HW5_1

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Q1. The pseudocode shown below is the calculation of pi by the method of numeric integration. Complete the serial code. There are many ways to calculate the pi value. Your code should follow the pseudocode.

```
[campbellrobert@hopper2 week5]$ ./pi_cal_ser
         N                    Pi   Elapsed wall clock time (sec)
 500000000               3.14159                          5.10996
```

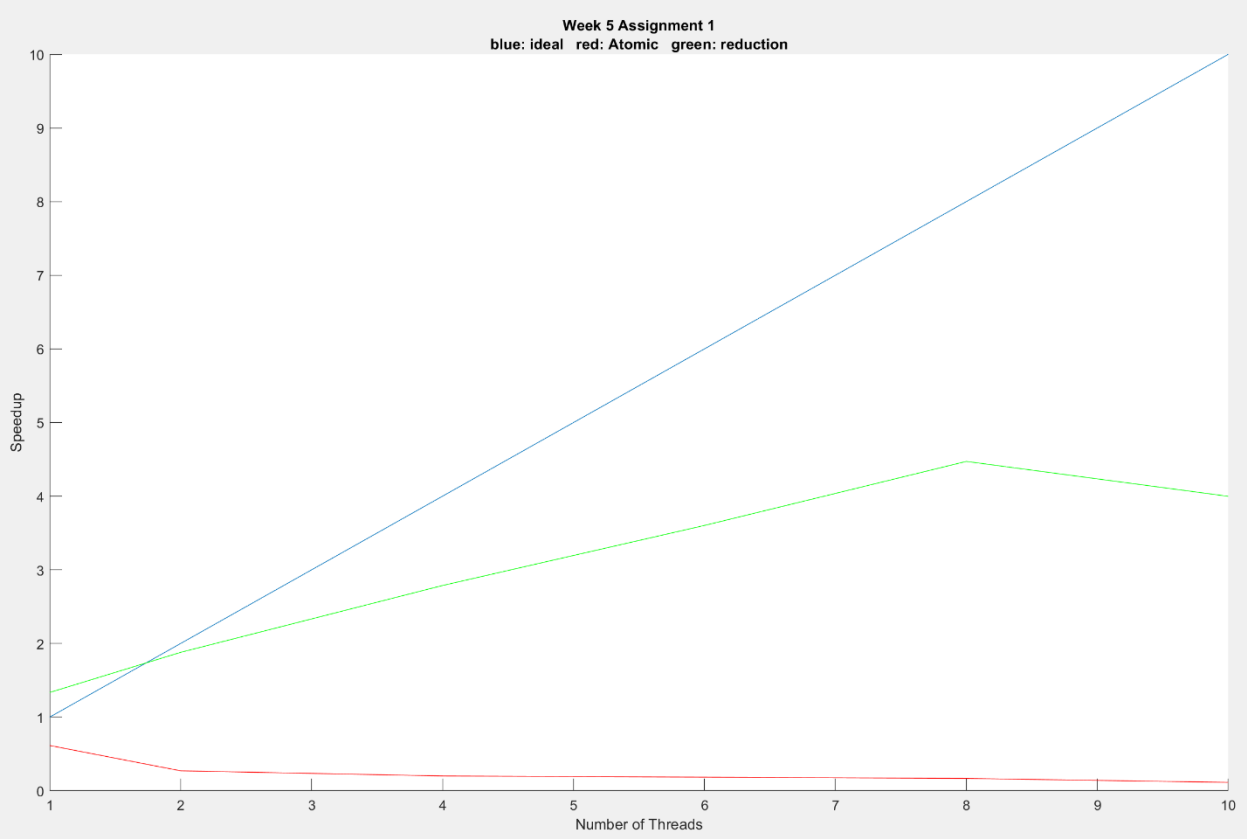
Q2. Parallelize it using the “reduction” clause and test it with P=1, 2, 4, 6, 8, 10. Run it on hopper.slu.edu and report the results as below. Hope you get a good speedup in this case.

```
[campbellrobert@hopper2 week5]$ ./pi_cal_red
         N                    Pi    Numer of threads   Elapsed wall clock time (sec)
 500000000               3.14159                   1                          3.82853
         N                    Pi    Numer of threads   Elapsed wall clock time (sec)
 500000000               3.14159                   2                          2.71869
         N                    Pi    Numer of threads   Elapsed wall clock time (sec)
 500000000               3.14159                   4                          1.83333
         N                    Pi    Numer of threads   Elapsed wall clock time (sec)
 500000000               3.14159                   6                          1.41838
         N                    Pi    Numer of threads   Elapsed wall clock time (sec)
 500000000               3.14159                   8                          1.14261
         N                    Pi    Numer of threads   Elapsed wall clock time (sec)
 500000000               3.14159                  10                          1.27791
```

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

```
[campbellrobert@hopper2 week5]$ ./pi_cal_at
         N                    Pi    Numer of threads   Elapsed wall clock time (sec)
 500000000               3.14159                   1                          8.81145
         N                    Pi    Numer of threads   Elapsed wall clock time (sec)
 500000000               3.14159                   2                           16.407
         N                    Pi    Numer of threads   Elapsed wall clock time (sec)
 500000000               3.14159                   4                          28.9007
         N                    Pi    Numer of threads   Elapsed wall clock time (sec)
 500000000               3.14159                   6                          28.1838
         N                    Pi    Numer of threads   Elapsed wall clock time (sec)
 500000000               3.14159                   8                          26.9536
         N                    Pi    Numer of threads   Elapsed wall clock time (sec)
 500000000               3.14159                  10                          28.1821
```

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



Atomic causes a worst case because every for-loop iteration has to wait for no other thread to be accessing the sum variable. This would be no better than the serial rate, but the atomic operations longer than just the simple addition, there is additional overhead for each additional thread, and every thread will have to wait for their individual turn.