Jetstream Overview: Programmable Cyberinfrastructure: Learning the Jetstream API

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Jeremy Fischer – Jeremy@iu.edu - Indiana University
Manager, Jetstream Cloud,
UITS Research Technologies

What is Jetstream and why does it exist?

- NSF’s first production cloud facility
- Focus on ease-of-use, broad accessibility
- User-selectable library of preconfigured virtual machines
- Provides on-demand interactive computing and analysis or persistent services such as gateways
- Enables configurable environments; programmable cyberinfrastructure
What Jetstream isn’t...

• It’s not traditional HPC
• There’s no shared filesystem (think cloudy!)
• There’s no high-end interconnect fabric (keep thinking cloudy!)
• There aren’t GPUs (yet...working on integrating them now!)
• It isn’t Amazon, Azure, or GCE (similar, but...)

RESEARCH TECHNOLOGIES
UNIVERSITY INFORMATION TECHNOLOGY SERVICES
Who uses Jetstream?

- The researcher needing a handful of cores (1 to 44/vCPU)
- Software creators and researchers needing to create their own VMs and workflows
- Science gateway creators using Jetstream as either the frontend or processor for scientific jobs
- STEM Educators teaching on a variety of subjects
Jetstream System Overview

IU Cyberinfrastructure

Jetstream (production)

<table>
<thead>
<tr>
<th>Compute</th>
<th>Storage</th>
</tr>
</thead>
<tbody>
<tr>
<td>320 Nodes 7,680 Cores 40 TB RAM 640 TB local disk</td>
<td>960 TB</td>
</tr>
</tbody>
</table>

TACC Cyberinfrastructure

Jetstream (production)

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U of Arizona Cyberinfrastructure

Jetstream (development)

<table>
<thead>
<tr>
<th>Compute</th>
</tr>
</thead>
<tbody>
<tr>
<td>16 Nodes 2 TB RAM 384 Cores 32 TB local disk</td>
</tr>
</tbody>
</table>
Platform Overview

- Globus Auth
- Atmosphere API
- Atmo Services
- XSEDE Accounting
- OpenStack
- Ceph

Indiana University

TACC
The Jetstream Atmosphere web interface
<table>
<thead>
<tr>
<th>Discipline or area of interest</th>
<th># of Jetstream allocations</th>
<th>SUUs allocated on Jetstream</th>
<th>SU Increase/Decrease on Jetstream over previous year</th>
<th>% of SUUs allocated on Jetstream</th>
<th>% of all SUUs allocated on other XSEDE-supported systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>Behavioral Sciences</td>
<td>6</td>
<td>3,465,516</td>
<td>100% Increase</td>
<td>4.24%</td>
<td>0.61%</td>
</tr>
<tr>
<td>Biological Sciences</td>
<td>89</td>
<td>15,041,928</td>
<td>72.18% Increase</td>
<td>18.40%</td>
<td>3.59%</td>
</tr>
<tr>
<td>Biophysics</td>
<td>86</td>
<td>3,627,026</td>
<td>44.15% Decrease</td>
<td>4.44%</td>
<td>13.56%</td>
</tr>
<tr>
<td>Computer Science</td>
<td>72</td>
<td>6,883,269</td>
<td>33.28% Increase</td>
<td>8.42%</td>
<td>2.98%</td>
</tr>
<tr>
<td>Earth Sciences</td>
<td>37</td>
<td>5,476,250</td>
<td>37.06% Increase</td>
<td>6.70%</td>
<td>4.60%</td>
</tr>
<tr>
<td>Education and Training</td>
<td>128</td>
<td>16,599,512</td>
<td>2.62% Increase</td>
<td>20.31%</td>
<td>4.66%</td>
</tr>
<tr>
<td>Engineering</td>
<td>13</td>
<td>520,690</td>
<td>71.21% Increase</td>
<td>0.64%</td>
<td>1.75%</td>
</tr>
<tr>
<td>Materials Science</td>
<td>6</td>
<td>1,035,508</td>
<td>100% Increase</td>
<td>1.27%</td>
<td>13.89%</td>
</tr>
<tr>
<td>Mathematics</td>
<td>13</td>
<td>688,505</td>
<td>150.37% Increase</td>
<td>0.84%</td>
<td>0.90%</td>
</tr>
<tr>
<td>Molecular Science/Biochemistry</td>
<td>21</td>
<td>4,254,643</td>
<td>10.15% Decrease</td>
<td>5.20%</td>
<td>5.83%</td>
</tr>
<tr>
<td>Neuroscience</td>
<td>19</td>
<td>4,708,180</td>
<td>327.87% Increase</td>
<td>5.76%</td>
<td>1.98%</td>
</tr>
<tr>
<td>Physics</td>
<td>10</td>
<td>2,440,581</td>
<td>15.58% Decrease</td>
<td>2.99%</td>
<td>8.65%</td>
</tr>
<tr>
<td>Social Sciences and Humanities</td>
<td>28</td>
<td>2,409,633</td>
<td>192.27% Increase</td>
<td>2.95%</td>
<td>0.81%</td>
</tr>
</tbody>
</table>
Jetstream for engineering researchers (and others)

- Matlab and SimuLink and additional toolkits are installed on Jetstream
- You do NOT need to have a local license to use MATLAB on Jetstream
- If you are a researcher, and MATLAB or SimuLink... you’re ready to go!
- If you are an engineering researcher, and you need other tools... let us know!
Jetstream for Education

Jetstream has been used in multiple graduate and undergraduate courses

• Management, Access, and Use of Big and Complex Data
• Multiple informatics and general bioinformatics courses
• Business Intelligence (big data and analysis)
• Research Topics in Music
• Multiple genetics and sequencing courses
• Multiple information security and assurance courses

Research Data Alliance workshops, Galaxy workshops, data analysis in finance using R, security and intrusion detection, and principles in cloud computing...
Jetstream usage highlights – 1 April 2019

• 414 active XSEDE projects covering 73 fields of science and over 2300 active users representing 207 institutions
• 80% of Jetstream users have not used any other XSEDE system
• >190M CPU hours allocated to XSEDE projects since June 2016
• 24 active science gateways
• 54 education/teaching allocations serving over 1000 students
• 1458 mean active VMs in previous qtr, 1590 peak active VM count
• Highest user satisfaction in most recent XSEDE survey
Requesting access to Jetstream

• Trial allocations available TODAY
  • http://wiki.jetstream-cloud.org/Jetstream+Trial+Access+Allocation
• You can request startup allocations anytime. (Startups are simple!)
  • http://wiki.jetstream-cloud.org/Jetstream+Allocations
• You can request allocations for educational use anytime.
• Next submission period for large allocations is 15 Jun 2019 – 15 Jul 2019
• Research allocation: Project desc (≤10 pages) and Scaling doc (≤5 pages)
  • We can help!
Where can I get help?

- User guides: [https://portal.xsede.org/user-guides](https://portal.xsede.org/user-guides)
- XSEDE KB: [https://portal.xsede.org/knowledge-base](https://portal.xsede.org/knowledge-base)
- Email: help@xsede.org
- Campus Champions: [https://www.xsede.org/campus-champions](https://www.xsede.org/campus-champions)
- Introduction to Jetstream Virtual Workshop: [https://cvw.cac.cornell.edu/jetstream/](https://cvw.cac.cornell.edu/jetstream/)
- Jetstream Allocations Virtual Workshop: [https://cvw.cac.cornell.edu/JetstreamReq/](https://cvw.cac.cornell.edu/JetstreamReq/)
Questions?

• Project email: help@jetstream-cloud.org Direct email: jeremy@iu.edu

License Terms

• Jetstream is supported by NSF award 1445604 (David Y. Hancock, IU, PI)
• XSEDE is supported by NSF award 1053575 (John Towns, UIUC, PI)
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And onward...
Cloud Computing Terms...simplified

**Image:** a file on a disk. It will be booted to create an...

**Instance:** a running virtual server; i.e. something you can log into.

**Running:** the *instance* is up & running

**Suspended:** the *instance* is memory resident but not running

**Stopped:** the *instance* is shutdown akin to powering down

**Shelved:** the *instance* is shutdown, backed up, and stored
Cloud Computing Terms...simplified

**Flavor**: the size of a running instance; i.e. #cores, RAM, disk

**Hypervisor**: the thing the instance runs on and is managed by; something akin to a software defined hardware compute server.

**Snapshot**: the process of taking an instance and turning it to an image.

**State**: something worth remembering; i.e. the state of the system
Object store: a blob of bits; it has a starting address & a size. There may be metadata associated with the object. The data is consumed in a streaming manner.

Block store: a software defined entity akin to an unformatted hardware disk drive.

Filesystem: hierarchical in nature, directories & files, ability to open, seek, read, write.

Persistent storage: If you pull the plug, it will still exist when power is restored. Safe to store data or state here.

Ephemeral storage: If you pull the plug, it no longer exists. (Don’t put your data here!!!)
OpenStack Overview

- Client
- Keystone
- Nova
- Glance
- Ceph
- Cinder

Token

Compute
Getting into the hands on part -

Open [https://goo.gl/7X3HQz](https://goo.gl/7X3HQz) in your browser

You’ll be connecting to a prepped host…but you might want to wait until I tell you something key first. 😊

`ssh trainXX@tutorial.jetstream-cloud.org`