BLG 608E – Parallel Algorithms
Homework #2
Due on: 24/12/2023

1. Parallel Matrix-Matrix Product using OpenMP

The code for multiplying two matrices a and b to yield matrix c is as follows:

```
for (i = 0; i < dim; i++) {
      for (j = 0; j < dim; j++) {
          c(i,j) = 0;
          for (k = 0; k < dim; k++) {
               c(i,j) += a(i, k) * b(k, j);
          }
     }
}
```

For the first part of this homework, implement and test the OpenMP program for computing a matrix-matrix product basing above sequential algorithm. Use the OMP_NUM_THREADS environment variable to control the number of threads and plot the performance with varying numbers of threads. Consider three cases in which (i) only the outermost loop is parallelized; (ii) the outer two loops are parallelized; and (iii) all three loops are parallelized. What is the observed result from these three cases?

2. Parallel Sparse Matrix-Vector Product using OpenMP

Consider a sparse matrix stored in the compressed row format (you may find a description of this format on the web or any suitable text on sparse linear algebra). Write an OpenMP program for computing the product of this matrix with a vector. Download sample matrices from the Matrix Market (http://math.nist.gov/MatrixMarket/) and test the performance of your implementation as a function of matrix size and number of threads.

Important Note: When presenting your results, clearly describe your environment, the processor, compiler and the used options, operating system, omp environment variable values, etc.