

DEEN DAYAL UPADHAYA COLLEGE



MATHEMATICS FOR COMPUTING PRACTICAL FILE

SUBMITTED BY :

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COURSE : BSC(H) COMPUTER SCIENCE

SEMESTER : I

QUESTION1. Find cofactors, determinant, adjoint and inverse of a matrix.

ANSWER:

A : matrix([1,5,7], [8,4,6], [9,2,3]);

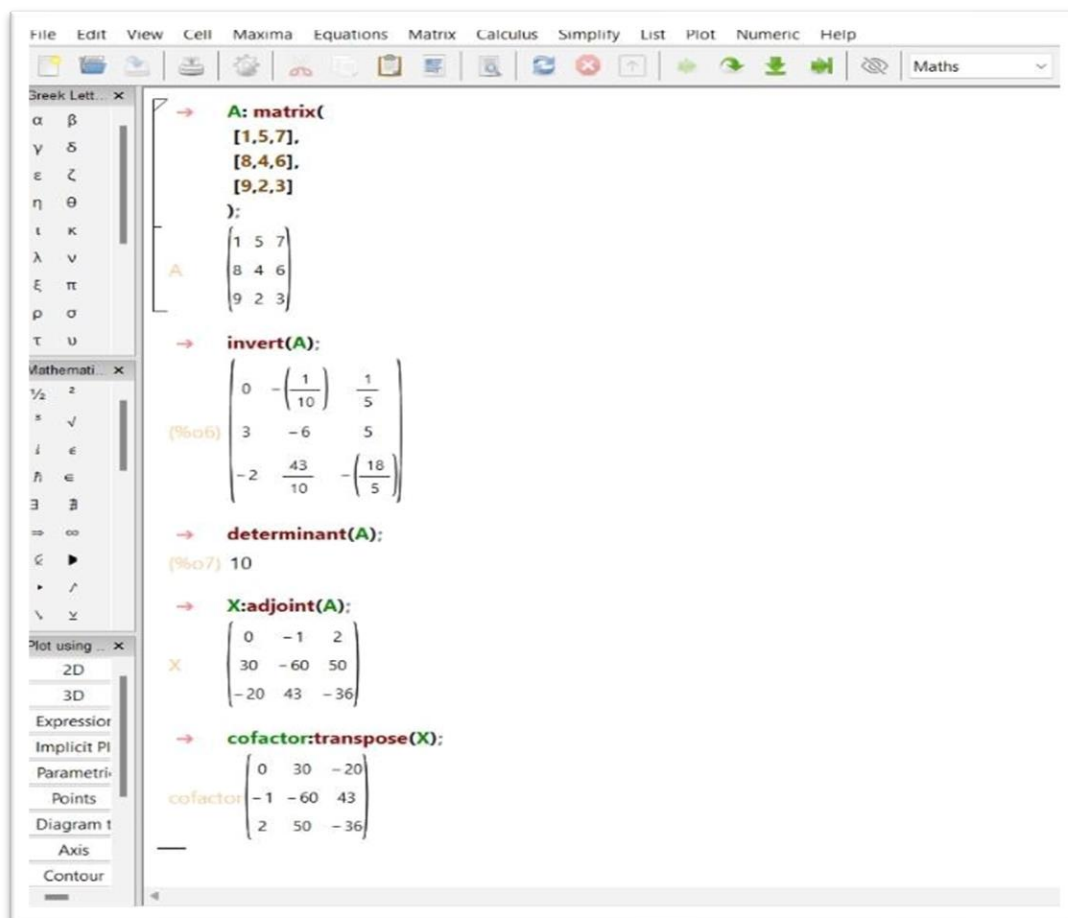
Invert(A);

Determinant(A);

X:adjoint(A);

Cofactor:transpose(X);

OUTPUT:



QUESTION 2: Convert the matrix into echelon form and find its rank.

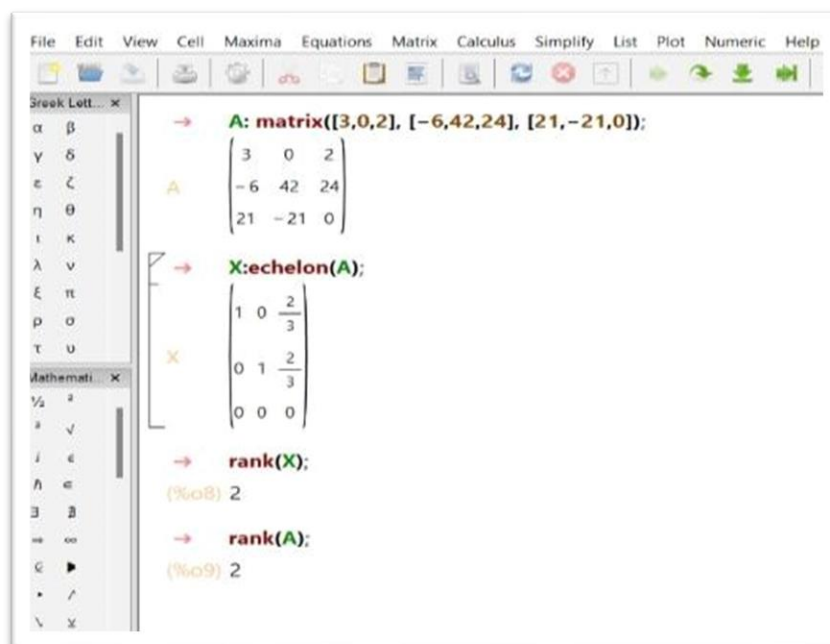
ANSWER:

A: matrix([3,0,2], [-6,42,24], [21,-21,0]);

X:echelon(A);

rank(A);

OUTPUT:



The screenshot shows a Maxima CAS window with the following content:

```
File Edit View Cell Maxima Equations Matrix Calculus Simplify List Plot Numeric Help
```

Break Lett... x

α β
γ δ
ε ζ
η θ
ι κ
λ ν
ξ π
ρ σ
τ υ

Mathemati... x

1/2 2
3 4
5 6
7 8
9 10
11 12
13 14
15 16

```
→ A: matrix([3,0,2], [-6,42,24], [21,-21,0]);  
A  

$$\begin{pmatrix} 3 & 0 & 2 \\ -6 & 42 & 24 \\ 21 & -21 & 0 \end{pmatrix}$$
  
→ X:echelon(A);  
X  

$$\begin{pmatrix} 1 & 0 & \frac{2}{3} \\ 0 & 1 & \frac{2}{3} \\ 0 & 0 & 0 \end{pmatrix}$$
  
→ rank(X);  
(%o8) 2  
→ rank(A);  
(%o9) 2
```

QUESTION 3: Solve a system of equations using Gauss elimination method.

ANSWER:

A:matrix([1,2,3],[9,18,30],[12,48,60]);

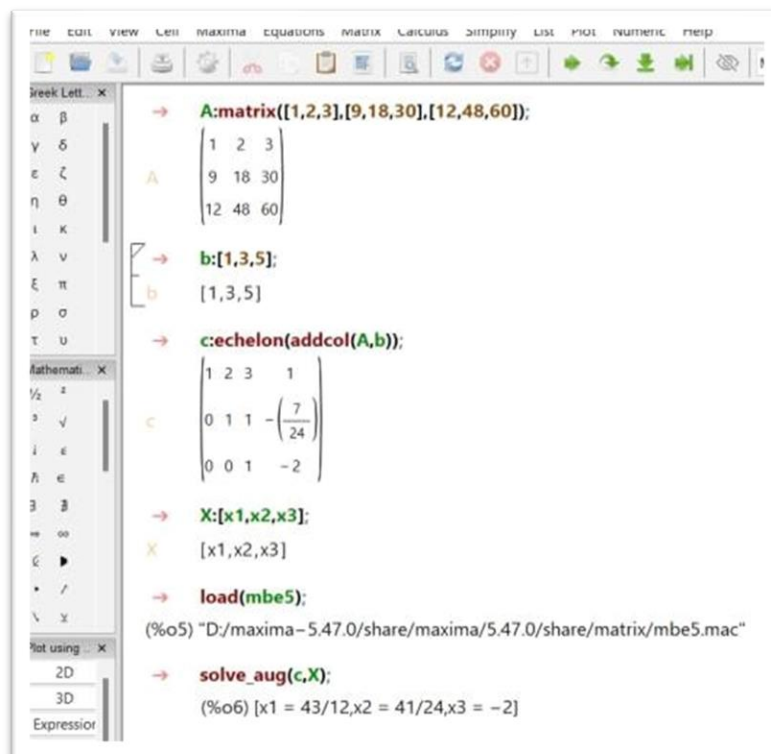
b:[1,3,5];

c:echelon(addcol(A,b));

X:[x1,x2,x3];

load(mbe5); solve aug(c,X);

OUTPUT:



The screenshot shows the Maxima CAS interface with the following commands and output:

```
→ A:matrix([1,2,3],[9,18,30],[12,48,60]);  
A  

$$\begin{bmatrix} 1 & 2 & 3 \\ 9 & 18 & 30 \\ 12 & 48 & 60 \end{bmatrix}$$
  
→ b:[1,3,5];  
b  

$$\begin{bmatrix} 1 \\ 3 \\ 5 \end{bmatrix}$$
  
→ c:echelon(addcol(A,b));  
c  

$$\begin{bmatrix} 1 & 2 & 3 & 1 \\ 0 & 1 & 1 & -\frac{7}{24} \\ 0 & 0 & 1 & -2 \end{bmatrix}$$
  
→ X:[x1,x2,x3];  
X  

$$\begin{bmatrix} x1 \\ x2 \\ x3 \end{bmatrix}$$
  
→ load(mbe5);  
(%o5) "D:/maxima-5.47.0/share/maxima/5.47.0/share/matrix/mbe5.mac"  
→ solve_aug(c,X);  
(%o6) [x1 = 43/12,x2 = 41/24,x3 = -2]
```

QUESTION 4: Solve a system of equations using the Gauss Jordan method.

ANSWER:

load(mbe5);

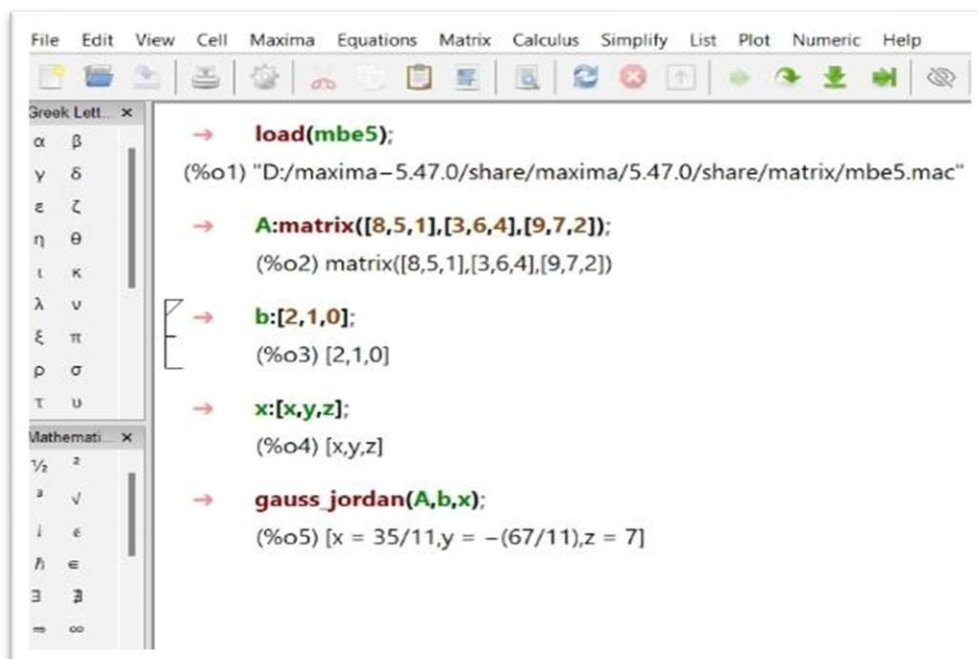
A:matrix([8,5,1],[3,6,4],[9,7,2]);

b:[2,1,0];

x:[x,y,z];

gauss_jordan(A,b,x);

OUTPUT:



The screenshot shows the Maxima CAS interface with the following commands and output:

```
→ load(mbe5);
(%o1) "D:/maxima-5.47.0/share/maxima/5.47.0/share/matrix/mbe5.mac"

→ A:matrix([8,5,1],[3,6,4],[9,7,2]);
(%o2) matrix([8,5,1],[3,6,4],[9,7,2])

→ b:[2,1,0];
(%o3) [2,1,0]

→ x:[x,y,z];
(%o4) [x,y,z]

→ gauss_jordan(A,b,x);
(%o5) [x = 35/11,y = -(67/11),z = 7]
```

QUESTION 5: Verify the linear dependence of vectors. Generate a linear combination of given vectors of R^n / matrices of the same size.

ANSWER:

u:[2,5,8];

v:[1,4,7];

w:[3,6,9];

A:matrix(u,v,w); X:echelon(A);

r:rank(A);

l:length(A);

if is(equal(r,l)) then print("vectors are linearly independent") else print("vectors are linearly dependent");

c1:4;

c2:6;

c3:8;

L:c1*u+c2*v+c3*w;

OUTPUT:

The screenshot shows a MATLAB script editor with three toolbars on the left: Greek Letters, Mathematical Symbols, and Plotting options. The script defines three vectors u , v , and w , forms a matrix A from them, and reduces it to echelon form X . It then checks the rank of A and prints a message based on whether the vectors are linearly independent or dependent. Comments at the bottom show the expected output for linearly dependent vectors.

```
→ u=[2,5,8];  
u [2,5,8]  
→ v=[1,4,7];  
v [1,4,7]  
→ w=[3,6,9];  
w [3,6,9]  
→ A=matrix(u,v,w);  
A  $\begin{bmatrix} 2 & 5 & 8 \\ 1 & 4 & 7 \\ 3 & 6 & 9 \end{bmatrix}$   
→ X=echelon(A);  
X  $\begin{bmatrix} 1 & 5 & 4 \\ 0 & 1 & 2 \\ 0 & 0 & 0 \end{bmatrix}$   
→ r=rank(A);  
r 2  
→ l=length(A);  
l 3  
→ if is(equal(r,l)) then print("vectors are linearly independent")  
else print("vectors are linearly dependent");  
vectors are linearly dependent  
(%s10) vectors are linearly dependent  
→ c1:4;  
c1 4  
→ c2:6;  
c2 6  
→ c3:8;  
c3 8  
→ l:c1-u+c2-v+c3-w;  
L [38,92,146]
```

QUESTION 6: Check the diagonalizable property of matrices and find the corresponding eigenvalue and verify the Cayley-Hamilton theorem.

ANSWER:

load(mbe5);

A:matrix([5,8,7],[9,6,4],[2,3,0]);

eigenvalues(A);

diagp(A);

c:charpoly(A,lambda);

expand(c);

R:-(A^^3)+11*(A^^2)+68*A+109*ident(3);

m:matrix([0,0,0],[0,0,0],[0,0,0]);

is(equal(R,m));

OUTPUT:

```

-- load(mbe5);
(%o7) "D:/maxima-5.47.0/share/maxima/5.47.0/share/matrix/mbe5.mac"

-- A:matrix([5,8,7],[9,6,4],[2,3,0]);
(%o8) matrix([5,8,7],[9,6,4],[2,3,0])

-- eigenvalues(A);
(%o9) [(325*((sqrt(3)*%i)/2 + (-1)/2))/9
      *((13*sqrt(3263))/(2*3^(3/2)) + 12337/54)
      ^ (1/3))
      + ((13*sqrt(3263))/(2*3^(3/2)) + 12337/54)^(1/3)*(-1/2 - (sqrt(3)*%i)/2)
      + 11/3,
      ((13*sqrt(3263))/(2*3^(3/2)) + 12337/54)^(1/3)*((sqrt(3)*%i)/2 + (-1)/2)
      + (325*(-1/2 - (sqrt(3)*%i)/2))/9
      *((13*sqrt(3263))/(2*3^(3/2)) + 12337/54)
      ^ (1/3)) + 11/3,
      ((13*sqrt(3263))/(2*3^(3/2)) + 12337/54)^(1/3)
      + 325/9*((13*sqrt(3263))/(2*3^(3/2)) + 12337/54)^(1/3)) + 11/3][1,1,1]]

-- diagp(A);
(%o10) true

-- c:charpoly(A,lambda);
(%o11) (5 - lambda)*(-((6 - lambda)*lambda) - 12) - 8*(-(9*lambda) - 8) + 7
      *(27
      - 2*(6 - lambda))

-- expand(c);
(%o12) -lambda^3 + 11*lambda^2 + 68*lambda + 109

-- R:-(A^^3)+11*(A^^2)+68*A+109*ident(3);
(%o13) matrix([[0,0,0],[0,0,0],[0,0,0]])

-- m:matrix([0,0,0],[0,0,0],[0,0,0]);
(%o14) matrix([[0,0,0],[0,0,0],[0,0,0]])

-- is(equal(R,m));
(%o15) true
  
```


QUESTION 7: Compute Gradient of a scalar field, Divergence and Curl of a vector field.

ANSWER:

load(vect);

F:[z^2,x^2,y^2];

curl(F);

express(curl(F));

ev(express(curl(F)),diff);

G:[3*x*z,2*x*y,-y*z^2];

ev(express(div(G)),diff);

f(x,y,z):=2*y^3+4*x*z+3*x; g:grad(f(x,y,z)); ev(express(g),diff);

OUTPUT:

The screenshot shows a CAS interface with a left-hand menu and a main workspace. The workspace displays the following commands and their outputs:

- load(vect);** (No output shown)
- F:[z^2,x^2,y^2];** (No output shown)
- curl(F);** (No output shown)
- express(curl(F));** (Output: $\left[\frac{d}{dy} y^2 - \frac{d}{dz} x^2, \frac{d}{dz} z^2 - \frac{d}{dx} y^2, \frac{d}{dx} x^2 - \frac{d}{dy} z^2 \right]$)
- ev(express(curl(F)),diff);** (Output: $[2y, 2z, 2x]$)
- G:[3*x*z,2*x*y,-y*z^2];** (No output shown)
- ev(express(div(G)),diff);** (Output: $-(2yz) + 3z + 2x$)
- f(x,y,z):=2*y^3+4*x*z+3*x;** (No output shown)
- g:grad(f(x,y,z));** (Output: $\text{grad} \left(4xz + 2y^3 + 3x \right)$)
- ev(express(g),diff);** (Output: $[4z + 3, 6y^2, 4x]$)