Laboratory # 5

Goals

The goals of this lab are:

1. To learn how to use commands that reveal architectures on a supercomputer.

2. To become accustomed to assimilating manufacturer specifications.

3. To learn how to configure and run a performance benchmark.

During Lab: Team Exploration of Alpine

The goal of this laboratory is for each student to produce their own report on the architecture and performance of one of Alpine's partitions. The expectations for that report are described in the next two sections. During lab time, students (working in teams of 2-3) should strategize and work together on the following tasks, which will produce information needed in the report.

1. Obtain results using `lstopo`.

2. Acquire the Empirical Roofline Toolkit ("ERT"). See the "Resources and Further Requirements" section below.

3. Create a new configuration file for "ERT" to enable it to execute on Alpine. See "Resources and Further Requirements" section, below.

4. Try to run ERT, which will include building and executing it. See "Resources and Further Requirements" section, below.

After Lab: Individual Lab Report

Each student should produce their own report, but can work with their teammate to produce the information required for that report. The report must include the following:

1. A pictorial and textual description of the architecture of each node.

2. A textual description of the CPU name and maker, accelerators (if present), URL references to manufacturer specifications.

3. The node's theoretical maximum memory bandwidth and theoretical maximum floating point operations (FLOPs) per second.

4. ERT results and comparison with theoretical estimates. Please note the requirements in the section below.

Resources and Further Requirements

- To acquire ERT:

  ```
  git clone https://bitbucket.org/berkeleylab/cs-roofline-toolkit.git
  ```

- Be sure to refer to the ERT manual (PDF file) in `cs-roofline-toolkit/Empirical_Roofline_Tool-1.1.0` to learn about the entries in the configuration file and about ways to run ERT. For example, you can separate the running process from the post-processing part; the post-processing part can be done on the compile nodes.

- To create the config file, in `cs-roofline-toolkit/Empirical_Roofline_Tool-1.1.0/Config` you will need to create a custom "config" file for Alpine. Consider adopting `config.madonna.lbl.gov.01` and modifying it as needed. **Note the following additional requirements of this lab:**

  1. You are to include multiple processes running in parallel, so `ERT_MPI` should be set to `true`.
  2. You are to include threading. So you will need to include `openmp` for the `ERT_OPENMP_CFLAGS` and `ERT_OPENMP_LDFLAGS` options.

- To run ERT interactively on a compute node, you would execute the following. But it is recommended that you use `sbatch` instead.

  ```
  cd cs-roofline-toolkit/Empirical_Roofline_Tool-1.1.0
  ./ert Config/<your new configuration filename>
  ```

- You will need an additional module. Be sure to load all of the modules below to run ERT (include in slurm script):

  ```
  module load intel
  module load impi
  module use /projects/scru5660/public/software/module
  ```

- In previous years, there were problems with gnuplot creating `.ps` files. This problem may not exist on Alpine. Just in case, though, it is recommended that you ask ERT to output `.png` instead of `.ps` files. If you choose to do that, make the following substitution

  ```
  OLD:
   set terminal postscript solid color
   set output "ERT_GRAPH.ps"
  NEW:
   set terminal png
   set output "ERT_GRAPH.png"
  ```

  in the following files:

  ```
  Empirical_Roofline_Tool-1.1.0/Plot/graph1.gnu.template
  Empirical_Roofline_Tool-1.1.0/Plot/graph2.gnu.template
  Empirical_Roofline_Tool-1.1.0/Plot/graph3.gnu.template
  Empirical_Roofline_Tool-1.1.0/Plot/graph4.gnu.template
  Empirical_Roofline_Tool-1.1.0/Plot/roofline.gnu.template
  ```

- To view results, find the `.ps` files or `.png` files, if you choose the option above. These files should appear in the results directory that you specified in your config file.

- Begin small. Get ERT running and then increase the values for `ERT_PROCS_THREADS`, `ERT_MPI_PROCS`, `ERT_OPENMP_THREADS`, and `ERT_NUM_EXPERIMENTS`.

Grading Rubric

Component	Expectations	Weight
Individual Post-Lab Report		
Textual descriptions of Alpine, references to specifications	2-3 pages, including figures	30%
Theoretical maximum CPU and memory bandwidth calculations and explanation	About 1 page	30%
Setup and execution of ERT, and discussion of ERT results	About 2 pages	40%