Matgeo Presentation - 12.238

ee25btech11063 - Vejith

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Question

The inverse of the matrix $\begin{pmatrix} 1 & 2 \\ 3 & 4 \end{pmatrix}$ is (CH 2010)

Solution

Let

$$\mathbf{A} = \begin{pmatrix} 1 & 2 \\ 3 & 4 \end{pmatrix} \tag{0.1}$$

The augmented matrix is

$$\left(\mathbf{A} \,\middle|\, \mathbf{I} \right) \implies \left(\begin{array}{cc|cc} 1 & 2 & 1 & 0 \\ 3 & 4 & 0 & 1 \end{array} \right) \xleftrightarrow{R_2 \to R_2 - 3R_1} \left(\begin{array}{cc|cc} 1 & 2 & 1 & 0 \\ 0 & -2 & -3 & 1 \end{array} \right) \tag{0.2}$$

$$\xleftrightarrow{R_1 \to R_1 + R_2} \left(\begin{array}{cc|cc} 1 & 0 & -2 & 1 \\ 0 & -2 & -3 & 1 \end{array} \right) \tag{0.3}$$

$$\xleftrightarrow{R_2 \to \frac{-1}{2} \times R_2} \left(\begin{array}{cc|cc} 1 & 0 & -2 & 1 \\ 0 & 1 & \frac{3}{2} & \frac{-1}{2} \end{array} \right) \tag{0.4}$$

As the left block of the Augmented matrix is $\mathbf{I}$ the right block is $\mathbf{A^{-1}}$.

$$\mathbf{A^{-1}} = \begin{pmatrix} -2 & 1 \\ \frac{3}{2} & \frac{-1}{2} \end{pmatrix} \tag{0.5}$$

C Code: inverse.c

```
#include <stdio.h>

int main() {
    FILE *fp;
    float a = 1, b = 2, c = 3, d = 4;
    float det, inv[2][2];

    det = a * d - b * c;

    if(det == 0) {
        printf("Inverse␣does␣not␣exist␣(determinant␣is␣zero).\n");
        return 0;
    }
    inv[0][0] = d / det;
    inv[0][1] = -b / det;
    inv[1][0] = -c / det;
    inv[1][1] = a / det;

    // Open file to write
    fp = fopen("inverse.dat", "w");
    if(fp == NULL) {
        printf("Error␣opening␣file!\n");
        return 1;
    }

    fprintf(fp, "The␣inverse␣of␣the␣matrix␣is:\n");
    fprintf(fp, "[␣%.2f␣␣%.2f␣]\n", inv[0][0], inv[0][1]);
    fprintf(fp, "[␣%.2f␣␣%.2f␣]\n", inv[1][0], inv[1][1]);

    fclose(fp);
    printf("Inverse␣matrix␣has␣been␣written␣to␣inverse.dat␣successfully.\n");
     return 0;}
```

Python: Solution.py

```
import numpy as np

# Define the matrix
A = np.array([[1, 2],
              [3, 4]])

# Compute the determinant
det = np.linalg.det(A)
print("Determinant of A:", det)

# Check if inverse exists
if det == 0:
    print("Inverse does not exist (determinant is zero).")
else:
    # Compute the inverse
    A_inv = np.linalg.inv(A)
    print("Inverse of the matrix A is:\n", A_inv)
```