Assignment-1 Solutions

Q1

$$A = \begin{bmatrix} 2 & 1 & -1 & 3 \\ -2 & 0 & 0 & 0 \\ 4 & 1 & -2 & 6 \\ -6 & -1 & 2 & 3 \end{bmatrix} \quad b = \begin{bmatrix} 13 \\ -2 \\ 24 \\ -14 \end{bmatrix} \quad c = \begin{bmatrix} 12 \\ -8 \\ 21 \\ -26 \end{bmatrix}$$

$$A = LU$$

$$\Rightarrow L = \begin{bmatrix} 1 & 0 & 0 & 0 \\ -1 & 1 & 0 & 0 \\ 2 & -1 & 1 & 0 \\ -3 & 2 & -1 & 1 \end{bmatrix} \quad U = \begin{bmatrix} 2 & 1 & -1 & 3 \\ 0 & 1 & -1 & 3 \\ 0 & 0 & -1 & 3 \\ 0 & 0 & 0 & 9 \end{bmatrix}$$

Solution of $Ax = b$ is,

$$x = \begin{bmatrix} 1 \\ 2 \\ -5 \\ 4/3 \end{bmatrix}$$

Solution of $Ax = c$ is,

$$x = \begin{bmatrix} 4 \\ 3 \\ 17.333 \\ 6.111 \end{bmatrix}$$

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Q2

$$A = \begin{bmatrix} 2 & 10 & 8 & 6 \\ 1 & 4 & -2 & -1 \\ 0 & 2 & 3 & 1 \\ 3 & 8 & 3 & 9 \\ 1 & 4 & 1 & 1 \end{bmatrix} \quad b = \begin{bmatrix} 52 \\ 14 \\ 12 \\ 51 \\ 15 \end{bmatrix} \quad c = \begin{bmatrix} 50 \\ 4 \\ 12 \\ 48 \\ 12 \end{bmatrix}$$

∴ The solution for $Ax = b$ using gauss-elimination with partial-pivoting and then back-substitution is:

$$x = \begin{bmatrix} 1 \\ 2 \\ 1 \\ 2 \\ 1 \end{bmatrix}$$

The solution for $Ax = c$ is,

$$x = \begin{bmatrix} 2 \\ 1 \\ 2 \\ 1 \\ 2 \end{bmatrix}$$

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Q3. The errors $(\|x - \hat{x}\|_\infty)$ in the computed solution are as follows:-

For $n=2$, error = 8.999
For $n=3$, error = 139.999591

For $n=4$, error = 5034.609136
For $n=5$, error = 131350.772353

For $n=6$, error = 3101926.690008
For $n=7$, error = 56267064.537896

For $n=8$, error = 330975606.613576
For $n=9$, error = 5814735632.519989

For $n=10$, error is larger than the upper limit for double-precision floating point numbers.