Astronomy 598 Topics in Theoretical Astrophysics (Scientific Supercomputing)

Autumn 2015 Problem Set 8

Due Date, Dec 2, 2015

Do all your work in a directory called

`abcxyz_hw8`

(replace abc with your first name and xyz with your last name). The directory should contain contain at least these 5 files: (a) your serial program (b) your parallel program (c) PBS script to submit the parallel program job (d) README file describing what the program does, how to compile and run the parallel program and the serial program, any limitations. (e) RESULTS file describing how you compared the output of the serial program and the parallel program in order to ensure that the parallel program gives the same results as the serial program. Use below command to tar the files and e-mail me your tar file with e-mail subject line ASTRO 598 HW8:

` tar -cvf abcxyz_hw8.tar abcxyz_hw8`

This problem is about parallel programming on a single node. Use a computation which can be parallelized and is from your research area.

(a) Write a serial version of your computation, run it and verify that the output is correct.

(b) Write a parallel version by applying the MapReduce approach to your computation: distribute the work to all the cores, do the work in parallel on all the cores, do a serial reduce phase. Use any one of these languages: C (OpenMP), C++ (OpenMP), MATLAB (parfor), R (library parallel, function mclapply), Python (package multiprocessing, function map). Run the parallel version of the program on hyak.

(c) Compare the outputs of the serial version and the parallel version and ensure that they give the same results. Write about this in the RESULTS file.

(d) Compare the running time of the serial version and the parallel version. Write about this in the RESULTS file.

(e) Is your computation "embarassingy parallel"? Describe the effect of Amdahl's law on your computation by approximately estimating p which is the fraction of the parallel part. Does p change with the size of your problem? Write about this in the README file.