Lab 4 Report

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Base Version:

1. Make the parameter N a command-line argument and remove the default value of 1000. If a user does not provide a value for N, the program should prompt the user, and exit:

   Done

2. Insert timing routines to measure the elapsed time of this program. You should leave the printf statement outside of the timing brackets. Also, report the timing in units of millisecond:

   Done

OpenMP Version:

Done

C++ MultiThread Version:

Done

Timing Study:

- Do you observe any performance improvement from the parallel versions over the sequential version?

  When the number of threads increase the elapsed time increases drastically. However, there is a slight improvement in the performance for increase in smaller number of threads.

  Tried with multiple inputs and 4 sample output screenshots are provided below.

As mentioned in the class, not always parallel programs are more efficient than the sequential programs. It always depends on how big the inputs are and what job the program is assigned and how many processors the system has.
In this case there is more overhead of creating and running the threads when there are more than 35 or above since the cores available in the linux system are 48.
However, when there is a something with much bigger inputs i.e in terms of millions, parallel program run faster as the overhead becomes very negligible.

With input N = 10000

```
hegde@catron:~/parallelprogramming/lab4$ ./sum 10000
Sum of 10000 sqrt(i*i) is 49995000
Elapsed time (gettimeofday):  msec=0.268000 ms
hegde@catron:~/parallelprogramming/lab4$ ./sum-omp 10000
Sum of 10000 sqrt(i*i) is 49995000
Elapsed time (gettimeofday): msec=0.311000 ms
hegde@catron:~/parallelprogramming/lab4$ ./sum-omp 10000 100
Sum of 10000 sqrt(i*i) is 49995000
Elapsed time (gettimeofday): msec=3.105000 ms
hegde@catron:~/parallelprogramming/lab4$ ./sum-omp 10000 10
Sum of 10000 sqrt(i*i) is 49995000
Elapsed time (gettimeofday): msec=0.531000 ms
hegde@catron:~/parallelprogramming/lab4$ ./sum-par 10000
Sum of 10000 sqrt(i*i) is 49995000
Elapsed time: 0.123091 ms
hegde@catron:~/parallelprogramming/lab4$ ./sum-par 10000 10
Sum of 10000 sqrt(i*i) is 49995000
Elapsed time: 0.230059 ms
hegde@catron:~/parallelprogramming/lab4$ ./sum-par 10000 100
Sum of 10000 sqrt(i*i) is 49995000
Elapsed time: 1.4396 ms
hegde@catron:~/parallelprogramming/lab4$
```

```
hegde@catron:~/parallelprogramming/lab4$ ./sum 10000
Sum of 10000 sqrt(i*i) is 49995000
Elapsed time (gettimeofday):  msec=0.161000 ms
hegde@catron:~/parallelprogramming/lab4$ ./sum-omp 10000 20
Sum of 10000 sqrt(i*i) is 49995000
Elapsed time (gettimeofday): msec=1.345000 ms
hegde@catron:~/parallelprogramming/lab4$ ./sum-omp 10000 15
Sum of 10000 sqrt(i*i) is 49995000
Elapsed time (gettimeofday): msec=0.844000 ms
hegde@catron:~/parallelprogramming/lab4$ ./sum-omp 10000 10
Sum of 10000 sqrt(i*i) is 49995000
Elapsed time (gettimeofday): msec=0.448000 ms
hegde@catron:~/parallelprogramming/lab4$ ./sum-par 10000 10
Sum of 10000 sqrt(i*i) is 49995000
Elapsed time: 1.17124 ms
hegde@catron:~/parallelprogramming/lab4$ ./sum-par 10000 15
Sum of 10000 sqrt(i*i) is 49895055
Elapsed time: 0.878612 ms
hegde@catron:~/parallelprogramming/lab4$ ./sum-par 10000 20
Sum of 10000 sqrt(i*i) is 49995000
Elapsed time: 0.357547 ms
hegde@catron:~/parallelprogramming/lab4$ ./sum-par 10000 35
Sum of 10000 sqrt(i*i) is 49745325
Elapsed time: 2.04822 ms
hegde@catron:~/parallelprogramming/lab4$ ./sum-par 10000 30
Sum of 10000 sqrt(i*i) is 49895055
Elapsed time: 1.77747 ms
hegde@catron:~/parallelprogramming/lab4$
```

With input N = 1000000

```
hegde@catron:~/parallelprogramming/lab4$ ./sum 1000000
Sum of 1000000 sqrt(i*i) is 499999500000
Elapsed time (gettimeofday):  msec=15.388000 ms
hegde@catron:~/parallelprogramming/lab4$ ./sum-omp 1000000
Sum of 1000000 sqrt(i*i) is 499999500000
Elapsed time (gettimeofday): msec=14.311000 ms
hegde@catron:~/parallelprogramming/lab4$ ./sum-omp 1000000 10
Sum of 1000000 sqrt(i*i) is 499999500000
Elapsed time (gettimeofday): msec=7.264000 ms
hegde@catron:~/parallelprogramming/lab4$ ./sum-omp 1000000 100
Sum of 1000000 sqrt(i*i) is 499999500000
Elapsed time (gettimeofday): msec=8.628000 ms
hegde@catron:~/parallelprogramming/lab4$ ./sum-par 1000000
Sum of 1000000 sqrt(i*i) is 499999500000
Elapsed time: 0.039539 ms
hegde@catron:~/parallelprogramming/lab4$ ./sum-par 1000000 10
Sum of 1000000 sqrt(i*i) is 499999500000
Elapsed time: 0.280338 ms
hegde@catron:~/parallelprogramming/lab4$ ./sum-par 1000000 100
Sum of 1000000 sqrt(i*i) is 499999500000
Elapsed time: 6.73328 ms
hegde@catron:~/parallelprogramming/lab4$
```

```
hegde@catron:~/parallelprogramming/lab4$ ./sum 1000000
Sum of 1000000 sqrt(i*i) is 499999500000
Elapsed time (gettimeofday):  msec=12.930000 ms
hegde@catron:~/parallelprogramming/lab4$ ./sum-omp 1000000 15
Sum of 1000000 sqrt(i*i) is 499999500000
Elapsed time (gettimeofday): msec=5.012000 ms
hegde@catron:~/parallelprogramming/lab4$ ./sum-omp 1000000 20
Sum of 1000000 sqrt(i*i) is 499999500000
Elapsed time (gettimeofday): msec=6.603000 ms
hegde@catron:~/parallelprogramming/lab4$ ./sum-omp 1000000 35
Sum of 1000000 sqrt(i*i) is 499999500000
Elapsed time (gettimeofday): msec=7.088000 ms
hegde@catron:~/parallelprogramming/lab4$ ./sum-omp 1000000 40
Sum of 1000000 sqrt(i*i) is 499999500000
Elapsed time (gettimeofday): msec=2.693000 ms
hegde@catron:~/parallelprogramming/lab4$ ./sum-omp 1000000 50
Sum of 1000000 sqrt(i*i) is 499999500000
Elapsed time (gettimeofday): msec=4.217000 ms
hegde@catron:~/parallelprogramming/lab4$ ./sum-par 1000000 15
Sum of 1000000 sqrt(i*i) is 499989500055
Elapsed time: 0.430416 ms
hegde@catron:~/parallelprogramming/lab4$ ./sum-par 1000000 20
Sum of 1000000 sqrt(i*i) is 499999500000
Elapsed time: 1.10726 ms
hegde@catron:~/parallelprogramming/lab4$ ./sum-par 1000000 30
Sum of 1000000 sqrt(i*i) is 499989500055
Elapsed time: 1.61385 ms
hegde@catron:~/parallelprogramming/lab4$ ./sum-par 1000000 40
Sum of 1000000 sqrt(i*i) is 499999500000
Elapsed time: 1.57153 ms
hegde@catron:~/parallelprogramming/lab4$ ./sum-par 1000000 50
Sum of 1000000 sqrt(i*i) is 499999500000
Elapsed time: 3.57367 ms
hegde@catron:~/parallelprogramming/lab4$
```