BLG 608E – Parallel Algorithms
Homework #1
Due on: 26/11/2023

Studying Sparse Matrix-Matrix Multiplication

In this homework, we will work on parallel algorithm development for sparse matrix-matrix multiplication.

There are multiple ways of implementing matrix multiplication in software. The most straightforward software approach is to implement it using three nested for loops as shown below. In this implementation that the result is the same even if we permute the order of the for loops. The *for* loops can be permuted in six different ways. Each permutation results in a different access pattern for the elements of **A** and **B** and sequence in which the partial sums are generated for the **C** matrix.

```
for (int m = 0; m < M; m++) {
    for (int n = 0; n < N; n++) {
        for (int k = 0; k < K; k++) {
            C[m][n] += A[m][k]*B[k][n];
        }
    }
}
```

In this homework, we will focus on three permutations, known as inner product, outer product, and row-by-row product.

I expect you to take the sparse matrix multiplication problem using these three permutations and apply the Foster's parallel algorithm design methodology (except the mapping stage). Apply the each step of the design methodology and clearly indicate the artifacts for each step (initial list of tasks, dependency and interaction graphs, consolidated tasks, etc.). Throughout your design, clearly show your reasoning for your design choices.