4003-531/4005-735 | **Parallel Computing I** | **Assignment 4**
Term 20102 | **February 4, 2011**

Assignment 4

Due: February 18, 2011

Before starting, be sure to review the instructions for running Parallel Java on the RIT CS Parallel Computers (`http://www.cs.rit.edu/~ark/runningpj.shtml`). Remember, to execute programs on the `thug`N backend nodes, submit it to the job queue running on `paranoia`. **Directly logging into the `thug`N backend nodes is not allowed.**

1. (30pts)

   Building Parallel Programs, Part III Exercises:

   (a) Exercise 50 (p. 579)
   Note: Formula should be for calculation time in *seconds*.

   (b) Exercise 51 (p. 579)

   (c) Exercise 52 (p. 579)
   Note: Formulas should be for speedup and efficiency of *one iteration* of the parallel version.

   (d) Exercise 53 (p. 579)
   Note: Be sure to explain what happens to speedup and efficiency as K increases (and n remains constant) and as n increases (and K remains constant).

   (e) How many parallel processes should be used to obtain the smallest running time and what is the corresponding speedup for a 1260×1260-element mesh? for a 4000×4000-element mesh? (Note that the number of parallel processes must be an integer.)

   (f) Exercise 54 (p. 579)
   Note: Complete the following table as part of the comparison. Be sure to take the number of iterations into account for the predicted running time, speedup, and efficiency.

		Measured			Predicted		
n	K	*T (sec)*	*Spdup*	*Eff*	*T (sec)*	*Spdup*	*Eff*
1260	seq	61.469	xxx	xxx		xxx	xxx
1260	1	59.649	1.031	1.031			
1260	2	33.681	1.825	0.913			
1260	4	19.747	3.113	0.778			
1260	8	13.799	4.455	0.557			
1260	20	13.757	4.468	0.223			
1260	40	13.143	4.677	0.117			
4000	seq	2104.482	xxx	xxx		xxx	xxx
4000	1	2077.124	0.987	0.987			
4000	2	1079.537	1.900	0.950			
4000	4	547.380	3.747	0.937			
4000	8	299.199	6.855	0.857			
4000	20	161.101	12.731	0.637			
4000	40	155.433	17.768	0.444			

Submission Submit a plain text file named `hw4-1.txt` or a PDF file named `hw4-1.pdf`. The `hw4-1` file should contain the solutions to the exercises.

2. (20pts)

Review the Mandelbrot Set programs from Lecture 07. You may download the program files `MandelbrotSetSeq.java` and `MandelbrotSetClu2.java` from the course website.

Write a Java program called `MandelbrotSetClu2Overlap.java` that, like `MandelbrotSetClu2.java`, uses the master-worker pattern, and, unlike `MandelbrotSetClu2.java`, uses the overlapped computation and communication pattern. In particular, a worker should overlap computing its next range of pixel data with communicating its previous range of pixel data.

Measure the total running time T for `MandelbrotSetSeq` with command-line arguments `3000 3000 -0.75 0 1125 1000 0.4 ms.pjg` on the `thug`N backend nodes and `MandelbrotSetClu2` and `MandelbrotSetClu2Overlap` with the same command-line arguments on the `thug`N backend nodes using 1, 2, 4, and 8, and 16 processors. Calculate *Speedup*, *Eff*, and *EDSF*. When measuring the total running time T for `MandelbrotSetClu2` and `MandelbrotSetClu2Overlap`, be sure to record the total running time of the rank which has the longest running time. Also measuring the total running time T for `MandelbrotSetClu2` and `MandelbrotSetClu2Overlap`, be sure to use a dynamic schedule (`-Dpj.schedule=dynamic(10)`) for load balancing. Submit your results in a table organized as follows:

K	T (msec)	*Speedup*	*Eff*	*EDSF*
`MandelbrotSetSeq`				
seq		xxx	xxx	xxx
`MandelbrotSetClu2`				
1				xxx
2				
4				
8				
16				
`MandelbrotSetClu2Overlap`				
1				xxx
2				
4				
8				
16				

Submission Submit `MandelbrotSetClu2Overlap.java` and a plain text file named `hw4-2.txt` or a PDF file named `hw4-2.pdf`. The `hw4-2` file should contain the tabulated results.

Submission

Submit a single ZIP file named `hw4.zip` to the `Homework 4` Dropbox on MyCourses by the due date. The `hw4.zip` file should contain:

- `hw4-1.txt` or `hw4-1.pdf`
- `MandelbrotSetClu2Overlap.java`
- `hw4-2.txt` or `hw4-2.pdf`

The `hw4.zip` file should contain no additional files.

Document History

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Original version