CS 301
High-Performance Computing

Lab 3: Problem B-1

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Contents

1 Introduction

1.1 Brief description of the problem.

Problem B-1 -> Matrix multiplication using transpose.

In this problem, our task is to multiply two matrices of size N. We are using transpose method to multiply the matrices. In this method, we take the transpose of the second matrix and multiply it with the first one. We multiply the i^{th} row of the first matrix with all the rows of the second matrix, to give the i^{th} row of the final matrix.

Now our goal is to write an optimal algorithm for calculating the upper problem so that we can get optimal use of our processor.

1.2 The complexity of the algorithm (serial).

Here time complexity will be the same as conventional method and space complexity will also be the same.

So The time complexity of the algorithm is:

$$O(N^3)$$

For storing 3 matrices of NXN we will need

$$3XN^2$$

space. So The space complexity of the algorithm is:

$$O(N^2)$$

2 Hardware Details

2.1 Hardware Details of LAB207 Computer

- CPU - 4
- Socket - 1
- Cores per Socket - 4
- Size of L1 cache - 64KB
- Size of L2 cache - 256KB
- Size of L3 cache - 6MB

2.2 Hardware Details of Cluster

- CPU - 16
- Socket - 2
- Cores per Socket - 8
- Size of L1 cache - 64KB
- Size of L2 cache - 256KB
- Size of L3 cache - 20MB

3 PART 1: LAB207 Computer

3.1 Profiling information

Here we have described the profiling information of the Lab207 Computer.

```
                     Call graph (explanation follows)


granularity: each sample hit covers 2 byte(s) for 0.23% of 4.36 seconds

index % time    self  children    called     name
                                                 <spontaneous>
[1]    100.0    4.36    0.00                 main [1]
                0.00    0.00       2/2           diff [2]
-----------------------------------------------
                0.00    0.00       2/2           main [1]
[2]      0.0    0.00    0.00       2         diff [2]
-----------------------------------------------
```

Figure 1: Profiling information- PC

3.2 Graph

Below we have depicted the Mean execution time vs problem size for Lab207 Computer.

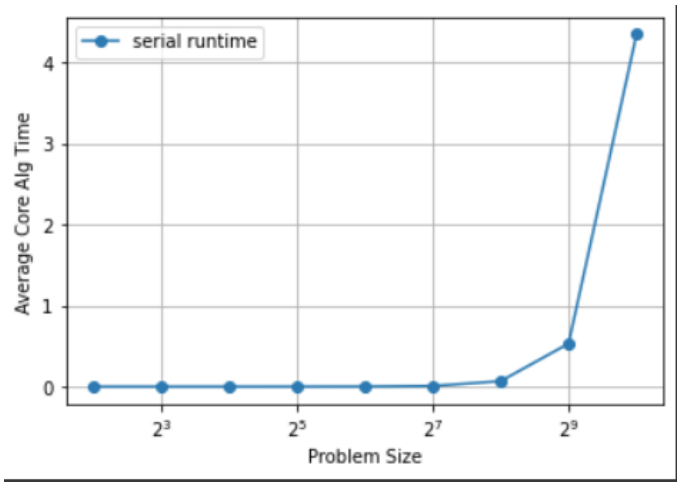

Figure 2: Algorithm time vs problem size - PC

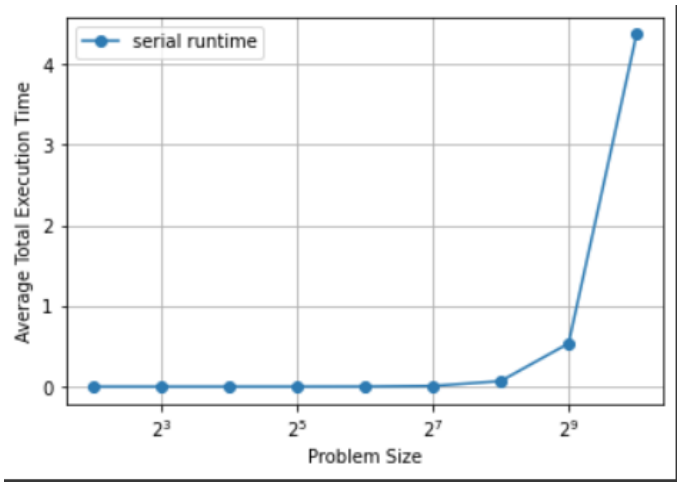

Figure 3: End-to-end execution time vs problem size - PC

4 PART 2: Cluster

4.1 Profiling information

Here we have described the profiling information of the Cluster.

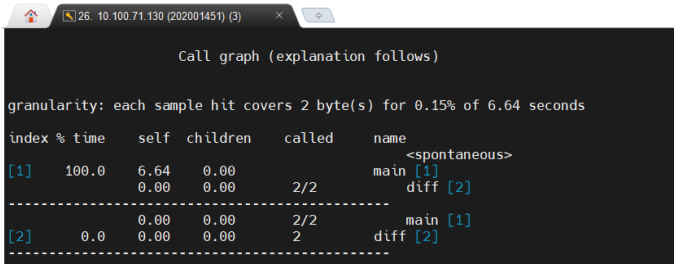

Figure 4: Profiling information - Cluster

4.2 Graph

Below we have depicted the Mean execution time vs problem size for Cluster.

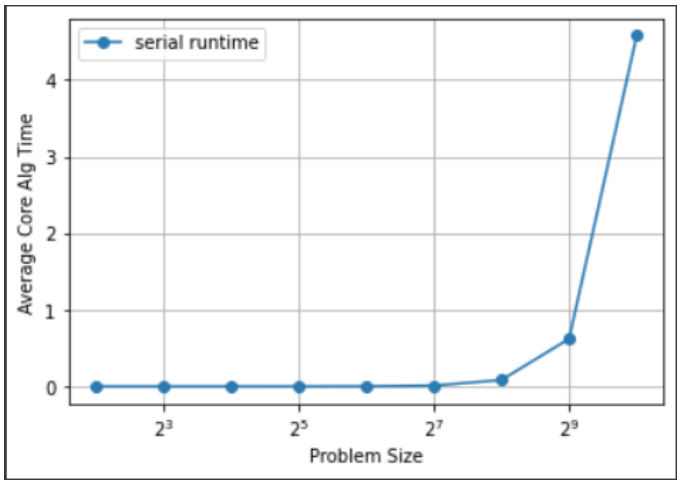

Figure 5: Algorithm time vs problem size - Cluster

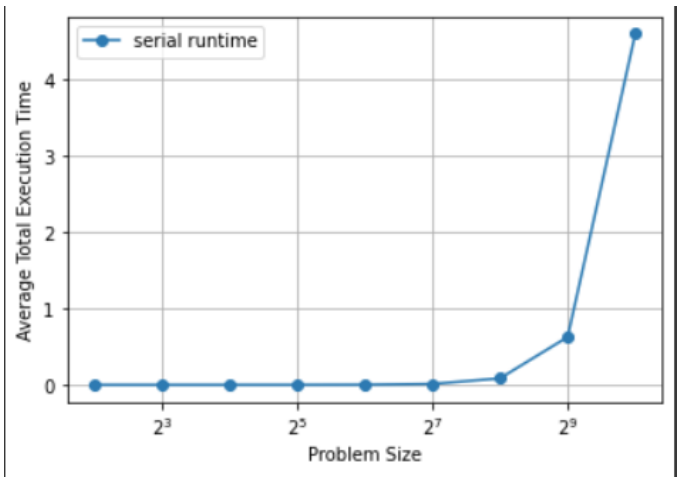

Figure 6: End-to-end execution time vs problem size - Cluster