IE 310 – Programming Assignment 2
Due on March 6, 2020, 23:59

In this assignment, you are going to write a program which solves a given set of linear equations. As you may have already noticed, linear algebra is the premise of linear optimization and we frequently need to solve system of linear equations. Gaussian elimination or Gauss-Jordan method can be used to solve such systems. Both methods take advantage of three basic elementary row operations listed below:

i. Interchanging two rows.
ii. Multiplying a row by a nonzero constant.
iii. Adding a multiple of a row to another row.

Suppose that a system of linear equations is given as $Ax = b$, where A is a nxn matrix, b is a column vector with n entries and x is a column vector with n variables. As you may recall, there are three possibilities about the solution of such a system:

i. If $rank(A) = n$, then $Ax = b$ has a unique solution.
ii. If $rank(A) = rank(A|b) < n$, then $Ax = b$ has infinitely many solutions.
iii. If $rank(A) < rank(A|b)$, then $Ax = b$ has no solutions.

You should write a computer program in **C, C++ or Python** which first identifies from the cases above and then, performs the following operations:

i. If $rank(A) = n$, then you should find the unique solution and additionally, you should also find A^{-1}.
ii. If $rank(A) = rank(A|b) < n$, then you should give an arbitrary solution.
iii. If $rank(A) < rank(A|b)$, then you should only state that the problem has no solution at all.

You need to test your algorithm with the three problem instances attached. The first number in .txt files gives the number n. Then, there is a $nx(n+1)$ matrix which represents the augmented matrix $[A|b]$. You can safely assume that the data is given correctly. Do not change the input format.

Please include text files into your program by using commands like "open" instead of giving numbers into the program. Also, please avoid using console to run your program. It is better if you use some IDE (Integrated Development Environment) while writing your code. Please run all three instances in your source code instead of changing the file name and running the program for each instance (i.e. write a function for operations and call it for each instances in main). Do not use any linear algebra libraries available!

You need to hand in a report which contains your description of the method and output of the problem each instance (you may include screenshots in your report or write your output in a text file.) Check below for output format. Please name your folder as "Name-Surname-ID-Assignment2". Submit your folders via Moodle page until due time.

Note: If you have difficulty in remembering the details of Gauss-Jordan method, refer to any elementary linear algebra book.

Output formats

i. "Unique solution: x y z …
Inverted A: a b c…
d e f…
g h i…
. . . "

ii. "Arbitrary variables: p r…
Arbitrary solution: p q r …"

iii. "Inconsistent problem"