Cameron Stiver Assignment 4 HPC

On this assignment I feel like I've had every issue possible. I really have tried a lot, perhaps more than any other assignment. I know some other students mentioned this wasn't as bad, so I'm not sure how I ran into so many issues with openmpi. It started mostly fine.

no changes, default pi

```
[cstiver@bridges2-login014 hw4-v2]$ srun ./pi 800000
srun: job 23556242 queued and waiting for resources
srun: job 23556242 has been allocated resources
PI is approx 3.14159265358979321747928681318740018468815833330154, Error is 0.00000000000000010148132334464321502309758216142654
14.446 Runtime ms
```

When I tried to run my first pi1 using openmpi, I immediately hit some issues with openmpi and the bridges srun command. I'm not sure what really was going on here. I emailed you about it and apparently only myself and maybe 1 other student had this issue

.

```
[cstiver@bridges2-login013 hw4-v2]$ module list

Currently Loaded Modules:
  1) allocations/1.0   2) psc.allocations.user/1.0   3) cuda/11.1.1 (H)   4) openmpi/4.1.1-gcc8.3.1

  Where:
   H:  Hidden Module



[cstiver@bridges2-login013 hw4-v2]$ mpic++ pi1.cpp -o pi1
[cstiver@bridges2-login013 hw4-v2]$ srun -n 1 ./pi1 800000
srun: job 23574119 queued and waiting for resources
srun: job 23574119 has been allocated resources
[r406.ib.bridges2.psc.edu:33235] OPAL ERROR: Unreachable in file pmix3x_client.c at line 112
--------------------------------------------------------------------------
The application appears to have been direct launched using "srun",
but OMPI was not built with SLURM's PMI support and therefore cannot
execute. There are several options for building PMI support under
SLURM, depending upon the SLURM version you are using:

  version 16.05 or later: you can use SLURM's PMIx support. This
  requires that you configure and build SLURM --with-pmix.

  Versions earlier than 16.05: you must use either SLURM's PMI-1 or
  PMI-2 support. SLURM builds PMI-1 by default, or you can manually
  install PMI-2. You must then build Open MPI using --with-pmi pointing
  to the SLURM PMI library location.

Please configure as appropriate and try again.
--------------------------------------------------------------------------
*** An error occurred in MPI_Init
*** on a NULL communicator
*** MPI_ERRORS_ARE_FATAL (processes in this communicator will now abort,
***    and potentially your MPI job)
[r406.ib.bridges2.psc.edu:33235] Local abort before MPI_INIT completed completed successfully, but am not able to aggregate error messages, and not able to
guarantee that all other processes were killed!
srun: error: r406: task 0: Exited with exit code 1
[cstiver@bridges2-login013 hw4-v2]$
```

I ditched srun and started using mpirun, and it actually started working.

https://slurm.schedmd.com/mpi_guide.html

I found this SLURM site talking about MPI and it mentions mpirun. I assume it's fine, but there is a chance it's running on the login node? I'm not really sure how to check. Either way, I then got pi1 to actually work!

new issue

```
[cstiver@bridges2-login012 hw4-v2]$ cat pi1-12-23579561.out
--------------------------------------------------------------------------------
There are messages associated with the following module(s):
--------------------------------------------------------------------------------

cuda/11.1.1:
   Warning - This module has been deprecated and is scheduled for removal.
   Please transition to a module from the production pool instead.

--------------------------------------------------------------------------------


--------------------------------------------------------------------------
A request was made to bind to that would result in binding more
processes than cpus on a resource:

   Bind to:     CORE
   Node:        r223
   #processes:  2
   #cpus:       1

You can override this protection by adding the "overload-allowed"
option to your binding directive.
--------------------------------------------------------------------------
```

This is where this site got my on the overload-allowed parameter.
https://slurm.schedmd.com/mpi_guide.html

```
module load openmpi/4.1.1-gcc8.3.1
mpic++ pi1.cpp -o pi1
mpirun -np 12 --bind-to core:overload-allowed ./pi1 800000
```

I started including this in all my jobs and it seemed to work and actually increase performance (at least time went down)

Since it seemed I needed to run the MPI stuff, I made jobs for all my files.

```
CSCI4110-Assignment-4-OpenMPI.pdf  job-pi1-48.sh  job-pi2-48.sh  job-pi3-48.sh  job-pi4-48.sh
job-pi1-1.sh                       job-pi2-1.sh   job-pi3-1.sh   job-pi4-1.sh   pi
job-pi1-12.sh                      job-pi2-12.sh  job-pi3-12.sh  job-pi4-12.sh  pi.cpp
job-pi1-24.sh                      job-pi2-24.sh  job-pi3-24.sh  job-pi4-24.sh  pi1
```

So to run them, just “sbatch job-pi1-12.sh” to run pi1 for 12 processes

pi1 1p

```
[cstiver@bridges2-login012 hw4-v2]$ cat pi123578373.out
--------------------------------------------------------------------------------
There are messages associated with the following module(s):
--------------------------------------------------------------------------------

cuda/11.1.1:
   Warning - This module has been deprecated and is scheduled for removal.
   Please transition to a module from the production pool instead.

--------------------------------------------------------------------------------

PI is approx 3.14159265358979323786228765591488354402827098965645, Error is 0.00000000000000012186432418737069838243769481778145
15.573 Runtime ms
```

pi1 1p

```
[cstiver@bridges2-login012 hw4-v2]$ cat pi1-1-23579858.out
------------------------------------------------------------------------------
There are messages associated with the following module(s):
------------------------------------------------------------------------------

cuda/11.1.1:
   Warning - This module has been deprecated and is scheduled for removal.
   Please transition to a module from the production pool instead.

------------------------------------------------------------------------------

PI is approx 3.14159265358979323786228765591488354402827098965645, Error is 0.00000000000000012186432418737069838243769481778145
15.3301 Runtime ms
```

piq 12p

```
[cstiver@bridges2-login012 hw4-v2]$ cat pi1-12-23579756.out
------------------------------------------------------------------------------
There are messages associated with the following module(s):
------------------------------------------------------------------------------

cuda/11.1.1:
   Warning - This module has been deprecated and is scheduled for removal.
   Please transition to a module from the production pool instead.

------------------------------------------------------------------------------

PI is approx 3.14159265358979323742860678692068177042528986930847, Error is 0.00000000000000012143064331837649660883471369743347
4.27864 Runtime ms
```

pi1 24p

```
[cstiver@bridges2-login012 hw4-v2]$ cat pi1-24-23579249.out
------------------------------------------------------------------------------
There are messages associated with the following module(s):
------------------------------------------------------------------------------

cuda/11.1.1:
   Warning - This module has been deprecated and is scheduled for removal.
   Please transition to a module from the production pool instead.

------------------------------------------------------------------------------

PI is approx 3.14159265358978106942762498210441890478250570595264, Error is 0.00000000000001204657033848643976625680807046592236
0.803108 Runtime ms
```

pi1 48p

```
[cstiver@bridges2-login012 hw4-v2]$ cat pi1-48-23579776.out
------------------------------------------------------------------------------
There are messages associated with the following module(s):
------------------------------------------------------------------------------

cuda/11.1.1:
   Warning - This module has been deprecated and is scheduled for removal.
   Please transition to a module from the production pool instead.

------------------------------------------------------------------------------

PI is approx 3.14159265358979323526020244194967290241038426756859, Error is 0.00000000000000011926223897340548774081980809569359
0.439718 Runtime ms
```

Then I started the major headache that would be pi2 and 3. I really broke my brain on this stuff. I had something along the lines of working well and then I started running into MPI errors all the time.

```
[r266:42480] *** An error occurred in MPI_Get
[r266:42480] *** reported by process [2158231553,0]
[r266:42480] *** on win ucx window 3
[r266:42480] *** MPI_ERR_OTHER: known error not in list
[r266:42480] *** MPI_ERRORS_ARE_FATAL (processes in this win will now abort
,
[r266:42480] ***    and potentially your MPI job)
[warn] Epoll MOD(1) on fd 25 failed.  Old events were 6; read change was 0
(none); write change was 2 (del): Bad file descriptor
[warn] Epoll MOD(4) on fd 25 failed.  Old events were 6; read change was 2
(del); write change was 0 (none): Bad file descriptor
```

This is such an obscure error, I couldn't really figure it out. When I tried commenting out Get it would say the same error but for some other MPI command.

```
[cstiver@bridges2-login014 hw4-v2]$ cat pi2-12-23631668.out
------------------------------------------------------------------------------
There are messages associated with the following module(s):
------------------------------------------------------------------------------

cuda/11.1.1:
   Warning - This module has been deprecated and is scheduled for removal.
   Please transition to a module from the production pool instead.

------------------------------------------------------------------------------

PI is approx 2.998391274467229600936279965139874548185616731643 68, Error is 0.143201379122563515061683503404310613404959440231 32
301.626 Runtime ms
```

I got it to run at one point but it wasn't adding/subtracting some things right, and it seemed to run way too long.

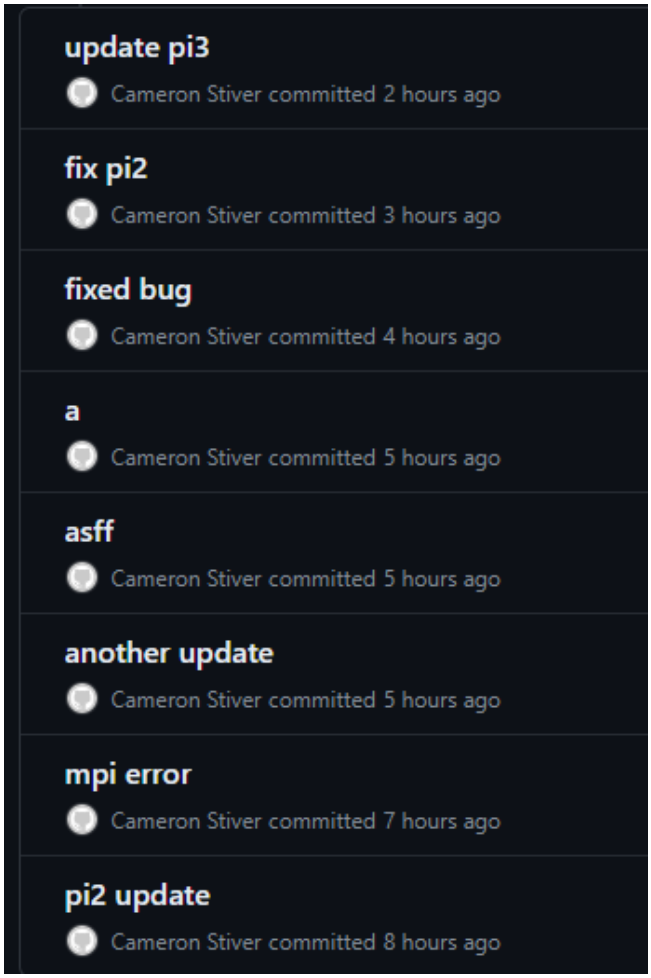
I eventually got it to work but I don't think it actually does everything it should, but at this point I've spent probably 15 hours at least with just MPI errors. The math adding/subtracting seems to have an issue

```
[cstiver@bridges2-login013 hw4-v2]$ cat pi2-12-23645775.out
------------------------------------------------------------------------------
There are messages associated with the following module(s):
------------------------------------------------------------------------------

cuda/11.1.1:
   Warning - This module has been deprecated and is scheduled for removal.
   Please transition to a module from the production pool instead.

------------------------------------------------------------------------------

PI is approx 3.143502767497045106504308109585110742045799270272 25, Error is 0.001910113907251
99050634464104092558045522309839725
1.47552 Runtime ms
```



At least 10 hours directly of messing with MPI on pi2 and 3 alone. I really, really wanted to get it working perfectly but I think it's been having issues from the start for me even with just compiling. It was cool to see pi1 progressively run faster and faster but I never got the error super low. I would have to look back at things as far as getting the error down instead of just trying to run it faster.

PI4 I chose to use openMP to just split the iterations between the designated number of threads instead of separate processes. I'm not sure if this is exactly what we had the option to do, since it functions very differently from the MPI process, but it was much easier and I frankly spent way too much time messing with PI2 and 3.

```
]$ g++ -fopenmp pi4.cpp -o pi4
]$ srun ./pi4 800000 12
```

```
[cstiver@bridges2-login014 hw4-v2]$ srun ./pi4 800000 48
srun: job 23648849 queued and waiting for resources
srun: job 23648849 has been allocated resources
PI is approx 3.14159265358979323851280895940618620443274267017841, Error is 0.00000000000000012251484549086200104284216649830341
3.63038 Runtime ms
```

Pi4 you can srun like normal! Thankfully! Normally functioning files!!!!!!! I made the number of threads a launch argument. You can pick any number but I tested it with the same numbers as the other ones like 12 and 48.