

Final Exam 2018

- 9- Convolutional layer in convolution neural network used for while the fully connected layer used for

Solution:

Convolutional layer used for:

- Extracting features from the input data by applying convolution operations.
- Detecting patterns such as edges and more complex features through multiple layers.
- Reducing the dimensionality of the data while preserving the spatial relationships.

While the fully connected layer used for:

- Interpreting the extracted features to make final predictions.
- Connecting every neuron from the previous layer to each neuron in the next layer.

- 6) What is the importance of using Relue layer and Pooling layer in connvolutional neural network?

Solution:

The ReLU layer is important in CNN for introducing non-linearity, allowing the model to learn complex patterns and relationships within the data. It helps in avoiding the vanishing gradient problem and accelerating convergence during training.

The Pooling layer is crucial for reducing the spatial dimensions of the feature maps, effectively Sub-Sampling the data. This helps in controlling overfitting, decreasing computational complexity, and extracting dominant features while preserving their spatial hierarchy.

Note: next question was the only question about CNN model in final exam 2019

Question 3 [6 marks]

In a convolutional neural network, consider RGB image with dimension 125×125 , suppose you use 10 filter with dimension 5×5 with stride 3 are used in convolution layer.

a) *what is the number of estimated parameters in this layer and the resulting feature map of these filters over the image?*

b) Suppose you use pad with three pixels border in this case what is the output of the convolutional layer?

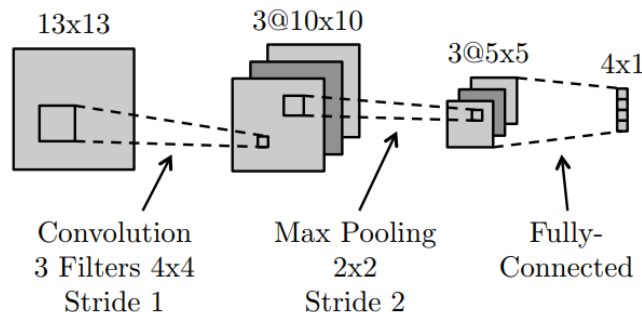
Solution:

a) $\text{filter_width} * \text{filter_height} * \text{number_of_input_channels} * \text{number_of_filters} = 5 * 5 * 3 * 10 = 750$

b) $(\text{input_width} + 2 * \text{padding} - \text{filter_width}) / \text{stride} + 1 = (125 + 2 * 3 - 5) / 3 + 1 = 43$

Final Exam 2020

Below is a diagram of a small convolutional neural network that converts a 13×13 image into 4 output values. The network has the following layers/operations from input to output: convolution with 3 filters, max pooling, ReLu, and finally a fully-connected layer. For this network we will not be using any bias/offset parameters (b). Please answer the following questions about this network.



(a) *How many weights in the convolutional layer do we need to learn?*

Sol: 48 weights. Three filters with $4 \times 4 = 16$ weights each.

(b) *How many ReLu operations are performed on the forward pass?*

Sol: 75 ReLu operations. ReLu is performed after the pooling step.

ReLu is performed on each pixel of the three 5×5 feature images.

(c) *How many weights do we need to learn for the entire network?*

Sol: 348 weights.

48 for the convolutional layer. Fully connected has $3 \times 5 \times 5 = 75$ pixels each connected to four outputs, which is 300 weights. Pooling layer does not have any weights.

(d) What are the convolutional and fully connected layers in convolution neural network used for?

Sol:

- Convolutional layers are used for feature extraction. They apply filters to the input data, enabling the network to detect patterns and features hierarchically. These layers are responsible for capturing spatial relationships in the input data.

- Fully connected layers are employed for classification or regression tasks. They take the features extracted by the convolutional layers and use them to make final predictions. Each neuron in a fully connected layer is connected to every neuron in the previous layer, allowing the network to learn complex relationships between features and produce the desired output.

(e) What is the disadvantage of a fully connected neural network compared to a convolutional neural network with the same size layers?

Sol:

There are too many weights to effectively learn.

3) What is the importance of using ReLu layer in convolutional neural network?

It is preferred to apply ReLu function before or after the pooling layer (justify your answer).

Sol:

introduces non-linearity to the network, allowing it to learn and approximate complex functions. This is crucial for capturing intricate patterns and relationships.

it's generally preferred to apply ReLU activation after the pooling layer:

- Pooling layers are primarily used for down-sampling, reducing the spatial dimensions of the feature maps while retaining the most important information. Applying ReLU after pooling allows the network to retain this important information while introducing non-linearity.

- Pooling layers are typically used to extract dominant features from the feature maps. Applying ReLU after pooling allows the network to capture these features more effectively by introducing non-linearity to the extracted features.

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If you find any mistake, please contact me

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