# Iowa High Performance Computing Summer School 2010

# IHPC 2010 In-Class Exercises #2

Tuesday, May 26, 2010

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/ihpc10/exercises.html`
   in the tar file `hydro_input_exercise2.tar`.

   (a) Run the strong scaling for 2, 4, 8, 16, 32, 64, 128, and 256 processors.

2. Weak Scaling of `HYDRO`
   Perform a strong scaling test using the example program `HYDRO`. An example input file for $\hat{n}$proc=2, `ws1a.in`, can be found on the website under under "Exercises"
   `http://www.physics.uiowa.edu/~ghowes/teach/ihpc10/exercises.html`
   in the tar file `hydro_input_exercise2.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) 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. Using the code you wrote in Exercises #1 to determine numerically the value of $\pi$, run the profiling tools `PAPI` and `MpiP` to determine a general overview of your code's performance and the MPI time and load balance. Run at least 16 processors.

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