CSCE 633 Homework- 4
Convolutional Neural Network

Question 1 : Convolution Operation

1. Convolution with stride of 1 :

$$\begin{bmatrix} -1 & 6 & 4 \\ 0 & 3 & 3 \\ -5 & 1 & 5 \end{bmatrix}$$

2. Zero padding of 1 + convolution with stride of 1 :

Input after zero padding of 1 is :

$$\begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 2 & 4 & 1 & 0 & 0 \\ 0 & 3 & 1 & 1 & 0 & 1 & 0 \\ 0 & 2 & 4 & 1 & 0 & 1 & 0 \\ 0 & 2 & 0 & 5 & 2 & 2 & 0 \\ 0 & 0 & 1 & 3 & 2 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix}$$

and the result is :

$$\begin{bmatrix} -3 & -2 & 2 & 4 & 1 \\ -7 & -1 & 6 & 4 & 1 \\ -5 & 0 & 3 & 3 & 2 \\ -5 & -5 & 1 & 5 & 4 \\ -1 & -6 & -3 & 5 & 4 \end{bmatrix}$$

3. Zero padding of 2 + convolution with stride of 2:

Input after zero padding of 2 is:

$$\begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 2 & 4 & 1 & 0 & 0 & 0 \\ 0 & 0 & 3 & 1 & 1 & 0 & 1 & 0 & 0 \\ 0 & 0 & 2 & 4 & 1 & 0 & 1 & 0 & 0 \\ 0 & 0 & 2 & 0 & 5 & 2 & 2 & 0 & 0 \\ 0 & 0 & 0 & 1 & 3 & 2 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix}$$

and the result after applying conv with stride of 2 is :

$$\begin{bmatrix} 0 & -4 & 4 & 0 \\ -5 & -1 & 4 & 2 \\ -4 & -5 & 5 & 4 \\ 0 & -3 & 2 & 1 \end{bmatrix}$$

4. Convolution with stride of 1 + max pooling of 3 with stride of 1:

Convolution with stride of 1 gives :

$$\begin{bmatrix} -1 & 6 & 4 \\ 0 & 3 & 3 \\ -5 & 1 & 5 \end{bmatrix}$$

and max pooling of 3 with stride of 1 gives :

$$\begin{bmatrix} 6 \end{bmatrix}$$

5. Zero padding of 2 + convolution with stride of 1 + max pooling of 3 with stride of 1:

After zero padding of 2 :

$$\begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 2 & 4 & 1 & 0 & 0 & 0 \\ 0 & 0 & 3 & 1 & 1 & 0 & 1 & 0 & 0 \\ 0 & 0 & 2 & 4 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 2 & 0 & 5 & 2 & 2 & 0 & 0 \\ 0 & 0 & 0 & 1 & 3 & 2 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix}$$

After applying conv with stride of 1 :

$$\begin{bmatrix} 0 & -2 & -4 & 1 & 4 & 1 & 0 \\ -3 & -3 & -2 & 2 & 4 & 1 & 1 \\ 5 & -7 & -1 & 6 & 4 & 1 & 2 \\ -7 & -5 & 0 & 3 & 3 & 2 & 4 \\ -4 & -5 & -5 & 1 & 5 & 4 & 4 \\ -2 & -1 & -6 & -3 & 5 & 4 & 3 \\ 0 & -1 & -3 & -1 & 2 & 2 & 1 \end{bmatrix}$$

After max pooling of 3 with stride of 1, the result is :

$$\begin{bmatrix} 5 & 6 & 6 & 6 & 4 \\ 5 & 6 & 6 & 6 & 4 \\ 5 & 6 & 6 & 6 & 5 \\ 0 & 3 & 5 & 5 & 5 \\ 0 & 1 & 5 & 5 & 5 \end{bmatrix}$$