Assignment 1, due October 16th 2019

The goal of this assignment is to get you acquainted with working on a distributed memory cluster as well as obtaining, illustrating, and interpreting measurement data.

Exercise 1

Description
This exercise consists in familiarizing yourself with SGE job submission.

You received user credentials for the LCC2 cluster. If you did not change the default password, do so **immediately**. You are responsible for this account during this semester.

You can find information about LCC2 at https://www.uibk.ac.at/zid/systeme/hpc-systeme/lcc2/ and information about SGE job submission at https://www.uibk.ac.at/zid/systeme/hpc-systeme/common/tutorials/sge-howto.html.

Please run any benchmarks or heavy CPU loads only on the compute nodes, not on the login node.
If you want to do some interactive experimentation, use an *interactive job* as outlined in the tutorial. Make sure to stop any interactive jobs once you are done.

Tasks

- Study how to submit jobs in SGE, how to check their state and how to cancel them.
- Prepare a submission script that starts an arbitrary executable, e.g. `/bin/hostname`
- In your opionion, what are the 5 most important parameters available when submitting a job and why? What are possible settings of these parameters, and what effect do they have?
- How do you run your program in parallel? What environment setup is required?

Exercise 2

This exercise consists in running an MPI microbenchmark in order to examine the impact of HPC topologies on performance.

Description
The OSU Micro-Benchmarks suite holds multiple benchmarks that measure low-level

performance properties such as latency and bandwidth between MPI ranks. Specifically, for this exercise, we are interested in the *point-to-point* ones, which exchange messages between 2 MPI ranks.

Tasks

- Download and build the OSU Micro-Benchmarks available at http://mvapich.cse.ohio-state.edu/download/mvapich/osu-micro-benchmarks-5.6.2.tar.gz. You can also use available binaries on LCC2 at `/scratch/c703429/osu-benchmark/libexec/osu-micro-benchmarks/mpi/pt2pt` (built with `openmpi/4.0.1`). Note: If you build yourself, do not forget to set the compiler parameters for `configure`, e.g. `./configure CC=mpicc CXX=mpic++ ...`
- After building, submit SGE jobs that run the `osu_latency` and `osu_bw` executables.
- Create a table and figures that illustrate the measured data and study them. What effects can you observe?
- Modify your experiment such that the 2 MPI ranks are placed on
  - different cores of the same socket,
  - different sockets of the same node, and
  - different nodes.
- Ammend your table and figures to include these additional measurements. What effects can you observe? How can you verify rank placement without looking at performance?
- How stable are the measurements when running the experiments multiple times?

General Notes

All the material required by the tasks above (e.g. code, figures, etc...) must be part of the solution that is handed in. Your experiments should be reproducible and comparable to your own measurements using the solution materials that you hand in.

Every member of your group must be able to explain the given problem, your solution, and possible findings. You may also need to answer detailed questions about any of these aspects.