ENSC 180 - Assignment 4

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1.
Script

```
A=[4 3 1;3 7 -1; 1 -1 9];
B=[10 8 7; 3 -3 0; 14 1 7];
C=[1 -1; 4 7; 9 5];

a=A+B
b=A*C
c=A'
d=A*A'
e=C*C'
f=inv(A)*inv(B)
g=[rank(A),rank(C)];
fprintf('g=\n\nrank of A = %d\nrank of C = %d\n\n',g(1),g(2));
h=det(A)
i=A\C
```

Output

```
a =
   14   11    8
    6    4   -1
   15    0   16
b =
   25   22
   22   41
   78   37
c =
    4    3    1
    3    7   -1
    1   -1    9
d =
   26   32   10
   32   59  -13
   10  -13   83
e =
    2   -3    4
   -3   65   71
    4   71  106
f =
   0.1200    0.3375   -0.1293
  -0.0173   -0.1140    0.0238
  -0.0946   -0.2301    0.1122
g =
    rank of A = 3
    rank of C = 2
```

```
h =
  154

i =
  -0.9091   -2.0000
   1.1364    2.0000
   1.2273    1.0000
```

2.
Function

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```
%This function add and multiply two matrices
function add_multiple(M1,M2)

[row1,cols1]=size(M1);
[row2,cols2]=size(M2);

%Addition
if row1==row2 && cols1==cols2
    sum=zeros(row1,cols1); %Initialize sum
    for i=1:row1
        for j=1:cols1
            sum(i,j)=M1(i,j)+M2(i,j);
        end
    end
    disp('Sum'); disp(sum);
else
    fprintf('ERROR: Illegal operation; Addition invaild\n');
end
fprintf('\n');
%Multiplication
if cols1~=row2 || row1==0 || row2==0
    fprintf('ERROR: Illegal operation; Multiplication invalid\n');
else
    product=zeros(row1,cols2); %Initialize product
    for i=1:row1
        for j=1:cols2
            dotp=0;
            for k=1:cols1
                dotp=dotp+M1(i,k)*M2(k,j); %dotp: dot product
            end
            product(i,j)=dotp;
        end
    end
disp('Product'); disp(product);
end
```

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Output using [A][B], [A][C], [C][A] respectively

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```
>>add_multiply(A,B)
Sum
    14    11     8
     6     4    -1
    15     0    16
```

```
Product
   63    24    35
   37     2    14
  133    20    70

>>add_multiply(A,C)
ERROR: Illegal operation; Addition invalid
Matrices must be of the same size

Product
   25    22
   22    41
   78    37

>>add_multiply(C,A)
ERROR: Illegal operation; Addition invalid
Matrices must be of the same size

ERROR: Illegal operation; Multiplication invalid
The number of columns in first matrix should be equal to the number of rows in the second
```

3.
Script

```
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%declare variables
A = [4 3 1;3 7 -1; 1 -1 9];
alpha = 0:0.001:10;

determinant = -alpha.^3+20*alpha.^2-116*alpha+154;

for i = 1 : 10000
   if determinant(i)*determinant(i+1) <= 0
      disp('One of the roots is ')
      disp(i*0.001)
   end
end

plot(alpha, determinant)
grid MINOR
title('alpha vs determinant[A-alphaI]')
xlabel('alpha')
ylabel('determinant[A-alphaI]')
——————————————————————————————————————
```
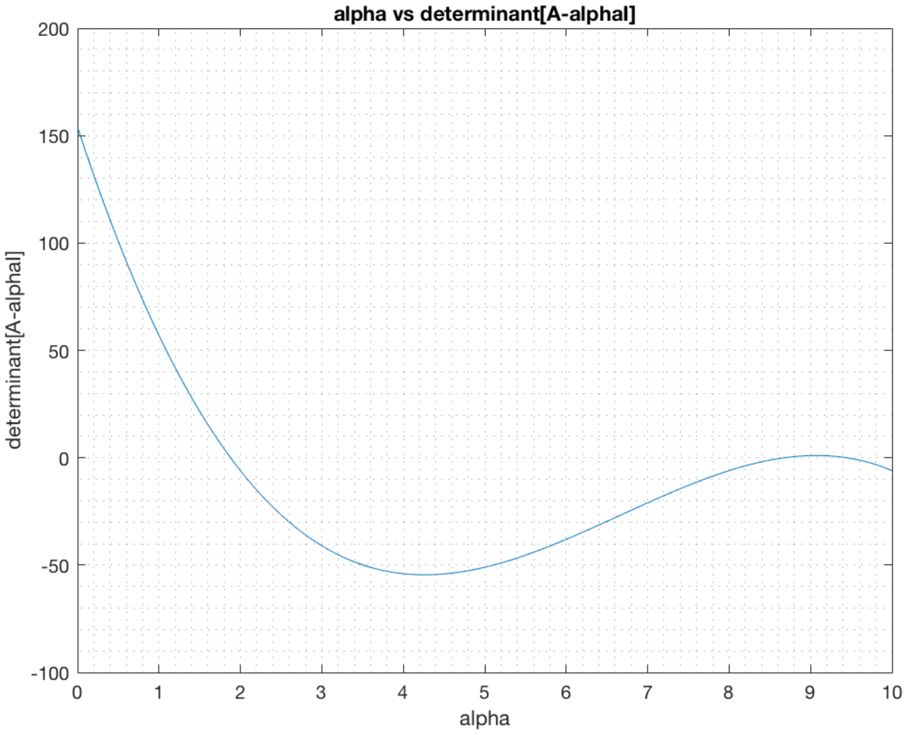

Output

```
——————————————————————————————————————
One of the roots is
   1.8800

One of the roots is
   8.6810

One of the roots is
   9.4400
```



4.
Script

```
%perform Gauss elimination for a general system of form [A]{x} = {b}
A=input ('Enter Matrix [A]\n');
b=input ('Enter a column of [b]\n');

[row1,cols1]=size(A);
row2=size(b);

if row1~=row2
   error('Invalid operation: Matrices have different heights\n');
elseif rank(A)<row1
   error('No unique solution: system is under defined\n');
elseif rank(A)>row1
   error('Infinite solutions: system is over defined\n');
else
   n=row1;
end

%create upper triangular matrix
s=0;
for j=1:n-1
   if A(j,j)==0
      k=j;
      for k=k+1:n
         if A(k,j)==0
```

```
                continue
            end
            break
        end
        B=A(j,:); C=b(j);
        A(j,:)=A(k,:); b(j)=b(k);
        A(k,:)=B; b(k)=C;
    end
    for i=1+s:n-1
        L=A(i+1,j)/A(j,j);
        A(i+1,:)=A(i+1,:)-L*A(j,:);
        b(i+1)=b(i+1)-L*b(j);
    end
    s=s+1;
end

%Solution of equations
x(n)=b(n)/A(n,n);
for i=n-1:-1:1
    sum=0;
    for j=i+1:n
        sum=sum+A(i,j)*x(j);
    end
    x(i)=(1/A(i,i))*(b(i)-sum);
end

fprintf('solution of linear equations\n');
disp(x’);
```

Output when inputting matrix C as several column vectors

```
%1st vector
Enter Matrix [A]
[4 3 1;3 7 -1; 1 -1 9]
Enter a column of [b]
[1; 4; 9]
solution of linear equations
   -0.9091
    1.1364
    1.2273

%2nd vector
Enter Matrix [A]
[4 3 1;3 7 -1; 1 -1 9]
Enter a column of [b]
[-1; 7; 5]
solution of linear equations
    -2
     2
     1
```