MA227 (Assignment-9)

1. Write a function *SelfMR.m* that takes an $n \times n$ positive definite matrix A, vector $b \in \mathbb{R}^{\kappa}$, initial vector x_0, integer $maxNumIter$ and positive small number $tol = 10^{-8}$, and returns solution to $Ax = b$. Use minimum residual (MR) method to find the solution and apply the following stopping criteria

   - No. of iteration $k > maxNumIter$ OR
   - $|r_k| \leq tol$.

   Here r_k represents the residual value in the $k-$th iteration. Test the function for $Ax = b$, where $A = \begin{bmatrix} 4 & -1 & 0 & 0 & 0 & 0 \\ -1 & 4 & -1 & 0 & 0 & 0 \\ 0 & -1 & 4 & -1 & 0 & 0 \\ 0 & 0 & -1 & 4 & -1 & 0 \\ 0 & 0 & 0 & -1 & 4 & -1 \\ 0 & 0 & 0 & 0 & -1 & 4 \end{bmatrix}$ and $b = \begin{bmatrix} 0 \\ 5 \\ 0 \\ 6 \\ -2 \\ 6 \end{bmatrix}$. Compare the result with the solution obtained by the function *SelfSD.m* in Assignment 8 in terms of number of iterations. What happens if you take $x_0 = 0$ and b as any eigenvector of A.

2. Write a function *SelfRNSD.m* that takes an $n \times n$ invertible matrix A, vector $b \in \mathbb{R}^{\kappa}$, initial vector x_0, integer $maxNumIter$ and positive small number $tol = 10^{-8}$, and returns solution to $Ax = b$. Use residual norm steepest descent (RNSD) method to find the solution and apply the following stopping criteria

   - No. of iteration $k > maxNumIter$ OR
   - $|r_k| \leq tol$.

   Here r_k represents the residual value in the $k-$th iteration. Test the function for $Ax = b$, where $A = \begin{bmatrix} 1 & -6 & 9 \\ 6 & 2 & 3 \\ 9 & 3 & 2 \end{bmatrix}$ and $b = \begin{bmatrix} 0 \\ 5 \\ 0 \end{bmatrix}$. Check the convergence of SD and MR methods for this example.