MAT 250 Course Project
Spring 2026

Due Date: Tuesday, March 31

- Implement the Gauss-Jordan Algorithm, with partial pivoting, to take any input $m \times n$ real matrix A and convert to its reduced row-echelon form.

- The input should be read from a text file as rows of numbers with comma as delimiter to separate entries.

- The algorithm should use partial pivoting, which means that in order to find a pivot for the next row you should choose the one with the largest absolute value, from all the rows at or below the desired pivot entry.

- Output should be written to a text file in similar format as input.

- Also output the rank of the matrix, and the number N of elementary row operations performed.

- Default names for input and output files are: input.txt and output.txt

- Use double precision and test a double x for zero if $|x| < 10^{-9}$.

- Write a function to implement previous as Boolean: IsZero(x).

- Write a similar function to implement Boolean: IsOne(x).

- For both debugging and grading purposes, implement the option to print resulting matrix and row operation (abbrev) used to obtain it, in the following ways. Notes: j and k can be chosen by user, either through interface or on command line. If $k > N$ print all results, and if $j > n$ just ignore.

    - the result after each of the first k elementary row operations
    - the result after processing column j

1. Definition of rref:

    - each nonzero row has first nonzero entry equal to 1 (leading 1)
    - zero rows are below all nonzero rows
    - leading one's $a_{i,j}$ and $a_{k,l}$ with $i < k$ must have $j < l$ (echelon form)
    - a leading one in entry $a_{i,j}$ implies $a_{k,j} = 0$ for all $k \neq i$

2. Row operations and abreviations:

    - i) swap rows i and j: $R1(i,j)$
    - ii) multiply row i by a nonzero constant c: $R2(i,c)$
    - iii) replace row i by itself plus a nonzero multiple c of row j: $R3(i,j,c)$

3. Gaussian Elimination Procedure with Partial Pivoting

   Assume $m, n \geq 1$. Set $i = 1$ and $j = 1$. While $i \leq m$ and $j \leq n$ do:

    - use row swaps to place element $a_{r,j}$ $(r \geq i)$ with largest absolute value into row i
    - if IsZero($a_{i,j}$) then increment j, otherwise divide row i by $a_{i,j}$
    - if IsOne($a_{i,j}$) then get zeros in other entries of column j, increment i and j

4. Extra Credit: Do all of the above for complex matrix entries.