CS3081 – Computational Mathematics
Assignment 2

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Question 4.23 – *Write a user-defined MATLAB function that decomposes an n x n matrix [A] into a lower triangular matrix [L] and an upper triangular matrix [U] using Gauss elimination without pivoting.*

```
function [L, U] = LUdecompGauss(A)

rows = size(A, 1);
L = eye(n);

for k = 1 : n
    % For each row k, access columns from k+1 to the end and divide by
    % the diagonal coefficient at A(k ,k)
    L(k + 1 : n, k) = A(k + 1 : n, k) / A(k, k);

    % For each row k+1 to the end, perform Gaussian elimination
    % In the end, A will contain U
    for l = k + 1 : n
        A(l, :) = A(l, :) - L(l, k) * A(k, :);
    end
end
U = A;

end
```

```
A = [4 -1 3 2;
     -8 0 -3 -3.5;
     2 -3.5 10 3.75;
     -8 -4 1 -0.5;];

[L,U] = LUdecompGauss(A);

disp(L);
disp(U);
```

L =

```
    1.0000         0         0
   -2.0000    1.0000         0
    0.5000    1.5000    1.0000
   -2.0000    3.0000   -0.5000
```

U =

```
    4.0000   -1.0000    3.0000
         0   -2.0000    3.0000
         0         0    4.0000
         0         0         0
```

Question 5.17 – *A football conference has six teams. The outcome of the games is recorded in a binary fashion. For example if team 1 defeats teams 5 and 6, then the equation x1 = x5 + x6 is written to indicate these results.*

a) *Find the eigenvalues and the corresponding eigenvectiors of [A] using MATLAB's built-in function eig.*

```
A = [ 0 0 0 1 0 0;
      1 0 1 0 1 1;
      0 1 0 0 1 0;
      1 1 0 0 1 0;
      1 1 1 0 0 1;
      1 0 0 0 1 0;]

% V = eigenvectors of A
% D = eigenvalues of A
[V,D]=eig(A)
```

Eigenvalues:

- 2.618033989
- 0.3820
- 0
- -1

Eigenvectors:

0.1761 + 0.0000i	0.3379 + 0.0000i	0.0000 + 0.0000i	−0.5773 − 0.0000i	−0.5773 + 0.0000i	0.5774 + 0.0000i
0.5155 + 0.0000i	−0.1443 + 0.0000i	0.0000 + 0.0000i	−0.0000 + 0.0000i	−0.0000 − 0.0000i	−0.0000 + 0.0000i
0.3938 + 0.0000i	−0.7555 + 0.0000i	−0.7071 + 0.0000i	0.0000 − 0.0000i	0.0000 + 0.0000i	0.0000 + 0.0000i
0.4611 + 0.0000i	0.1290 + 0.0000i	0.0000 + 0.0000i	0.5774 + 0.0000i	0.5774 + 0.0000i	−0.5773 + 0.0000i
0.5155 + 0.0000i	−0.1443 + 0.0000i	−0.0000 + 0.0000i	−0.0000 + 0.0000i	−0.0000 − 0.0000i	−0.0000 + 0.0000i
0.2642 + 0.0000i	0.5068 + 0.0000i	0.7071 + 0.0000i	0.5773 + 0.0000i	0.5773 − 0.0000i	−0.5774 + 0.0000i

b) *Find the eigenvector from part (a) whose entries are all real and of the same sign. Rank the teams from best to worst based on the indices of the teams corresponding to the largest to the smallest entries in that eigenvector.*

0.1761 + 0.0000i	0.3379 + 0.0000i	0.0000 + 0.0000i	-0.5773 - 0.0000i	-0.5773 + 0.0000i	0.5774 + 0.0000i
0.5155 + 0.0000i	-0.1443 + 0.0000i	0.0000 + 0.0000i	-0.0000 + 0.0000i	-0.0000 - 0.0000i	-0.0000 + 0.0000i
0.3938 + 0.0000i	-0.7555 + 0.0000i	-0.7071 + 0.0000i	0.0000 - 0.0000i	0.0000 + 0.0000i	0.0000 + 0.0000i
0.4611 + 0.0000i	0.1290 + 0.0000i	0.0000 + 0.0000i	0.5774 + 0.0000i	0.5774 + 0.0000i	-0.5773 + 0.0000i
0.5155 + 0.0000i	-0.1443 + 0.0000i	-0.0000 + 0.0000i	-0.0000 + 0.0000i	-0.0000 - 0.0000i	-0.0000 + 0.0000i
0.2642 + 0.0000i	0.5068 + 0.0000i	0.7071 + 0.0000i	0.5773 + 0.0000i	0.5773 - 0.0000i	-0.5774 + 0.0000i

From above we can see that the eigenvector whose entries are all real and of the same sign is the eigenvector:

$$\begin{bmatrix} 0.1761 \\ 0.5155 \\ 0.3938 \\ 0.4611 \\ 0.5155 \end{bmatrix}$$

This vector can be interpreted as the weighted score of each team. We can then, using this eigenvector rank the teams from best to worst as follows:

$$\begin{aligned} x_1 &= 0.1761 \\ x_2 &= 0.5155 \\ x_3 &= 0.3938 \\ x_4 &= 0.4761 \\ x_5 &= 0.5155 \end{aligned}$$

Following this we can determine that teams x_2 and x_5 can be considered the best teams with regards to wins, followed by x_4 then x_3 then x_1.

However, team x_2 did in fact beat x_5 so in theory they could be considered the best.