

# COL216 Assignment 3: Report

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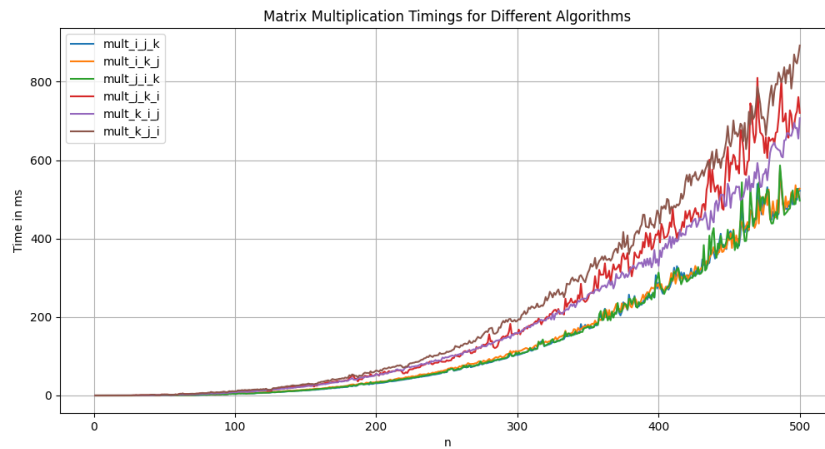
## 1 Introduction

In this assignment, we experimented with the order of loops in case of matrix multiplication and transpose. Though we could not concretely arrive at the cache parameters such as block size, the effect of row major format which is the standard in C++ was quite evident. Cache parameters could not be inferred due to the following reasons:

- Lack of proper knowledge
- Lack of sources testifying the accuracy of this method in predicting parameters

Two experiments were conducted.

## 2 Matrix Multiplication

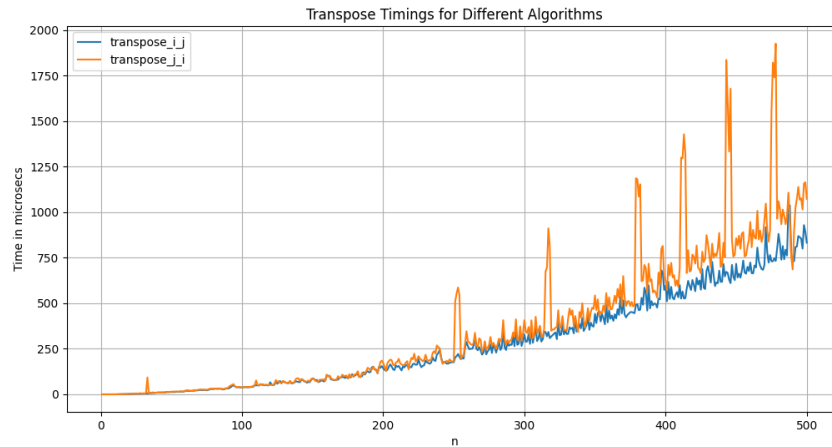


### 2.1 Observations

- The case when  $i$  occurs in the innermost loop takes greatest amount of time due to a cache miss at each access leading to delay caused by loading the entire row repeatedly.
- To some surprise, when  $i$  is innermost loop,  $j$  being in the second loop leads to lesser delay as compared to  $k$  being in the second loop
- $i$  being in the outermost loop leads to least amount of row misses and hence the minimum time.

- Although the case of mult-j-i-k closely overlaps with cases of i being in outermost loop, it shows greater amplitude in fluctuations, the reason for which is not clear
- Trying to predict the cache block size from this data would involve substantial assumptions which would deem the analysis unreliable especially when multiple processes are running on the same machine.

### 3 Matrix transpose



#### 3.1 Observations

- When i is in the outer loop, less cache misses occur.
- When i is in the inner loop, amplitude of fluctuations in time when misses occur becomes significant in some places. Also, the n-difference between these peaks decreases eventually, the reason for which is not clear.

### 4 Conclusion

The only clear conclusion from the experiments was that knowledge of the underlying architecture of the machine and language is necessary for writing correct and efficient programs. Alternatively, if C++ used column major format, j being in the outermost loop would have provided the best results as it would have resulted in minimum number of column hits. However, I reiterate that no meaningful inference about cache parameters can be drawn.