3. CNN - Continued
Convolution Neural Networks (Continued)

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CNN - Numerical Example

1/1 point (graded)
In this problem, we are going to work out the outputs of a tiny toy example of CNN that is made up of just one conv layer consisting of just one filter F of shape 2×2 followed by a max-pooling layer of shape 2×2. The input image is of shape 3×3

The output of the CNN is calculated as $\mathrm{Pool}\left(\mathrm{ReLU}\left(\mathrm{Conv}\left(I\right)\right)\right)$ where ReLU is the rectified linear activation function given by:

$$\mathrm{ReLU}\left(x\right) = \max\left(0, x\right)$$

Also assume that the stride for the convolution and pool layers is 1

For the following values of the image I and filter weights F enter below the value of the output of the CNN (hint - it will be a single integer):

$$I = \begin{bmatrix} 1 & 0 & 2 \\ 3 & 1 & 0 \\ 0 & 0 & 4 \end{bmatrix}$$

$$F = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$$

5

✔ **Answer:** 5

Solution:

First let's calculate the output of the convolutional layer

$$I = \begin{bmatrix} 1 & 0 & 2 \\ 3 & 1 & 0 \\ 0 & 0 & 4 \end{bmatrix}$$

$$F = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$$

$$\text{Conv}\,(I) = \begin{bmatrix} 1 & 0 & 2 \\ 3 & 1 & 0 \\ 0 & 0 & 4 \end{bmatrix} . \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$$

$$\text{Conv}\,(I) = \begin{bmatrix} 2 & 0 \\ 3 & 5 \end{bmatrix}$$

$$\text{ReLU}\left(\text{Conv}\left(I\right)\right) = \text{ReLU}\left(\begin{bmatrix} 2 & 0 \\ 3 & 5 \end{bmatrix}\right)$$

$$\text{ReLU}\left(\text{Conv}\left(I\right)\right) = \begin{bmatrix} 2 & 0 \\ 3 & 5 \end{bmatrix}$$

$$\text{Pool}\left(\text{ReLU}\left(\text{Conv}\left(I\right)\right)\right) = \text{Pool}\left(\begin{bmatrix} 2 & 0 \\ 3 & 5 \end{bmatrix}\right)$$

$$\text{Pool}\left(\text{ReLU}\left(\text{Conv}\left(I\right)\right)\right) = 5$$

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Answers are displayed within the problem

CNN Meaning

1/1 point (graded)

If you are trying to recognize a large number of features, you should have a small number of filters.

- true
- false ✔

Solution:

Each filter represents a distinct set of weights, which corresponds to searching for a particular feature in the image. If you have a large number of features, you want many filters.

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