

MATLAB Deep Learning Notes XII

Key Words : The structure of example CNN; The result images

1. The Structure of Example CNN

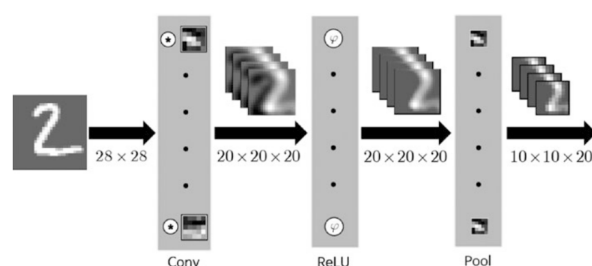


Figure 1: How the image is processed while it passes through the convolution and pooling layers.

1. The original dimension of the MNIST image is 28×28

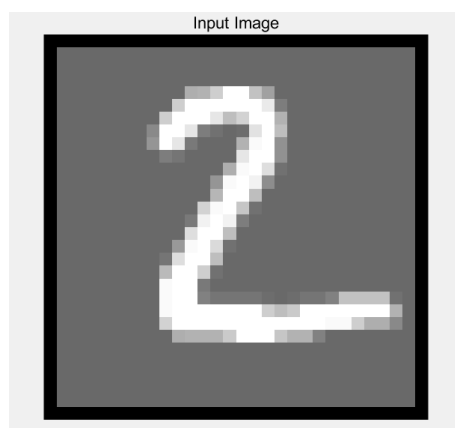


Figure 2: One of the original dimension of the MNIST image.

2. We have 20 9×9 convolution filters as follows

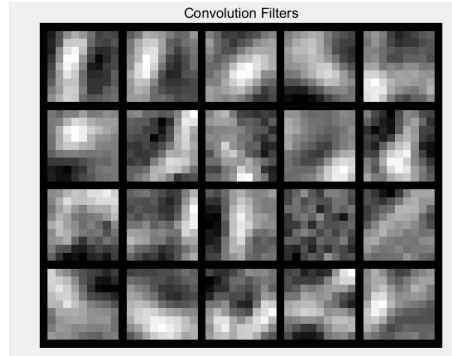


Figure 3: 20 9×9 convolution filters.

3. Once the image is processed with 20 9×9 convolution filter, it becomes 20 20×20 feature maps.

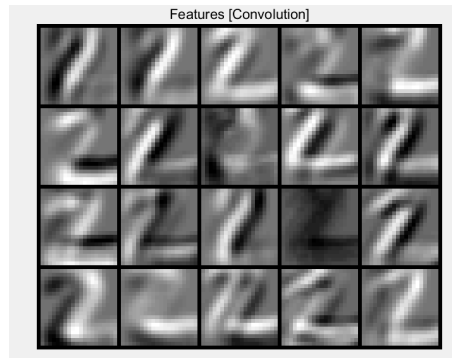


Figure 4: 20 20×20 feature maps.

4. The ReLU function processed on the feature map from the convolution layer.

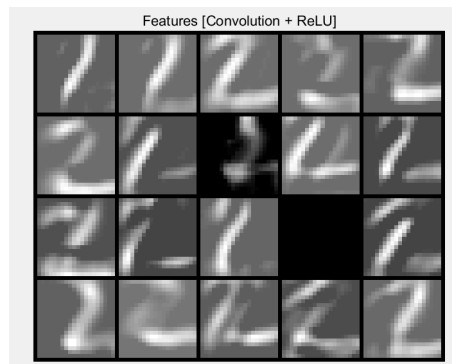


Figure 5: The ReLU function processed on the feature map from the convolution layer.

5. Through the 2×2 mean pooling process, the pooling layer shrinks feature maps to 20×10 features maps.

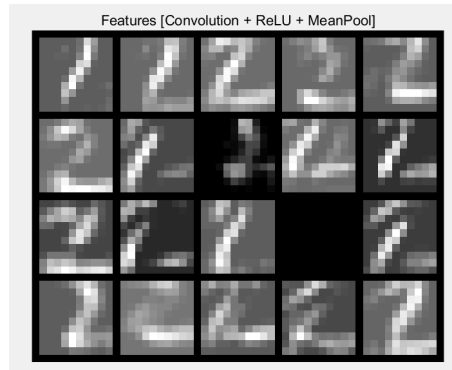


Figure 6: 20 10×10 features maps.

Program 28: plotFeatures

Listing 1: plotFeatures.m

```

1 clear
2
3 load('MnistConv.mat')
4
5 k = 2; % figure of the number 2
6 x = X( :, :, 2)
7 y1 = conv( x, W1 );
8 y2 = ReLU(y1);
9 y3 = pool(y2);
10 y4 = reshape( y3, [ ], 1);
11 v5 = W5 * y4;
12 y5 = ReLU(v5);
13 v = Wo * y5;
14 y = softmax(v);
15
16 figure;
17 display_network(x( : ));
18 title('Input Image')
19
20 convFilters = zeros( 9*9, 20 );
21 for i = 1 : 20
22     filter = W1( :, :, i );
23     convFilters( :, i ) = filter( : );
24 end
25 figure

```

```
26 display_network(convFilters);
27 title('Convolution Filters')
28
29 fList = zeros( 20 * 20, 20 );
30 for i = 1 : 20
31     feature = y1( :, :, i );
32     fList( :, i ) = feature( : );
33 end
34 figure
35 display_network(fList);
36 title('Features [Convolution]')
37
38 fList = zeros( 20 * 20, 20 );
39 for i = 1 : 20
40     feature = y2( :, :, i );
41     fList( :, i ) = feature( : );
42 end
43 figure
44 display_network(fList);
45 title('Features [Convolution + ReLU]')
46
47 fList = zeros( 10 * 10, 20 );
48 for i = 1 : 20
49     feature = y3( :, :, i );
50     fList( :, i ) = feature( : );
51 end
52 figure
53 display_network(fList);
54 title('Features [Convolution + ReLU + MeanPool]')
```