Department of Mathematics and Computing
Indian institute of technlogy (ISM) Dhanbad, Winter semester, 2022-23

Assignment

Course title: Numerical Linear Algebra (MCO533), Credit points: 10%
Instructor:Srinivasa Rao Pentyala, Email: psrao@iitism.ac.in

Instructions: Any preferred programming language **C, C++, Python, MATLAB ...** etc. and need to submit printed copy in the office Room No: 517, Science Block by **20/04/2023, 5:00 PM**. Please make to include all comments along with sample input and output to increase the readability of the algorithm.

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1. Solve the strictly diagonal dominant system $\begin{bmatrix} 10 & 5 & 5 & 5 \\ 5 & 10 & 1 & 2 \\ -1 & 0 & 10 & 2 \\ -1 & -4 & -3 & 10 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix} = \begin{bmatrix} 13 \\ 13 \\ 10 \\ 7 \end{bmatrix}$, using Gauss-Elimination without pivoting and with pivoting.
2. Apply householder transformation for the matrix $\begin{bmatrix} 0 & 1 & 1 \\ 1 & 2 & 3 \\ 1 & 1 & 1 \end{bmatrix}$, you may start with $u = [1\ 1\ 1]^T$
3. Find QR factorization of $A = \begin{bmatrix} 10 & 1 & 1 & 1 \\ 2 & 10 & 1 & 1 \\ 1 & 1 & 10 & 1 \\ 1 & 1 & 1 & 10 \end{bmatrix}$ by given's method.
4. Let $A = \begin{bmatrix} 1 & 2 & 3 \\ 2 & 3 & 4 \\ 3 & 4 & 6 \end{bmatrix}$ compute the eigenvalues of A, take $E = 10^{-4}a \times I_{3\times 3}$, then compute Eigenvalies of $A + C$.
5. Given two real symmetric matrices A and B by $A = \begin{bmatrix} 6 & 4 & -2 \\ 4 & 12 & -4 \\ -2 & -4 & 13 \end{bmatrix}$ and $B = \begin{bmatrix} 1 & -1 & 1 \\ -1 & 1 & -1 \\ 1 & -1 & 1 \end{bmatrix}$ determine a non-singular matrix P, such that $P^T AP = I$.
6. Find the SVD of A, $U\Sigma V^T$, where $A = \begin{bmatrix} 3 & 2 & 2 \\ 2 & 3 & -2 \end{bmatrix}$
7. Find QR of A, where $A = \begin{bmatrix} 2 & 1 & 0 \\ 1 & 2 & 1 \\ 0 & 1 & 2 \end{bmatrix}$
8. Compute a basis for the null space of the matrix Find, where $A = \begin{bmatrix} 1 & -1 & 1 & 2 \\ 2 & 1 & 3 & 2 \\ 1 & 5 & 3 & -2 \end{bmatrix}$
9. For the Hessenberg System $AX = B$ where $A = \begin{bmatrix} 1 & 2 & 3 \\ 2 & 3 & 4 \\ 0 & 5 & 6 \end{bmatrix}$, $B = \begin{bmatrix} 6 \\ 9 \\ 11 \end{bmatrix}$, using partial pivoting compute the growth factor.
10. Construct QR factorization using Householder method for the matrix where $A = \begin{bmatrix} 1 & 1 \\ 0.0001 & 0 \\ 0 & 0.0001 \end{bmatrix}$