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Machine Learning with Python-From Linear Models to Deep Learning

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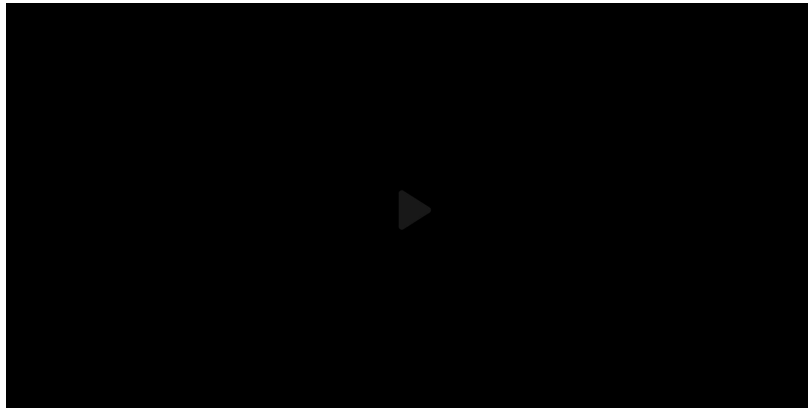


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3. CNN - Continued

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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

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

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

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):

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

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

✓ Answer: 5

Solution:

First let's calculate the output of the convolutional layer

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

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

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

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

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

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

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

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

Submit

You have used 1 of 3 attempts

i 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

i Answers are displayed within the problem

Recitation: Convolution/Cross Correlation: Definition

[Start of transcript. Skip to the end.](#)



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.

Video

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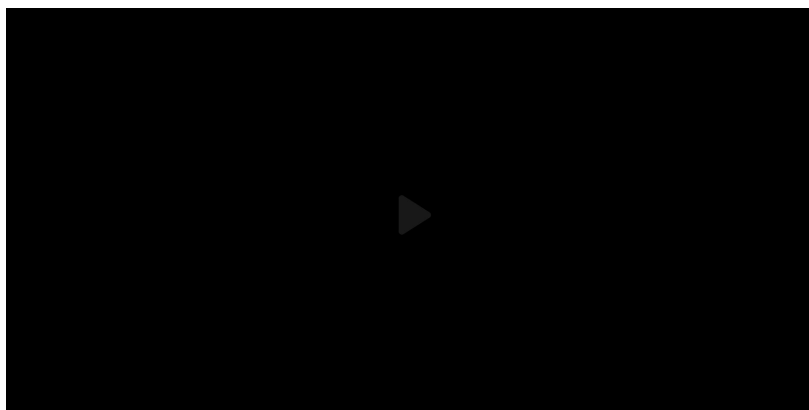
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Discrete 1D example

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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



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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CNN - Continued

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- ? [ATTN@STAFF => EFFECT OF OBJECT SIZE ON CONVOLUTION!!](#) 2

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...
- 💬 [Discrete 2D example](#) 9

In the last video the matrix should be $\begin{bmatrix} 2 & 0 \\ 0 & 2 \end{bmatrix}$ instead of $\begin{bmatrix} 2 & 0 \\ 0 & 1 \end{bmatrix}$, right?
- 💬 [Recitations are awesome](#) 9

I really appreciate these complementary videos summerizing topics or giving practical examples that help us understand concepts bette...
- ? [Why is the order of values important to conceptually define that something is a filter or an inverse filter?](#) 2

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...
- 💬 [How to formally represent matrix operation in discrete 2D case?](#) 1

The operation of iteratively multiplying a smaller filter matrix over sub-parts of the input image, as described in the 2-D Convolution Dis...
- 💬 [Deep Learning MIT free course](#) 3

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...
- ? [Conv\(I\)](#) 8

Is Conv(I) the convolution of I and F or their cross-correlation?
- 💬 [Kernels, Pooling, Filters, etc. Useful video.](#) 2

Hi! I found this video from another EDX course useful for clarifying some of the concepts covered here: <https://www.youtube.com/result...>
- ✓ [lost Pool](#) 3

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...

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