HW3

Problem 1

Receptive field is a way of measuring network component's dependency, i.e. A block on current map is determined by how many blocks from a previous layer. To calculate the receptive fields, we need a set of parameters for each layer: filter size k, stride s, offset(padding) p, and calculate the compound parameter when layers are stacked together.

(a) expression for the receptive field

$$R_i = R_{i-1} + (k-1)j_{i-1},$$

Where $j_i = j_{i-1}\ s$, j represents jump (distance between two consecutive features). The first layer is the input layer, with j=1.

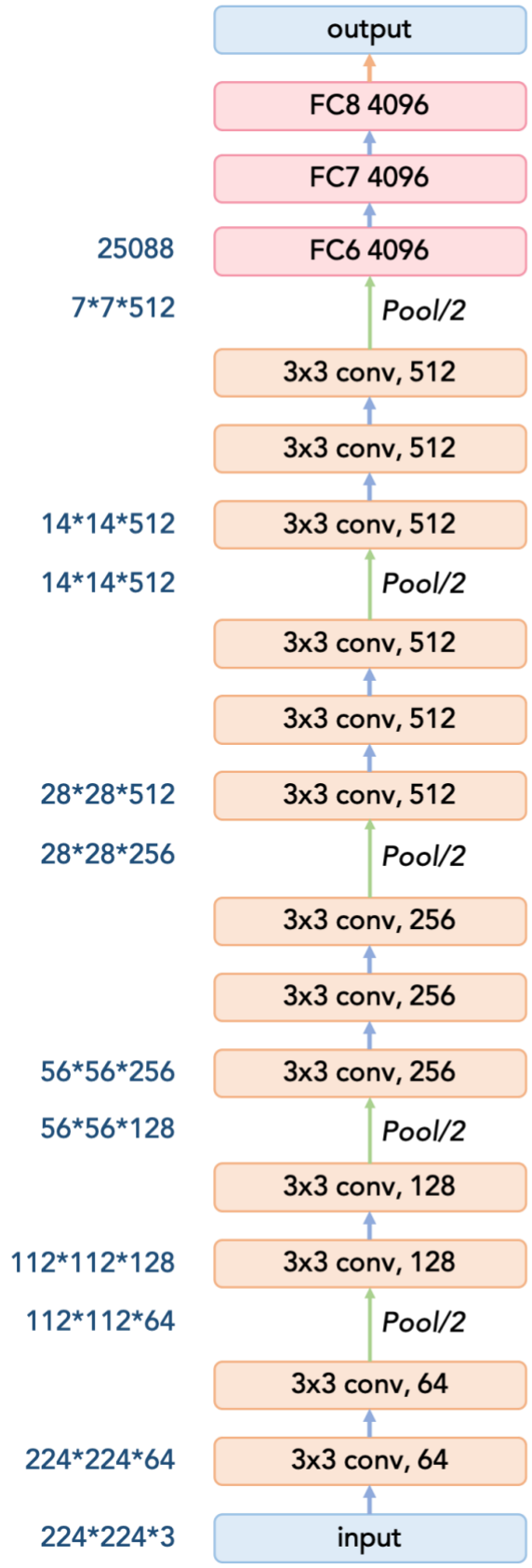
(b) Assume k_p and s_p are kernel size and stride for the pooling layer respectively, then the receptive fields for layer i is:

$R_i = R_{i-1} + (k-1)j_{i-1},$ if layer i is convolutional layer with $j_i = j_{i-1}\ s$

$R_i = R_{i-1} + (k_p - 1)j_{i-1},$ if layer i is pooling layer, with $j_i = j_{i-1}\ s_p$

(c) receptive field of VGG16

Layer Index	**Filter Size**	**Stride**	**Receptive Field Size**
Conv 1.1	3	1	3
Conv 1.2	3	1	5
Pool 1	2	2	6
Conv 2.1	3	1	10
Conv 2.2	3	1	14
Pool2	2	2	16
Conv 3.1	3	1	24
Conv 3.2	3	1	32
Conv 3.3	3	1	40
Pool 3	2	2	44
Conv 4.1	3	1	60
Conv 4.2	3	1	76
Conv 4.3	3	1	92
Pool 4	2	2	100
Conv 5.1	3	1	132
Conv 5.2	3	1	164
Conv 5.3	3	1	196
Pool 5	2	2	212



(k, s)	(k, s)'	receptive field
7 x 1	404 x 32	404 x 404
2 x 2	212 x 32	212 x 212
3 x 1	196 x 16	196 x 196
3 x 1	164 x 16	164 x 164
3 x 1	132 x 16	132 x 132
2 x 2	100 x 16	100 x 100
3 x 1	82 x 8	92 x 92
3 x 1	76 x 8	76 x 76
3 x 1	60 x 8	60 x 60
2 x 2	44 x 8	44 x 44
3 x 1	40 x 4	40 x 40
3 x 1	32 x 4	32 x 32
3 x 1	24 x 4	24 x 24
2 x 2	16 x 4	16 x 16
3 x 1	14 x 2	14 x 14
3 x 1	10 x 2	10 x 10
2 x 2	6 x 2	6 x 6
3 x 1	5 x 1	5 x 5
3 x 1	3 x 1	3 x 3

Reference:
[1] http://zike.io/posts/calculate-receptive-field-for-vgg-16/
[2] https://medium.com/mlreview/a-guide-to-receptive-field-arithmetic-for-convolutional-neural-networks-e0f514068807