

# Assignment 1 Report

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## Question 1 :

### 1. Dense matrices :

- Storage :  $O(3 * n^2)$  memory required,  $n^2$  for each of the two matrices, and one for the output matrix.
- Flops :  $2 * n^3$ , since there are three nested loops for matrix multiplication, and the loop equation involves one addition, and one multiplication.

### 2. Banded matrices :

- Storage :  $O(3 * (p + q + 1) * n)$  memory for banded matrices, where  $p$  = lower bandwidth of the matrix and  $q$  = upper bandwidth.
- Flops :  $2 * n^3$  for naive matrix multiplication.

### 3. Sparse matrices :

#### a. Coordinate Storage format (COO) :

- Storage :  $O(3 * \text{NNZ})$  for each matrix, due to tuples (row, col, val) for each non zero value in the matrix. Total of  $9 * \text{NNZ}$  storage required (NNZ = Non Zero values in matrix).
- Flops :  $2 * \text{NNZ}_A * B_n$ , where  $B_n$  is the number of columns in B.

#### b. Compressed Sparse Row format (CSR) :

- Storage :  $O(2 * \text{NNZ} + m + 1)$ , NNZ for col indices and value indices,  $(m+1)$  for row indices.
- Flops :  $2 * B_n * A_m * \text{NNZ}_A$ .