CSE218

Home Assignment 2

Topic: Gaussian Elimination

Problem statement: A circle given by the equation $x^2 + y^2 + ax + by + c = 0$ passes through the points (-2, 0), (-1, 7), and (5, -1). We want to find the values of constants a, b, and c.

Solution approach: The above problem can be transformed such that solving a system of linear equations would yield us the values of the unknown constants. In this assignment, you will implement the Gaussian Elimination method for solving a system of linear equations. A system of linear equations is often represented in matrix form as $AX = B$ where A is the coefficient matrix, X is the variable matrix (a column vector), and B is the right-hand side constant matrix (also a column vector).

You should write a python function *GaussianElimination(A,B,pivot,showall)* to implement the task. The function returns the solution as a column vector. The parameters *pivot* and *showall* are explained below.

Param *pivot*: If this flag is set to, then use partial pivoting with Gaussian elimination. By default, this flag should be true. Partial pivoting works as follows. At the beginning of each step of forward elimination, a row switching is done based on the following criterion. If there are n equations, then there are $n-1$ forward elimination steps. At the beginning of the kth step of forward elimination, one finds the maximum of

$$\left|a_{kk}\right|, \left|a_{k+1,k}\right|, \ldots\ldots\ldots, \left|a_{nk}\right|$$

Then if the maximum of these values is $\left|a_{pk}\right|$ in the pth row, $k \leq p \leq n$, then switch rows p and k.

Please see textbook chapter "3.1.gaussian_elimination.doc" for more details with example problems.

Param *showall*: The parameter *showall* is a flag variable. Your program should have provision to show the intermediate matrices (both A and B) after every sub-steps of the forward elimination if this flag is set to true. By default, this flag should be true. A sub-step of forward elimination is a single row operation done to set the leftmost element of the row to zero (0).

Sample input/output: The first integer in the sample input denotes the number of unknown variables in the system. This is also the number of linear equations given. Next inputs will be matrices A and B in row major order (as shown in the input below).

Your program should output the solution vector and intermediate matrices (if d flag is set programmatically). The elements of the solution vector should be printed up to four (4) decimal places.

Sample input	Sample output
3 25 5 1 64 8 1 144 12 1 106.8 177.2 279.2	0.2905 19.6905 1.0857
3 20 15 10 -3 -2.249 7 5 1 3 45 1.751 9	1.0000 1.0000 1.0000