Python Programming –Final Term Exam

ESS 112 - Programming I

International Institute of Information Technology – Bangalore

Problem 3

Marks: 6

Problem Description:

Convolution of two tensors: Consider a tensor of rank 1 and dimensions 5 x 7. An example tensor is given below (You can see visually that this matrix resembles the digit 1).

0	1	1	0	0
1	0	1	0	0
0	0	1	0	0
0	0	1	0	0
0	0	1	0	0
0	0	1	0	0
1	1	1	1	1

Suppose you are given an image tensor H of dimension 5 x 7 and a feature detector tensor F of dimensions 3 x 3. The convolution of two tensors F and H is defined by the formula below.

G[m][n] = F⊗H = $\sum_j \sum_k F[j][k] * H[m-j][n-k]$

Write a function convolve(H,F) which computes the convolution of two tensors. If the input tensors are of dimensions 5 x 7 and 3 x 3 then the output tensor is of dimensions 3 x 5.

Assume that a tensor is represented as a list of lists in a row major fashion. In other words a given tensor H of dimension m x n is represented as
H = [[h_{00} …,$h_{0(m-1)}$] [[h_{10} …,$h_{1(m-1)}$],… [[$h_{(n-1)0}$ …,$h_{(n-1)(m-1)}$]]

Input format:

First line of input will contain row R and column C size of the matrix separated by space. Next input will be the H matrix of size R and C over R lines

This will be followed by the size of the feature matrix F in the form of row R1 and columns C2. Finally we will input the F matrix of size R1 and C1 over R1 lines.

Elements in the H and F matrix will be integer values

Output format:

Output will be the convoluted matrix G

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Sample Input:

```
7 5
0 1 1 0 0
1 0 1 0 0
0 0 1 0 0
0 0 1 0 0
0 0 1 0 0
0 0 1 0 0
1 1 1 1 1
3 3
-1 -1 –1
0 0 0
1 1 1
```

Sample output:

```
0 -1 -1
2 2 1
0 1 1
1 1 1
0 0 0
```