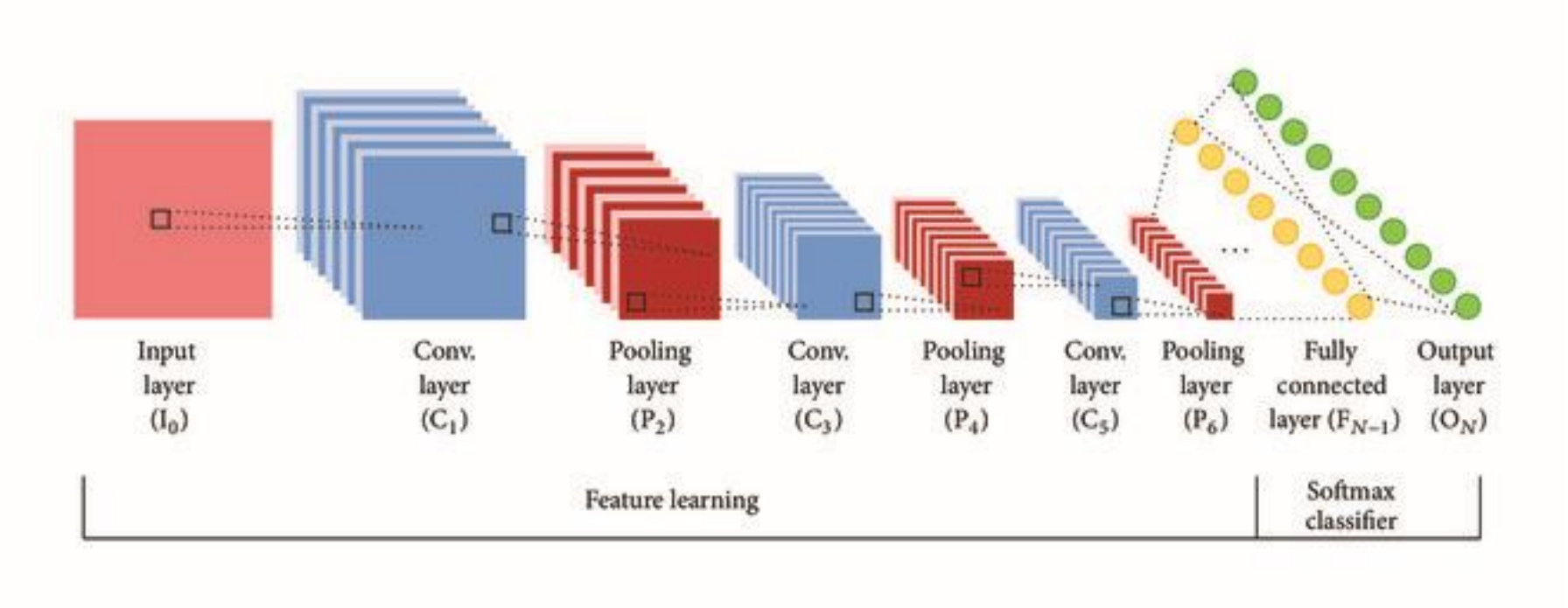
Building the first CNN Architecture & Parameters Calculations



--- Ramendra Kumar ---

Convolution Operation : Input with one channel

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

Input

1	0	1
0	1	0
1	0	1

Kernel/Filter

1x1	1x0	1x1	0	0
0x0	1x1	1x0	1	0
0x1	0x0	1x1	1	1
0	0	1	1	0
0	1	1	0	0

Stride?

4		

Output

Convolution Operation : Input with three channel

0	0	0	0	0	0	...
0	156	155	156	158	158	...
0	153	154	157	159	159	...
0	149	151	155	158	159	...
0	146	146	149	153	158	...
0	145	143	143	148	158	...
...	...	...	...	...	...	...

Input Channel #1 (Red)

0	0	0	0	0	0	...
0	167	166	167	169	169	...
0	164	165	168	170	170	...
0	160	162	166	169	170	...
0	156	156	159	163	168	...
0	155	153	153	158	168	...
...	...	...	...	...	...	...

Input Channel #2 (Green)

0	0	0	0	0	0	...
0	163	162	163	165	165	...
0	160	161	164	166	166	...
0	156	158	162	165	166	...
0	155	155	158	162	167	...
0	154	152	152	157	167	...
...	...	...	...	...	...	...

Input Channel #3 (Blue)

-1	-1	1
0	1	-1
0	1	1

Kernel Channel #1

1	0	0
1	-1	-1
1	0	-1

Kernel Channel #2

0	1	1
0	1	0
1	-1	1

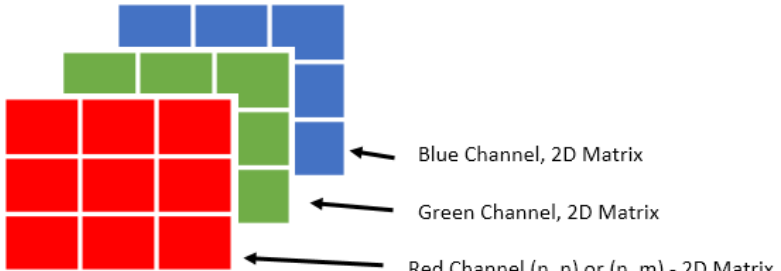
Kernel Channel #3

$308 + (-498) + 164 + 1 = -25$

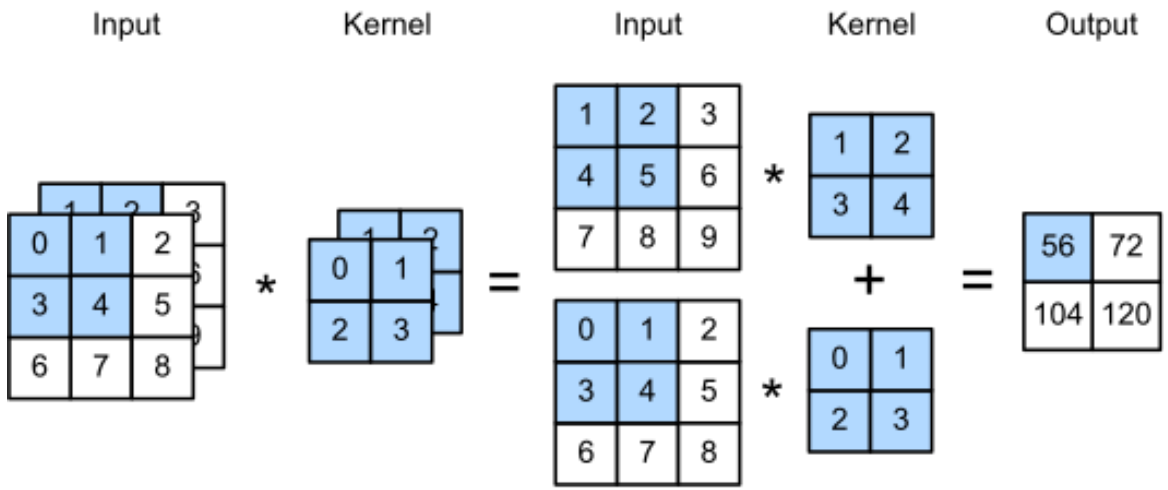
Bias = 1

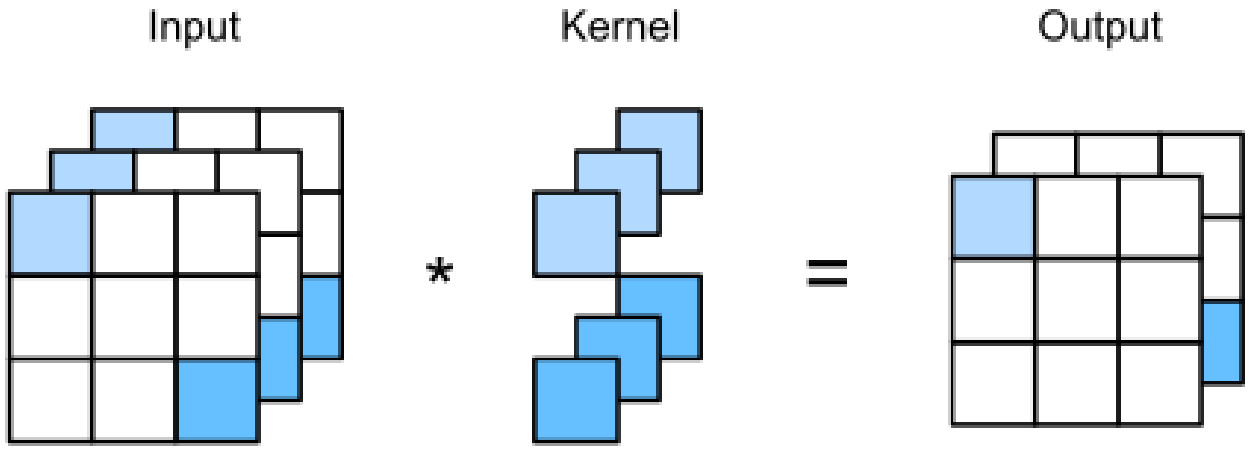
Output

-25				...
				...
				...
				...
...	...	...	...	...



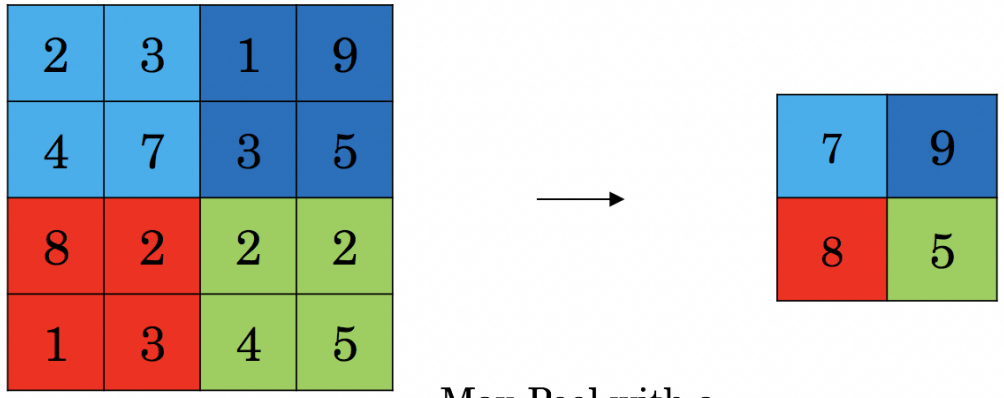
Convolution Operation : Single / Multiple Kernel





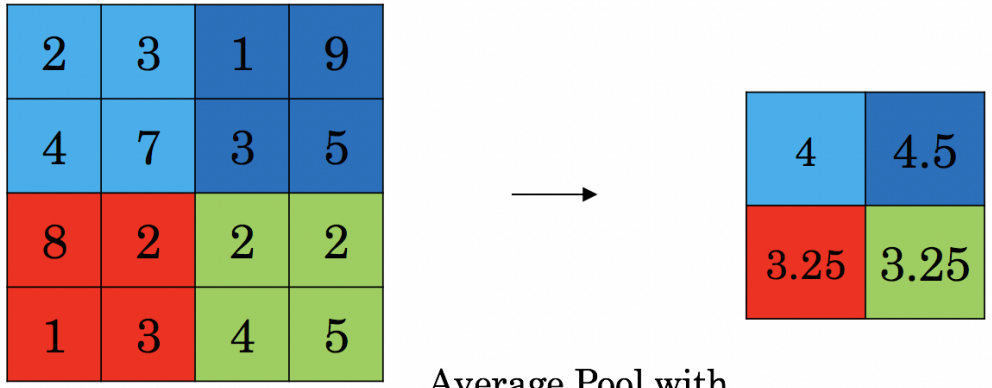
Pooling Operation

Max Pool



Max-Pool with a 2 by 2 filter and stride 2.

Average Pool



Average Pool with a 2 by 2 filter and stride 2.

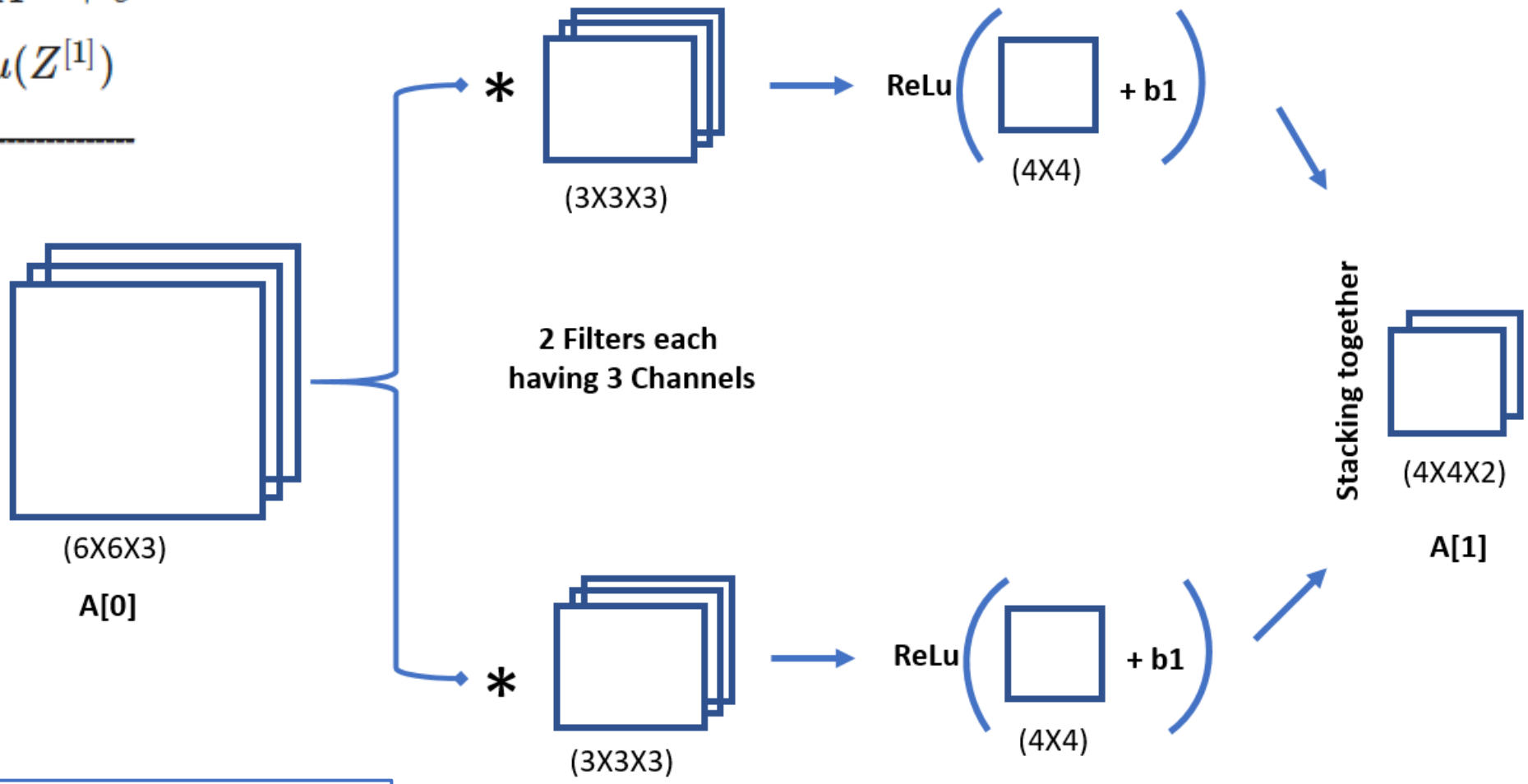
Zero Padding

0	0	0	0	0	0
0	35	19	25	6	0
0	13	22	16	53	0
0	4	3	7	10	0
0	9	8	1	3	0
0	0	0	0	0	0

Deeper look into One Layer of a Convolution

$$Z^{[1]} = W^{[1]} \circledast A^{[0]} + b^{[1]}$$

$$A^{[1]} = ReLu(Z^{[1]})$$



$$Output\ shape\ after\ Conv = \frac{n+2p-f}{s} + 1$$

Deeper look into One Layer of a Convolution

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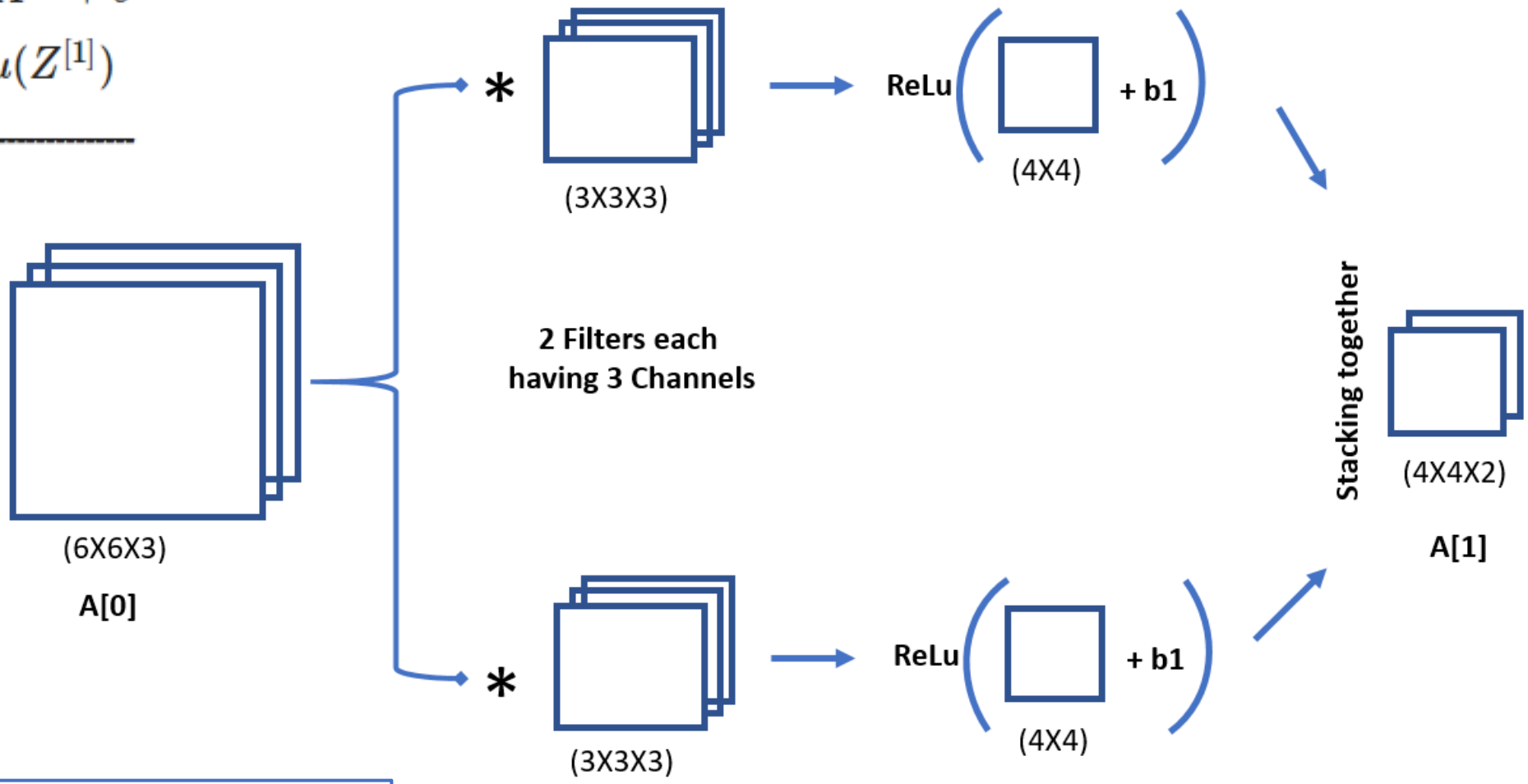
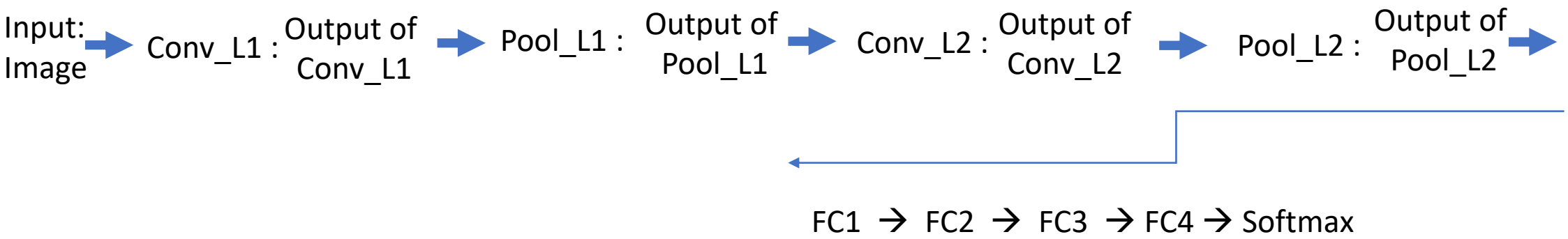


$$Output\ shape\ after\ Conv = \frac{n+2p-f}{s} + 1$$

Calculating Parameters= $\left(f^l \times f^l \times n_c^{l-1} + 1\right) \times n_f^l$

CNN Architecture

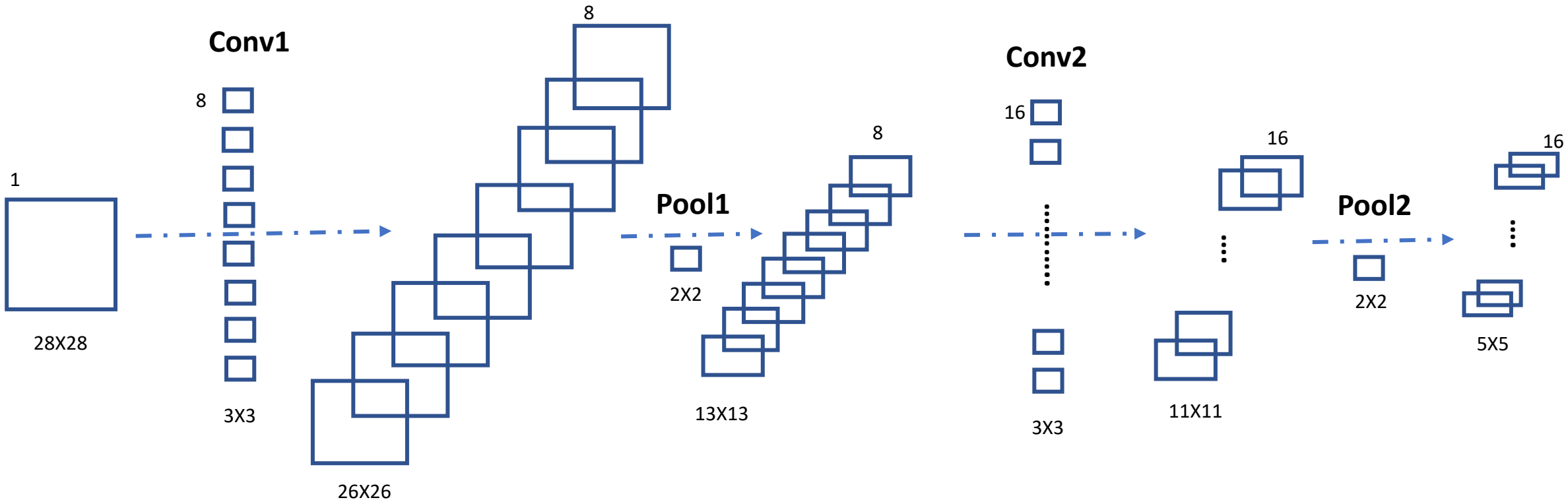
U3W12_41_FashionMNIST_CNN_C.ipynb



CNN Example 1:

P1: $(3 \times 3 \times 1 + 1) \times 8 = 80$

P2: $(3 \times 3 \times 8 + 1) \times 16 = 1168$



Input: Image | Conv1 | Output of Conv1 | Pool1 | Output of Pool1 | Conv2 | Output of Conv2 | Pool2 | Output of Pool2

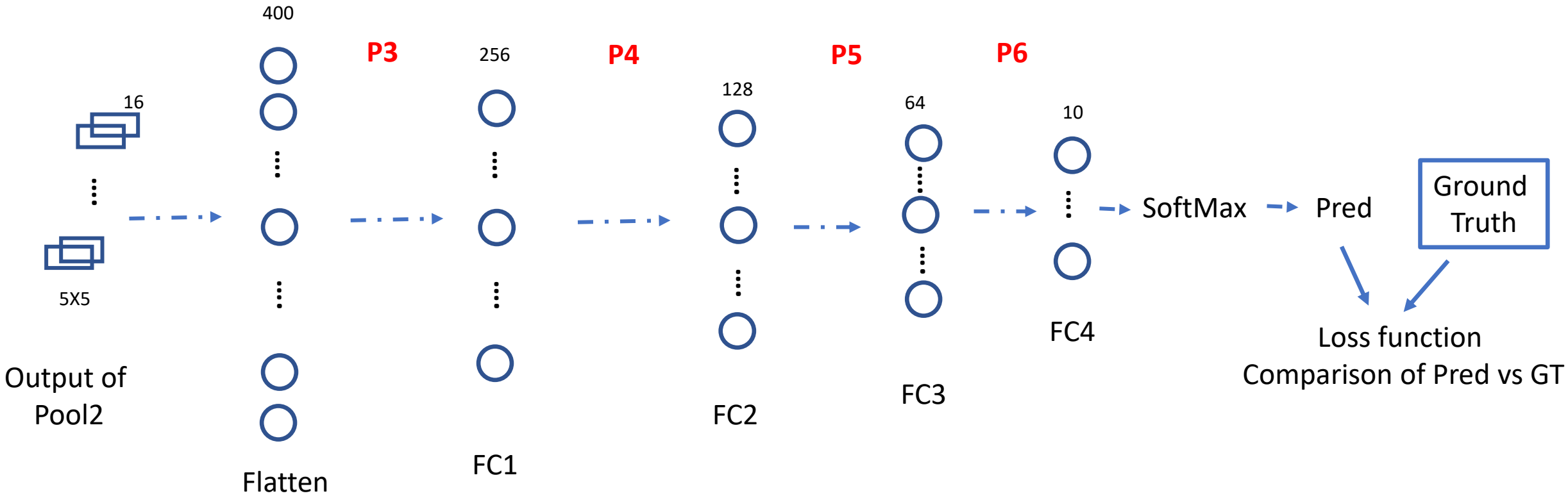
$$Output\ shape\ after\ Conv = \frac{n+2p-f}{s} + 1$$

$$Output\ shape\ after\ Pool = \frac{n-f}{s} + 1$$

Calculating Parameters= $\left(f^l \times f^l \times n_c^{l-1} + 1\right) \times n_f^l$

P3 : [256, 400] + b(256) =$((256 \times 400) + 256) = 102{,}656$

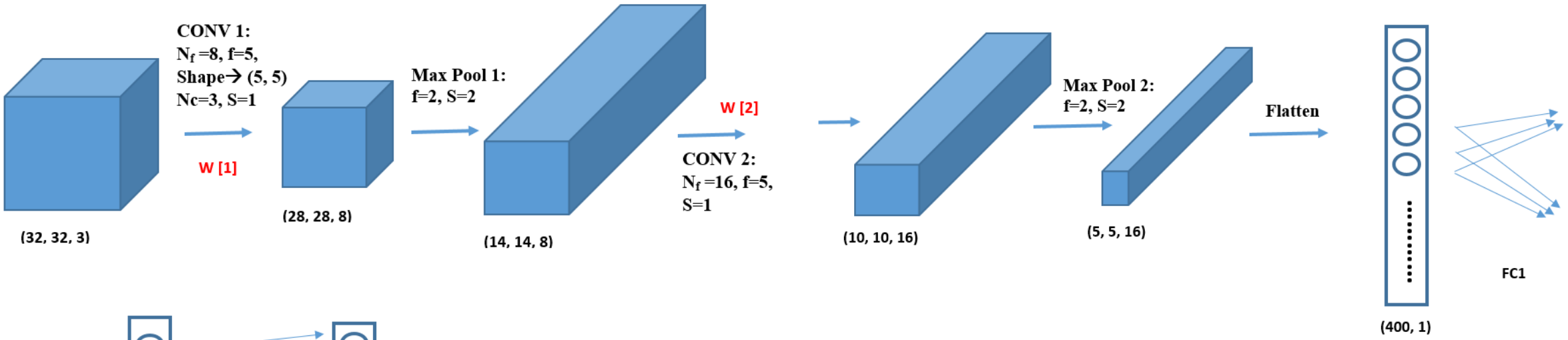
P4 : [128, 256] + b(128) =$((128 \times 256) + 128) = 32{,}896$

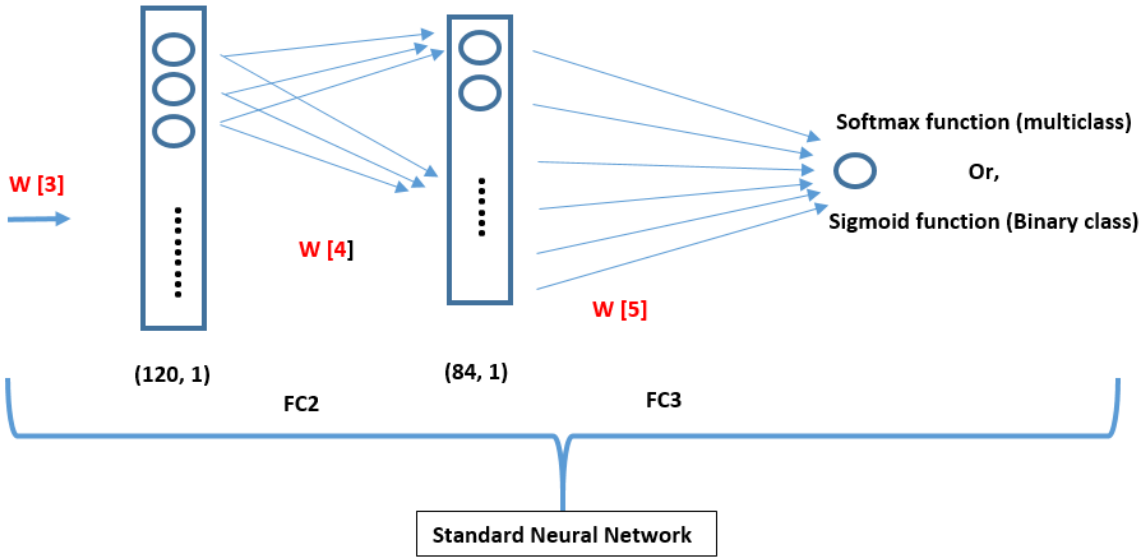


P5 : [64, 128] + b(64) =$((64 \times 128) + 64) = 8{,}256$

P6 : [10, 64] + b(10) =$((10 \times 64) + 10) = 650$

CNN Example 2:





	Activation shape	Activation Size	Parameters
Input	(32,32,3)	3072	0
CONV 1: Nf =8, f=5, Shape: (5, 5) , Nc=3, S=1	(28,28,8)	6272	608
Pool1: f=2, s=2	(14,14,8)	1568	0
CONV 2: Nf =16, f=5, Nc=8, S=1	(10,10,16)	1600	3216
Pool2 : f=2, s=2	(5,5,16)	400	0
FC1	(120,1)	120	48120
FC2	(84,1)	84	10164
FC3-Softmax	(10,1)	10	850

Thanks!