Running a Roofline Analysis with Intel Advisor

A roofline analysis helps you determine whether your application has achieved the best possible performance, limited by the machine capabilities. If not, you can explore the possibility of algorithm changes to improve performance.

Running the Analysis

The Intel Advisor tool is available as a module on HECC resources. To do a roofline analysis, load the module and run two analyses: survey and tripcounts, as follows:

```bash
module use /nasa/modulefiles/testing
module load mpi-hpe/mpt.2.18r160
module load advisor/2018
mpiexec -np x advixe-cl -collect survey -project-dir my_result -- ./a.out
mpiexec -np x advixe-cl -collect tripcounts -flop -project-dir my_result -- ./a.out
```

Note: Be sure to specify the same directory (`-project-dir`) for the survey and tripcounts analyses. The tripcounts run will take longer time than the survey run.

If these two runs are successful, you can start the Intel Advisor GUI and choose one of the ranks to analyze.

Reviewing the Results

To start the GUI:

```bash
advixe-gui my_result
```

To see a roofline chart for the rank chosen, do one of the following:

- In the navigation panel, click the black icon (`black-icon.png`) under Run Roofline.
- Click the Survey & Roofline panel in the main window, then click the vertical bar labeled ROOFLINE.

In the sample roofline chart shown below, the X axis is arithmetic intensity (measured in flops/byte) and the Y axis is the performance in Gflops/second, both in logarithmic scale:
Before it collects data on your application, Intel Advisor runs benchmarks to measure the hardware limitations of your machine. It plots these on the chart as lines, called *roofs*. The horizontal lines represent the number of floating point computations of a given type your hardware can perform in a given span of time. The diagonal lines are representative of how many bytes of data a given memory subsystem can deliver per second.

In the chart, each dot is a loop or function in your application. The dot's position indicates the performance of the loop or function, which is affected by its optimization and its arithmetic intensity. The dot's size and color indicate how much of the total application time the loop or function takes. In the sample chart shown above, loops A and G (large red dots), and to a lesser extent loop B (yellow dot far below the roofs), are the best candidates for optimization. Loops C, D, and E (small green dots) and H (yellow dot) are poor candidates because they do not have much room to improve.

Important: Intel Advisor uses a cache-aware roofline model. In the classic roofline model, a kernel's arithmetic intensity would change with problem size or cache usage optimization, because the byte count was based on DRAM traffic only. This is not the case in the cache-aware roofline model, where arithmetic intensity is a fixed value tied to the algorithm itself; it only changes when the algorithm is altered, either by the programmer or occasionally by the compiler.

**Additional Resources**

- [Getting Started with Intel Advisor](#)
- [Intel Advisor Roofline](#)
- [Getting Started with Intel Advisor Roofline Feature](#)
- [Intel video: Introduction to Intel Advisor Roofline Feature](#)
- [Roofline: An Insightful Visual Performance Model for Floating-Point Programs and Multicore Architecture, 2009](#) (PDF)
- [Cache-aware Roofline Model: Upgrading the Loft, 2013](#) (PDF)