

# Advanced MPI (Message Passing Interface)

# Outline

- Definition and Use
- General Form of MPI code
- MPI Code for Complex Computation
- Load the module (software application)
- Job Script Code
- Run the job script
- Screenshots of example of program codes run:
  - Mpi\_nbody\_basic
  - Mpi\_nbody\_red
  - Mpi\_tsp\_dyn
  - MPI\_tsp\_stat
  - More
- Run job
- Output

# Definition and Use

The main concepts of MPI are:

- . Used to create parallel SPMD programs on
  - distributed-memory machines with explicit message passing

The Routines available for

point-to-point communication

collective communication

1-to-many

many-to-1

many-to-many

synchronization

# Structure of MPI code

- `#include <mpi.h>`
- ...
- `ierr=MPI_Init(&argc, &argv);`
- `ierr=MPI_Comm_size(MPI_COMM_WORLD,&npes);`
- `ierr=MPI_Comm_rank(MPI_COMM_WORLD,&iam);`
- ...
- `ierr=MPI_Finalize();`

# Structure of MPI Code

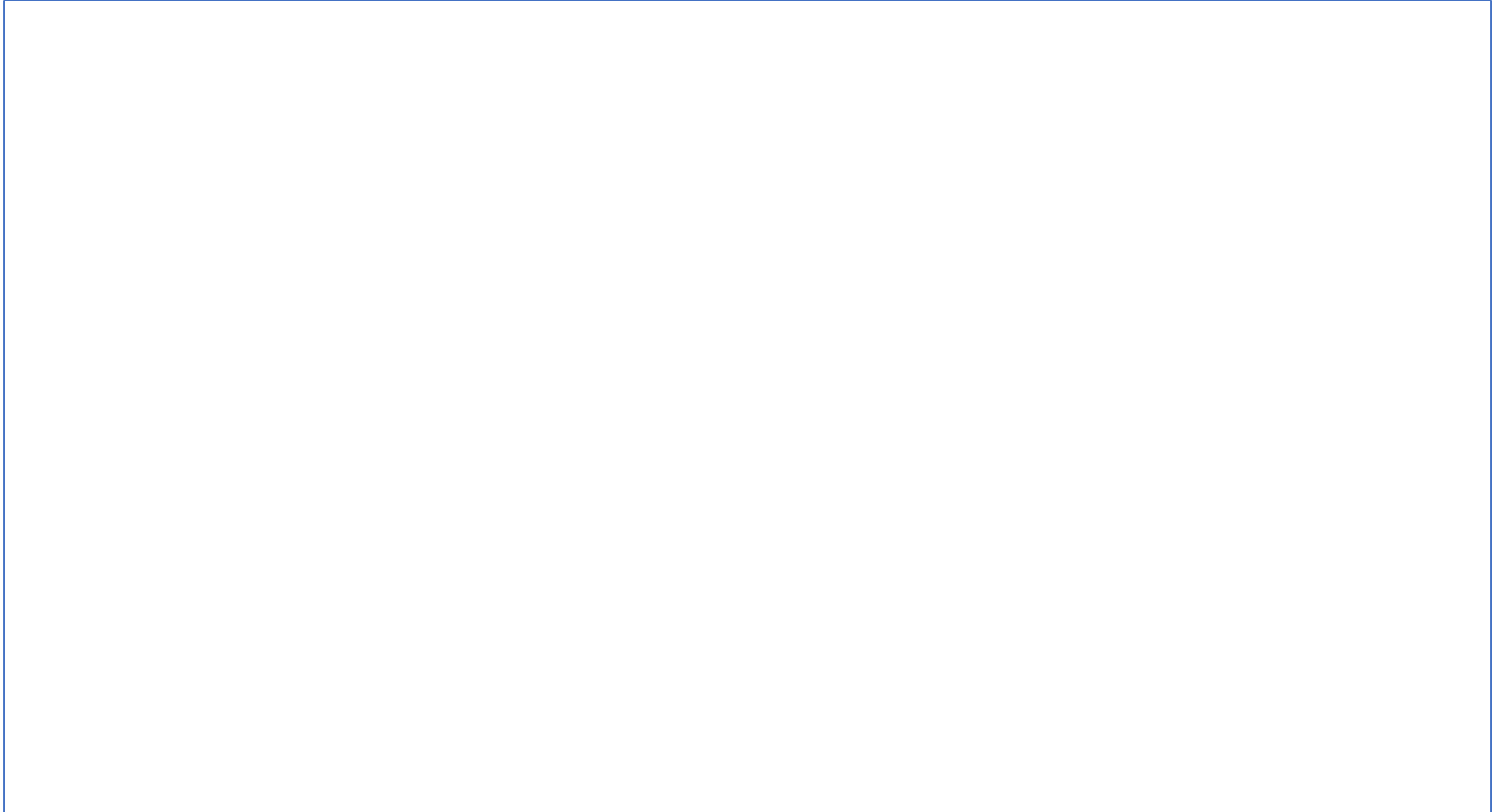
- A parallel “Hello, World” program
  - – Initialize MPI
  - – Have each node print out its node number
  - – Quit MPI

- `#include <mpi.h>`
- ...
- `ierr=MPI_Init(&argc, &argv);`
- `ierr=MPI_Comm_size(MPI_COMM_WORLD,&npes);`
- `ierr=MPI_Comm_rank(MPI_COMM_WORLD,&iam);`
- ...
- `ierr=MPI_Finalize();`

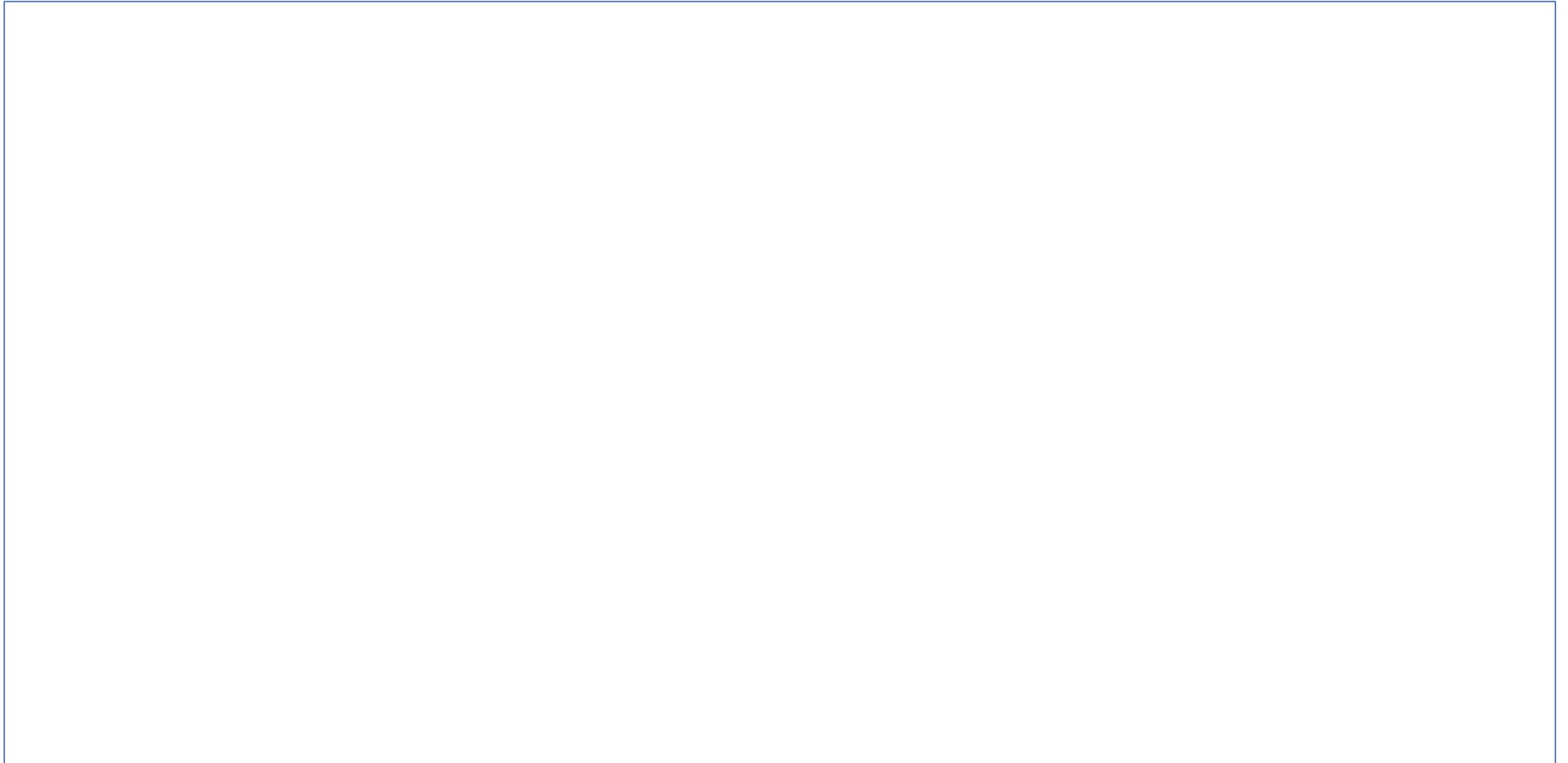
# Load the module (software application)

- `module load OpenMPI`
- `sbatch myJobScript`
- `queue -u haboudj`

# Job Script Code (SLURM)

A large empty rectangular box with a blue border, intended for SLURM job script code.

# Run the job script





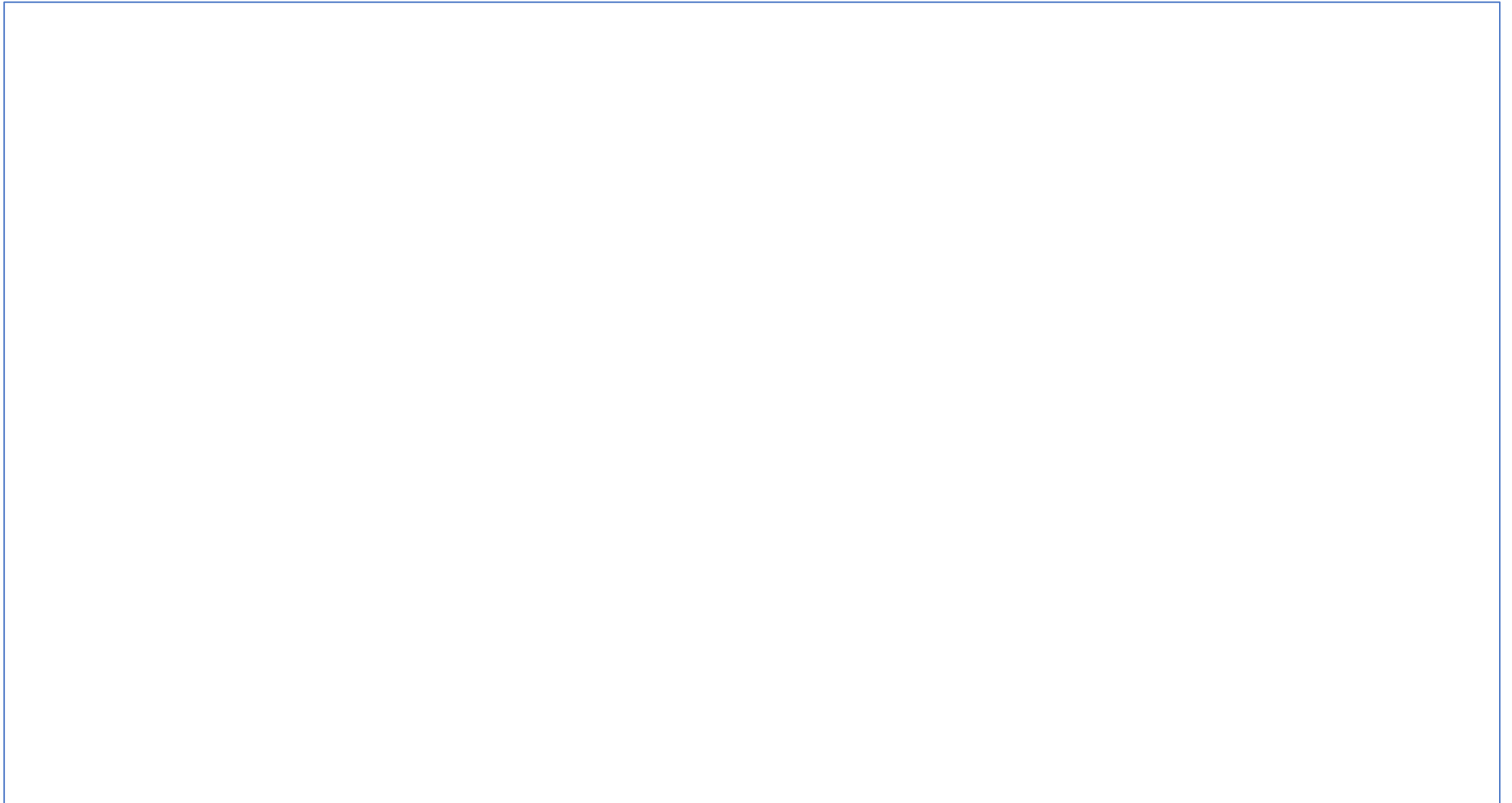
# Steps to Use a Super Computer (Example Template)

- `ssh username@hostname.ncsa.illinois.edu<ENTER>`
- `git clone \ https://github.com/aaronweeden/pi2018-submitting.git<ENTER>`
- `cd pi2018-submitting<ENTER>`
- `cc -o test.exe test.c<ENTER>`
- `cat test.pbs<ENTER>`
- `#!/bin/bash`
- `#PBS -l nodes=2:ppn=32:xe`
- `#PBS -l walltime=00:05:00`
- `#PBS -N test`
- `cd $PBS_O_WORKDIR`
- `aprun -n 4 ./test.exe|sort`

# Running Job Script

- **cat test.pbs<ENTER>**
- **#!/bin/bash**
- **#PBS -l nodes=2:ppn=32:xe**
- **#PBS -l walltime=00:05:00**
- **#PBS -N test**
- **cd \$PBS\_O\_WORKDIR**
- **aprun -n 4 ./test.exe | sort**

# Error and Output Files



# References

1. [https://people.sc.fsu.edu/~jburkardt/c\\_src/laplace\\_mpi/laplace\\_mpi.html](https://people.sc.fsu.edu/~jburkardt/c_src/laplace_mpi/laplace_mpi.html)
2. Please see the TACC CS395 COURSE MATERIALSs1.
3. <https://www.cs.usfca.edu/~peter/ipp/>