources

- [Perlmutter](#) - A Cray EX system with AMD EPYC CPUs and NVIDIA A100 GPUs
- [Cori](#) - A Cray XC40 system with Intel Haswell and Intel [CPUs](#)

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Bringing Science Solutions to the World

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NERSC Systems

NERSC is one of the largest facilities in the world devoted to providing computational resources for scientific computing.

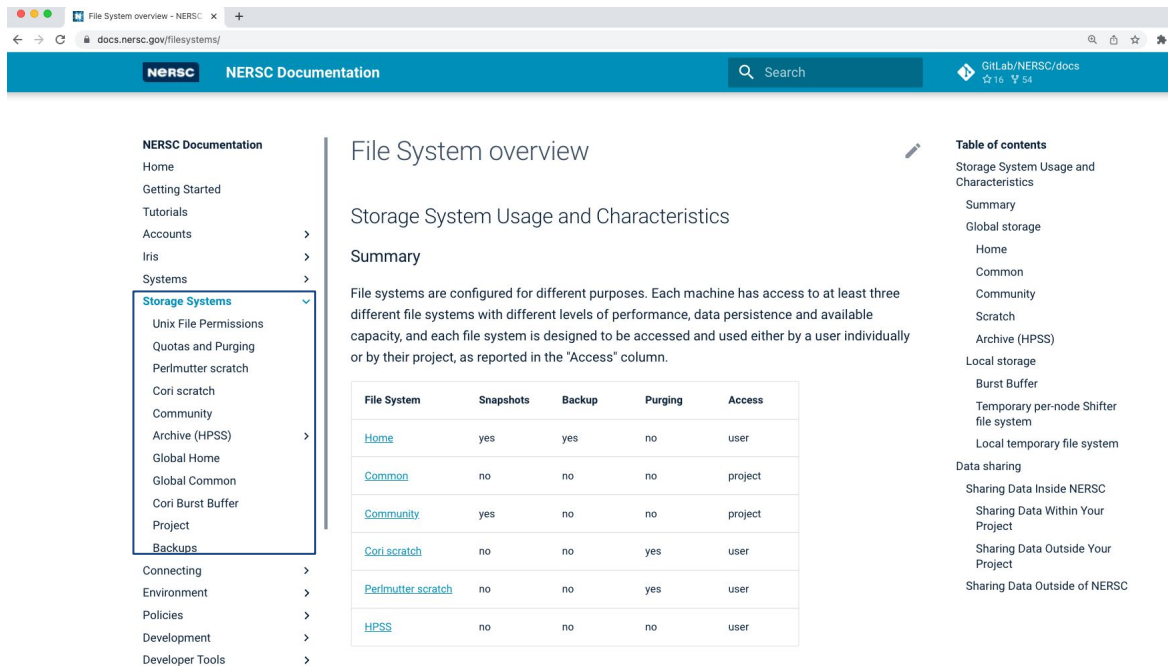
Perlmutter

[Perlmutter](#) is a HPE (Hewlett Packard Enterprise) Cray EX supercomputer, named in honor of Saul Perlmutter, an astrophysicist at Berkeley Lab who shared the 2011 Nobel Prize in Physics for his contributions to research showing that the expansion of the universe is accelerating.

Perlmutter, based on the HPE Cray Shasta platform, is a heterogeneous system comprising both CPU-only and GPU-accelerated nodes, with a performance of 3-4 times Cori when the installation completes.

We are in the process of Perlmutter Phase 2 integration (adding CPU only nodes and upgrading our system network to Slingshot 11). The final system will consist of 1536 GPU accelerated nodes with 1 AMD Milan processor and 4 NVIDIA A100 GPUs, and 3072 CPU-only nodes with 2 AMD Milan processors. The actual number of nodes available will be in flux during the integration and acceptance of the full system.

NERSC Documentation - Storage Overview



The screenshot shows the NERSC Documentation website. The browser address bar displays 'docs.nersc.gov/filesystems/'. The page title is 'File System overview'. The left sidebar contains a navigation menu with categories like 'NERSC Documentation', 'Storage Systems', 'Backups', 'Connecting', 'Environment', 'Policies', 'Development', and 'Developer Tools'. The 'Storage Systems' category is expanded, showing sub-items like 'Unix File Permissions', 'Quotas and Purging', 'Perlmutter scratch', 'Cori scratch', 'Community', 'Archive (HPSS)', 'Global Home', 'Global Common', 'Cori Burst Buffer', 'Project', and 'Backups'. The main content area is titled 'File System overview' and 'Storage System Usage and Characteristics'. It includes a 'Summary' section stating that file systems are configured for different purposes and provides a table of file system characteristics. The right sidebar contains a 'Table of contents' for the 'Storage System Usage and Characteristics' section, listing items like 'Summary', 'Global storage', 'Home', 'Common', 'Community', 'Scratch', 'Archive (HPSS)', 'Local storage', 'Burst Buffer', 'Temporary per-node Shifter file system', 'Local temporary file system', 'Data sharing', 'Sharing Data Inside NERSC', 'Sharing Data Within Your Project', 'Sharing Data Outside Your Project', and 'Sharing Data Outside of NERSC'.

File System overview

Storage System Usage and Characteristics

Summary

File systems are configured for different purposes. Each machine has access to at least three different file systems with different levels of performance, data persistence and available capacity, and each file system is designed to be accessed and used either by a user individually or by their project, as reported in the "Access" column.

File System	Snapshots	Backup	Purging	Access
Home	yes	yes	no	user
Common	no	no	no	project
Community	yes	no	no	project
Cori scratch	no	no	yes	user
Perlmutter scratch	no	no	yes	user
HPSS	no	no	no	user

NERSC Documentation - Connecting to NERSC

The screenshot shows the NERSC Documentation website. The browser address bar displays `docs.nersc.gov/connect/`. The page has a blue header with the NERSC logo, the text "NERSC Documentation", a search bar, and a GitHub repository link "GitLab/NERSC/docs".

NERSC Documentation

- Home
- Getting Started
- Tutorials
- Accounts >
- Iris >
- Systems >
- Storage Systems >
- Connecting >**
 - Multi-Factor Authentication
 - Federated Identity
 - NoMachine / NX, X Windows Accelerator
- Environment >
- Policies >
- Development >
- Developer Tools >
- Running Jobs >
- Applications >
- Analytics >
- Machine Learning >
- Performance >
- Services >
- Science Partners >
- Acronyms

Connecting to NERSC

Login Nodes

Opening an [SSH connection](#) to NERSC systems results in a connection to a login node. Typically systems will have multiple login nodes which sit behind a load balancer. New connections will be assigned a random node. If an account has recently connected the load balancer will attempt to connect to the same login node as the previous connection.

Connect to NERSC Computational Systems

Please make sure you have configured [Multi-Factor Authentication \(MFA\)](#) prior to login.

To access Perlmutter via `ssh` you can do the following:

```
ssh <user>@perlmutt-p1.nersc.gov
```

or

```
ssh <user>@saul-p1.nersc.gov
```

Similarly, you can access Cori with

```
ssh <user>@cori.nersc.gov
```

Table of contents

- Login Nodes
- Connect to NERSC
- Computational Systems
 - X11 Forwarding
- SSH
 - Connecting with SSH
 - Password-less logins and transfers
 - SSH certificate authority
 - Key fingerprints
 - Perlmutter
 - Cori
 - DTN[01-04]
 - NoMachine/NX
 - Host Keys
 - Perlmutter
 - Cori
- Troubleshooting
 - "Access Denied", "Permission Denied" or "Too many authentication failures"
 - Host authenticity
 - Host identification changed
 - SSH connection disconnects periodically

NERSC Documentation - Running Jobs

The screenshot shows a web browser window displaying the NERSC Documentation page for 'Running Jobs'. The browser's address bar shows 'docs.nersc.gov/jobs/'. The page has a blue header with the NERSC logo, a search bar, and a GitLab link. A left sidebar contains a navigation menu with 'Running Jobs' highlighted. The main content area is titled 'Running Jobs' and includes a paragraph about Slurm, a 'Table of contents' on the right, and a 'Jobs' section at the bottom. A 'Tip' box is also present.

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- Policies >
- Development >
- Developer Tools >
- Running Jobs** ✓
- Queues and Charges
- Example Jobs
- Best Practices
- Troubleshooting Jobs
- Monitoring
- Affinity
- Interactive
- Reservations
- Workflow Tools >
- Checkpoint/Restart >
- Applications >

Running Jobs

NERSC uses [Slurm](#) for cluster/resource management and job scheduling. Slurm is responsible for allocating resources to users, providing a framework for starting, executing and monitoring work on allocated resources and scheduling work for future execution.

Additional Resources

- Documentation: <https://slurm.schedmd.com/documentation.html>
- Tutorial: <https://slurm.schedmd.com/tutorials.html>
- Manual: https://slurm.schedmd.com/man_index.html
- FAQ: <https://slurm.schedmd.com/faq.html>

Jobs

A **job** is an allocation of resources such as compute nodes assigned to a user for an amount of time. Jobs can be interactive or batch (e.g., a script) scheduled for later execution.

Tip

NERSC provides an extensive set of [example job scripts](#)

Once a job is assigned a set of nodes, the user is able to initiate parallel work in the form of job steps (sets of tasks) in any configuration within the allocation.

Table of contents

- Additional Resources
- Jobs
- Submitting jobs
 - sbatch
 - salloc
 - srun
- Options
 - Commonly Used Options
 - Writing a Job Script
 - Defaults
- Debugging issues
- Available memory for applications on compute nodes
- Quota Enforcement
- Queue Wait Times
- Further reading about jobs
- Additional Constraints

NERSC Documentation - Programming Models

The screenshot shows a web browser window with the URL `docs.nersc.gov/development/programming-models/`. The page has a blue header with the NERSC logo and "NERSC Documentation". A search bar is on the right. On the left, a navigation menu lists various documentation topics, with "Programming Models" expanded to show sub-topics like MPI, OpenMP, OpenACC, CUDA, UPC, UPC++, Coarrays, SYCL, and Kokkos. The main content area is titled "Programming Models" and contains two paragraphs. The first paragraph states that a wide variety of programming models are used on NERSC systems, with MPI and OpenMP being the most common. The second paragraph discusses parallel programming models at NERSC, noting the transition from vector to distributed memory (MPP) architectures and the use of MPI. A third paragraph begins with "However, as on-node parallelism rapidly increases..." and discusses the benefits of different abstractions for expressing on-node parallelism. On the right, a "Table of contents" lists links to various topics: Parallel programming models at NERSC, Cori, Perlmutter, and beyond: Performance and portability, Why MPI + OpenMP?, Combining Programming Models, Distributed memory (inter-node) parallelism, Shared memory (intra-node) parallelism, CPU, and GPU.

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- OpenMP >
- OpenACC
- CUDA
- UPC
- UPC++
- Coarrays
- SYCL
- Kokkos

Programming Models

A wide variety of programming models are used on NERSC systems. The most common is MPI + OpenMP, but many others are supported.

Parallel programming models at NERSC

Since the transition from vector to distributed memory (MPP) supercomputer architectures, the majority of HPC applications deployed on NERSC resources have evolved to use MPI as their sole means of expressing parallelism. As single processor core compute nodes on MPP architectures gave way to multicore processors, applying the same abstraction (processes passing messages) to each available core remained an attractive alternative - no code changes were required, and vendors made an effort to design optimized fast-paths for on-node communication.

However, as on-node parallelism rapidly increases and competition for shared resources per processing element (memory per core, bandwidth per core, etc.) does as well, now is a good time to assess whether applications can benefit from a different abstraction for expressing on-node parallelism. Examples of desirable functionality [Click to go back, hold to see history](#) the latter include more efficient utilization of resources (e.g. through threading) or the ability to exploit unique architectural features (e.g. vectorization).

Cori, Perlmutter, and beyond: Performance and portability

Cori Phase II system, arrived in mid-2016, continues this trend toward greater intra-node

Table of contents

- Parallel programming models at NERSC
- Cori, Perlmutter, and beyond: Performance and portability
- Why MPI + OpenMP?
- Combining Programming Models
- Distributed memory (inter-node) parallelism
- Shared memory (intra-node) parallelism
- CPU
- GPU

Thank You and
Welcome to
NERSC!

