Laboratory Exercise-4 (Part-A)

(Gaussian Elimination)

9-Sep-2020

1. **Aim** Here you will solve $AX = B$, where A is a $N \times N$ matrix and B is a $N \times 1$ matrix.

2. **Write a code**

   System of linear equations can be solved by Gaussian elimination in MATLAB using $X = A\backslash B$ (with a backslash). Write a code that will do the following

   - Choose a value of N (size of linear system)
   - Construct matrices A and B by assigning random values to elements of A and B. This can be done in MATLAB using $A = rand(N, N)$ and $B = rand(N, 1)$.
   - Solve the resulting equation for X using MATLAB function for Gaussian elimination.
   - Measure the run time of the Gaussian elimination procedure. *Do not include run time for generation of A & B.* Later you should compare this with Jacobi method.
     Check https://in.mathworks.com/help/matlab/ref/toc.html on how to do this.

3. **Test the code** for some simple system of 2 & 3 linear equations. Does your code give the correct answer for your chosen system of linear equations? *Never skip this step of testing your code.*

4. **Run the code**

   Run your code for different values of N ranging from 10 to 30000. Measure the time for each N. How does time (T) change with N. Plot N vs T.

Laboratory Exercise-4 (Part-B)

(Jacobi method)

9-Sep-2020 & 16-Sep-2020

1. **Aim** Here you will solve $AX = B$ using Jacobi Method
2. **Write a Jacobi method code**
   - Construct matrices A and B by assigning random values to elements of A and B.
   - Verify if the matrix is diagonally dominant. If it satisifes this condition only then carry on with the procedure of Jacobi method.
   - Also verify that that the spectral radius of $T = D^{-1}(L + U)$ for the matrix generated is less than one. For diagonally dominant matrix spectral radius of T should be less than one (condition required for convergence)
     Check MATLAB documentation for the MATLAB function to find out eigenvalue of a matrix and then its largest value (magnitude). Use these. In a later lab you will write your own code to do the same.
   - Write a code to implement the iterative steps of Jacobi method to get solution of
   - Measure the run time of the iterative steps of the code.
3. **Test the code** for a system of 3 linear equations for which A is diagonally dominant/
4. **Run the code**
   Run the Jacobi method code for different values of N ranging from 10 to 30000. Measure the time for each N.
   (a) How does time (T) change with N. Plot N vs T.
   (b) Compare T for Jacobi and Gaussian method. Which one is preferable in terms of speed?