



Homework 3

Due: 11:59 PM, Tue, Feb 19, 2019

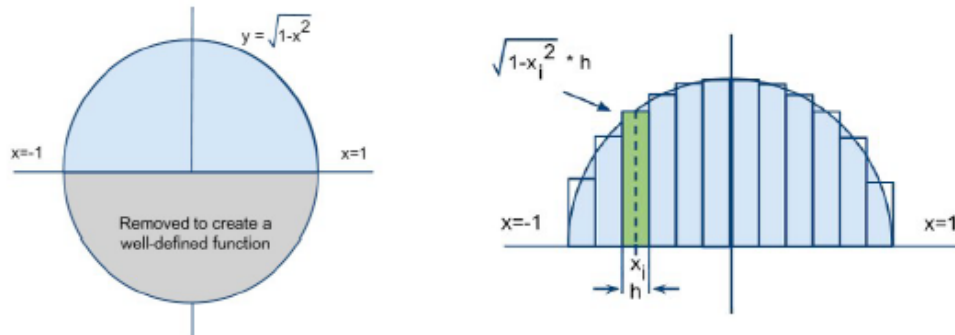
Total score: 100

Program language: C++

Submission: Source code and analysis file (docx, pdf, txt) through git

Problem: Calculate Pi using numeric integration methods. Parallelize it using OpenMP and analyze the performance as below. Prepare a document (.txt, .pdf, or .docx) to analyze results.

Q1. The pseudocode shown below is the calculation of pi by the method of numeric integration. Complete the serial code. Refer the course slide "OpenMP_3".



```

1  sum = 0;
2  h = 2.0 / n_rect;
3  for ( i = 0; i < n_rect; i++ ) {
4      x = -1 + ( i + 0.5 ) * h;
5      sum += sqrt( 1 - x * x ) * h;
6  }
7
8  pi = sum*2.0;

```

- Set the number of rectangles to 500000000.
- Use `clock_t begin = clock();` or any time function begin and end of the code to measure elapsed time.
- Generate output as below and put it in the analysis text format.

```

[ahnt@hopper:~/Course/csci4850/2019S/Homework/hw3]$ ./hw3_pi_cal_ser
      n      Pi      time
500000000  3.14159  12.24

```



Q2. Parallelize it using "reduction" clause and test it with P=1, 2, 4, 6, 8, 10. Run it on hopper.slu.edu and report the results as below. Hope you get good speedup in this case.

```
[ahnt@hopper:~/Course/csci4850/2019S/Homework/hw3]$ g++ -fopenmp hw3_pi_cal_par.cpp -o hw3_pi_cal_par
[ahnt@hopper:~/Course/csci4850/2019S/Homework/hw3]$ ./hw3_pi_cal_par
```

n	threads	Pi	time
500000000	1	3.14159	
n	threads	Pi	
500000000	2	3.14159	
n	threads	Pi	
500000000	4	3.14159	
n	threads	Pi	
500000000	6	3.14159	
n	threads	Pi	
500000000	8	3.14159	
n	threads	Pi	
500000000	10	3.14159	

- You should use `omp_get_wtime()` to measure time.
- The calculated PI should be correct enough.

Q3. Change the "reduction" clause to use "atomic" directive. Then, test it with P=1, 2, 4, 6, 8. Report the results as previous.

Q4. Plot the speedup with three cases: ideal, reduction, and atomic as below, then provide your comments why atomic is a bad idea for this case. I strongly recommend you to use R or MATLAB to plot it as below.

