Homework 1, problem 2 Due Tuesday Tuesday Feb 14th.

Task: Write a program for sparse matrix vector multiplication, try to optimize the performance with tiling and unrolling ideas discussed in context of dense matrices.

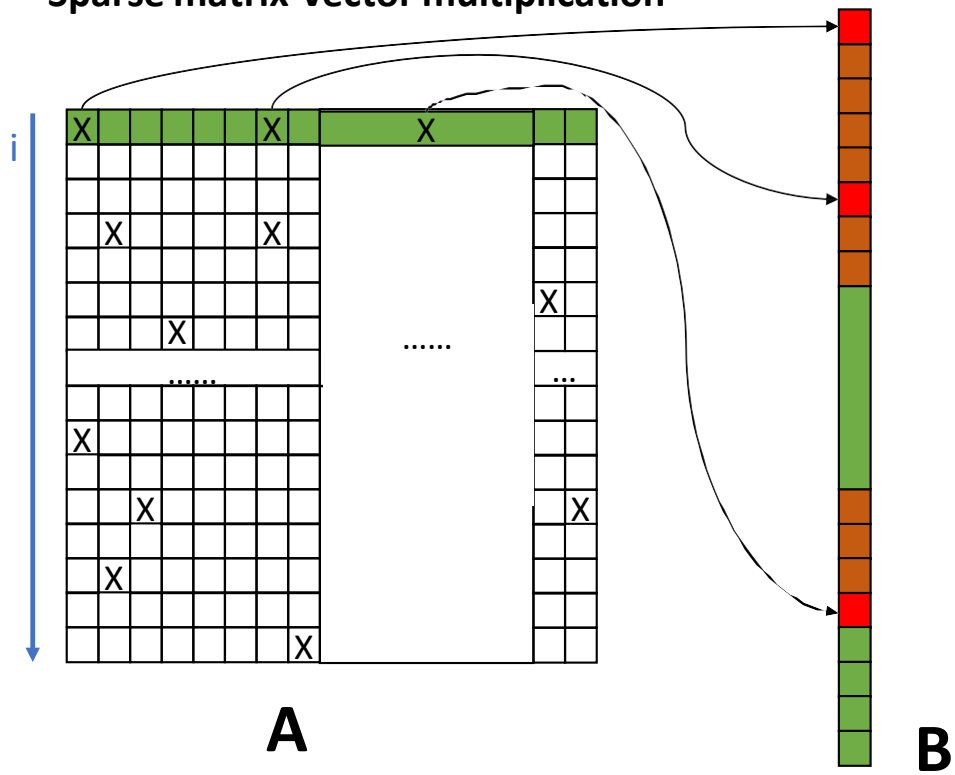
Input data:
Sparse matrix: copy the file from https://sparse.tamu.edu/SNAP/higgs-twitter. The first row of the input file is the number of rows, number of columns, number of nonzeros of the sparse matrix Each of the following row represents a nonzero as row_index, column_index, value.
Dense vector: assume all elements in the dense vector are 1.

Requirements:

1) Store the sparse matrix in CSR or COO, see https://en.wikipedia.org/wiki/Sparse_matrix#Compressed_sparse_row_(CSR,_CRS_or_Yale_format) for more details.
2) Write the program in C or C++, compile the program with g++
3) Use 'gettimeofday' to measure the execution time of the loop.
4) Try to divide the sparse matrix into column blocks, and see if the performance is improved.
5) Submit the source code on ICON before the deadline

Blocking (Tiling)

Sparse matrix-vector multiplication




```
for (int i=0; i<N; i++) {
    C[i] = 0.0;
    for (int j=rowptr[i]; j<rowptr[i+1]; j++) {
        col = colidx[j];
        val = value[j];
        C[i] += val * B[col];
    }
}
```