The Holland Computing Center supports a diverse collection of research computing hardware. Anyone in the University of Nebraska system is welcome to apply for an account on HCC machines.

Access to these resources is by default shared with the rest of the user community via various job schedulers. These policies may be found on the pages for the various resources. Alternatively, a user may buy into an existing resource, acquiring 'priority access'. Finally, several machines are available via Condor for opportunistic use. This will allow users almost immediate access, but the job is subject to preemption.

**New Users Sign Up**

**Quick Start Guides**

**Which Cluster to Use?**

**Crane**: Crane is the newest and most powerful HCC resource. If you are new to using HCC resources, Crane is the recommended cluster to use initially. Limitations: Crane has only 2 CPU/16 cores and 64GB RAM per node. If your job requires more than 16 cores per node or you need more than 64GB of memory, consider using Tusker instead.

**Tusker**: Similar to Crane, Tusker is another cluster shared by all campus users. It has 4 CPU/64 cores and 256GB RAM per nodes. Two nodes have 512GB RAM for very large memory jobs. So for jobs requiring more than 16 cores per node or large memory, Tusker would be a better option.

**Sandhills**: Sandhills is a condominium-style cluster, and the majority is owned by various research groups on campus. Jobs from resource owners have first priority in their owned partitions. Users that do not own resources (Guests) can do opportunistic computation, but we would recommend using Crane or Tusker.

**User Login**

For Windows users, please refer to this link [For Windows Users]. For Mac or Linux users, please refer to this link [For Mac/Linux Users].

```bash
ssh crane.unl.edu -l <username>
or
ssh tusker.unl.edu -l <username>
or
ssh sandhills.unl.edu -l <username>
```

**Duo Security**

Duo two-factor authentication is **required** for access to HCC resources. Registration and usage of Duo security can be found in this section: [Setting up and using Duo]
Important Notes

- The Crane, Tusker and Sandhills clusters are separate. But, they are similar enough that submission scripts on whichever one will work on another, and vice versa.

- The worker nodes cannot write to the /home directories. You must use your /work directory for processing in your job. You may access your work directory by using the command:

  $ cd $WORK

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General Instructions

- Submitting Jobs
- Compiling Source Code
- Handling Data

Advanced Usage

- Submitting an MPI Job
- Submitting a Job Array
- Submitting an Interactive Job
- Available Partitions
- Submitting an OpenMP Job
- Submitting CUDA or OpenACC Jobs
- Submitting R jobs
### Resources
- **Crane** - HCC’s newest machine, Crane has 7232 Intel Xeon cores in 452 nodes with 64GB RAM per node.
- **Tusker** - consists of 106 AMD Interlagos-based nodes (6784 cores) interconnected with Mellanox QDR Infiniband.
- **Sandhills** - has 1440 AMD cores housed in 42 nodes with 128GB per node and 2 nodes with 256GB per node.
- **Red** - This cluster is the resource for UNL’s US CMS Tier-2 site.
  - CMS
  - Open Science Grid
  - MyOSG
- **Glidein** - A gateway to running jobs on the OSG, a collection of computing resources across the US.
- **Anvil** - HCC’s cloud computing cluster based on Openstack

### Resource Capabilities

<table>
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<tr>
<th>Cluster</th>
<th>Overview</th>
<th>Processors</th>
<th>RAM</th>
<th>Connection</th>
<th>Storage</th>
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</thead>
<tbody>
<tr>
<td>Crane</td>
<td>548 node Production-mode LINUX cluster</td>
<td>452 Intel Xeon E5-2670 2.60GHz 2 CPU/16 cores per node</td>
<td>452 nodes @ 64GB</td>
<td>QDR Infiniband</td>
<td>~1.8 TB local scratch per node</td>
</tr>
<tr>
<td></td>
<td></td>
<td>116 Intel Xeon E5-2697 v4 2.3GHz, 2 CPU/36 cores per node</td>
<td>79 nodes @ 256GB</td>
<td>EDR Omni-Path Architecture</td>
<td>~4 TB local scratch per node</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(<em>CraneOPA</em>)</td>
<td>37 nodes @ 512GB</td>
<td></td>
<td>~1452 TB shared Lustre storage</td>
</tr>
<tr>
<td>Tusker</td>
<td>82 node Production-mode LINUX cluster</td>
<td>Opteron 6272 2.1GHz, 4 CPU/64 cores per node</td>
<td><strong>256 GB RAM per node</strong></td>
<td>QDR Infiniband</td>
<td>~500 TB shared Lustre storage</td>
</tr>
<tr>
<td></td>
<td></td>
<td>***2 Nodes with 512GB per node</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>****1 Node with 1024GB per node</td>
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</tr>
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<td></td>
<td></td>
<td>~175 TB shared Lustre storage</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Sandhills</td>
<td>108 node Production-mode LINUX cluster (condominium model)</td>
<td>62 4-socket Opteron 6376 (2.3 Ghz, 64 cores/node)</td>
<td>62 nodes @ 192GB</td>
<td>QDR Infiniband Gigabit Ethernet</td>
<td>~175 TB shared Lustre storage</td>
</tr>
<tr>
<td></td>
<td></td>
<td>44 4-socket Opteron 6128 (2.0 Ghz, 32 cores/node)</td>
<td>44 nodes @ 128GB</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 4-socket Opteron 6168 (1.9 Ghz, 48 cores/node)</td>
<td>2 nodes @ 256GB</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| Red | 344 node Production-mode LINUX cluster | Various Xeon and Opteron processors
7,280 cores maximum, actual number of job slots depends on RAM usage | 1.5-4GB RAM per job slot | 1Gb, 10Gb, and 40Gb Ethernet | ~6.67PB of raw storage space |
<table>
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<tbody>
<tr>
<td>Anvil</td>
<td>76 Compute nodes (Partially used for cloud, the rest used for general computing), 12 Storage nodes, 2 Network nodes Openstack cloud</td>
<td>76 Intel Xeon E5-2650 v3 2.30GHz 2 CPU/20 cores per node</td>
<td>76 nodes @ 256GB</td>
<td>10Gb Ethernet</td>
<td>528 TB Ceph shared storage (349TB available now)</td>
</tr>
</tbody>
</table>

You may only request the following amount of RAM: *62.5GB, **250GB, ***500GB, and ****1000GB.