3. CNN - Continued

Exercises due Nov 5, 2020 05:29 IST *Completed*

Convolution Neural Networks (Continued)

Start of transcript. Skip to the end.

All right.

So let's look at how to then actually construct

a convolutional neural network.

I will take input image here.

And now, since each convolution corresponds

to some weight matrix here associated

0:00 / 0:00 1.25x

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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 $\text{Pool}\left(\text{ReLU}\left(\text{Conv}\left(I\right)\right)\right)$ where ReLU is the rectified linear activation function given by:

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

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

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

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

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

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

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

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

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

$$\mathrm{Pool}\,(\mathrm{ReLU}\,(\mathrm{Conv}\,(I))) = 5$$

Submit You have used 1 of 3 attempts

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.

Submit You have used 2 of 2 attempts

Answers are displayed within the problem

Recitation: Convolution/Cross Correlation: Definition

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0:00 / 0:00 1.25x

SPEAKER: Welcome to the recitation

of convolutional neural network.

In this video, we will talk about

the mathematical operation that is

used in the convolutional layer of CNN, which namely

is convolution, or its equivalence, called

cross correlation.

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Discrete 1D example

Start of transcript. Skip to the end.

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INSTRUCTOR: So what we just talked about

is a continuous version of the convolution

and cross-correlation.

But as you know, most of our signals in the digital world

are actually discrete functions, for example an image or video.

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Discrete 2D example

Start of transcript. Skip to the end.

0:00 / 0:00 1.25x

PROFESSOR WANGZHI: Now let's take a look

at the two-dimensional case of cross-correlation.

One example of the two-dimensional signal

would be an image which is just a 2D

matrix of discrete numbers.

So in the 2D version of cross-

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Topic: Unit 3 Neural networks (2.5 weeks):Lecture 12. Convolutional Neural Networks / 3. CNN - Continued

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? ATTN@STAFF => EFFECT OF OBJECT SIZE ON CONVOLUTION!!
If my training images contain an object at a given size. So my convolution filters will learn the features of this object at a specific pixel siz... 2

Discrete 2D example
In the last video the matrix should be [[2, 0][0,2]] instead of [[2, 0][0,1]], right? 9

Recitations are awesome
I really appreciate these complementary videos summerizing topics or giving practical examples that help us understand concepts bette... 9

? Why is the order of values important to conceptually define that something is a filter or an inverse filter?
With CNNs we learn inverse filters, but what does this mean? Isn't just another filter? I mean, why is the order of values important to co... 2

How to formally represent matrix operation in discrete 2D case?
The operation of iteratively multiplying a smaller filter matrix over sub-parts of the input image, as described in the 2-D Convolution Dis... 1

Deep Learning MIT free course
For those who want to delve in the deep learning field, I have found this great course from the MIT which is totally focus in deep learnin... 3

? Conv(I)
Is Conv(I) the convolution of I and F or their cross-correlation ? 8

Kernels, Pooling, Filters, etc. Useful video.
Hi! I found this video from another EDX course useful for clarifying some of the concepts covered here: https://www.youtube.com/result... 2

lost Pool
Hi, I dont understand very well de pool function in term of mathematics. I have done the convolution and the ReLU, but i dont know ho... 3

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