Documentation for StarCCM

Integration on Ganymede

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Introduction

Since everyone on the team is starting from a different place with respect to knowledge of Linux systems and specifically HPC systems, this documentation is written to provide a foundation for all members to learn and utilize the system. The goal is for this documentation to provide universal and reproducible results so anyone can start running simulations on Ganymede as efficiently as possible. This will correlate with the docs already written by CIRC while offering more details on Linux systems and using StarCCM in particular.

Installing the VPN

Since CIRC already offers great documentation on connecting to Ganymede, this will mainly detail possible errors and ideas to keep in mind while following their docs, and I do not have a Mac to test on. First, you have to download and connect to the UTD VPN if you are not on Cometnet in order to connect to Ganymede. The Global Protect VPN is notorious for being buggy, so beware that it will probably not work the first install.

- **Linux**

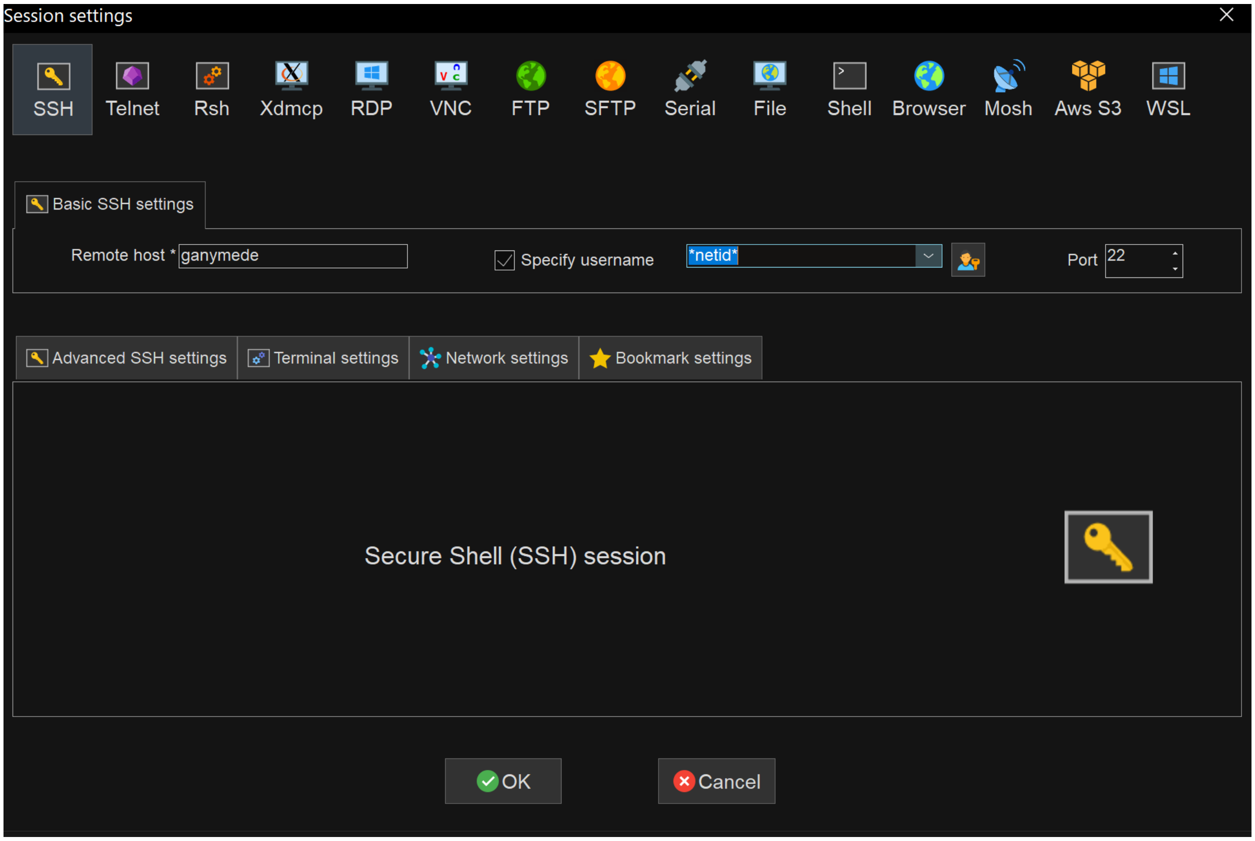
While Linux systems provide the easiest method to connect to Ganymede, it is recommended to use MacOS or Windows to download the VPN as at least on Fedora 36, Global Protect will not connect. CIRC does state that Linux is supported so your mileage may vary.

- **Windows**

The Windows install for the VPN is much simpler, but may still cause issues when trying to connect. The first install on several systems tested, has returned a stale web request error when signing in to the UTD SSO. This can normally be fixed by uninstalling and reinstalling. If the error persists, changing your default browser to google chrome seems to work consistently.

Terminal Client

Ganymede requires either a terminal client to access it or a program such as X2Go which provides a virtual desktop over SSH. Both Linux and MacOS have their own built-in terminal so use using them will be easiest. For everyone else on Windows, MobaXTerm will be the easiest to quickly setup and access and share files with Ganymede. Assuming you are using MobaXTerm, you can right click on the left side under "User Sessions" then click "New Session". A window will appear where you will click on SSH at the top left.



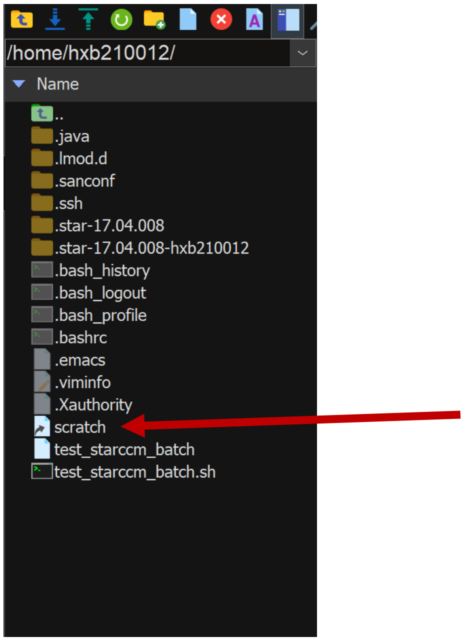
Remote host * ganymede

☑ Specify username *netid*

Port 22

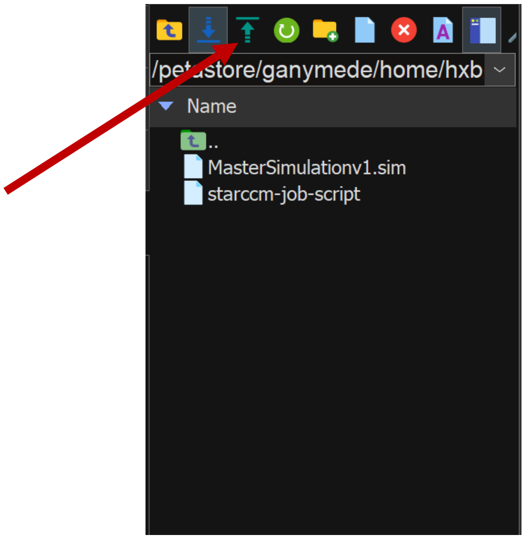
In the "Remote host" box type <ganymede> as shown, then check the specify username and enter your netid in the box and click "OK" when done. This will allow you automatically connect to Ganymede when you double click on the new session you created. After running the session for the first time, you will see a line asking for you to enter your password. Do note that Linux terminals will not show the characters you type. Once you type in your password and hit enter, a box will appear asking if you want to remember the password on this system. Clicking yes will save the password allowing you to connect to Ganymede by only double clicking the session.

Ganymede Basics



```
/home/hxb210012/
Name
..
.java
.lmod.d
.sanconf
.ssh
.star-17.04.008
.star-17.04.008-hxb210012
.bash_history
.bash_logout
.bash_profile
.bashrc
.emacs
.viminfo
.Xauthority
scratch
test_starccm_batch
test_starccm_batch.sh
```

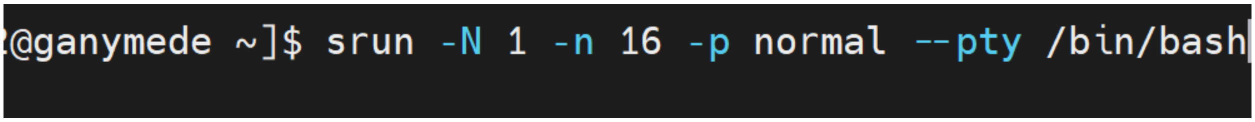
For our purposes, Ganymede has two file systems that we have access to. The first is the home directory where you are in when you login. Each user only has 20GB allocated in here and has serious bandwidth limitations for larger scripts. Since each simulation we run will be multiple GBs in size and intensive, all files should be stored in the scratch directory. Every user has their own scratch directory and there are no limits on the size each user has. In addition to the different storage spaces, there are two different nodes we have access to. When we connect to Ganymede, we are connected to the login node which hands connections and works with Slurm, the job scheduler, to run jobs on a compute node; however, for every computational task we need to run it on a compute node. CIRC gives more details on exactly the specs of the systems and also gives examples for manipulating files from the command line, so go there first for any question not covered here. Because most of the users will be running MobaXTerm, this will give explain moving files using its GUI. The easiest way to upload files from your computer to your scratch directory is to click on the icon that says "scratch" on the left side of the screen. Once the scratch directory is listed, right click followed by "upload to current folder" which will bring up a normal windows file explorer where you can search for the file you want to upload. You can also click third icon at the top of the directory to upload to the current directory.



To go back to the home directory view you can click on the drop down menu and click "/home/netid".

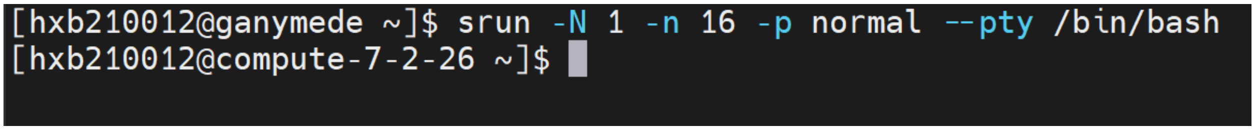
Accessing a Compute Node

In order to run our simulations, we have to connect to a compute node. For the moment, we cannot use multiple nodes in parallel to run our jobs, but it is possible so this will be updated when that is available. We have two main methods to access a compute node, srun and salloc. Since Ganymede uses the job scheduler slurm, these commands will all start with a s. Srun is the easier to understand option and is invoked by typing this into the terminal.



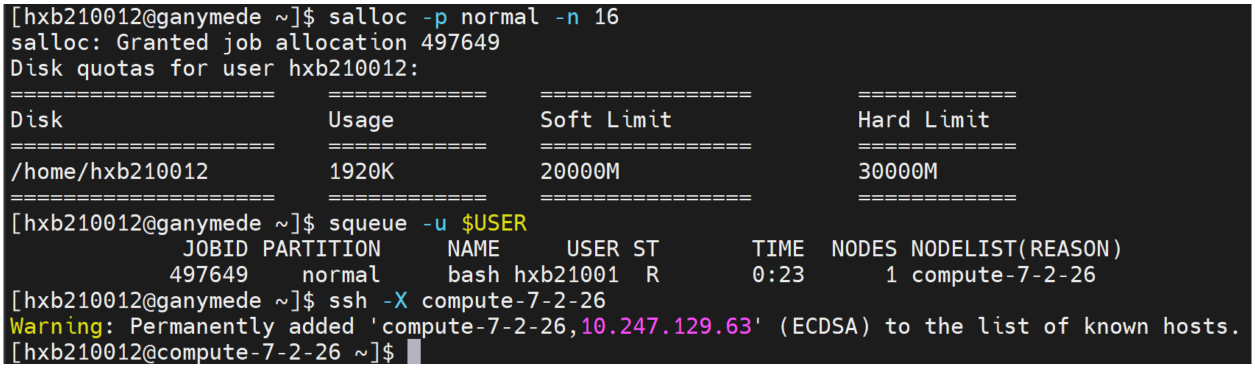
```
@ganymede ~]$ srun -N 1 -n 16 -p normal --pty /bin/bash
```

Srun is the slurm command to ask for a compute node, -N 1 asks for 1 node, -n 16 gives us all 16 cores from that 1 node, -p normal allocates us the normal partition, and –pty /bin/bash is needed to allocate the node properly for our use case. After hitting enter, a 1 node will be queued and allocated to you when available. You know you are in a compute node when you see @compute-x-x-xx.



```
[hxb210012@ganymede ~]$ srun -N 1 -n 16 -p normal --pty /bin/bash
[hxb210012@compute-7-2-26 ~]$ 
```

The second method is using salloc followed by squeue to access the node.

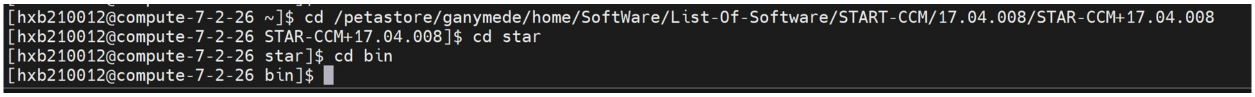


```
[hxb210012@ganymede ~]$ salloc -p normal -n 16
salloc: Granted job allocation 497649
Disk quotas for user hxb210012:
====================    ============    ================        ============
Disk                    Usage           Soft Limit              Hard Limit
====================    ============    ================        ============
/home/hxb210012         1920K           20000M                  30000M
====================    ============    ================        ============
[hxb210012@ganymede ~]$ squeue -u $USER
             JOBID PARTITION     NAME     USER ST       TIME  NODES NODELIST(REASON)
            497649    normal     bash hxb21001  R       0:23      1 compute-7-2-26
[hxb210012@ganymede ~]$ ssh -X compute-7-2-26
Warning: Permanently added 'compute-7-2-26,10.247.129.63' (ECDSA) to the list of known hosts.
[hxb210012@compute-7-2-26 ~]$ 
```

Salloc -p normal -n 16 uses the same options as srun shown above. This allocates a compute node to the user. Squeue displays the compute node you are allocated with -u $USER specifying your account. Then you can type ssh -X node_name to connect into the compute node.

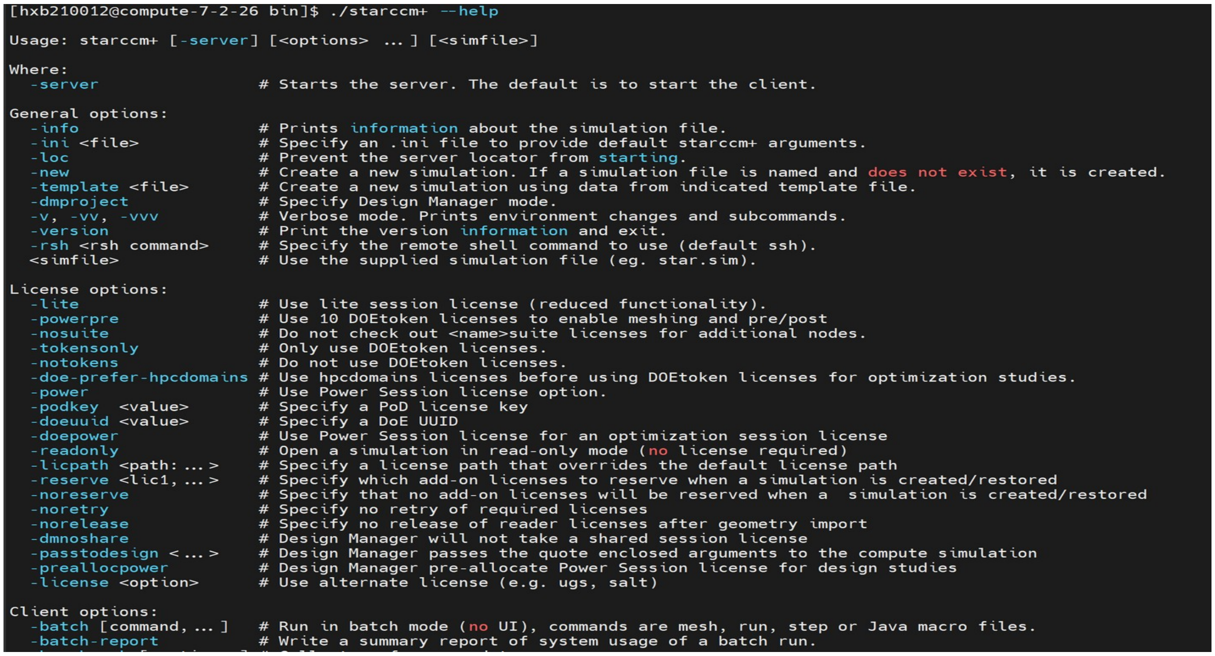
Accessing StarCCM+

To change directory into where the executable of star is located, you type:



```
[hxb210012@compute-7-2-26 ~]$ cd /petastore/ganymede/home/SoftWare/List-Of-Software/START-CCM/17.04.008/STAR-CCM+17.04.008
[hxb210012@compute-7-2-26 STAR-CCM+17.04.008]$ cd star
[hxb210012@compute-7-2-26 star]$ cd bin
[hxb210012@compute-7-2-26 bin]$ 
```

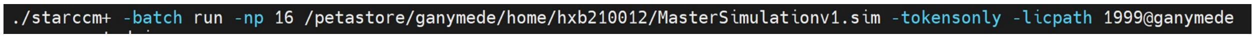
Now that you have access to the executable you can start running simulations. To run star you type "./starccm+" at the start of the line. Typing "./starccm+ --help" displays the command proc and info and what each parameter does in star.



```
[hxb210012@compute-7-2-26 bin]$ ./starccm+ --help

Usage: starccm+ [-server] [<options> ... ] [<simfile>]

Where:
  -server                 # Starts the server. The default is to start the client.

General options:
  -info                   # Prints information about the simulation file.
  -ini <file>             # Specify an .ini file to provide default starccm+ arguments.
  -loc                    # Prevent the server locator from starting.
  -new                    # Create a new simulation. If a simulation file is named and does not exist, it is created.
  -template <file>        # Create a new simulation using data from indicated template file.
  -dmproject              # Specify Design Manager mode.
  -v, -vv, -vvv           # Verbose mode. Prints environment changes and subcommands.
  -version                # Print the version information and exit.
  -rsh <rsh command>      # Specify the remote shell command to use (default ssh).
  <simfile>               # Use the supplied simulation file (eg. star.sim).

License options:
  -lite                   # Use lite session license (reduced functionality).
  -powerpre               # Use 10 DOEtoken licenses to enable meshing and pre/post
  -nosuite                # Do not check out <name>suite licenses for additional nodes.
  -tokensonly             # Only use DOEtoken licenses.
  -notokens               # Do not use DOEtoken licenses.
  -doe-prefer-hpcdomains # Use hpcdomains licenses before using DOEtoken licenses for optimization studies.
  -power                  # Use Power Session license option.
  -podkey  <value>        # Specify a PoD license key
  -doeuuid <value>        # Specify a DoE UUID
  -doepower               # Use Power Session license for an optimization session license
  -readonly               # Open a simulation in read-only mode (no license required)
  -licpath <path: ... >   # Specify a license path that overrides the default license path
  -reserve <lic1, ... >   # Specify which add-on licenses to reserve when a simulation is created/restored
  -noreserve              # Specify that no add-on licenses will be reserved when a  simulation is created/restored
  -noretry                # Specify no retry of required licenses
  -norelease              # Specify no release of reader licenses after geometry import
  -dmnoshare              # Design Manager will not take a shared session license
  -passtodesign < ... >   # Design Manager passes the quote enclosed arguments to the compute simulation
  -preallocpower          # Design Manager pre-allocate Power Session license for design studies
  -license <option>       # Use alternate license (e.g. ugs, salt)

Client options:
  -batch [command, ... ]  # Run in batch mode (no UI), commands are mesh, run, step or Java macro files.
  -batch-report           # Write a summary report of system usage of a batch run.
```

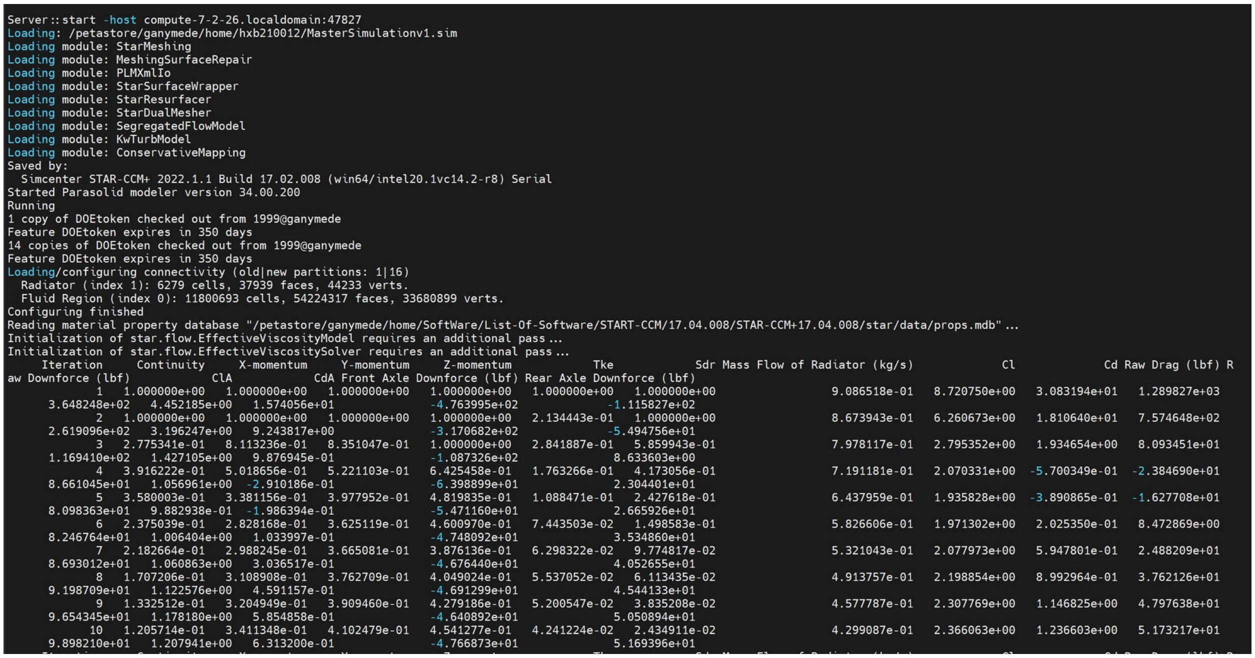
Running Simulations

There are many different options and methods to running simulations, but this will detail the easiest method until I have time to test them and update here. Simplest method is to type "./starccm+ -batch run -np 16 <location and name of .sim file> -tokensonly -licpath 1999@ganymede".



```
./starccm+ -batch run -np 16 /petastore/ganymede/home/hxb210012/MasterSimulationv1.sim -tokensonly -licpath 1999@ganymede
```

Once the simulation starts you should see something like this



```
Server::start -host compute-7-2-26.localdomain:47827
Loading: /petastore/ganymede/home/hxb210012/MasterSimulationv1.sim
Loading module: StarMeshing
Loading module: MeshingSurfaceRepair
Loading module: PLMXmlIo
Loading module: StarSurfaceWrapper
Loading module: StarResurfacer
Loading module: StarDualMesher
Loading module: SegregatedFlowModel
Loading module: KwTurbModel
Loading module: ConservativeMapping
Saved by:
  Simcenter STAR-CCM+ 2022.1.1 Build 17.02.008 (win64/intel20.1vc14.2-r8) Serial
Started Parasolid modeler version 34.00.200
Running
1 copy of DOEtoken checked out from 1999@ganymede
Feature DOEtoken expires in 350 days
14 copies of DOEtoken checked out from 1999@ganymede
Feature DOEtoken expires in 350 days
Loading/configuring connectivity (old|new partitions: 1|16)
  Radiator (index 1): 6279 cells, 37939 faces, 44233 verts.
  Fluid Region (index 0): 11800693 cells, 54224317 faces, 33680899 verts.
Configuring finished
Reading material property database "/petastore/ganymede/home/SoftWare/List-Of-Software/START-CCM/17.04.008/STAR-CCM+17.04.008/star/data/props.mdb" ...
Initialization of star.flow.EffectiveViscosityModel requires an additional pass ...
Initialization of star.flow.EffectiveViscositySolver requires an additional pass ...
     Iteration     Continuity     X-momentum     Y-momentum     Z-momentum            Tke            Sdr Mass Flow of Radiator (kg/s)             Cl             Cd Raw Drag (lbf) R
aw Downforce (lbf)            ClA            CdA Front Axle Downforce (lbf) Rear Axle Downforce (lbf)
             1   1.000000e+00   1.000000e+00   1.000000e+00   1.000000e+00   1.000000e+00   1.000000e+00                 9.086518e-01   8.720750e+00   3.083194e+01   1.289827e+03
      3.648248e+02   4.452185e+00   1.574056e+01              -4.763995e+02             -1.115827e+02
             2   1.000000e+00   1.000000e+00   1.000000e+00   1.000000e+00   2.134443e-01   1.000000e+00                 8.673943e-01   6.260673e+00   1.810640e+01   7.574648e+02
      2.619096e+02   3.196247e+00   9.243817e+00              -3.170682e+02             -5.494756e+01
             3   2.775341e-01   8.113236e-01   8.351047e-01   1.000000e+00   2.841887e-01   5.859943e-01                 7.978117e-01   2.795352e+00   1.934654e+00   8.093451e+01
      1.169410e+02   1.427105e+00   9.876945e-01              -1.087326e+02              8.633603e+00
             4   3.916222e-01   5.018656e-01   5.221103e-01   6.425458e-01   1.763266e-01   4.173056e-01                 7.191181e-01   2.070331e+00  -5.700349e-01  -2.384690e+01
      8.661045e+01   1.056961e+00  -2.910186e-01              -6.398899e+01              2.304401e+01
             5   3.580003e-01   3.381156e-01   3.977952e-01   4.819835e-01   1.088471e-01   2.427618e-01                 6.437959e-01   1.935828e+00  -3.890865e-01  -1.627708e+01
      8.098363e+01   9.882938e-01  -1.986394e-01              -5.471160e+01              2.665926e+01
             6   2.375039e-01   2.828168e-01   3.625119e-01   4.600970e-01   7.443503e-02   1.498583e-01                 5.826606e-01   1.971302e+00   2.025350e-01   8.472869e+00
      8.246764e+01   1.006404e+00   1.033997e-01              -4.748092e+01              3.534860e+01
             7   2.182664e-01   2.988245e-01   3.665081e-01   3.876136e-01   6.298322e-02   9.774817e-02                 5.321043e-01   2.077973e+00   5.947801e-01   2.488209e+01
      8.693012e+01   1.060863e+00   3.036517e-01              -4.676440e+01              4.052655e+01
             8   1.707206e-01   3.108908e-01   3.762709e-01   4.049024e-01   5.537052e-02   6.113435e-02                 4.913757e-01   2.198854e+00   8.992964e-01   3.762126e+01
      9.198709e+01   1.122576e+00   4.591157e-01              -4.691299e+01              4.544133e+01
             9   1.332512e-01   3.204949e-01   3.909460e-01   4.279186e-01   5.200547e-02   3.835208e-02                 4.577787e-01   2.307769e+00   1.146825e+00   4.797638e+01
      9.654345e+01   1.178180e+00   5.854858e-01              -4.640892e+01              5.050894e+01
            10   1.205714e-01   3.411348e-01   4.102479e-01   4.541277e-01   4.241224e-02   2.434911e-02                 4.299087e-01   2.366063e+00   1.236603e+00   5.173217e+01
      9.898210e+01   1.207941e+00   6.313200e-01              -4.766873e+01              5.169396e+01
```

Breakdown of the command:

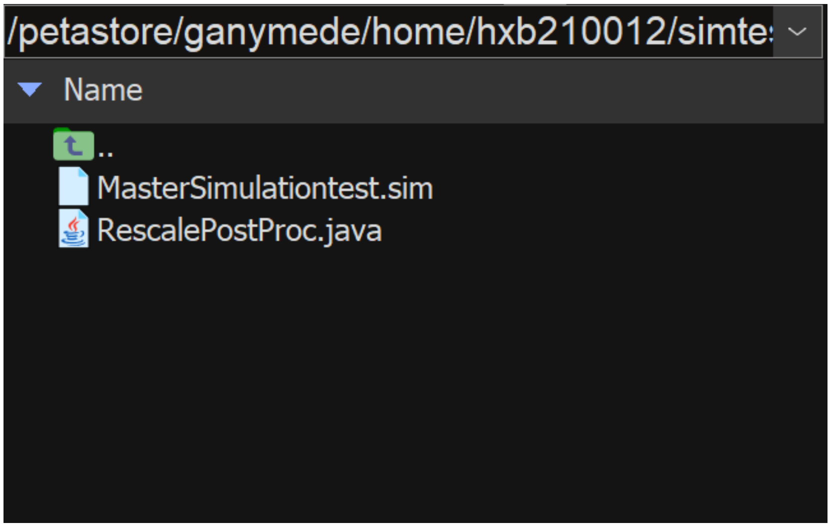
- “./starccm+”
  - Starts the executable for star
- “-batch run”
  - Batch opens star without the GUI
  - -run tells the solver to run until the stopping criteria is met

- “-np 16”
    - -np 16 runs star using 16 cores
        - 16 is chosen since it is the max per the one node we are using, but fewer can be used
- “/petastore/ganymede/home/<netid>/MasterSimulationv1.sim”
    - Represents the absolute file path to the simulation file we are trying to use
- “-tokensonly”
    - Specifies to only use DOEtoken licenses
- “-licpath 1999@ganymede”
    - Specifies to use the license of Star: 1999@ganymede

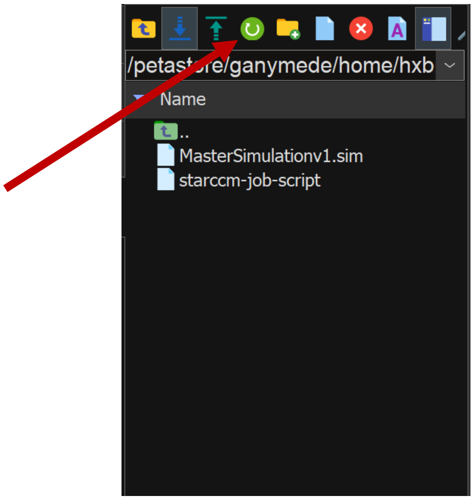
Running Batch Scripts

While the method above is fine for running a single short simulation with only one node, we will not always have the time to wait for resources to become available, so we can use batch scripts to queue and run our simulations automatically.

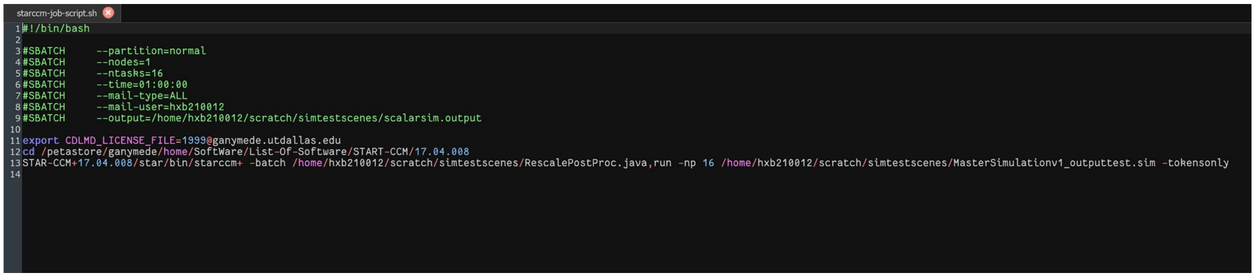
To start, download the .java file, .sh batch file from box under Baseline Simulation/HPC Baseline, and use any .sim file you want. Then go to MobaXTerm (or any other terminal client but this is for Moba specifically), click on your scratch directory and right-click to create new directory. Finally, right click or follow the directions earlier to upload the .java file and the .sim file to this folder. It should look something like this: (note /simtest is just the name of the directory I created yours will be different)



Next go back into the scratch directory and upload the .sh file there. You will have to click on the green circle shown below to refresh in order to view the batch file.



Once you see the batch file, double click on it to open the file. You should see this:



```
#!/bin/bash

#SBATCH     --partition=normal
#SBATCH     --nodes=1
#SBATCH     --ntasks=16
#SBATCH     --time=01:00:00
#SBATCH     --mail-type=ALL
#SBATCH     --mail-user=hxb210012
#SBATCH     --output=/home/hxb210012/scratch/simtestscenes/scalarsim.output

export CDLMD_LICENSE_FILE=1999@ganymede.utdallas.edu
cd /petastore/ganymede/home/SoftWare/List-Of-Software/START-CCM/17.04.008
STAR-CCM+17.04.008/star/bin/starccm+ -batch /home/hxb210012/scratch/simtestscenes/RescalePostProc.java,run -np 16 /home/hxb210012/scratch/simtestscenes/MasterSimulationv1_outputtest.sim -tokensonly
```

Before doing anything else, change anywhere you see hxb210012 to your own netid otherwise this will not work.

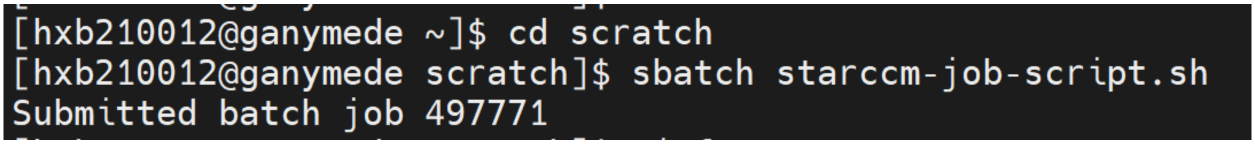
A break down of what each command does:

- “#!/bin/bash”
    - Just tells it to run using the bash shell, for our purposes just means the command line
- “#SBATCH”
    - Specifies to use Slum batch settings
    - “—partition=normal”
        - Requests resources from the normal partition on Ganymede
    - “—nodes=1”
        - Requests for 1 node
    - “—ntasks=16”
        - Requests for 16 cores to be used
    - “—time=01:00:00”
        - Sets a time limit of 1 hour for the simulation
            - hh:mm:ss up to 96 hours
    - “—mail-type=All” and “mail-user=<netid>”
        - Are you used to email you when the system begins and finishes running the simulation
        - optional

- "—output=/home/netid/scratch/simtest/file.output"
    - Outputs a file with details about the simulation
    - It is optional but good for debugging
- "export CDLMD_LICENSE_FILE=1999@ganymede.utdallas.edu"
    - Grabs a license to run the software
- "cd /petastore/ganymede/home/SoftWare/List-Of-Software/START-CCM/17.04.008"
    - Navigates to where star is located
- "STAR-CCM+17.04.008/star/bin/starccm+"
    - Navigates to and runs star
- "-batch /home/netid/scratch/simtest/RescalePostProc.java,run"
    - Runs without the GUI
    - First starts the .java macro file
    - Then runs until the stopping criteria is met
- "-np 16"
    - Requests for all 16 cores of our 1 node to be used
- "/home/netid/scratch/simtest/file.sim"
    - Is the location of the sim file located in the directory you put it in earlier
- "-tokensonly"
    - Specifies to only use DOEtoken licenses

Again, make sure to change it to your own netid for this to work. While you don’t have to place the sim file and java file in their own directory, depending on the simulation you run, it will help to contain all the scenes and files in one place for each simulation. Then save and exit the file.

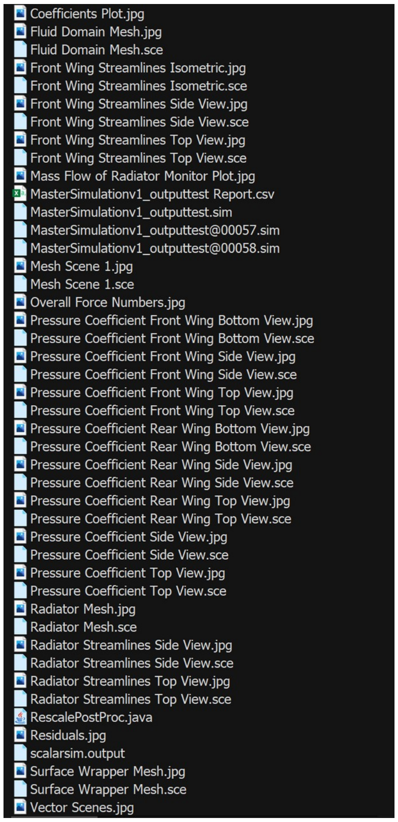
Finally, to run this batch file you only need two commands, cd scratch, and sbatch file.sh.



```
[hxb210012@ganymede ~]$ cd scratch
[hxb210012@ganymede scratch]$ sbatch starccm-job-script.sh
Submitted batch job 497771
```

Your batch file will now be submitted and queued by Slurm. If you opted for the email command before, you should receive emails before and after about the job; otherwise, you can just come back later and refresh the folder until you see the scenes and output file. There is also squeue to view information about the current running jobs.

Example Folder after running the master simulation. (will depend on the simulation file)



```
Coefficients Plot.jpg
Fluid Domain Mesh.jpg
Fluid Domain Mesh.sce
Front Wing Streamlines Isometric.jpg
Front Wing Streamlines Isometric.sce
Front Wing Streamlines Side View.jpg
Front Wing Streamlines Side View.sce
Front Wing Streamlines Top View.jpg
Front Wing Streamlines Top View.sce
Mass Flow of Radiator Monitor Plot.jpg
MasterSimulationv1_outputtest Report.csv
MasterSimulationv1_outputtest.sim
MasterSimulationv1_outputtest@00057.sim
MasterSimulationv1_outputtest@00058.sim
Mesh Scene 1.jpg
Mesh Scene 1.sce
Overall Force Numbers.jpg
Pressure Coefficient Front Wing Bottom View.jpg
Pressure Coefficient Front Wing Bottom View.sce
Pressure Coefficient Front Wing Side View.jpg
Pressure Coefficient Front Wing Side View.sce
Pressure Coefficient Front Wing Top View.jpg
Pressure Coefficient Front Wing Top View.sce
Pressure Coefficient Rear Wing Bottom View.jpg
Pressure Coefficient Rear Wing Bottom View.sce
Pressure Coefficient Rear Wing Side View.jpg
Pressure Coefficient Rear Wing Side View.sce
Pressure Coefficient Rear Wing Top View.jpg
Pressure Coefficient Rear Wing Top View.sce
Pressure Coefficient Side View.jpg
Pressure Coefficient Side View.sce
Pressure Coefficient Top View.jpg
Pressure Coefficient Top View.sce
Radiator Mesh.jpg
Radiator Mesh.sce
Radiator Streamlines Side View.jpg
Radiator Streamlines Side View.sce
Radiator Streamlines Top View.jpg
Radiator Streamlines Top View.sce
RescalePostProc.java
Residuals.jpg
scalarsim.output
Surface Wrapper Mesh.jpg
Surface Wrapper Mesh.sce
Vector Scenes.jpg
```

Commands TLDR:

- Interactive
  - Srun -N 1 -np 16 -p normal –pty/bin/bash
  - ./starccm+ -batch run -np 16 <location and name of .sim file> -tokensonly -licpath 1999@ganymede
  - ./starccm+ -batch macro.java,run -np 16 <location and name of .sim file> -tokensonly -licpath 1999@ganymede
    - Uses a .java file in addition to normal
- Batch
  - Note Last 3 lines should be only on one, may not matter though

    ```
    #!/bin/bash
    #SBATCH     --partition=normal
    #SBATCH     --nodes=1
    #SBATCH     --ntasks=16
    #SBATCH     --time=01:00:00
    #SBATCH     --mail-type=ALL
    #SBATCH     --mail-user=netid
    #SBATCH     --output=/home/netid/scratch/scalarsim.output
    export CDLMD_LICENSE_FILE=1999@ganymede.utdallas.edu
    cd
    /petastore/ganymede/home/SoftWare/List-Of-Software/START-CCM/17.04.008
    STAR-CCM+17.04.008/star/bin/starccm+ -batch
    /home/netid/scratch/RescalePostProc.java,run -np 16
    /home/netid/scratch/MasterSimulationv1_outputtest.sim -tokensonly
    ```

  - Sbatch starccm-job-script.sh