Will the Reference Matrix act as the Kernel of Matrix Transformation?

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Abstract: *In 2016, Sanil formulated a parallel computing strategy to transpose Boolean matrix. This paper explores the applicability of the method for matrix transformation. Here, the reference matrix acts as the kernel of the transformation.*

Keywords: *Kernel, Matrix Transpose, Matrix Transformation.*

I. Introduction

The transpose of A, denoted by A^T, is the q x p matrix obtained by interchanging the rows and columns of A. In the Zero- One matrix transpose algorithm, the algorithm is running by combining the characteristics of logical AND (□) with logical OR operations [1, 2]. This paper investigates some possibilities of matrix transformation by exploiting the characteristics of the reference matrix.

II. Method

Let A be a matrix of size p x q.

Step. 1 Create a Reference Matrix $D_{i,j}$

Step. 2 Compute $A^T \leftarrow A \,.\, D_{i,j}$ with cell values

$$\sum_{i=1}^{p} W_{i,j}, \text{where } j = 1,2, \ldots . q$$

This can be illustrated as follows:

Consider the matrix of order p x q , where p = 3 and q = 5.

$$\begin{matrix} 7 & 7 & 9 & 5 & 4 \\ 3 & 4 & 6 & 2 & 3 \\ 5 & 2 & 2 & 7 & 2 \end{matrix}$$

Let the reference matrix $D_{i,j}$ be

$$\begin{matrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{matrix}$$

The input matrix A of order p x q operates logical AND with reference matrix $D_{i,\,j}$ gives A^T with the cell values W_{ij}.

7	7	9	5	4	□	1	0	0
3	4	6	2	3	□	0	1	0
5	2	2	7	2	□	0	0	1

Input **Reference Matrix**

The value of W_{ij} can be computed as,

$$A^T \leftarrow A \,.\, D_{i,\,j}$$

This gives the transpose of the matrix A of order p x q as the output, that is A^T with order q x p (q = 5, p = 3)

7	3	5
7	4	2
9	6	2
5	2	7
4	3	2

III. REFERENCE MATRIX AS THE KERNEL OF THE TRANSFORMATION

Let the matrix A(p x q) be

$$\begin{matrix} 7 & 2 & 3 \\ 4 & 1 & 5 \end{matrix}$$

where, p = 2 and q = 3.

Case **i**) Let us define the reference matrix $D_{i,j}$ as

$$\begin{matrix} 1 & 0 \\ 0 & 1 \end{matrix}$$

The transformation can computed as:

Input Kernel $D_{i,j}$

7	2	3	□	1	0
4	1	5	□	0	1

↓ ↓

7	4
2	1
3	5

Here, identity matrix acts as the kernel to find the transpose.

Case **ii**) Let us define the reference matrix $D_{i,j}$ as

0 1
1 0

The transformation can computed as:

Input Kernel $D_{i,j}$

7	2	3	□	0	1
4	1	5	□	1	0

↓ ↓

4	7
1	2
5	3

Case **iii**) Let us define the reference matrix $D_{i,j}$ as

1 1
0 0

The transformation can computed as:

Input Kernel $D_{i,j}$

7	2	3	□	1	1
4	1	5	□	0	0

↓ ↓

7	7
2	2
3	3

Case **iv**) Let us define the reference matrix $D_{i,j}$ as

0 0
1 1

The transformation can computed as:

Input Kernel $D_{i,j}$

7	2	3	□	0	0
4	1	5	□	1	1

↓ ↓

4	4
1	1
5	5

Case **v**) Let us define the reference matrix $D_{i,j}$ as

1 0
1 0

The transformation can computed as:

Input Kernel $D_{i,j}$

7	2	3	□	1	0
4	1	5	□	1	0

↓ ↓

11	0
3	0
8	0

Case **vi)** Let us define the reference matrix $D_{i,j}$ as

0 1
0 1

The transformation can computed as:

Input Kernel $D_{i,j}$

7	2	3	□	0	1
4	1	5	□	0	1

↓ ↓

0	11
0	3
0	8

IV. SUMMARY

This paper illustrates the matrix transformation algorithm by changing kernel values. We observe the fact that the reference matrix acts as the kernel of the transformation. This method can be applied to develop a way of research in Computer Graphics.

REFERENCES

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