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INTRODUCTION:

Introduction to Matrices in Solving Real-World Problems

Matrices are structured collections of numbers organized into rows and columns. They provide a concise and efficient way to represent and manipulate large sets of data. In the context of solving real-world problems, matrices are used to model relationships between different quantities, analyze systems, and perform transformations. Here are some examples of how matrices are applied to address real-world challenges:

Computer Graphics and Image Processing:

- 3D Transformations: Matrices are used to perform translation, rotation, scaling, and other transformations on 3D objects in computer graphics.
- Image Filters: In image processing, matrices are applied as filters to enhance or modify images, like blurring, sharpening, and edge detection.

Economics and Finance:

- Input-Output Analysis: Matrices model economic relationships between different sectors of an economy, helping economists study the effects of changes in one sector on others.
- Portfolio Optimization: Matrices aid in optimizing investment portfolios by analyzing risk and return characteristics of various assets.

Machine Learning and Data Analysis:

- Linear Regression: Matrices are used to represent data points and coefficients in linear regression models, which predict outcomes based on input features.
- Principal Component Analysis (PCA): Matrices help reduce the dimensionality of data and identify underlying patterns in large datasets.

Robotics and Control Systems:

- Robot Kinematics: Matrices model the movement and transformation of robotic arms, aiding in motion planning and control.
- Control Theory: Matrices represent system dynamics, allowing engineers to design controllers for systems ranging from industrial machinery to drones.

In essence, matrices serve as a bridge between mathematical theory and real-world applications. They enable us to formulate and solve complex problems efficiently and provide insights into the behavior of various systems. As you delve deeper into specific fields, you'll discover even more ways matrices are harnessed to solve real-world challenges.

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Example problems which arise in Multi Branch Business

A manufacturer produces three types of bolts,x,y which he sells in two markets.annual sales (in rupees) are indicated below:

	Products		
markets	x	y	z
Vashi market	10	30	40
Mumbai market	60	20	80

Q 1. I unit sale price of x ,y and z are 2.5 and 1.5 and 1.0 rupees ,then answer the following question using concepts of matrices

1.find the total revenue collected by vashi market.

2. find the total revenue collected by mumbai market.

3.if the unit costs of the above three commodities are 2.0 rupees,1 .00 rupees and 0.50 rupees respectively,then find the gross profit from both the markets

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Program to solve the questions using matix :

1)find the total revenue collected by vashi market.

Solution:To get the revenue of Vashi market we could first summarize the products in 1x3 Matrix where row represents the market name and each column represents the type of product

Products	x	y	z
Vashi	10	30	40

After that we can consider the price for each product in 3x1 Matrix where each row represents type of product and column represents price of product

		Price
Products	x	2.5
	y	1.5
	z	1

To get the revenue of Vashi market we could multiply by both the matrix to perform this we could write c++ program which makes easier to perform matrix calculations:

CODE:

```
#include <iostream>


int main() {
    int matrix1[1][3] = {10,30,40}; // 1x3 matrix
    float matrix2[3][1] = {2.5, 1.5, 1}; // 3x1 matrix
    int result[1][1] = {0}; // Resulting matrix


    // Perform matrix multiplication
    for (int i = 0; i < 1; ++i) {
        for (int j = 0; j < 1; ++j) {
```

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```
            for (int k = 0; k < 3; ++k) {
                result[i][j] += matrix1[i][k] * matrix2[k][j];
            }
        }
    }

    // Display the result
    std::cout << "Total Revenue by vashi market is: ";
    std::cout << result[0][0] << std::endl;

    return 0;
}
```

Output:

```
Total Revenue by vashi market is: 110
PS C:\Users\pursh\OneDrive\Desktop\C>
```

By Performing this program we can conclude that Vashi market as revenue of rupees 110 by selling all the three products.

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2) find the total revenue collected by mumbai market.

Solution:To get the revenue of Mumbai market we could first summarize the products in 1x3 Matrix where row represents the market name and each column represents the type of product

Products	x	y	z
Mumbai	60	20	80

After that we can consider the price for each product in 3x1 Matrix where each row represents type of product and column represents price of product

		Price
Products	x	2.5
	y	1.5
	z	1

To get the revenue of Mumbai market we could multiply by both the matrix to perform this we could write c++ program which makes easier to perform matrix calculations:

CODE:

```
#include <iostream>


int main() {
    int matrix1[1][3] = {60,20,80}; // 1x3 matrix
    float matrix2[3][1] = {2.5, 1.5, 1}; // 3x1 matrix
    int result[1][1] = {0}; // Resulting matrix


    // Perform matrix multiplication
    for (int i = 0; i < 1; ++i) {
        for (int j = 0; j < 1; ++j) {
            for (int k = 0; k < 3; ++k) {
```

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```
                result[i][j] += matrix1[i][k] * matrix2[k][j];
            }
        }
    }

    // Display the result
    std::cout << "Total Revenue by Mumbai market is: ";
    std::cout << result[0][0] << std::endl;

    return 0;
}
```

Output:

```
Total Revenue by Mumbai market is: 260
PS C:\Users\pursh\OneDrive\Desktop\C>
```

By Performing this program we can conclude that the Mumbai market has revenue of rupees by 260 selling all the three products.

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3.if the unit costs of the above three commodities are 2.0 rupees,1 .00 rupees and 0.50 rupees respectively,then find the gross profit from both the markets

Solution:

To get the gross profit of both the branch first we can add the sales of both markets.TO do so will add both 1x3 matrix as follow:

Sales of Vashi

Products	x	y	z
Vashi	10	30	40

Sales of Mumbai

Products	x	y	z
Mumbai	60	20	80

CODE TO ADD MOTH MATRIX:

CODE TO ADD MOTH MATRIX:

```
#include <iostream>

int main() {

    int matrix1[1][3] = {10, 30, 40};

    int matrix2[1][3] = {40,60,80};

    int result[1][3];


    // Perform matrix addition

    for (int i = 0; i < 1; ++i) {

        for (int j = 0; j < 3; ++j) {

            result[i][j] = matrix1[i][j] + matrix2[i][j];

        }

    }
```

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```
    // Display the result
    std::cout << "Total Sales of Both markets are:" << std::endl;
    for (int i = 0; i < 1; ++i) {
        for (int j = 0; j < 3; ++j) {
            std::cout << result[i][j] << " ";
        }
        std::cout << std::endl;
    }

    return 0;
}
```

Output:

```
Total Sales of Both markets are:
50 90 120
PS C:\Users\pursh\OneDrive\Desktop\C>
```

Now we have the total sales of Both markets for product x,y,z

To get the gross profit of both markets first we need to find their margin per product to get such we can subtract the selling price and cost price of each product and get then multiply the total sales and margin:

Products	x	y	z
Price	2.5	1.5	1
Products	x	y	z
Cost	2	1	0.5

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By subtracting we can say that the margin per product stands at 0.50 per product:

Products	Margin
x	0.50
y	0.50
z	0.50

Now we have the sales of both markets wich we have derived by performing c++ program

Products	x	y	z
Sales	50	90	120

CODE:

```
#include <iostream>


int main() {
    int matrix1[1][3] = {1, 2, 3}; // 1x3 matrix
    int matrix2[3][1] = {4, 5, 6}; // 3x1 matrix
    int result[1][1] = {0}; // Resulting matrix

    // Perform matrix multiplication
    for (int i = 0; i < 1; ++i) {
        for (int j = 0; j < 1; ++j) {
            for (int k = 0; k < 3; ++k) {
                result[i][j] += matrix1[i][k] * matrix2[k][j];
            }
        }
    }
```

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```
    // Display the result
    std::cout << "Gross Profit of both markets stands at ";
    std::cout << result[0][0] << std::endl;

    return 0;
}
```

OUTPUT:

```
Gross Profit of both markets stands at 32
PS C:\Users\pursh\OneDrive\Desktop\C>
```

By Performing this program we can conclude that the both market has gross profit of rupees by 32 selling all the three products

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CONCLUSION:

In conclusion, matrix applications in business extend far beyond mathematical abstraction. They serve as practical tools that empower decision-makers to navigate the complexities of modern business environments. By employing matrices to analyze data, optimize processes, and make informed choices, businesses gain a competitive edge, improve efficiency, and make more accurate predictions about their operations. As businesses continue to grow in complexity, the role of matrices in shaping strategies and fostering innovation will only become more pronounced.