Assignment 3
Frequently Asked Questions

Big picture: Coding for scalability tests

global_pi.c ← global_avg.c + pi.c (fixed problem-size scaling)

global_pi_iso.c ←(a few lines change) global_pi.c (isogranular scaling)

Why does the measured runtime vary across different Slurm jobs?

Discovery cluster is composed of a heterogeneous mixture of computing nodes with varying CPUs and GPUs, hence different performance. This causes runtime variation across different Slurm jobs, depending on which nodes were allocated to the job. You can find the CPU information for one of the allocated nodes (on which your script is being executed) by including the following line in your Slurm script:

```
cat /proc/cpuinfo > cpuinfo.txt
```

cpuinfo.txt

```
model name: Intel(R) Xeon(R) CPU E5-2640 v4 @ 2.40GHz
...
```

Discovery Compute Nodes

https://carc.usc.edu/user-information/user-guides/hpc-basics/discovery-resources

Partition	CPU model	CPU frequency	CPUs/node	GPU model	GPUs/node	Memory/node	Nodes
main	xeon-2640v3	2.60 GHz	16	---	---	59 GB	81
main	xeon-2640v4	2.40 GHz	20	---	---	59 GB	51
main	xeon-4116	2.10 GHz	24	---	---	89 GB	39
main	xeon-4116	2.10 GHz	24	---	---	184 GB	41
main	xeon-2640v3	2.60 GHz	16	K40	2	59 GB	17
main	xeon-2640v4	2.40 GHz	20	K40	2	59 GB	40
epyc-64	epyc-7542	2.90 GHz	64	---	---	248 GB	32

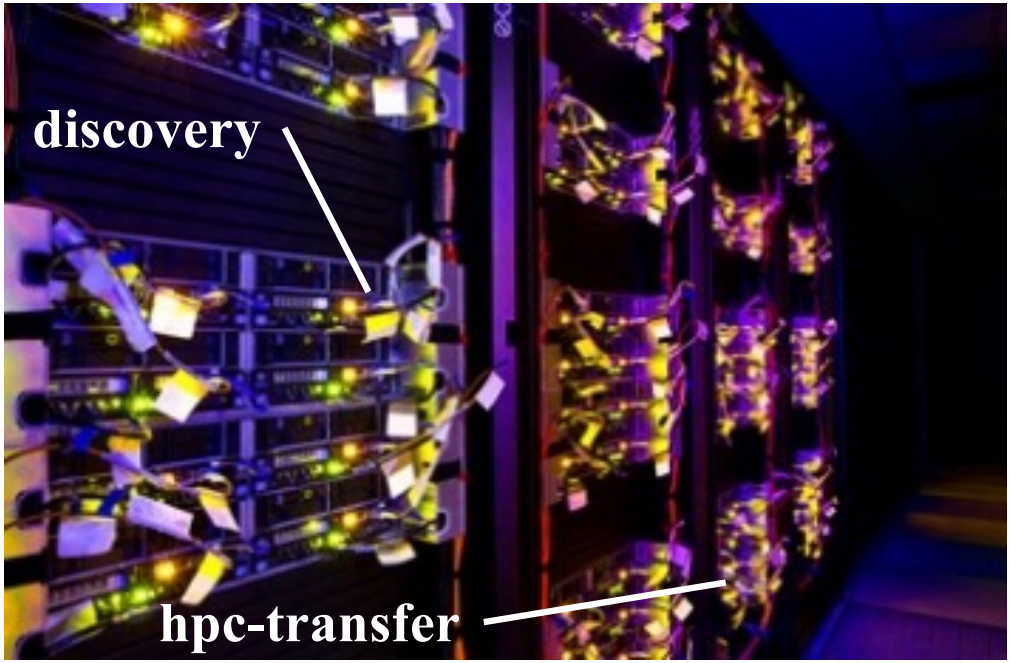
Also, optimization flag for compiler matters: `mpicc –O –o global_pi global_pi.c -lm`

Why is the measured runtime nonmonotonic as a function of the number of processors in some isogranular-scaling tests?

Even if you have dedicated access to the allocated computing nodes, you are still sharing network with other users. The communication time that MPI_Send() and MPI_Recv() take is thus affected by network interference. (Like your Internet speed slows down when someone at your home is downloading a big file.) Don't worry about small fluctuation in your plot. Or, submit multiple plots, with explanations.

```
[anakano@discovery ~]$ ping hpc-transfer
time=0.130 ms
time=0.090 ms
time=0.090 ms
time=0.113 ms
```

"See" network interference
***cf.* LA traffic**

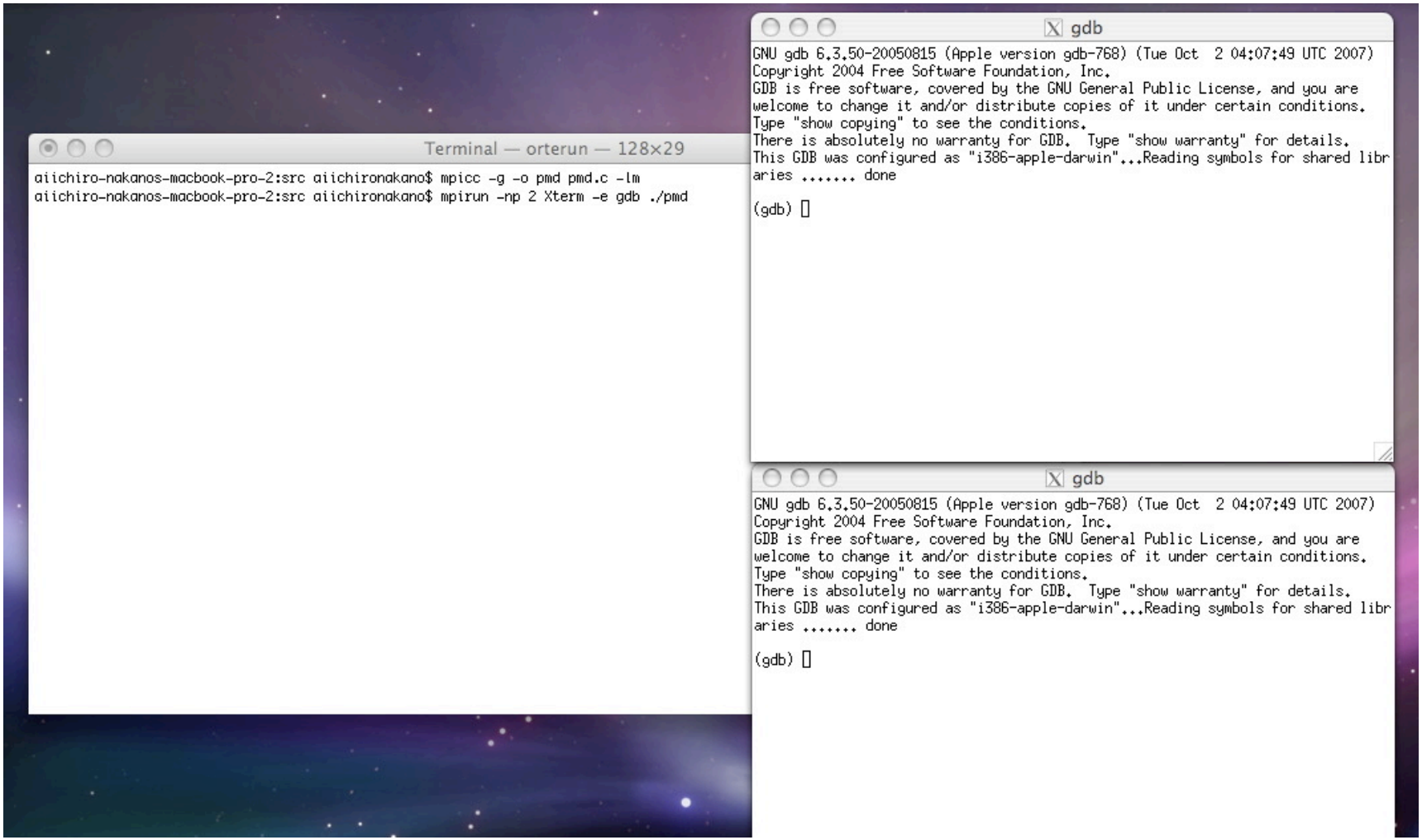


And you are sharing the nodes with other users.

How to debug MPI programs?

Different MPI ranks are different processes running on different computers, thus not executing in lockstep. This makes debugging MPI programs rather difficult. People usually insert MPI_Barrier() and printf() statements to locate the specific line where one or more ranks are crashing. Some systems allow MPI to work with debuggers like GDB, but I have not used them personally.

GNU C compiler-based MPI implementation (not on Discovery)



Finally: Please do not use “mpirun” on discovery

The login node, discovery.usc.edu, is a login node shared by hundreds of users, and you are not supposed to run any serious programs on it. Please always use sbatch (in batch mode) or salloc (interactively) to run any MPI program, so that your program will run on dedicated computing nodes instead.

```
[anakano@discovery ~]$ ps -al
F S   UID     PID     PPID  C PRI  NI ADDR SZ WCHAN  TTY          TIME CMD
0 S 600118 133743   133453  3  80   0 - 524624 futex_ pts/6   00:14:32 viddy
0 S 354380 135459   135081  0  80   0 - 32268 poll_s pts/37   00:00:00 tmux: clie
1 S 354380 139661  3585060  0  80   0 - 28800 do_wai pts/57   00:00:00 bash
0 S 600493 626548   626491  0  80   0 - 83498 ep_pol pts/23   00:00:42 jupyter-no
0 S 323474 1154053 1133677  0  80   0 - 25299 do_wai pts/0    00:00:00 salloc
0 S 323474 1154202 1154053  0  80   0 - 83412 futex_ pts/0    00:00:00 srun
0 S 600773 1540702 1539154  0  80   0 - 28357 do_wai pts/25   00:00:00 bash
0 S 350473 1625067 1533720  0  80   0 - 39577 hrtime pts/13   00:00:05 watch
0 S 331977 1676488 1665045  0  80   0 - 32245 sys_pa pts/32   00:00:00 screen
0 S 352098 1680441 1661650  0  80   0 -  2082 n_tty_ pts/24   00:00:00 less
0 R  55322 1728179 1727860  0  80   0 - 38341 -      pts/46   00:00:00 ps
0 S 299827 2729297 2729150  0  80   0 - 37700 poll_s pts/19   00:00:00 vim
0 T 326739 2852294   60416  0  80   0 - 32348 do_sig pts/4    00:00:00 vim
1 S 354380 2885468   62782  0  80   0 - 28798 do_wai pts/14   00:00:00 bash
0 S 354380 2885544 2885468  0  80   0 - 395384 futex_ pts/14  00:00:00 srun
...
```