Task 3 - CNN

Given the following matrix:

$$A = \begin{bmatrix} 5 & 9 & 5 & 3 & 5 \\ 4 & 2 & 4 & 1 & 7 \\ 6 & 4 & 2 & 0 & 3 \\ 8 & 3 & 6 & 9 & 5 \\ 8 & 3 & 6 & 4 & 9 \end{bmatrix}$$

a) 1. Calculate the output for the 3x3 Vertical Line Filter with a Stride of 1.

Filter:

$$F = \begin{bmatrix} -1 & 1 & -1 \\ -1 & 1 & -1 \\ -1 & 1 & -1 \end{bmatrix}$$

i. Without padding

$$filter_1(A, F) = \frac{1}{9} \begin{bmatrix} -5-4-6+9+2+4-5-4-2=-11 & -9-2-4+5+4+2-3-1-0= \\ -4-6-8+2+4+3-4-2-6=-21 & -2-4-3+4+2+6-1-0-9= \\ -6-8-8+4+3+3-2-6-6=-26 & -4-3-3+2+6+6-0-9-4= \end{bmatrix}$$

ii. With padding

$$filter_{S_q=1}\left(\begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 5 & 9 & 5 & 3 & 5 & 0 \\ 0 & 4 & 2 & 4 & 1 & 7 & 0 \\ 0 & 6 & 4 & 2 & 0 & 3 & 0 \\ 0 & 8 & 3 & 6 & 9 & 5 & 0 \\ 0 & 8 & 3 & 6 & 4 & 9 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix}, F \right) = \frac{1}{9} \begin{bmatrix} -0-0-0+0+5+4-0-9-2=-2 & -0-5- \\ -0-0-0+5+4+6-9-2-4=0 & -5-4-6 \\ -0-0-0+4+6+8-2-4-3=9 & -4-6-8 \\ -0-0-0+6+8+8-4-3-3=12 & -6-8-8 \\ -0-0-0+8+8+0-3-3-0=10 & -8-8-0 \end{bmatrix}$$

1. b) Pool your results from part a). Use Minimum Pooling (3x3) with a Stride of 2. (1 P.)

i. Without padding

$$pool_2\left(\frac{1}{9} \begin{bmatrix} -11 & -8 & -22 \\ -21 & -7 & -17 \\ -26 & -9 & -18 \end{bmatrix} \right) = \frac{1}{9}[-26]$$

ii. With padding

$$pool_2\left(\frac{1}{9}\begin{bmatrix}-2 & -7 & -6 & -17 & 8\\ 0 & -11 & -8 & -22 & 11\\ 9 & -21 & -7 & -17 & 5\\ 12 & -26 & -9 & -18 & 4\\ 10 & -22 & -7 & -13 & 1\end{bmatrix}\right) = \frac{1}{9}\begin{bmatrix}-21 & -22\\ -26 & -18\end{bmatrix}$$