ASSIGNMENT HPC-3

Roll No: 41205

Problem Statement:

For Bubble Sort and Merge Sort, based on existing sequential algorithms, design, and implement parallel algorithm utilizing all resources available.

Objective:

1. To under basics of OpenMP
2. Apply parallel programming concepts on and sort arrays

Outcome: One will be able to write parallel programs to sort arrays of large sizes using OpenMP

Pre-requisites:

1. 64-bit Linux OS
2. Programming Languages: C/C++

Hardware Specification:

1. x86_64 bit
2. 2/4 GB DDR RAM
3. 80 - 500 GB SATA HD
4. 1GB NIDIA TITAN X Graphics Card

Software Specification:

1. Ubuntu 14.04

Theory:

- OpenMP is a set of compiler directives as well as an API for programs written in C, C++, or FORTRAN that provides support for parallel programming in shared-memory environments.
- OpenMP identifies parallel regions as blocks of code that may run in parallel.
- Application developers insert compiler directives into their code at parallel regions, and these directives instruct the OpenMP run-time library to execute the region in parallel.

Syntax:

1. Parallel creation of threads:

   ```
   #pragma omp parallel
   ```

2. Create specific number of threads:

   ```
   #pragma omp parallel num_threads(count)
   ```

3. Run for loop:

   ```
   #pragma omp parallel for
   ```

4. Create sections:

   ```
   #pragma omp parallel sections num_threads(3)
   {
      #pragma omp section
        {
          printf("Hello World One");
        }


      #pragma omp section
        {
          printf("Hello World Two");
        }

      #pragma omp section
        {
          printf("Hello World Three");
        }

   }
   ```

Running the program:

```
!g++ -fopenmp file.cpp
!./a.out
```

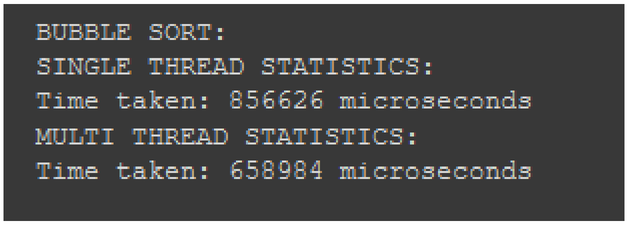
Test Cases:

#	Input	Expected Output	Actual Output	Result
1	Sort array using bubble sort	Array sorted Multithread faster	Array sorted Single: 856626	Success

		than single thread	microseconds Multi: 658984 microseconds	
2	Sort array using merge sort	Value: 26185517 Multithread faster than single thread	Array sorted Single: 231307 microseconds Multi: 174487 microseconds	Success

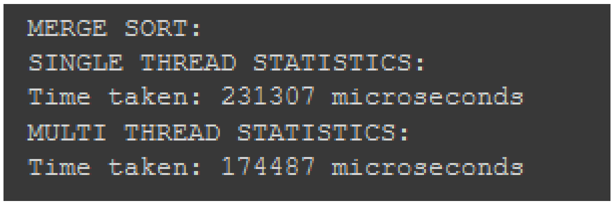
Output:

Bubble Sort



```
BUBBLE SORT:
SINGLE THREAD STATISTICS:
Time taken: 856626 microseconds
MULTI THREAD STATISTICS:
Time taken: 658984 microseconds
```

Merge Sort



```
MERGE SORT:
SINGLE THREAD STATISTICS:
Time taken: 231307 microseconds
MULTI THREAD STATISTICS:
Time taken: 174487 microseconds
```

Conclusion: We were thus able to sort arrays using multithreading with the help of OpenMP using merge and bubble sort algorithms.