

Computation of Convolutions

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a) 1D Example

$$(x \circ u)_i = \sum_{j=1}^w x_{(i-1+j)} \cdot u_j$$

i_1	i_2	i_3	i_4	i_5	i_6	i_7	i_8	i_9
1	3	-2	0	2	-1	3	1	2

w_1	w_2	w_3	b
2	1	-1	2

S=1, P=0

i_1	i_2	i_3	i_4	i_5	i_6	i_7	i_8	i_9
1	3	-2	0	2	-1	3	1	2
$(1 \cdot 2 + 3 \cdot 1 + -2 \cdot -1) + 2 = 9$								
$(6 + -2 + 0) + 2 = 6$								
$(-4 + 0 + -2) + 2 = -4$								
\vdots								
o_1	o_2	o_3	o_4	o_5	o_6	o_7		
9	6	-4	5	2	2	7		

S=2, P=0

i_1	i_2	i_3	i_4	i_5	i_6	i_7	i_8	i_9
1	3	-2	0	2	-1	3	1	2
$(1 \cdot 2 + 3 \cdot 1 + -2 \cdot -1) + 2 = 9$								
$(-4 + 0 + -2) + 2 = -4$								
\vdots								
o_1	o_2	o_3	o_4					
9	-4	2	7					

S=4, P=0

$$\begin{array}{cccccccc}
 i_1 & i_2 & i_3 & i_4 & i_5 & i_6 & i_7 & i_8 & i_9 \\
 \hline
 1 & 3 & -2 & 0 & 2 & -1 & 3 & 1 & 2 \\
 (1 \cdot 2 + 3 \cdot 1 + -2 \cdot -1) + 2 = 9 \\
 (4 + 1 + -3) + 2 = 2 \\
 (4 + ? + ?) + 2 = ?
 \end{array}$$

$$\begin{array}{ccc}
 o_1 & o_2 & o_3 \\
 \hline
 9 & 2 & -
 \end{array}$$

! Incompatible stride value !

S=1, P=1

$$\begin{array}{cccccccccc}
 p_1 & i_1 & i_2 & i_3 & i_4 & i_5 & i_6 & i_7 & i_8 & i_9 & p_2 \\
 \hline
 0 & 1 & 3 & -2 & 0 & 2 & -1 & 3 & 1 & 2 & 0 \\
 (0 \cdot 2 + 1 \cdot 1 + 3 \cdot -1) + 2 = 0 \\
 (2 + 3 + 2) + 2 = 9 \\
 (6 + -2 + 0) + 2 = 6 \\
 (-4 + 0 + -2) + 2 = -4 \\
 \vdots
 \end{array}$$

$$\begin{array}{ccccccccc}
 o_1 & o_2 & o_3 & o_4 & o_5 & o_6 & o_7 & o_8 & o_9 \\
 \hline
 0 & 9 & 6 & -4 & 5 & 2 & 2 & 7 & 6
 \end{array}$$

S=4, P=1

$$\begin{array}{cccccccccc}
 p_1 & i_1 & i_2 & i_3 & i_4 & i_5 & i_6 & i_7 & i_8 & i_9 & p_2 \\
 \hline
 0 & 1 & 3 & -2 & 0 & 2 & -1 & 3 & 1 & 2 & 0 \\
 (0 \cdot 2 + 1 \cdot 1 + 3 \cdot -1) + 2 = 0 \\
 (0 + 2 + 1) + 2 = 5 \\
 (2 + 2 + 0) + 2 = 6
 \end{array}$$

$$\begin{array}{ccc}
 o_1 & o_2 & o_3 \\
 \hline
 0 & 5 & 6
 \end{array}$$

As we can see, we only get the same Dimensions for a stride value of 1 and padding 1

b) 2D Example

- We will get 2 activation maps (RGBFilter1, RGBFilter2)
- 3x3x2
- 2x2x2
- 2x2x3, S=2, P=2