Introduction to Kamiak
Training Workshop

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hpc.wsu.edu/training/slides
hpc.wsu.edu/training/follow-along
hpc.wsu.edu/cheat-sheet

These slides
Handout
Cheat Sheet

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What is Kamiak

- Kamiak is a **cluster** of many individual computers (called **nodes**) connected by a high-speed network
- Each computer is like your laptop, but with more cores (40) and memory
- Applications can run in **parallel** over many cores and across multiple nodes
- **Speeds up** solving large problems

Nodes: 135
Cores: 3,292
Memory: 32 TB
Storage: 1.2 PB
GPU cores: 60,032
What you will learn today

- Transfer files to and from Kamiak
- Logging into Kamiak
- Basic Linux commands to navigate folders, move files
- How to run jobs on Kamiak
  - Submit batch jobs
  - Interactive compute session
  - Use job arrays
  - Find and load software modules
- How to get help
- Best practices to being a good user
- How to invest in Kamiak for nodes or storage
Transferring Files to and from Kamiak

• For Windows, first make sure you have Ubuntu installed. To install Ubuntu, see: hpc.wsu.edu/cheat-sheet

• There are several ways to transfer and synchronize files between your laptop and Kamiak.

• Transfer
  
  *scp* (secure copy), *sftp* (secure file transfer protocol)
  
  Windows alternative: *Winscp*

• Synchronize
  
  *rsync*
Transferring Files - `scp`

- Let’s transfer some files from Kamiak to our machine
  
  *Make sure you are on your laptop, not logged into Kamiak*

  **Open a terminal window**
  - Terminal >> New Window *(Mac)*
    - Start >> Ubuntu *(Windows)*
  - `cd`

  **Transfer a folder from Kamiak to my laptop**
  - `scp -r your.name@kamiak.wsu.edu:/opt/apps/samples/training .`
    - Recursive, copies all files in folder
    - From Kamiak
    - To current folder on laptop

  **Now from my laptop back to Kamiak**
  - `scp -r training your.name@kamiak.wsu.edu:~/`
    - From my machine
    - To my home directory on Kamiak
We can also synchronize folders between Kamiak and your laptop so that they have the same contents.

```
rsync -ravx source destination
```

- Copies any changed files from the source to the destination
- Only adds or replaces files, doesn’t delete them from the destination
- Useful for data backups and mirroring

**Common options used with rsync**

- `-r` recursive copy, all subfolders and files
- `-a` archive mode, preserves permissions, ownership
- `-v` verbose
- `-x` don't cross filesystem boundaries
- `-z` compress file data
- `-h` print output in human-readable format
Transferring Files - \texttt{rsync}

- Let’s synchronize a folder on Kamik to our laptop
  \textit{Make sure you are on your laptop, not logged into Kamiak}

  \begin{itemize}
  \item \texttt{cd}
  \item \texttt{rsync -ravx training/ your.name@kamiak.wsu.edu:~/training}
  \end{itemize}

Recursive, archive, verbose, compress

From folder on my laptop

To folder on Kamiak

\begin{verbatim}
sumo(10011) %rsync -ravx training/ peter.mills@kamiak.wsu.edu:~/training
peter.mills@kamiak.wsu.edu's password:
sending incremental file list

sent 219 bytes  received 21 bytes  43.64 bytes/sec
total size is 3,105  speedup is 12.94
sumo(10012) %
\end{verbatim}
Logging into Kamiak - ssh

Open a terminal window
• Terminal >> New Window (Mac)
  Start >> Ubuntu (Windows)

Log into Kamiak
• ssh your.name@kamiak.wsu.edu
• exit

Follow along
See also: hpc.wsu.edu/users-guide/terminal-ssh
Basic Linux Commands

• There are many basic linux commands you must master

  cd  *path*  move your current position in the folder tree

  ls  *path*  list contents of a folder ("ls" for current folder)

  cp  *from*  *to*  copy files, for folders use "cp -r from to"

  mv  *from*  *to*  move files and folders

  rm  *todelete*  delete files, for folders user "rm -r -l path"

• Special pathnames  
  *Example: cd ~/..

  ..  means one level up, the parent folder

  .  means the current folder

  ~  means your home directory

• For other commands see hpc.wsu.edu/cheat-sheet or Ch2 of the tutorial sent in email
Text Editors

• If you want to open and edit files, you need to also choose a text editor to use:

- There are many tutorials on different text editors as well.
Running Jobs on Kamiak – Key Concepts

- Kamiak is a **cluster** of computers called **nodes**, each with many cores

- Each **core** (processor), can execute a different program (**task**)
  - 20 cores can do 20 different things at once

- Nodes are grouped into **partitions**
  - Each partition holds nodes owned by a PI or college
  - Also overarching shared backfill partition (“kamiak”) for all users

- You submit a **job** asking for a number of cores

- Job gets added to a **queue** to wait in line
  - One queue for each partition (i.e., group of nodes)
  - Job waits to run until resources are available

- **Slurm job scheduler** decides:
  - Who goes first, who gets what
  - Who gets bumped (preempted) from backfill if an investor needs node back

- **Cores (cpu’s) are the unit of resource allocation**
  - Each core can only be used by 1 job at any time
  - Cores can be allocated to a job from parts of several nodes

- **Applications will only run in parallel if they are built to do so**
  - Kamiak does not parallelize your program
  - It just runs your program on the node it assigns it to
• Kamiak's nodes are grouped into partitions, each owned by investor
• All nodes also belong to a shared partition (called "kamiak")
  - *Can be used by all users*
• Investors have priority access to the nodes they own
  - *You will get bumped if an investor’s job can’t find enough idle cores to run, and yours would allow it to start*

• Resource limits for backfill jobs
  - Currently: 180 CPU cores (~ 9 standard compute nodes)
How to Run Jobs on Kamiak

There are two ways to run jobs on Kamiak

- **sbatch** `myJob.sh** Batch job submission**
  - Says what partition to submit to, default is backfill queue
  - Says what resources your job needs (cpu’s/cores, memory, GPU’s)
  - Says what program to run

- **idev** Interactive session on compute node
  - Puts you on a compute node
  - Just type in commands and see them executed

Do not run compute or compile jobs on login nodes, use **sbatch** or **idev** instead
Submitting Batch Jobs to Kamiak

- Log into Kamiak
  
  `ssh your.name@kamiak.wsu.edu`

  `cd training`

  `. setup.sh`  # One-time setup only for this training

- Create/edit a job script
  
  `cat myJob.sh`

- Submit the job script to the job queue
  
  `sbatch myJob.sh`  # `sbatch --test-only myJob.sh`

- View the job queue
  
  `squeue -u your.name`  # Shows pending and running jobs

  `squeue -j jobNumber`

- Cancel the job
  
  `scancel jobNumber`  # Cancel job

- View past and active jobs
  
  `sacct -S 10/26/20 -u your.name`  # Past job history

  `scontrol show job jobNumber`  # Job details`
Viewing Information about the Cluster

- What partitions and nodes are available
  ```bash
  sinfo -a | more  # Availability (alloc, idle, mix)
  ```

- View all running and queued jobs
  ```bash
  squeue -a | more  # Queued jobs for all partitions
  ```

- View node details
  ```bash
  scontrol show node cn93  # Amount of memory, cpus, GPU's
  ```
Interactive Jobs

- **idev** creates an interactive session on a compute node
  - Same options as **sbatch**
  - Can also **ssh** to a compute node if you have a job allocated on it

```
kamiak$ idev -N 1 --ntasks=1 -cpus-per-task=2 -t 360
Idev interatively runs commands on a compute node.
See 'man salloc' for idev options to reserve a job allocation.
To use a GPU within idev: use 'srun yourCommand', e.g. 'srun python -i'.
To use X11 forwarding from a compute node:
  Use 'ssh -Y' or more secure 'ssh -X' to log into Kamiak.
  Within idev, use 'srun --x11' to launch a task with a user interface.
Recommend using 'srun -I' to launch a task without hanging.
Default time is 60 minutes. Use '-t yourMinutes' to override.
salloc: Granted job allocation 1160832
Allocated nodes: cn32

cn32$ module avail

cn32$ module load python/2.7.15

cn32$ module list
Currently Loaded Modules:
  1) StdEnv
  2) intel/xe_2016_update3
  3) workspace_maker/master
  4) python/2.7.15
```
Interactive Jobs

Use `srun -l` to avoid hanging if resources are not available
Job Arrays

- **Template** to create multiple instances of a job
  - `#SBATCH --array=1-5` *Creates 5 instances, one for each index 1, 2, 3, 4, 5*

- Each instance is an individual job with the same resources
  - Template holds place in queue, spawns instances as resources become available

- Each instance has a unique index `$SLURM_ARRAY_TASK_ID`
  - Can use index however you want, in different ways

- Example: run the same program over different files *(data_1.txt)*

Please use job arrays instead of submitting hundreds of individual jobs
Running Job Arrays

kamiak$ cat jobArray.sh

kamiak$ sbatch jobArray.sh
Submitted batch job 1161089

kamiak$ squeue -u peter.mills
JOBID PARTITION NAME USER ST TIME NODES Nodelist(REASON)
1161089_0 kamiak myJobArr peter.mi R 0:01 1 cn32
1161089_1 kamiak myJobArr peter.mi R 0:01 1 cn32
1161089_2 kamiak myJobArr peter.mi R 0:01 1 cn32

kamiak$ cat output/myJobArray*out
Starting job array 0 on host cn32
Processing data file: inputs/data_0.txt
Starting job array 1 on host cn32
Processing data file: inputs/data_1.txt
Starting job array 2 on host cn32
Processing data file: inputs/data_2.txt

kamiak$ scancel 1161089

See: /opt/apps/samples/training
Other Types of Jobs

- **Single node shared memory**
  - Multithreaded or OpenMP
  - Threads share memory

- **Multiple nodes**
  - MPI for message passing
  - Tasks do not share memory

- **GPU (Graphics Processing Unit) accelerators**
  - Thousands of tiny pixel cores, and matrix processors
  - Offloads kernel function to run over many data points
  - Requires CUDA, OpenCL, OpenACC

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**Examples**

- **Single node shared memory**
  
  ```
  #SBATCH --nodes=1
  #SBATCH --ntasks=1
  #SBATCH --cpus-per-task=20
  export OMP_NUM_THREADS=$SLURM_CPUS_PER_TASK
  ```

- **Multiple nodes**
  
  ```
  #SBATCH --nodes=1-2
  #SBATCH --ntasks=4
  #SBATCH --cpus-per-task=1
  ```

- **GPU (Graphics Processing Unit) accelerators**
  
  ```
  #SBATCH --nodes=1
  #SBATCH --ntasks=1
  #SBATCH --cpus-per-task=1
  #SBATCH --gres=gpu:tesla:1
  ```

---

See samples in:

```
/opt/apps/samples/advanced
```
Kamiak has many software packages already installed and available for use. "module" commands set up the environment for your software to run:
- Adds programs to your executable search path
- Pulls in any software dependencies

- `module avail python3` # See available python3 modules
- `module load python3` # Load latest version
- `module list` # See loaded modules
- `module unload python3` # Unload a module
- `module load python3/3.4.3` # Load specific version *(Recommended)*
- `module list` # See loaded modules
- `module avail` # See available modules for compiler
- `module spider` # See all modules
- `module whatis anaconda3` # See what a module does
- `module help anaconda3` # See help for a module
- `which python3` # See that python is in your path
- `printenv PATH` # See effects of loading modules
- `printenv LD_LIBRARY_PATH`
Kamiak Storage

- Kamiak has 4 types of storage available to users:
  - `/home/your.netid` 100GB per user
  - `/data/pi.name` 500GB per PI lab (e.g., `/data/clark`)
    - Extra storage is available for rent from CIRC service center
  - `/scratch` Temporary storage, available to all users
  - `/local` Temporary storage on node, for all users

![Diagram of storage and network connections]
• Use `mkworkspace` to create a scratch directory that expires in two weeks
  
  ```bash
  export myscratch="$(mkworkspace)"
  ```
  - Can be used inside a job script, for faster staging or a larger storage space

• Use `mkworkspace -b /local` to create a scratch directory on a node’s SSD
  
  ```bash
  export myscratch="$(mkworkspace -b /local)"
  ```

• Use `lsworkspace` to list your scratch allocations (can also just use `ls`)
  
  ```bash
  lsworkspace -v
  ls -ld /scratch/${USER}*
  ```

• Just use `rm` to delete your scratch directory when done
  
  ```bash
  rm -r -l $myscratch
  ```
The Center for Institutional Research Computing (CIRC) provides cutting-edge high-performance computing (HPC) resources and expertise to advance computational and data-intensive research across WSU. CIRC's goal is to propel WSU into a position of national leadership in research computing by providing state-of-the-art HPC hardware and software infrastructure and a world-class team that supports its effective utilization and fosters computational literacy. Our services include support, guidance, and training in the use of the HPC cluster, application development and deployment, and investing in nodes and storage.
1. **My job never ran and it didn’t create output files.**
   * Check in the directory where you submitted the job, by default Slurm will place output files there?

2. **“Requested node configuration is not available”**
   * Your resource request is wrong (e.g. asks for more cores per node than exist) or the nodes with enough resources are offline (check `sinfo`).

3. **My queue/partition is busy and my jobs are waiting too long.**
   * Use smaller jobs which are easier for Slurm to find resources for.
   * Switch to a partition with available resources, such as backfill.

4. **My GPU job won’t run, it says there are no CUDA capable devices.**
   * Ensure you requested a GPU with the `--gres` option of `sbatch`.

5. **My jobs get cancelled with a memory error.**
   * Use `--mem` or `--mem-per-cpu` options of `sbatch` to request more memory.
   * `sacct -u your.name -o jobid,reqmem,maxrss,state,nodelist` to see how much memory you used (`maxRSS` is per task)
Being a Good User

Kamiak is a shared cluster for all of WSU and your access to it is a privilege. Its resources are finite and care must be taken to ensure its continued usefulness for yourself and the greater research community.

Do

- Cite Kamiak in your work
- Report issues via Kamiak’s Service Desk
- Abide by Kamiak’s End User License Agreement and WSU policies
- Use accurate resource requirements (CPU, time, memory)

Don’t

- Do not run intensive workloads (computing, installs, or long-running file transfers) on a login node, use `sbatch` or `idev` to run on a compute node
- Do not submit thousands of jobs – use job arrays
- Do not give your password to anyone, ever
Purchasing Nodes and Renting Extra Storage

- All users have access to the backfill queue, /home and /scratch storage, and any /data storage made available by their PI
- If you need more → have your PI become an investor
- Submit a service request to purchase nodes or rent extra storage
  - *Nodes are permanently owned by the investor with a 5-year warranty*
  - *Storage can be rented in units of 512GB per year*

### Standard Compute Nodes

Please note that these prices are estimates and are subject to change.

If you are planning on purchasing a node or applying for grant funding, please contact our Service Desk for up to date pricing and availability, or alternate configurations (e.g. different RAM configurations).

<table>
<thead>
<tr>
<th>Processors</th>
<th>Cores per Node</th>
<th>Memory</th>
<th>Local Disk</th>
<th>Network cards</th>
<th>Warranty/Service Term</th>
<th>Budgetary Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dual Intel Xeon Gold 6230</td>
<td>40</td>
<td>384GB, 2933 MT/s DDR4</td>
<td>1 x 480GB SSD</td>
<td>• 10Gb SFP+</td>
<td>5 years</td>
<td>$15,100</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• 100Gb InfiniBand</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dual Intel Xeon Gold 6230</td>
<td>40</td>
<td>192GB, 2933 MT/s DDR4</td>
<td>1 x 480GB SSD</td>
<td>• 10Gb SFP+</td>
<td>5 years</td>
<td>$12,200</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• 100Gb InfiniBand</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
• We will be sending out a qualtrix survey to get your feedback about this training event

• Other training sessions are planned throughout the year – let us know in the survey what topics would be of interest

• Other ways to learn more and participate in Kamiak governance:
  - CIRC Advisory Committee - share your ideas with its members
  - WSU HPC club - 4 nodes purchased through Tech Fee grant
Transferring Files - `scp`

```
sumo(10110) %scp -r peter.mills@kamiak.wsu.edu:/opt/apps/samples/training ./
peter.mills@kamiak.wsu.edu's password:
data_2.txt       100%  29  10.2KB/s   00:00
data_1.txt       100%  29  8.5KB/s   00:00
data_0.txt       100%  29  8.2KB/s   00:00
setup.sh         100% 156  83.6KB/s   00:00
jobArray.sh      100% 1252 590.4KB/s   00:00
myJob.sh         100%  999  504.2KB/s   00:00
helloWorld.py    100%  611  302.3KB/s   00:00
sumo(10111) %

sumo(10116) %scp -r training peter.mills@kamiak.wsu.edu:~/
peter.mills@kamiak.wsu.edu's password:
helloWorld.py    100%  611  68.0KB/s   00:00
data_0.txt       100%  29  3.9KB/s   00:00
data_1.txt       100%  29  4.6KB/s   00:00
data_2.txt       100%  29  4.9KB/s   00:00
jobArray.sh      100% 1252 116.8KB/s   00:00
myJob.sh         100%  999  110.7KB/s   00:00
setup.sh         100% 156  18.5KB/s   00:00
sumo(10117) %
```
Batch Job Script

```
#!/bin/bash
#SBATCH --partition=kamiak     # Partition/Queue to use
#SBATCH --job-name=myJob      # Job name
#SBATCH --output=myJob_%j.out  # Output file (stdout)
#SBATCH --error=myJob_%j.err   # Error file (stderr)
#SBATCH --mail-type=ALL       # Email notification: BEGIN,END,FAIL,ALL
#SBATCH --job-name=myJob      # Job name
#SBATCH --time=7-00:00:00      # Wall clock time limit Days-HH:MM:SS
#SBATCH --nodes=1              # Number of nodes (min-max) Where (layout)
#SBATCH --ntasks-per-node=1    # Number of tasks per node (max)
#SBATCH --ntasks=1             # Number of tasks (processes) What (cpus)
#SBATCH --cpus-per-task=2      # Number of cores per task (threads)

echo "I am job $SLURM_JOBID running on nodes $SLURM_JOB_NODELIST"

module load python/2.7.15   # Load software module from Kamiak repository
srun python helloWorld.py -w # Each task runs this program (total 1 times)
                             # Each srun is a job step, and spawns -ntasks

echo "Completed job on node $HOSTNAME"
```
Submitting, Viewing, and Canceling Batch Jobs

```bash
ekamiak$ sbatch myJob.sh
Submitted batch job 1160269

kamiak$ squeue -u peter.mills
  JOBID   PARTITION     NAME     USER ST       TIME  NODES NODELIST(REASON)
  1160269  kamiak myJob  peter.mi PD       0:00      1 (Priority)

kamiak$ squeue -u peter.mills
  JOBID   PARTITION     NAME     USER ST       TIME  NODES NODELIST(REASON)
  1160269  kamiak myJob  peter.mi  R       0:02      1 cn93

kamiak$ squeue -j 1160269
  JOBID   PARTITION     NAME     USER ST       TIME  NODES NODELIST(REASON)
  1160269  kamiak myJob  peter.mi  R       0:17      1 cn93

kamiak$ cat myJob_1160269.out
I am job 1160269 running on nodes cn93
Hello World! from cn93

kamiak$ scancel 1160269
```

See also: `man sbatch`
### Viewing Job History and Details

**kamiak$ sacct -S 10/26/20 -u peter.mills**

<table>
<thead>
<tr>
<th>JobID</th>
<th>JobName</th>
<th>Partition</th>
<th>Account</th>
<th>AllocCPUS</th>
<th>State</th>
<th>ExitCode</th>
</tr>
</thead>
<tbody>
<tr>
<td>1160269</td>
<td>myJob</td>
<td>kamiak</td>
<td>circ</td>
<td>2</td>
<td>CANCELLED+</td>
<td>0:0</td>
</tr>
<tr>
<td>1160269.bat+</td>
<td>batch</td>
<td>circ</td>
<td>2</td>
<td>CANCELLED</td>
<td>0:20</td>
<td></td>
</tr>
<tr>
<td>1160269.0</td>
<td>python</td>
<td>circ</td>
<td>2</td>
<td>CANCELLED</td>
<td>0:20</td>
<td></td>
</tr>
</tbody>
</table>

**kamiak$ scontrol show job 1160269**

JobId=1160269  JobName=myJob

- **UserId=peter.mills (8316)**
- **GroupId=its_p_sys_ur_kam-circ (7060)**
- **MCS_label=N/A**
- **Priority=4294680391**
- **Nice=0**
- **Account=circ**
- **QOS=normal**
- **JobState=TIMEOUT**
- **Reason=TimeLimit**
- **Dependency=(null)**
- **Requeue=1**
- **Restarts=0**
- **BatchFlag=1**
- **Reboot=0**
- **ExitCode=0:15**
- **RunTime=00:01:20**
- **TimeLimit=00:01:00**
- **TimeMin=N/A**
- **SubmitTime=2020-02-26T13:56:50**
- **EligibleTime=2020-02-26T13:56:50**
- **StartTime=2020-02-26T13:57:03**
- **EndTime=2020-02-26T13:58:23**
- **Deadline=N/A**
- **Partition=kamiak**
- **AllocNode:Sid=login-p1n02:33414**
- **NodeList=cn93**
- **BatchHost=cn93**
- **NumNodes=1**
- **NumCPUs=2**
- **NumTasks=1**
- **CPUs/Task=2**
- **ReqB:S:C:T=0:0:*:***
- **TRES=cpu=2,mem=16G,node=1**
- **Gres=(null)**
- **Reservation=(null)**
- **Command=/home/peter.mills/training/myJob.sh**
- **WorkDir=/home/peter.mills/training**
- **StdErr=/home/peter.mills/training/myJob_1160269.err**
- **StdIn=/dev/null**
- **StdOut=/home/peter.mills/training/myJob_1160269.out**
## Viewing Available Partitions

```
kamiak$ sinfo -a | more
```

<table>
<thead>
<tr>
<th>PARTITION</th>
<th>AVAIL</th>
<th>TIMELIMIT</th>
<th>NODES</th>
<th>STATE</th>
<th>NODELIST</th>
</tr>
</thead>
<tbody>
<tr>
<td>cahnrs</td>
<td>up</td>
<td>7-00:00:00</td>
<td>1</td>
<td>mix</td>
<td>cn9</td>
</tr>
<tr>
<td>cahnrs</td>
<td>up</td>
<td>7-00:00:00</td>
<td>10</td>
<td>alloc</td>
<td>cn[1-8,10-11]</td>
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<tr>
<td>cahnrs_bigmem</td>
<td>up</td>
<td>7-00:00:00</td>
<td>1</td>
<td>mix</td>
<td>sn4</td>
</tr>
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<td>cahnrs_gpu</td>
<td>up</td>
<td>7-00:00:00</td>
<td>1</td>
<td>mix</td>
<td>sn2</td>
</tr>
<tr>
<td>cas</td>
<td>up</td>
<td>7-00:00:00</td>
<td>2</td>
<td>mix</td>
<td>cn[23-24]</td>
</tr>
<tr>
<td>cas</td>
<td>up</td>
<td>7-00:00:00</td>
<td>9</td>
<td>alloc</td>
<td>cn[14-15,17-2]</td>
</tr>
<tr>
<td>cas</td>
<td>up</td>
<td>7-00:00:00</td>
<td>1</td>
<td>down</td>
<td>cn16</td>
</tr>
<tr>
<td>clark</td>
<td>up</td>
<td>7-00:00:00</td>
<td>5</td>
<td>idle</td>
<td>cn[80-84]</td>
</tr>
<tr>
<td>test</td>
<td>up</td>
<td>4:00:00</td>
<td>1</td>
<td>mix</td>
<td>cn32</td>
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<tr>
<td>test</td>
<td>up</td>
<td>4:00:00</td>
<td>1</td>
<td>alloc</td>
<td>cn33</td>
</tr>
<tr>
<td>free_gpu</td>
<td>up</td>
<td>7-00:00:00</td>
<td>1</td>
<td>mix</td>
<td>sn3</td>
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<tr>
<td>free_phi</td>
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<td>7-00:00:00</td>
<td>1</td>
<td>resv</td>
<td>sn1</td>
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<tr>
<td>kamiak*</td>
<td>up</td>
<td>7-00:00:00</td>
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<td>maint</td>
<td>cn72</td>
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<tr>
<td>kamiak*</td>
<td>up</td>
<td>7-00:00:00</td>
<td>27</td>
<td>mix</td>
<td>cn[9,12-13,23-]</td>
</tr>
<tr>
<td>kamiak*</td>
<td>up</td>
<td>7-00:00:00</td>
<td>34</td>
<td>alloc</td>
<td>cn[1-8,10-11,]</td>
</tr>
<tr>
<td>kamiak*</td>
<td>up</td>
<td>7-00:00:00</td>
<td>30</td>
<td>idle</td>
<td>cn[53-71,80,]</td>
</tr>
<tr>
<td>kamiak*</td>
<td>up</td>
<td>7-00:00:00</td>
<td>1</td>
<td>down</td>
<td>cn16</td>
</tr>
</tbody>
</table>

See also: https://hpc.wsu.edu/queue-list
### Viewing the Job Queue

```bash
kamiak$ squeue -a | more
```

<table>
<thead>
<tr>
<th>JOBID</th>
<th>PARTITION</th>
<th>NAME</th>
<th>USER</th>
<th>ST</th>
<th>TIME</th>
<th>NODES</th>
<th>NODELIST (REASON)</th>
</tr>
</thead>
<tbody>
<tr>
<td>474239</td>
<td>cas</td>
<td>tp4</td>
<td>craig.te</td>
<td>PD</td>
<td>0:00</td>
<td>2</td>
<td>(Resources)</td>
</tr>
<tr>
<td>474240</td>
<td>cas</td>
<td>tp5</td>
<td>craig.te</td>
<td>PD</td>
<td>0:00</td>
<td>2</td>
<td>(Priority)</td>
</tr>
<tr>
<td>474241</td>
<td>cas</td>
<td>tp6</td>
<td>craig.te</td>
<td>PD</td>
<td>0:00</td>
<td>2</td>
<td>(Priority)</td>
</tr>
<tr>
<td>471077</td>
<td>popgenom</td>
<td>BFS.3L.i</td>
<td>joel.t.n</td>
<td>R</td>
<td>9-03:34:38</td>
<td>1</td>
<td>cn77</td>
</tr>
<tr>
<td>471078</td>
<td>popgenom</td>
<td>BFS.2R.i</td>
<td>joel.t.n</td>
<td>R</td>
<td>9-03:34:03</td>
<td>1</td>
<td>cn29</td>
</tr>
<tr>
<td>471079</td>
<td>popgenom</td>
<td>BFS.2L.i</td>
<td>joel.t.n</td>
<td>R</td>
<td>9-03:33:14</td>
<td>1</td>
<td>cn29</td>
</tr>
<tr>
<td>473678</td>
<td>kamiak</td>
<td>cle_6cma</td>
<td>tung.ngu</td>
<td>R</td>
<td>6-05:07:11</td>
<td>1</td>
<td>cn7</td>
</tr>
<tr>
<td>473722</td>
<td>beckman</td>
<td>hydr-vra</td>
<td>hong.zho</td>
<td>R</td>
<td>6-04:28:26</td>
<td>2</td>
<td>[43-44]</td>
</tr>
<tr>
<td>473726</td>
<td>beckman</td>
<td>occ-1na3</td>
<td>hong.zho</td>
<td>R</td>
<td>5-23:37:54</td>
<td>2</td>
<td>[52-53]</td>
</tr>
</tbody>
</table>
Viewing Node Details

kamiak$ scontrol show node cn93
NodeName=cn93 Arch=x86_64 CoresPerSocket=14
    CPUAlloc=20 CPUErr=0 CPUTot=28 CPULoad=22.11
AvailableFeatures=broadwell,e5-2660-v4-2.00ghz,avx2
ActiveFeatures=broadwell,e5-2660-v4-2.00ghz,avx2
Gres=(null)
NodeAddr=cn93 NodeHostName=cn93 Version=17.02
OS=Linux **RealMemory=128658** AllocMem=128000 FreeMem=7234 Sockets=2 Boards=1
State=MIXED ThreadsPerCore=1 TmpDisk=64329 Weight=62000 Owner=N/A MCS_label=N/A
Partitions=clark,adam,storfer,bio534,kamiak
BootTime=2019-11-28T09:00:39 SlurmdStartTime=2019-11-28T09:01:34
CfgTRES=cpu=28,mem=128658M
AllocTRES=cpu=20,mem=125G
CapWatts=n/a
CurrentWatts=125 LowestJoules=15477 ConsumedJoules=1017346137
ExtSensorsJoules=n/s ExtSensorsWatts=0 ExtSensorsTemp=n/s
Job Array Script

```bash
#!/bin/bash

#SBATCH --partition=kamiak       # Partition/Queue to use
#SBATCH --job-name=myJobArray    # Job name
#SBATCH --output=output/myJobArray_%A_%a.out # Output filename, jobid_index
#SBATCH --error=output/myJobArray_%A_%a.err  # Error filename, jobid_index
#SBATCH --time=7-00:00:00         # Wall clock time limit Days-HH:MM:SS
#SBATCH --mail-type=ALL          # Email notification: BEGIN,END,FAIL,ALL
#SBATCH --mail-user=your.name@wsu.edu # Email address for notifications
#SBATCH --array=0-2:1             # Number of jobs, in steps of 1

#SBATCH --nodes=1                # Number of nodes (min-max)
#SBATCH --ntasks-per-node=1      # Number of tasks per node (max)
#SBATCH --cpus-per-task=1        # Number of cores per task (threads)
#SBATCH --mem-per-cpu=8G         # Memory per core (gigabytes)

# Runs this job 3 times, with index SLURM_ARRAY_TASK_ID as 0,1,2
# Split your data into 3 files, name them data_0.txt, data_1.txt, data_2.txt
# Each job array step is scheduled as an individual job
# Each job array step is allocated the above resources (cores, memory)

echo "Starting job array $SLURM_ARRAY_TASK_ID on host $HOSTNAME"

module load python
srun python helloWorld.py -w "inputs/data_${SLURM_ARRAY_TASK_ID}.txt"

echo "Completed job array $SLURM_ARRAY_TASK_ID on host $HOSTNAME"
```
### Available Software Modules on Kamiak

---

#### Compilers

- **StdEnv (L)**
  - gcc/5.2.0
  - intel/xe_2016_update2
- **gcc/4.9.3**
  - gcc/6.1.0 (D)
  - intel/xe_2016_update3 (L,D)

---

#### intel/xe_2016_update3 Software

- bazel/0.4.2
- fftw/3.3.4
- netcdf/4
- cmake/3.7.2
- gromacs/2016.2_mdrun
- nwchem/6.6
- corset/1.06
- gromacs/2016.2_mpi (D)
- octave/4.0.1
- eems/8ee979b
- hdf5/1.8.16
- siesta/4.0_mpi
- elpa/2016.05.003
- lammps/16feb16
- stacks/1.44
- espresso/5.3.0
- mvapich2/2.2

---

#### Other Software

- anaconda2/2.4.0
- lmod/6.0.1
- anaconda2/4.2.0 (D)
- lobster/2.1.0
- anaconda3/2.4.0
- mercurial/3.7.3-1
- anaconda3/4.2.0 (D)
- music/4.0
- bamtools/2.4.1
- mzmine/2.23
- binutils/2.25.1
- netapp/5.4p1
- blast/2.2.26
- netapp/5.5 (D)
- bonnie++/1.03e
- octave/4.2.0 (D)
- boost/1.59.0
- openblas/0.2.18_barcelona
- bowtie/1.1.2
- openblas/0.2.18_haswell
- canu/1.3
- openblas/0.2.18 (D)
- cast/dbf2ec2
- orangefs/2.9.6
- cp2k/4.1_pre_openmp
- parmetis/4.0.3
Available Software Modules on Kamiak (Cont’d)

---------------------------------- Other Software ----------------------------------
  jemalloc/4.4.0            (D)  trinity/2.2.0
  laszip/2.2.0          valgrind/3.11.0
  libgeotiff/1.4.0      workspace_maker/master  (L,D)
  libint/1.1.4            workspace_maker/1.1b
  libkml/1.3.0          workspace_maker/1.1
  liblas/1.8.0          workspace_maker/1.2
  libspatialite/4.3.0a  zlib/1.2.11
  libxsmm/1.4.4

---------------------------------- Licensed Software ----------------------------------
  clc_genomics_workbench/6.0.1        gaussian/09.d.01  vasp/5.4.4
  clc_genomics_workbench/8.5.1 (D)  green/1.0
  dl_polly/4.08                 stata/14

Where:
  D: Default Module
  L: Module is loaded

Use "module spider" to find all possible modules.
Use "module keyword key1 key2 ..." to search for all possible modules
matching any of the "keys".