CSCE 659 Fall 2017

HW 1: Parallel Programming with MPI

Due: 11:59pm Tuesday, October 3, 2017

Compile and execute the program in the file `compute_pi_mpi.c`, which computes an estimate of π using the parallel algorithm discussed in class. The program is available at `ecampus.tamu.edu`. It should be compiled and executed on `ada.tamu.edu`. You may need to use `dos2unix` on the downloaded files to strip additional characters introduced by ecampus.

Load the Intel software stack prior to compiling and executing the code.

```
module load intel/2017A
```

To compile, use the command:

```
mpiicc -o compute_pi_mpi.exe compute_pi_mpi.c
```

To execute the program, use

```
mpirun –np <p> ./compute_pi_mpi.exe <n>
```

where <n> represents the number of intervals and <p> represents the number of processes. The output of a sample run is shown below.

```
mpirun -np 4 compute_pi_mpi.exe 100000000
n = 100000000, p = 4, pi = 3.1415926535897749, relative error =
5.80e-15, time (sec) =   0.0608
```

The run time of the code should be measured when it is executed in dedicated mode. Use the batch file `compute_pi_mpi.job`, also available on ecampus, to execute the code in dedicated mode using the following command:

```
bsub < compute_pi_mpi.job
```

Execute the code for $n=10^8$ with p chosen to be 2^k, for k = 0, 1, …, 6. Specify `ptile=4` in the job file. Using the experimental data obtained from these experiments, answer the following questions.

1. (10 points) Plot execution time versus p to demonstrate how time varies with the number of processes. Use a logarithmic scale for the x-axis.
2. (10 points) Plot speedup versus p to demonstrate the change in speedup with p.
3. (5 points) Using the definition: efficiency = speedup/p, plot efficiency versus p to demonstrate how efficiency changes as the number of processes is increased.
4. (5 points) What value of p minimizes the parallel runtime?
5. (10 points) With $n=10^8$ and p=64, determine the value of ptile that minimizes the `total_time`. Plot time versus ptile to illustrate your experimental results for this question.
6. (10 points) Repeat the experiments with p=64 for $n=10^2$, 10^4, 10^6 and 10^8.
    a. Plot the speedup observed w.r.t. p=1 versus n.

b. Plot the relative error versus n to illustrate the accuracy of the algorithm as a function of n.

Submission: Upload a single PDF or MSWord document with your answers to ecampus.