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Panel-C, Batch-C1

Subject-FDS

FDS Lab - Assignment - 1

Problem Statement

Write a C program to perform the following computation on the matrix : a) Addition of 2 matrices, b) Subtraction of 2 matrices, c) Multiplication of 2 matrices and d) Transpose of a matrix

Objective :

- i) To study memory representations and ~~not~~ operations associated with arrays.
- ii) To understand the implementation of formal parameters and actual parameters.

Theory:

- One dimensional and two dimensional arrays :

One dimensional array:

- It stores a single list of various elements having a similar data types.
- It represents multiple data items in the form of a list
- One can easily receive it in a pointer, an unsized array, or a sized array.



Two-dimensional arrays.

- It stores an array of various arrays, or a list of various lists, or an array of various one-dimensional arrays.
- It represents multiple data items in the form of a table that contains columns and rows.
- The parameters that receive it must define an array's right most dimension.

- Matrix Operations with one example each.

i) Addition: Matrix addition is the addition of two matrices by adding the corresponding entries.

$$\text{Ex: } \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix} + \begin{bmatrix} 5 & 6 \\ 9 & 11 \end{bmatrix} = \begin{bmatrix} 6 & 8 \\ 12 & 15 \end{bmatrix}$$

ii) Subtraction: It is the subtraction of two matrices by subtracting the corresponding entries.

$$\text{Ex: } \begin{bmatrix} 12 & -3 \\ 2 & 15 \end{bmatrix} - \begin{bmatrix} 6 & 1 \\ 11 & -8 \end{bmatrix} = \begin{bmatrix} 6 & -4 \\ -9 & 23 \end{bmatrix}$$

iii) Multiplication: Matrix multiplication, also known as matrix product and the multiplication of 2 matrices, produces a single matrix. It's a type of binary operation.

$$\begin{aligned} \text{Ex: } \begin{bmatrix} -1 & 4 \\ 2 & 3 \end{bmatrix} \begin{bmatrix} 9 & -3 \\ 6 & 1 \end{bmatrix} &= \begin{bmatrix} (-1)(9) + 4(6) & (-1)(-3) + (4)(1) \\ (2)(9) + 3(6) & 2(-3) + 3(1) \end{bmatrix} \\ &= \begin{bmatrix} 15 & 7 \\ 36 & -3 \end{bmatrix} \end{aligned}$$



iv) Transpose: The transpose of a matrix is found by interchanging its rows into columns or columns into rows

Ex : Let $A = \begin{bmatrix} 7 & 11 \\ 21 & 16 \end{bmatrix}$

$$A^T = \begin{bmatrix} 7 & 21 \\ 11 & 16 \end{bmatrix}$$

- formal parameters: A variable and its type as they appear in the prototype of the function or method.

- Actual parameters: The variable or expression corresponding to a formal parameter that appears in the function or method call in the calling environment.

Implementation:

- Platform:

- 64-bit Open source Linux or its derivatives.

- Open source C programming tool like gcc/Eclipse Editor

- PSEUDO Code:

Write pseudo code for addition or subtraction, multiplication and transpose

(a) Addition:-

Input:- Two matrices $A_{m \times n}$ and $B_{m \times n}$

Output:- $C_{m \times n}$

```

begin
  for (i=0; i<n; i++)
    for (j=0; j<n; j++)
      c[i][j] = a[i][j] + b[i][j]
    end for
  end for

```

End Matrix Addition

b) Multiplication:

Input: A, B with $m \times n$ and $p \times q$

Output: C with order $m \times q$

check if ($n == p$)

if (true)

begin

for (i=0; i<m; i++)

for (j=0; j<q; j++)

c[i][j] = 0;

end for

end for

for (i=0; i<m; i++)

for (j=0; j<q; j++)

for (k=0; k<n; k++)

c[i][j] = c[i][j] + a[i][k] * b[k][j]

end for

end for

end matrix multiplication

c) Transpose:

Input: $A[M][N]$

Output: $B[N][M]$

Begin

for ($i=0; i < m; i++$)

for ($j=0; j < n; j++$)

$B[i][j] = A[j][i]$

end for

end for

End Matrix Transpose

Time Complexity:

a) addition = $O(M * N)$

b) Multiplication = $O(N^2 * N)$

c) Transpose = $O(1)$?

Conclusion:

Thus, implemented matrix operations using different functions.

FAQ's.

Q1) What's the difference between pass-by-value and pass-by-reference in C functions?

→ Pass by value refers to a mechanism of copying the function parameter value to another variable while the pass by reference refers to a mechanism of passing the actual parameters to the function.

Q2) What's the difference between single quoted and double quoted declaration of char array?

→ Double quotes are used to denote a speech or or a quotation where single quotation quote are used to indicate quote within a quotation. Single quotes can not hold/print escape sequences directly, while double can.

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