Quiz 2 Solution

Section 5D

Image:

58	36	5	30	37	62	7	81
42	31	9	11	14	51	62	52
23	90	71	29	10	71	49	55
28	82	30	7	70	55	52	19
52	47	90	29	53	28	96	8
85	45	95	95	9	32	54	48
49	71	26	75	41	50	17	15
63	29	49	77	18	28	40	51

Image Size = 8x8

Filter Size =5x5

A. Convolution Layer:

(i) Padding the Image:

0	0	0	0	0	0	0	0	0	0
0	58	36	5	30	37	62	7	81	0
0	42	31	9	11	14	51	62	52	0
0	23	90	71	29	10	71	49	55	0
0	28	82	30	7	70	55	52	19	0
0	52	47	90	29	53	28	96	8	0
0	85	45	95	95	9	32	54	48	0
0	49	71	26	75	41	50	17	15	0
0	63	29	49	77	18	28	40	51	0
0	0	0	0	0	0	0	0	0	0

(ii) Filter 1:

3	2	1	-1	1
0	5	2	3	0
-1	1	-2	-3	-1
5	2	0	1	0
4	2	1	0	-2

Applying on Image,

e.g,

For first cell = relu [(0*3) + (0*2) +(0*1) +(0*-1) +(0*1) + (0*0) + (58*5) + (36*2)+(5*3) + (30*0) + (0*-1) + (42*1) + (31*-2) + (9*-3) + (11*-1) + (0*5) + (23*2) + (90*0) + (71*1) + (29*0) + (0*4) + (28*2) + (82*1)+ (30*0) +(7*-2)] + 0.5

= relu [560.5]

= 560.5

Result of F1 on Image:

560.5	694.5	946.5	753.5	392.5	1013.5
256.5	889.5	985.5	467.5	756.5	1337.5
611.5	1672.5	1140.5	1079.5	900.5	1079.5
431.5	1359.5	1409.5	1210.5	1421.5	799.5
479.5	1104.5	1449.5	956.5	1176.5	968.5
819.5	1218.5	910.5	1265.5	665.5	842.5

(iii) Filter 2:

1	2	3	4	5
0	9	8	7	6
3	2	1	0	4
9	8	7	6	5
-1	0	-2	4	8

Applying on Image,

e.g,

For first cell = relu[(0*1) + (0*2) +(0*3) +(0*4) +(0*5) + (0*0) + (58*9) + (36*8)+(5*7) + (30*6) + (0*3) + (42*2) + (31*1) + (9*0) + (11*4) + (0*9) + (23*8) + (90*7) + (71*6) + (29*5) + (0*-1) + (28*0) + (82*-2)+ (30*4) +(7*8)] + 0.8

= relu(2581.8)

= 2581.8

Result of F2 on Image:

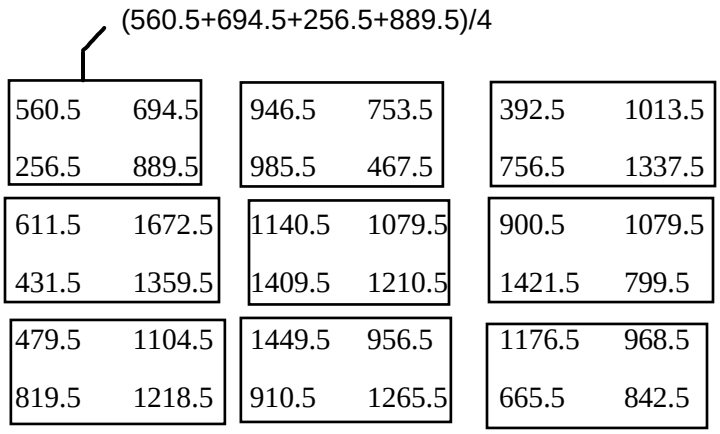
2581.8	3197.8	3862.8	3431.8	3334.8	2620.8
2912.8	3140.8	3945.8	3966.8	4179.8	3381.8
4512.8	4534.8	4154.8	4609.8	4261.8	3794.8
4774.8	5513.8	4709.8	5141.8	4262.8	2862.8
4874.8	4937.8	4828.8	4744.8	4528.8	2717.8
4965.8	4854.8	4516.8	4262.8	3591.8	2697.8

B. Max Pooling Layer:

Filter size=2

Stride = 2

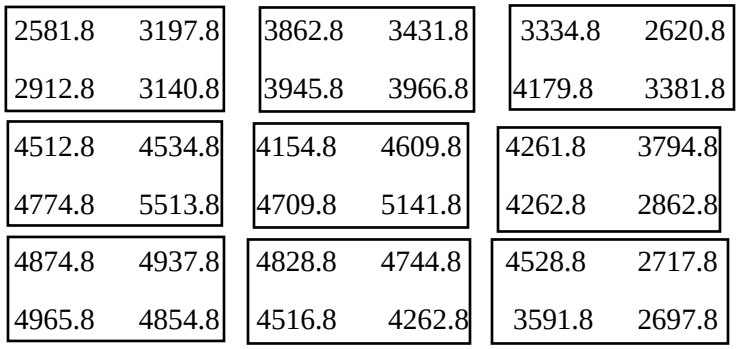
(i) For F1 Resultant:



Mean Pooling Result:

600.25	788.25	875
1018.75	1210	1050.25
905.5	1145.5	913.25

(ii) For F2 Resultant:



Mean Pooling Result:

2958.3	3801.1	3379.3
4834.05	4654.05	3795.55
4908.3	4589.05	3384.05

C. Flattening:

(i) For F1 Mean Pooling Resultant:

600.25

788.25

875

1018.75

1210

1050.25

905.5

1145.5

913.25

(ii) For F2 Mean Pooling Resultant:

2958.3

3801.1

3379.3

4834.05

4654.05

3795.55

4908.3

4589.05

3384.05

Combining it we get the flattened layer/input layer,

600.25

788.25

875

1018.75

1210

1050.25

905.5

1145.5

913.25

2958.3

3801.1

3379.3

4834.05

4654.05

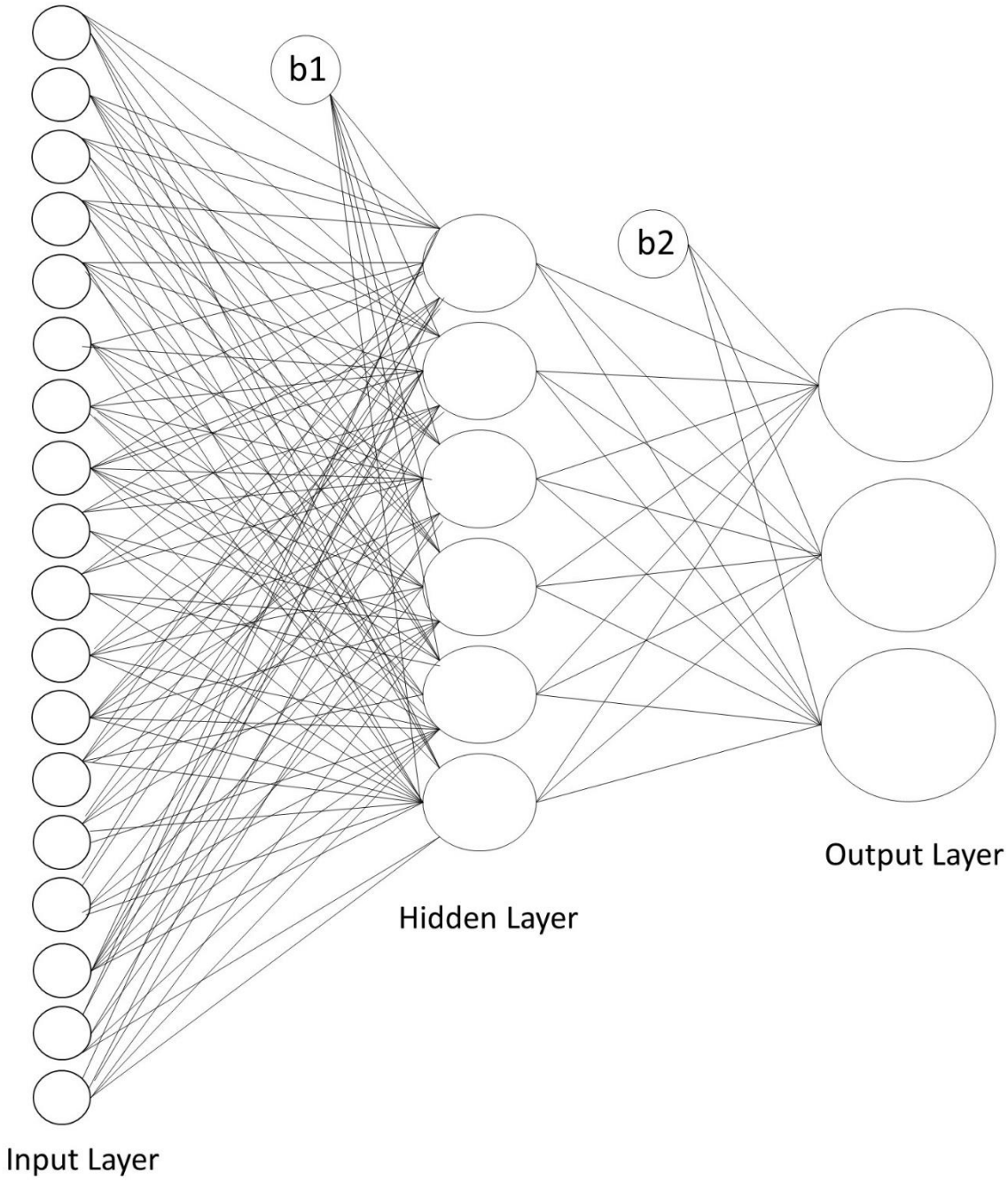
3795.55

4908.3

4589.05

3384.05

D. MLP:



(i) Hidden Layer:

Activation function= tanh

Weights=Bias=0.3

H = tanh(W^t.I +b1

$$=\tanh\left(\begin{bmatrix} 0.3 & 0.3 & 0.3 & 0.3 & 0.3 & 0.3 & 0.3 & 0.3 & 0.3 & 0.3 & 0.3 & 0.3 & 0.3 & 0.3 & 0.3 & 0.3 & 0.3 & 0.3 \\ 0.3 & 0.3 & 0.3 & 0.3 & 0.3 & 0.3 & 0.3 & 0.3 & 0.3 & 0.3 & 0.3 & 0.3 & 0.3 & 0.3 & 0.3 & 0.3 & 0.3 & 0.3 \\ 0.3 & 0.3 & 0.3 & 0.3 & 0.3 & 0.3 & 0.3 & 0.3 & 0.3 & 0.3 & 0.3 & 0.3 & 0.3 & 0.3 & 0.3 & 0.3 & 0.3 & 0.3 \\ 0.3 & 0.3 & 0.3 & 0.3 & 0.3 & 0.3 & 0.3 & 0.3 & 0.3 & 0.3 & 0.3 & 0.3 & 0.3 & 0.3 & 0.3 & 0.3 & 0.3 & 0.3 \\ 0.3 & 0.3 & 0.3 & 0.3 & 0.3 & 0.3 & 0.3 & 0.3 & 0.3 & 0.3 & 0.3 & 0.3 & 0.3 & 0.3 & 0.3 & 0.3 & 0.3 & 0.3 \\ 0.3 & 0.3 & 0.3 & 0.3 & 0.3 & 0.3 & 0.3 & 0.3 & 0.3 & 0.3 & 0.3 & 0.3 & 0.3 & 0.3 & 0.3 & 0.3 & 0.3 & 0.3 \end{bmatrix} * \begin{bmatrix} 600.25 \\ 788.25 \\ 875 \\ 1018.75 \\ 1210 \\ 1050.25 \\ 905.5 \\ 1145.5 \\ 913.25 \\ 2958.3 \\ 3801.1 \\ 3379.3 \\ 4834.05 \\ 4654.05 \\ 3795.55 \\ 4908.3 \\ 4589.05 \\ 3384.05 \end{bmatrix} + \begin{bmatrix} 0.3 \\ 0.3 \\ 0.3 \\ 0.3 \\ 0.3 \\ 0.3 \end{bmatrix}\right)$$

$$= \tanh\left(\begin{bmatrix} 13443.15 \\ 13443.15 \\ 13443.15 \\ 13443.15 \\ 13443.15 \end{bmatrix} + \begin{bmatrix} 0.3 \\ 0.3 \\ 0.3 \\ 0.3 \\ 0.3 \\ 0.3 \end{bmatrix}\right)$$

$$= \tanh\left(\begin{bmatrix} 13443.45 \\ 13443.45 \\ 13443.45 \\ 13443.45 \\ 13443.45 \\ 13443.45 \end{bmatrix}\right)$$

$$= \begin{bmatrix} 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \end{bmatrix}$$

(ii) Output Layer:

Activation function= softmax

Weights=Bias=0.4

$O = \text{softmax}(W^t.H + b2)$

$$= \text{softmax}\left(\begin{bmatrix} 0.4 & 0.4 & 0.4 & 0.4 & 0.4 \\ 0.4 & 0.4 & 0.4 & 0.4 & 0.4 \\ 0.4 & 0.4 & 0.4 & 0.4 & 0.4 \end{bmatrix} * \begin{bmatrix} 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \end{bmatrix} + \begin{bmatrix} 0.4 \\ 0.4 \\ 0.4 \end{bmatrix}\right)$$

$$= \text{softmax}\left(\begin{bmatrix} 2.4 \\ 2.4 \\ 2.4 \end{bmatrix} + \begin{bmatrix} 0.4 \\ 0.4 \\ 0.4 \end{bmatrix}\right)$$

$$= \text{softmax}\left(\begin{bmatrix} 2.8 \\ 2.8 \\ 2.8 \end{bmatrix}\right)$$

$$= \begin{bmatrix} 0.33 \\ 0.33 \\ 0.33 \end{bmatrix}$$