

SMAI ASSIGNMENT- 6 REPORT

MARCH 6

AYUSH KUMAR DWIVEDI
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Convolution Neural Network (CNN)

Answer 1:

I implemented the forward pass of described CNN using LeNet architecture and obtained the following results:

```
Image Reading Complete !
    The shape of read image is: (3, 32, 32)

    Demonstration of Padding Capability !!! (If
intended for use)
    Padding is complete !
    Shape of input image =  (32, 32, 3)
    Shape of padded image = (36, 36, 3)

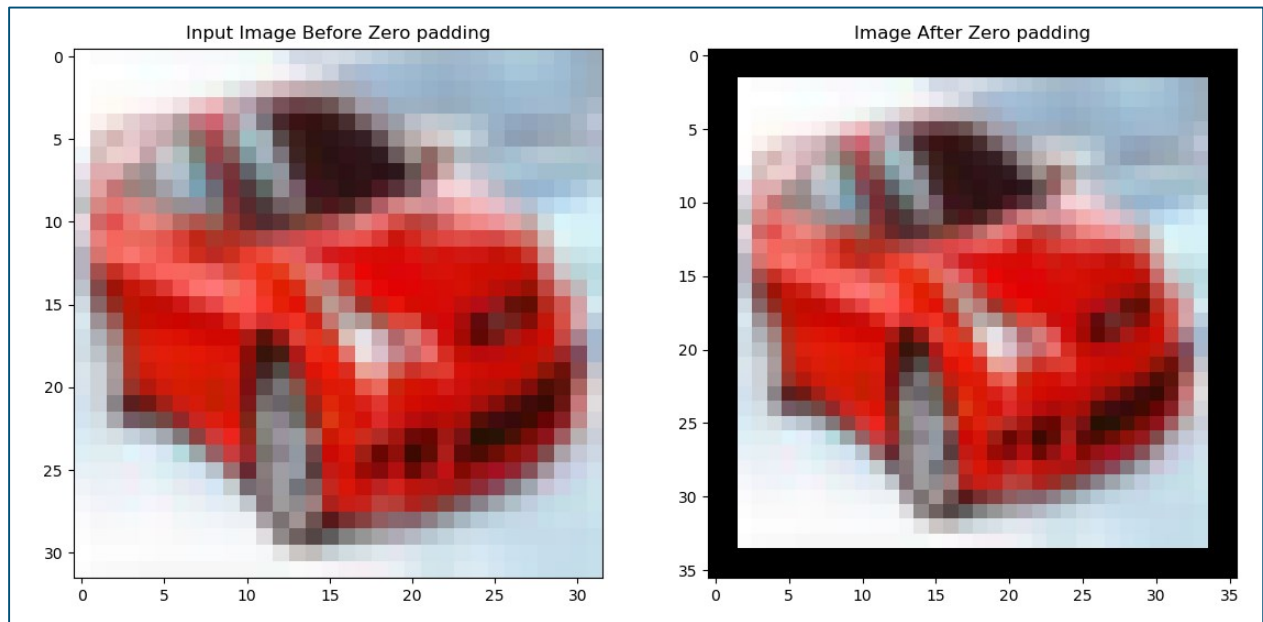
    Conv1 o/p:  (6, 28, 28)
    pool1 o/p:  (6, 14, 14)
    Conv2 o/p:  (16, 10, 10)
    pool2 o/p:  (16, 5, 5)

    Data sent to fully connected layer !!!

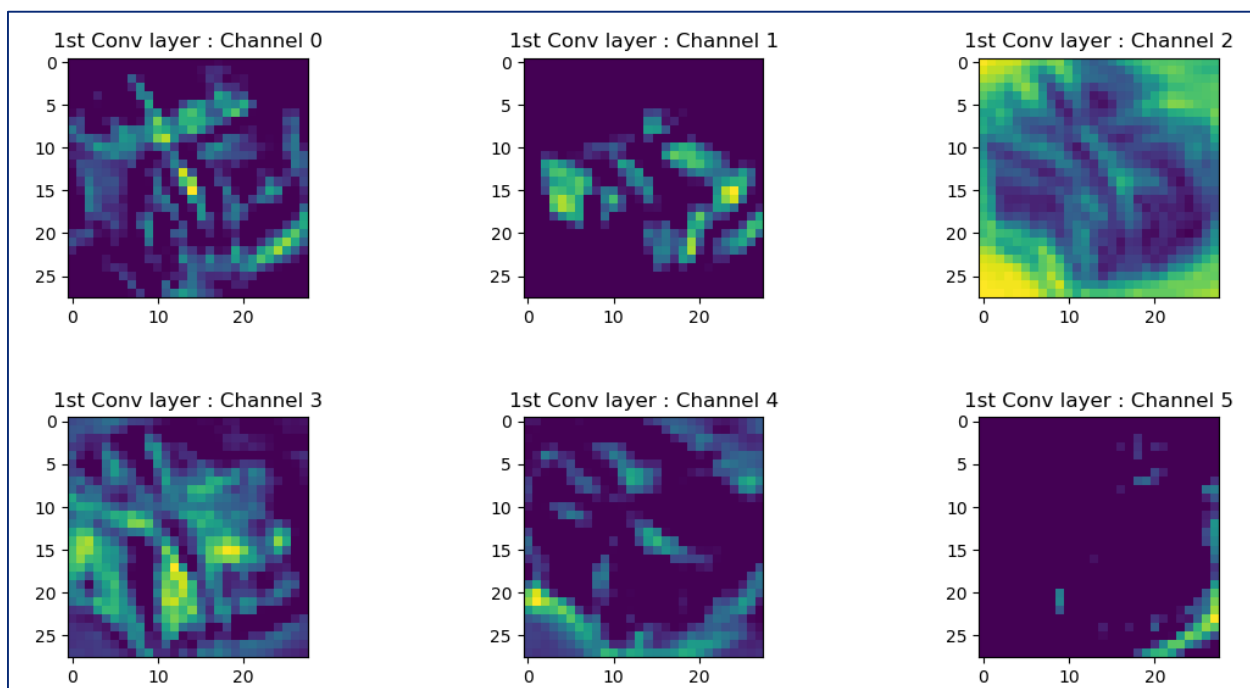
    Output Probabilities:
[[0.1000014 ]
 [0.10000123]
 [0.09999849]
 [0.09999659]
 [0.10000312]
 [0.09999902]
 [0.09999561]
 [0.10000353]
 [0.1000004 ]
 [0.10000062]]
```

The following are the obtained results at the output of each layer:

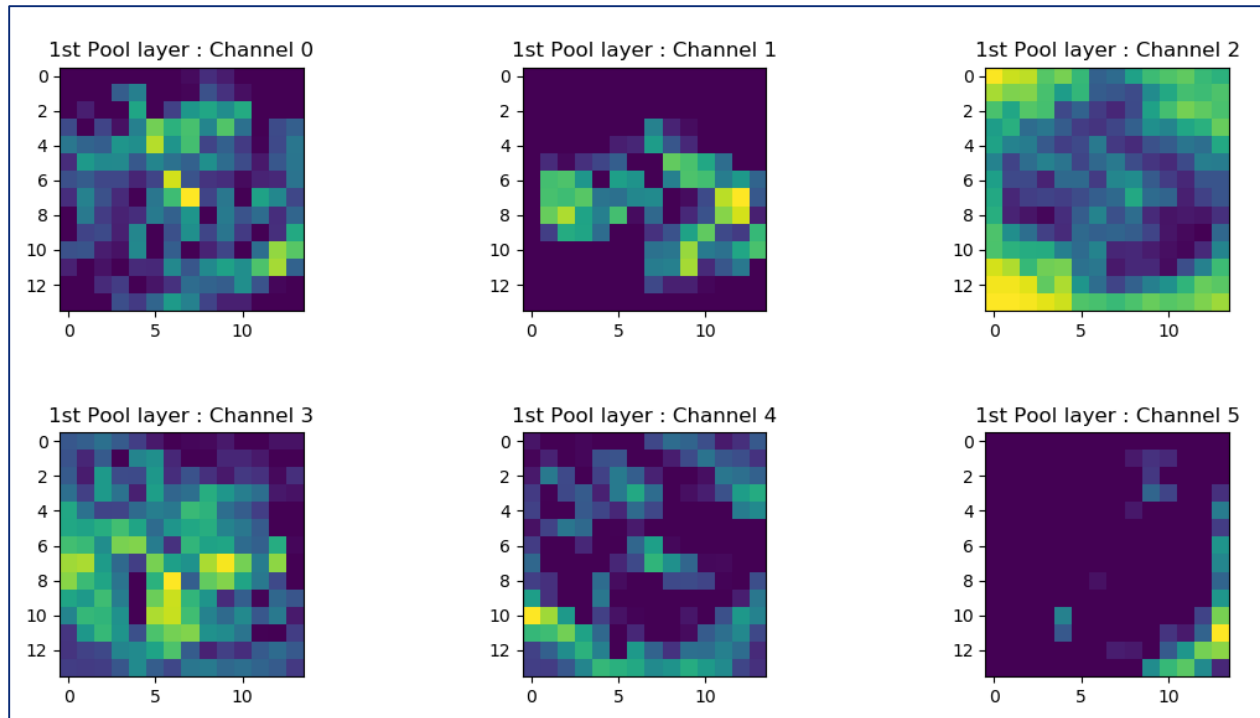
1. Input Image and Image obtained after performing Zero Padding



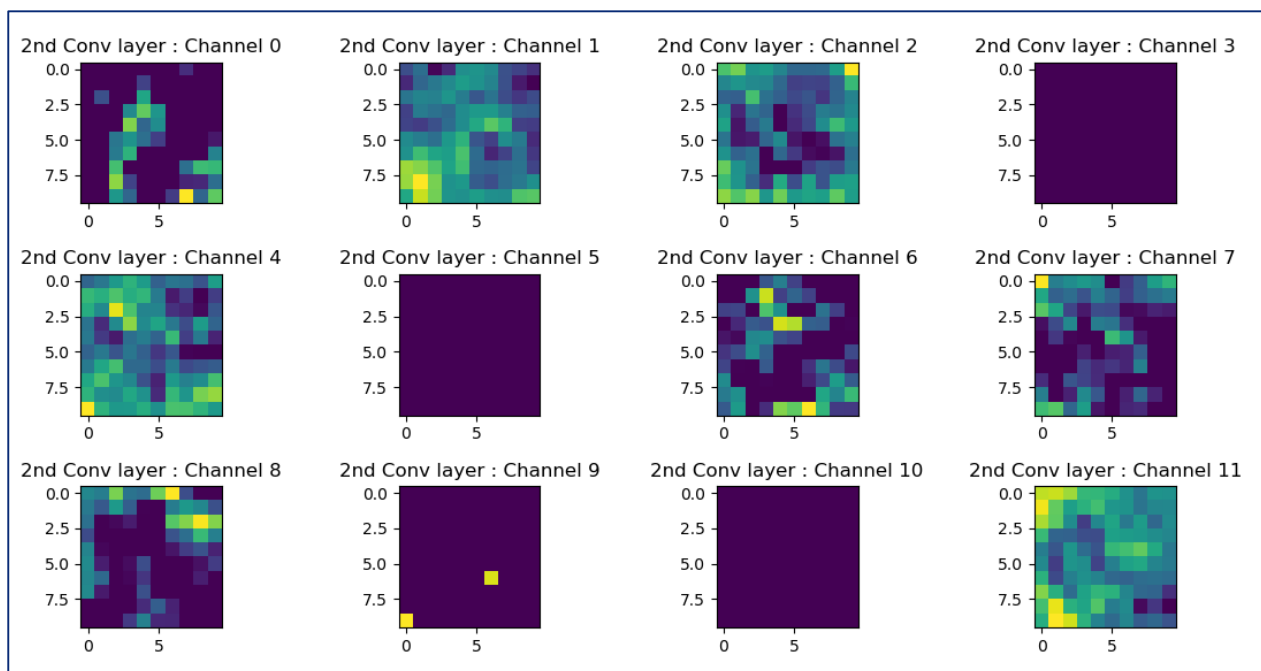
2. Output image obtained for all 6 channels after first convolution layer.



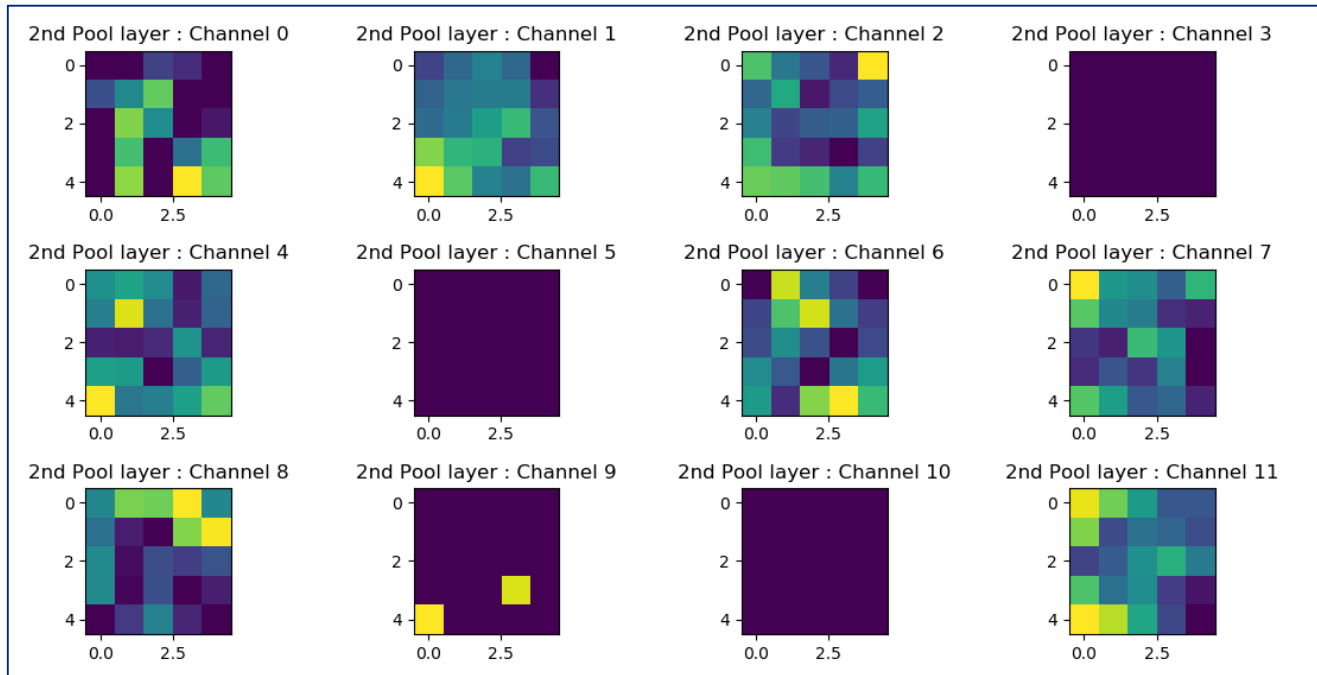
3. Output image obtained for all 6 channels after first pooling layer.



4. Output image for all 12 channels obtained after second convolution layer.



5. Output image obtained for all 12 channels after second pooling layer.



Answer 2:

1. What are the number of parameters in 1st convolutional layers?

A: First convolution layer has 6 filters of size 5X5X3 each and a bias vector.

Hence the total number of parameters is equal to

$$\# \text{Parameters} = (6 \times 5 \times 5 \times 3) + 6 = 456$$

2. What are the number of parameters in pooling operation?

A: There are no parameters that could be learnt in pooling layer. Since the pooling type (max/avg/min) is fixed, there is no need to change the parameters in the pooling kernel.

3. Which of the following operations contain most number of parameters?

A:

$$\# \text{Parameters in Conv 1} = (6 \times 5 \times 5 \times 3) + 6 = 456$$

$$\# \text{Parameters in Conv 2} = (16 \times 5 \times 5 \times 6) + 16 = 2416$$

$$\# \text{Parameters in FC1} = (400 \times 120) + 120 = 48120$$

$$\# \text{Parameters in FC2} = (120 \times 84) + 84 = 10164$$

Hence it is evident from the calculation done till now that **fully connected layer will have the most number of parameters.**

4. Which operation consume most amount of memory?

A: Most memory is in early convolution and most parameters are in late FC.

5. Try different activation functions and describe observations.

A: It is not directly intuitive to observe effect of activation functions in described case since back propagation is not being performed and the forward pass is also being performed only for single image. Effect of activation function will be better understood, given the weights are being updated after calculating losses.