Cooper Tush

Dr. Sathyanarayanan Aakur

CS-4783-65788

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Machine Learning Assignment 3 Question 3

1.

The dimension of the input is X = (6, 6).

The dimension of the kernel or filter is f = (3, 3).

The number of parameters in the kernel is 9.

2.

The output of the convolution operation, with the given parameters is (4, 4). We can find it by using the calculations below:

Output equals ((input + 2\*p – k) / s) + 1 with input = 6, k = 3, p = 0, s = 1.

Which gives us ((6 + 2\*0 – 3) / 1) + 1 = ((6 + 0 – 3) / 1) + 1 = (3/1) + 1 = 3 + 1 = 4.

So, the output for the activation map is 4.

3.

If we apply a maxpooling with a kernel of 2 then the output will be (2, 2).

So, the output would be: ([16, 9, -4, -18], [17, -5, -10, -12], [11, -9, -17, 2], [9, -1, -15, 16])

To get this we can calculate the input by the filter using matrix multiplication.

7\*1 + 5\*0 + 0\*(-1) + 6\*2 + 4\*0 + 5\*(-2) + 9\*1 + 0\*0 + 2\*(-1) = 7 + 0 + 0 + 12 + 0 + (-10) + 9 + 0 + (-2) = 16.

5\*1 + 0\*0 + 0\*(-1) + 4\*2 + 5\*0 + 1\*(-2) + 0\*1 + 2\*0 + 2\*(-1) = 5 + 0 + 0 + 8 + 0 + (-2) + 0 + 0 + (-2) = 9.

0\*1 + 0\*0 + 3\*(-1) + 5\*2 + 1\*0 + 4\*(-2) + 2\*1 + 2\*0 + 5\*(-1) = 0 + 0 + (-3) + 10 + 0 + (-8) + 2 + 0 + (-5) = -4

0\*1 + 3\*0 + 2\*(-1) + 1\*2 + 4\*0 + 8\*(-2) + 2\*1 + 5\*0 + 4\*(-1)= 0 + 0 + (-2) + 2 + 0 + (-16) + 2 + 0 + (-4)= -18

6\*1 + 4\*0 + 5\*(-1) + 9\*2 + 2\*0 + 2\*(-2) + 6\*1 + 3\*0 + 4\*(-1) = 6 + 0 + (-5) + 18 + 0 + (-4) + 6 + 0 + (-4) = 17

4\*1 + 5\*0 + 1\*(-1) + 0\*2 + 2\*0 + 2\*(-2) + 3\*1 + 4\*0 + 7\*(-1) = 4 + 0 + (-1) + 0 + 0 + (-4) + 3 + 0 + (-7) = -5

5\*1 + 1\*0 + 4\*(-1) + 2\*2 + 2\*0 + 5\*(-2) + 4\*1 + 7\*0 + 9\*(-1)= 5 + 0 + (-4) + 4 + 0 + (-10) + 4 + 0 + (-9)= -10

1\*1 + 4\*0 + 8\*(-1) + 2\*2 + 5\*0 + 4\*(-2) + 7\*1 + 9\*0 + 8\*(-1) = 1 + 0 + (-8) + 4 + 0 + (-8) + 7 + 0 + (-8) = -12

9\*1 + 0\*0 + 2\*(-1) + 6\*2 + 3\*0 + 4\*(-2) + 5\*1 + 7\*0 + 5\*(-1) = 9 + 0 + (-2) + 12 + 0 + (-8) + 5 + 0 + (-5) = 11

0\*1 + 2\*0 + 2\*(-1) + 3\*2 + 4\*0 + 7\*(-2) + 7\*1 + 5\*0 + 6\*(-1) = 0 + 0 + (-2) + 6 + 0 + (-14) + 7 + 0 + (-6) = -9

2\*1 + 2\*0 + 5\*(-1) + 4\*2 + 7\*0 + 9\*(-2) + 5\*1 + 6\*0 + 9\*(-1)= 2 + 0 + (-5) + 8 + 0 + (-18) + 5 + 0 + (-9)= -17

2\*1 + 5\*0 + 4\*(-1) + 7\*2 + 9\*0 + 8\*(-2) + 6\*1 + 9\*0 + 0\*(-1) = 2 + 0 + (-4) + 14 + 0 + (-16) + 6 + 0 + 0 = 2

6\*1 + 3\*0 + 4\*(-1) + 5\*2 + 7\*0 + 5\*(-2) + 7\*1 + 9\*0 + 0\*(-1) = 6 + 0 + (-4) + 10 + 0 + (-10) + 7 + 0 + 0 = 9

3\*1 + 4\*0 + 7\*(-1) + 7\*2 + 5\*0 + 6\*(-2) + 9\*1 + 0\*0 + 8\*(-1)= 3 + 0 + (-7) + 14 + 0 + (-12) + 9 + 0 + (-8)= -1

4\*1 + 7\*0 + 9\*(-1) + 5\*2 + 6\*0 + 9\*(-2) + 0\*1 + 8\*0 + 2\*(-1)= 4 + 0 + (-9) + 10 + 0 + (-18) + 0 + 0 + (-2)=-15

7\*1 + 9\*0 + 8\*(-1) + 6\*2 + 9\*0 + 0\*(-2) + 8\*1 + 2\*0 + 3 \*(-1) = 7 + 0 + (-8) + 12 + 0 + 0 + 8 + 0 + (-3) = 16