Iowa High Performance Computing Summer School 2015

Parallel Performance and Optimization Exercises

Wednesday, June 3, 2015

1. Strong Scaling of `HYDRO`
   Perform a strong scaling test using the example program `HYDRO`. An example input file, `ss1a.in`, can be found on the website under "Exercises"
   `http://www.physics.uiowa.edu/~ghowes/teach/ihpc15/exercises.html`
   in the tar file `hydro_input_scaling_exercise.tar`.

   (a) Run the strong scaling for 2, 4, 8, 16, 32, 64, 128, and 256 cores. Note that, due to the limiation of the IHPC queue on Neon of 256 cores, your submitted jobs with 128 and 256 cores may wait a long time before enough resources are available for them to run.

   (b) Present your strong scaling test results in graphical form using `gnuplot` (see the `HYDRO` documentation for instructions on using `gnuplot` for plotting data and producing a postscript figure of the result).

2. Weak Scaling of `HYDRO`
   Perform a strong scaling test using the example program `HYDRO`. An example input file for `nproc=2`, `ws1a.in`, can be found on the website under under "Exercises"
   `http://www.physics.uiowa.edu/~ghowes/teach/ihpc15/exercises.html`
   in the tar file `hydro_input_scaling_exercise.tar`.

   (a) Run the weak scaling for 2, 4, 8, 16, 32, 64, 128, and 256 processors. Be sure to determine a reasonable way to double the problem size for each case.

   (b) Present your weak scaling test results in graphical form using `gnuplot` (see the `HYDRO` documentation for instructions on using `gnuplot` for plotting data and producing a postscript figure of the result).

   (c) For a single doubling, do the results differ if the grid is doubled in the x direction rather than the y direction? Can you think of any reason why this may be? To see if there is a difference, try running a series of scaling runs from 2 to 256 processors doubling the size only in x, and then repeat the series doubling only in y.

3. Compute the load balance in `HYDRO` by adding some communication between processors at the end of the code to pass the timing statistics. Consider the following issues:

   - Each processor computes its own timing statistics independently.
   - Which of the timing categories do you want to use to determine the load balance?

4. Advanced: Modify `HYDRO` to enable domain decomposition in two dimensions. Consider the issue of how to achieve good load balancing.