Math 471 - Laboratory Experiment with Octave

Write a program in Octave to implement the shifted inverse power method for the eigenvalue problem $Ax = \lambda x$. The value of the shifted parameter is α and is given by the user. Recall how one might guess the values of α. For example, if $\alpha = 0$, then this iteration method yields the smallest (in absolute value) eigenvalue and its corresponding eigenvector.

The first lines of the program should contain the matrix A, the value of α, and the initial starting vector for the iteration. To invert the matrix A in the iteration use Octave's LU decomposition and then invert the L and U separately. The stopping criterion is when the 2 norm of the difference between two consecutive eigenvector iterates is less than 10^{-4}. Compare your results with the results obtained using the build-in Octave command eig.

```
[lambda, v] = eig (a)
```

1. Use your program on:

$$A = \begin{pmatrix} 2.5 & -2.5 & 3.0 & 0.5 \\ 0.0 & 5.0 & -2.0 & 2.0 \\ -0.5 & -0.5 & 4.0 & 2.5 \\ -2.5 & -2.5 & 5.0 & 3.5 \end{pmatrix}$$

   Use the shifts $\alpha = 0,\ 2.5,\ 4.5$ and an initial vector with all ones.

2. Consider

$$A = \begin{pmatrix} 0 & 11 & -5 \\ -2 & 17 & -7 \\ -4 & 26 & -10 \end{pmatrix}$$

   Use the shift $\alpha = 0,\ 4.2$ and the starting vector (1,2,1)'. Repeat using the same shifts but with the starting vector (1,1,1)'. Write a short report describing the outcome.

Here is a crude program for the power method

```
a = [ 0 11 -5;-2 17 -7; -4 26 -10]
x = [1 1 1]'
err = 1;
while (err-0.001  >= 0)
   y = a*x;
   c1 = norm(y,inf);
   y = y/c1;
err = norm(y-x);
x=y;
endwhile
x
c1
exit
```