

Matgeo Presentation - Problem 5.2.65

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Question

Solve

$$\mathbf{X} + \mathbf{Y} = \begin{pmatrix} 5 & 2 \\ 0 & 9 \end{pmatrix} \text{ and } \mathbf{X} - \mathbf{Y} = \begin{pmatrix} 3 & 6 \\ 0 & -1 \end{pmatrix}$$

Solution

Given,

$$\mathbf{X} + \mathbf{Y} = \begin{pmatrix} 5 & 2 \\ 0 & 9 \end{pmatrix} \quad (0.1)$$

$$\mathbf{X} - \mathbf{Y} = \begin{pmatrix} 3 & 6 \\ 0 & -1 \end{pmatrix} \quad (0.2)$$

$$\Rightarrow \begin{pmatrix} 1 & 1 \\ 1 & -1 \end{pmatrix} \begin{pmatrix} \mathbf{X} \\ \mathbf{Y} \end{pmatrix} = \begin{pmatrix} \mathbf{A} \\ \mathbf{B} \end{pmatrix} \quad (0.3)$$

$$\mathbf{A} = \begin{pmatrix} 5 & 2 \\ 0 & 9 \end{pmatrix} \text{ and } \mathbf{B} = \begin{pmatrix} 3 & 6 \\ 0 & -1 \end{pmatrix} \quad (0.4)$$

Forming the Augmented matrix

$$\left(\begin{array}{cc|c} 1 & 1 & \mathbf{A} \\ 1 & -1 & \mathbf{B} \end{array} \right) \xrightarrow{R_2 \rightarrow R_2 - R_1} \left(\begin{array}{cc|c} 1 & 1 & \mathbf{A} \\ 0 & -2 & \mathbf{B} - \mathbf{A} \end{array} \right) \quad (0.5)$$

$$\Rightarrow -2\mathbf{Y} = \mathbf{B} - \mathbf{A} \quad (0.6)$$

Solution

$$\mathbf{B} - \mathbf{A} = \begin{pmatrix} -2 & 4 \\ 0 & -10 \end{pmatrix} \quad (0.7)$$

$$\implies \mathbf{Y} = \begin{pmatrix} 1 & -2 \\ 0 & 5 \end{pmatrix} \quad (0.8)$$

$$\implies \mathbf{X} + \mathbf{Y} = \begin{pmatrix} 5 & 2 \\ 0 & 9 \end{pmatrix} \quad (0.9)$$

$$\implies \mathbf{X} = \begin{pmatrix} 4 & 4 \\ 0 & 4 \end{pmatrix} \quad (0.10)$$

on back substitution we get

$$\implies \mathbf{X} = \begin{pmatrix} 4 & 4 \\ 0 & 4 \end{pmatrix} \text{ and } \mathbf{Y} = \begin{pmatrix} 1 & -2 \\ 0 & 5 \end{pmatrix} \quad (0.11)$$

C Code: matrix.c

```
#include <stdio.h>

int main() {
    FILE *fp;
    fp = fopen("matrix.dat", "w"); // open file for writing
    if (fp == NULL) {
        printf("Error opening file!\n");
        return 1;
    }

    // Define the given matrices
    int A[2][2] = { {5, 2}, {0, 9} }; // X + Y
    int B[2][2] = { {3, 6}, {0, -1} }; // X - Y
    int X[2][2], Y[2][2];

    // Calculate X = (A + B)/2
    for (int i = 0; i < 2; i++) {
        for (int j = 0; j < 2; j++) {
            X[i][j] = (A[i][j] + B[i][j]) / 2;
        }
    }

    // Calculate Y = (A - B)/2
    for (int i = 0; i < 2; i++) {
        for (int j = 0; j < 2; j++) {
            Y[i][j] = (A[i][j] - B[i][j]) / 2;
        }
    }

    // Write results to file
    fprintf(fp, "Matrix_X:\n");
    for (int i = 0; i < 2; i++) {
        for (int j = 0; j < 2; j++) {
```

C Code: matrix.c

```
fprintf(fp, "%d_", X[i][j]);
    }
    fprintf(fp, "\n");
}

fprintf(fp, "\nMatrix_Y:\n");
for (int i = 0; i < 2; i++) {
    for (int j = 0; j < 2; j++) {
        fprintf(fp, "%d_", Y[i][j]);
    }
    fprintf(fp, "\n");
}

fclose(fp);
printf("Solution_written_to_matrix.dat\n");
return 0;
}
```

Python: solution.py

```
import numpy as np

# Given matrices
A = np.array([[5, 2],
              [0, 9]]) # X + Y
B = np.array([[3, 6],
              [0, -1]]) # X - Y

# Solve for X and Y
X = (A + B) / 2
Y = (A - B) / 2

print("Matrix_X:")
print(X)
print("\nMatrix_Y:")
print(Y)
```