ECE 563 Fall 2022, Exam 1 takehome

Ask questions on Piazza or office hours, not by talking to other students. Do this on your own, although you can use slides, videos, and the web sites (but you cannot post questions to those web sites – you can only look at pre-existing material) to help in developing solutions. By turning in a solution, you are stating that you did the work on your own, with the exceptions noted above.

All problems are OpenMP. You can run this on scholar, or any other machine you have access to that has OpenMP installed.

Question 1. Given the code in Q1.c, perform three dot products and time them:

1. A sequential dot product. This will be useful for checking your answers. By using longs during testing you don't have to worry about roundoff errors. A routine that performs a dot product on a region of the array is provided.
2. A dot product done using tasks. Tasks should be spawned and each task should compute a region of the array. Do this in the main routine so to make grading easier for me. Only four threads should be active to run tasks, and only 4 tasks should be spawned.
3. A dot product using an OpenMP reduction.

Timings should be printed, as shown in the Q1.c code.

Question 2. Write a program that traverses a tree sequentially and in parallel, and at each node does the following:

1. Gets the element of data indexed by the valIdx field of the node.
2. Increments that data element.

After the traversal, the values of the data fields should be printed, and the sum of the data fields should be printed. Your sequential and parallel traversals should give the same answers. You do not need to print timing information. Q2.c gives code that builds the tree and initializes the data.

Your program should not have races. For synchronization, use locks, not critical. Feel free to use the structure of the tree to simplify your traversals.

Question 3. Write a program that solves the boundary value problem, shown in slide 23 of following the example in the 563F5AlgorithmDesign.pdf, in parallel. You will need to

1. Allocate storage to hold the rod. Elements are initialized to 100.
2. End element of the rod, represent the ice water, and are initialized to 0. They should not be updated.
3. The rod, including end elements representing ice water, should be 100 points long
4. Run the simulation in parallel for 1000 steps

5. A point $P_{t,n}$ is computed as ($P_{t-1,n-1}$, $P_{t-1,n}$, $P_{t-1,n+1}$)/3.
6. When computing points at time t, you cannot overlay data for time t-1 until time t points have finished reading that data.
7. For output, simply print the elements of your computation. It should be symmetric, i.e, given p points, points 0 and p-1 should be equal, 1 and p-2, and so forth.

Question 4. How much time did you spend on this exam. This will not affect your grade, you will get the same number of points for whatever you answer.

What to turn in: turn a .zip file containing files Q1.c, Q2.c and Q3.c with your code. Turn in .output files for each of these giving the output for running your program. For question 4, turn in Q4.txt with the answer. Good luck, and have a great break!