Coding Assignment # 1

Numerical Methods I (CH2030)

Due Date: Oct 23, 2020

1. Write a Fortran code for solving the given Ax = b using the following direct methods:

$$\begin{bmatrix} 5 & -2 & 3 \\ 3 & 9 & -5 \\ 3 & -2 & 7 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = \begin{bmatrix} 27 \\ -11 \\ 51 \end{bmatrix}$$

a) Gauss Elimination, print the values of x, modified A and b.

b) LU Decomposition (Doolittle's method), print the values of x, L, U, modified b.

c) Gauss Jordan, print the values of x, inverse of A.

d) Gauss Jacobi (starting point [1 2 1), Tolerance = 1e-5.

e) Gauss Seidel (starting point [1 2 1]), Tolerance = 1e-5.

f) Successive Over-relaxation (starting point [1 2 1] with weight as 1.5, Tolerance = 1e-5)

For iteration methods (d) – (f), print the iteration number along-with the solution obtained after every iteration.

2. Write a Fortran code for the following:

a) With $\boldsymbol{x}^{(1)} = [1 \;\; 1]^{\mathrm{T}}$, solve **F(x)** using Successive Substitution (SS) method. Tolerance = 1e-7.

$$F_1(\boldsymbol{x}) = 2x_1^2 - 5x_2^3 - 3 = 0$$

$$F_2(\boldsymbol{x}) = 3x_1^3 + 2x_2^2 - 26 = 0$$

For the case of Successive Substitution use the following choice of **f(x).**

$$\boxed{\begin{aligned} x_1^{(k+1)} &= [x_1 + 2x_1^2 - 5x_2^3 - 3]^{(k)} \equiv f_1(\boldsymbol{x}) \\ x_2^{(k+1)} &= [3x_1^3 + x_2 + 2x_2^2 - 26]^{(k)} \equiv f_2(\boldsymbol{x}) \end{aligned}}$$

Check whether the solution converges & print the iteration number along-with the solution after every iteration.

b) Using NR method, solve **F(x)** given in (a) using Newton Raphson (NR) method with same initial guess & print the values as mentioned in (a). **Do not** use any inbuilt functions for computing matrix multiplication and inverse of a function.

c) Repeat the same calculations as in (b) with $\boldsymbol{x}^{(1)} = [0.5 \;\; 0.5]^{\mathrm{T}}$. Additionally, print the initial guess that has converged faster (converged in less number of iterations).