18AIC301J: DEEP LEARNING TECHNIQUES

B. Tech in ARTIFICIAL INTELLIGENCE, 5th semester

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Section: A, slot:D

Venue: TP 804

Academic Year: 2022-22

UNIT-3

One hot representation of words, Distributed representation of words
SVD for learning word Representations, Continuous bag of words model, Skip-gram model, Hierarchical Softmax
Implement skip gram model to predict words within a certain range before and after the current word
Introduction to Convolution Neural Networks, Kernel filters
The convolution operation with Filters, padding and stride, Multiple Filters, Max pooling and non-linearities
Implement LeNet for image classification
Classic CNNs architecture- The ImageNet challenge, Understanding Alex Net architecture
ZFNet, The intuition behind GoogleNet, Average pooling, Residual CNN-ResNet architecture
Implement ResNet for detecting Objects.

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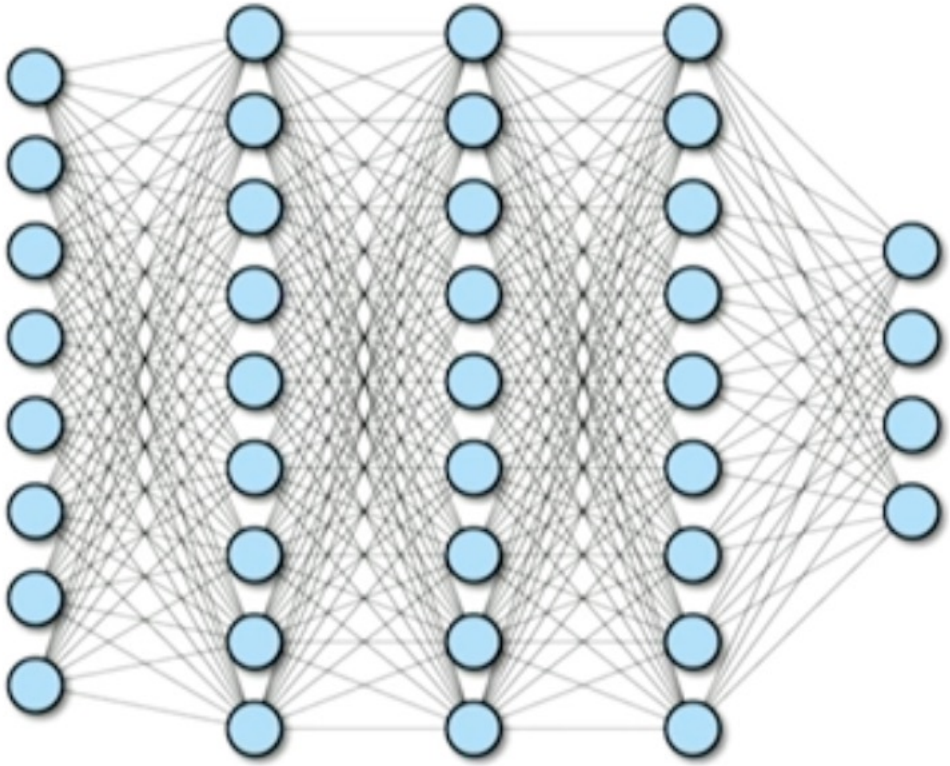
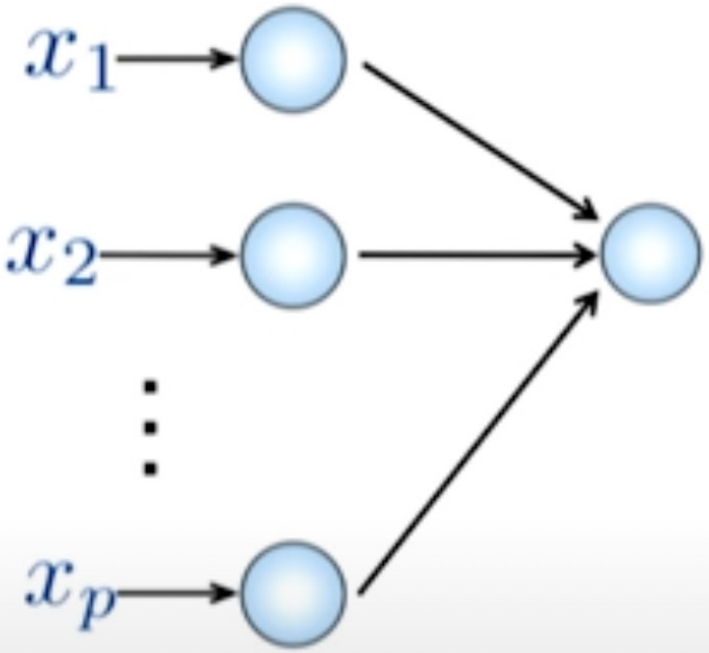
Fully Connected Neural Network



Fully connected Neural Networks

Input:

- 2D image
- Vector of pixel values



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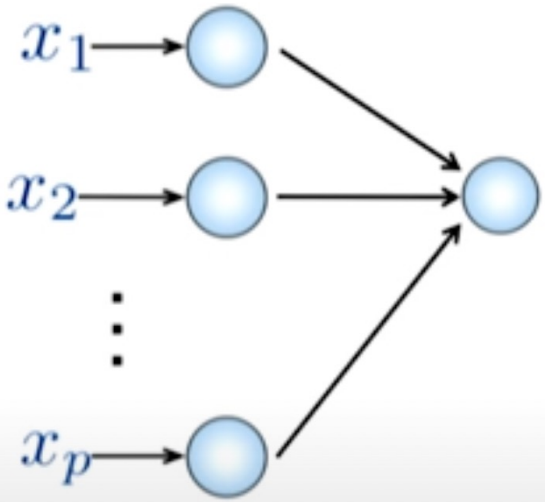
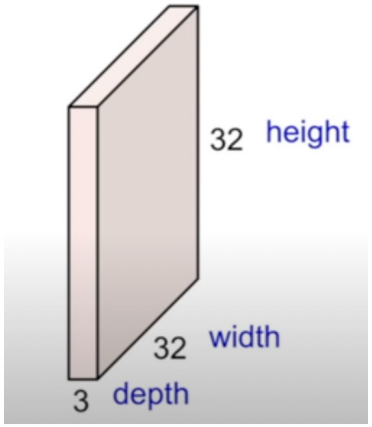


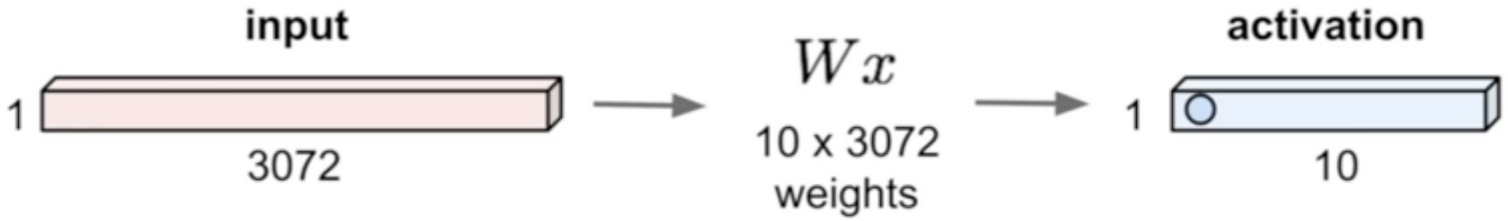
Fully Connected:

- Connect neuron in hidden layer to all neurons in input layer
- No spatial information!
- And many, many parameters!

Fully connected Neural Networks



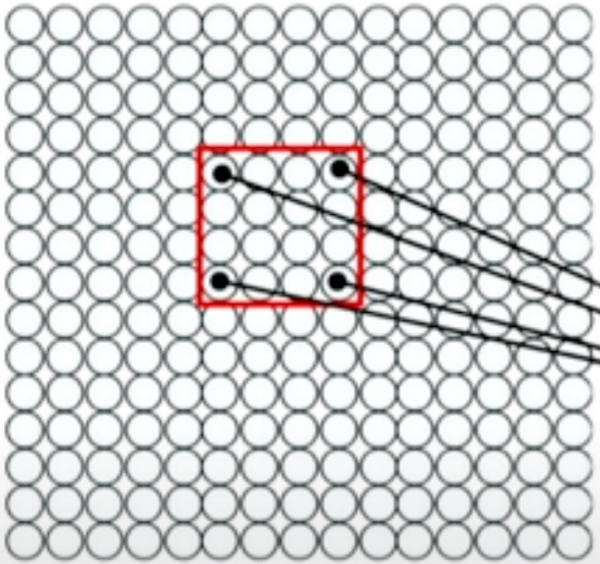
32x32x3 image -> stretch to 3072 x 1



How can we use spatial structure in the input to inform the architecture of the network?

Using Spatial Structure

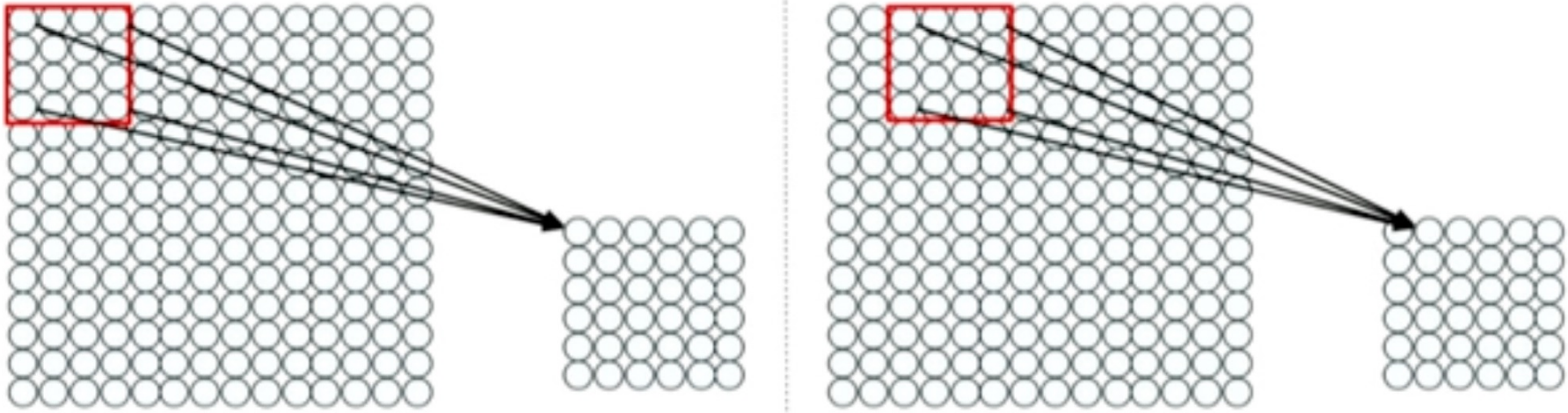
Input: 2D image.
Array of pixel values



Idea: connect patches of input to neurons in hidden layer.

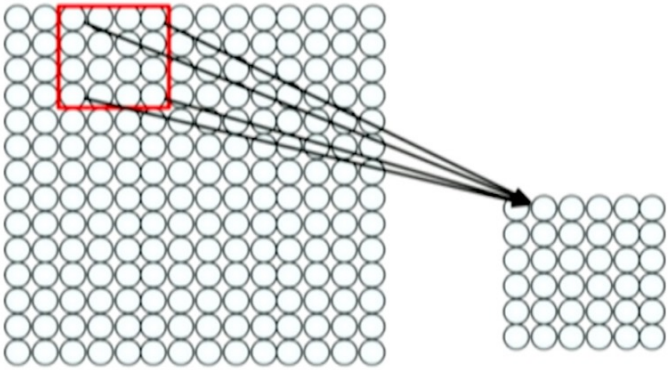
Neuron connected to region of input. Only "sees" these values.

Using Spatial Structure



Connect patch in input layer to a single neuron in subsequent layer.
Use a sliding window to define connections.
How can we **weight** *the patch to detect particular features?*

Feature Extraction with Convolution



- Filter of size 4x4 : 16 different weights
- Apply this same filter to 4x4 patches in input
- Shift by 2 pixels for next patch

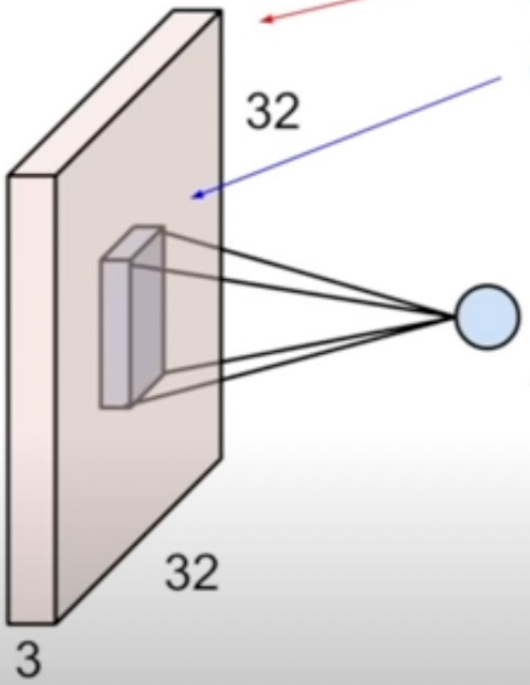
This "patchy" operation is **convolution**

1) Apply a set of weights – a filter – to extract **local features**

2) Use **multiple filters** to extract different features

3) **Spatially share** parameters of each filter

CONVOLUTION LAYER



32x32x3 image

5x5x3 filter w

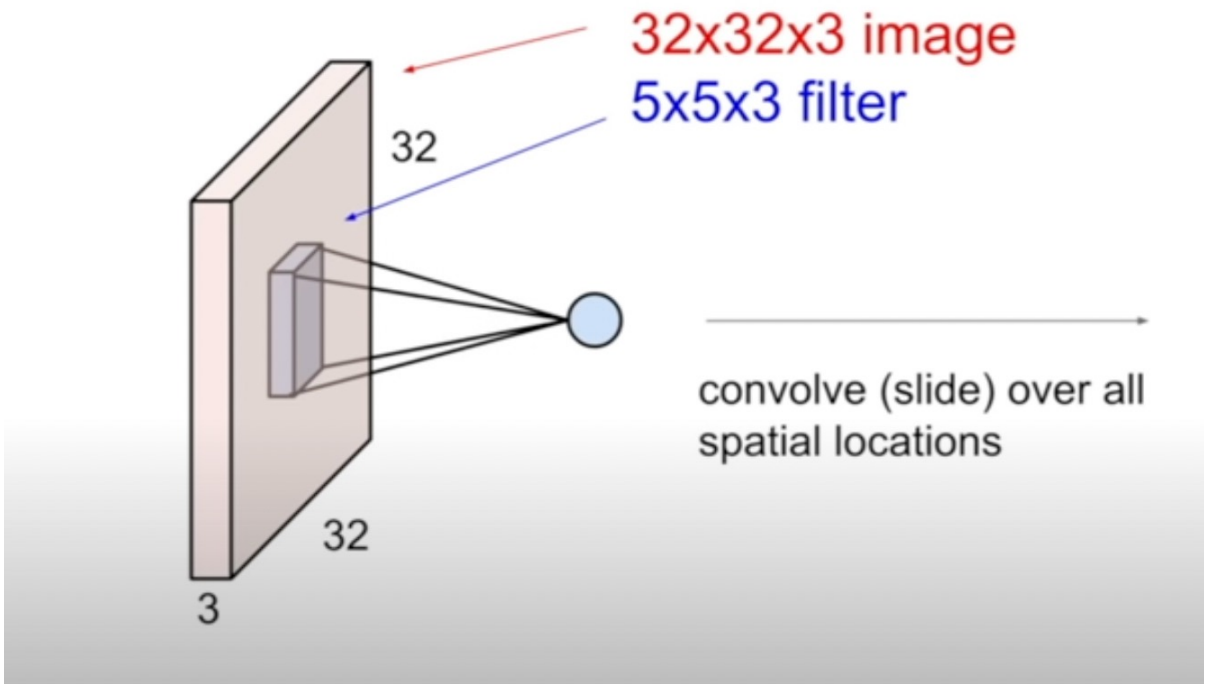
1 number:

the result of taking a dot product between the filter and a small 5x5x3 chunk of the image (i.e. 5*5*3 = 75-dimensional dot product + bias)

$$w^T x + b$$

Stanford cs231n: https://www.youtube.com/watch?v=bNb2fEVKeEo&t=2949s

Convolution Layer



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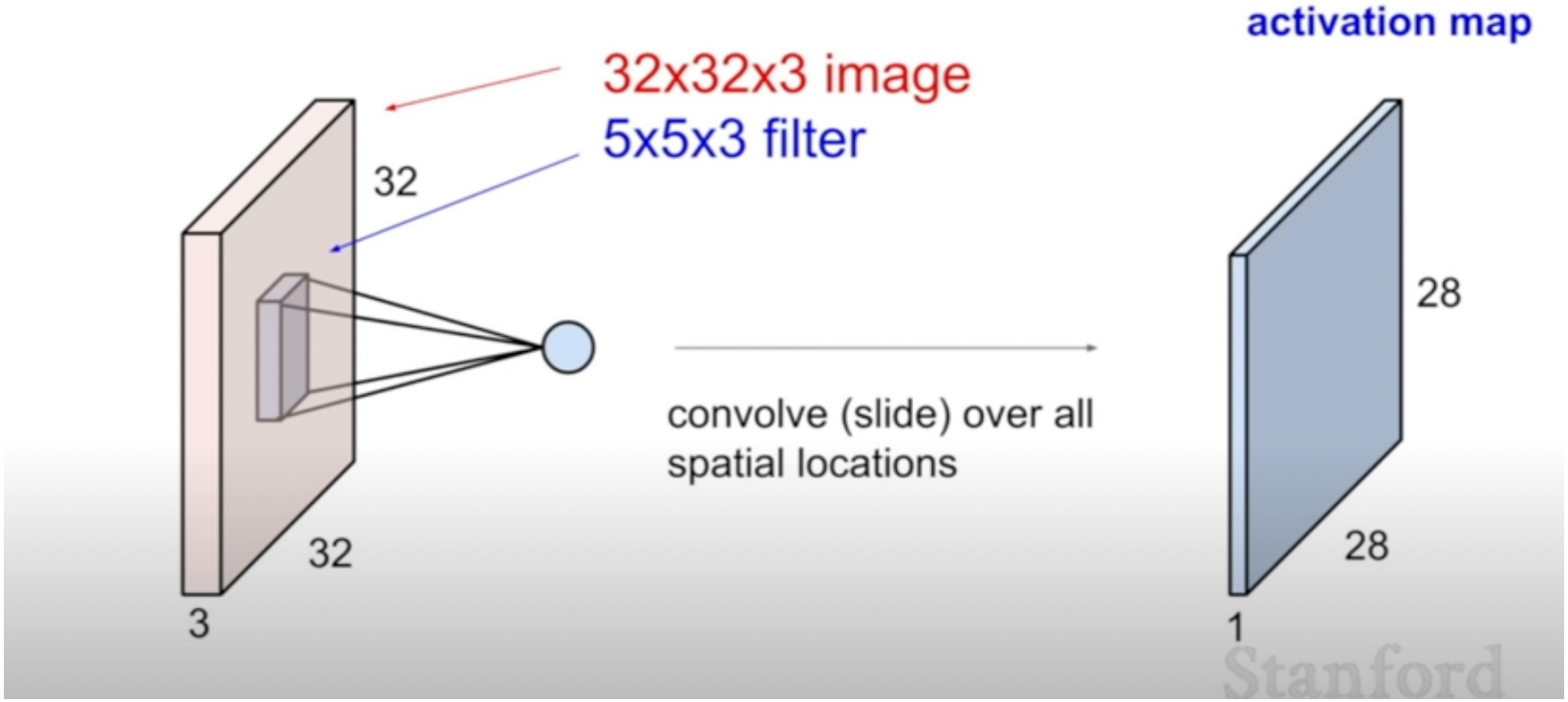
Convolution Layer



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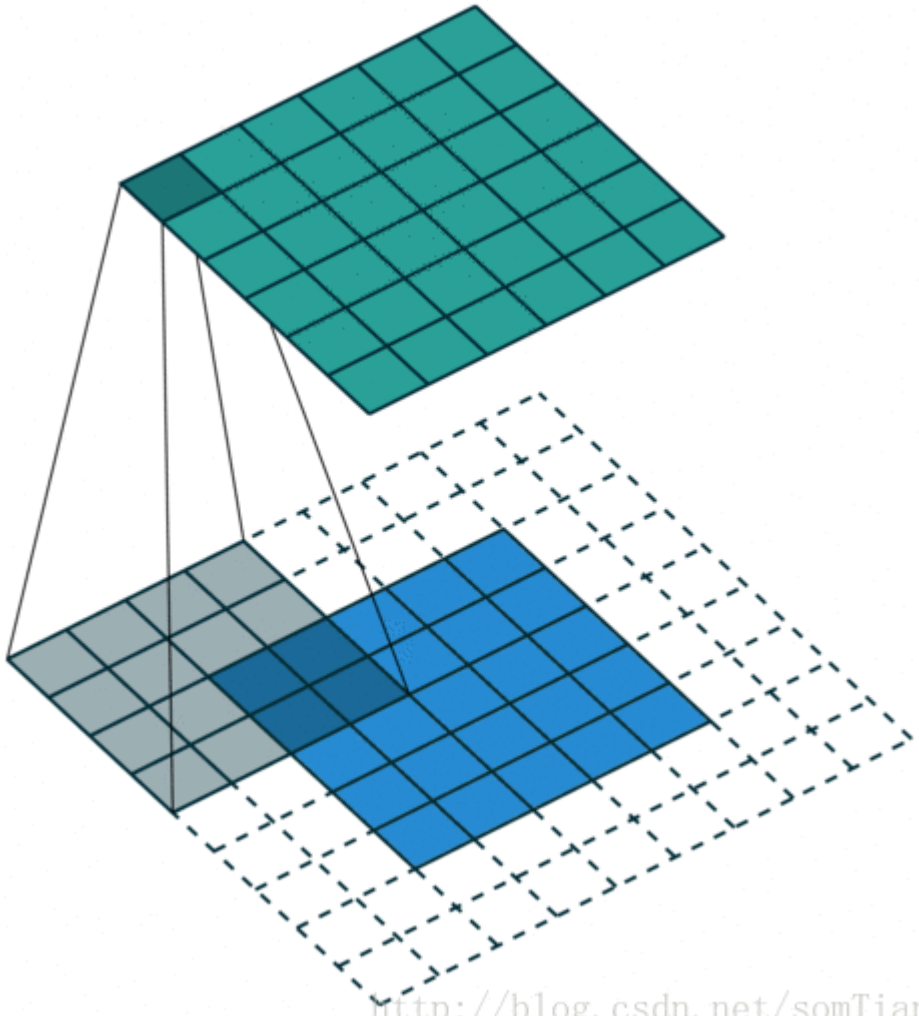
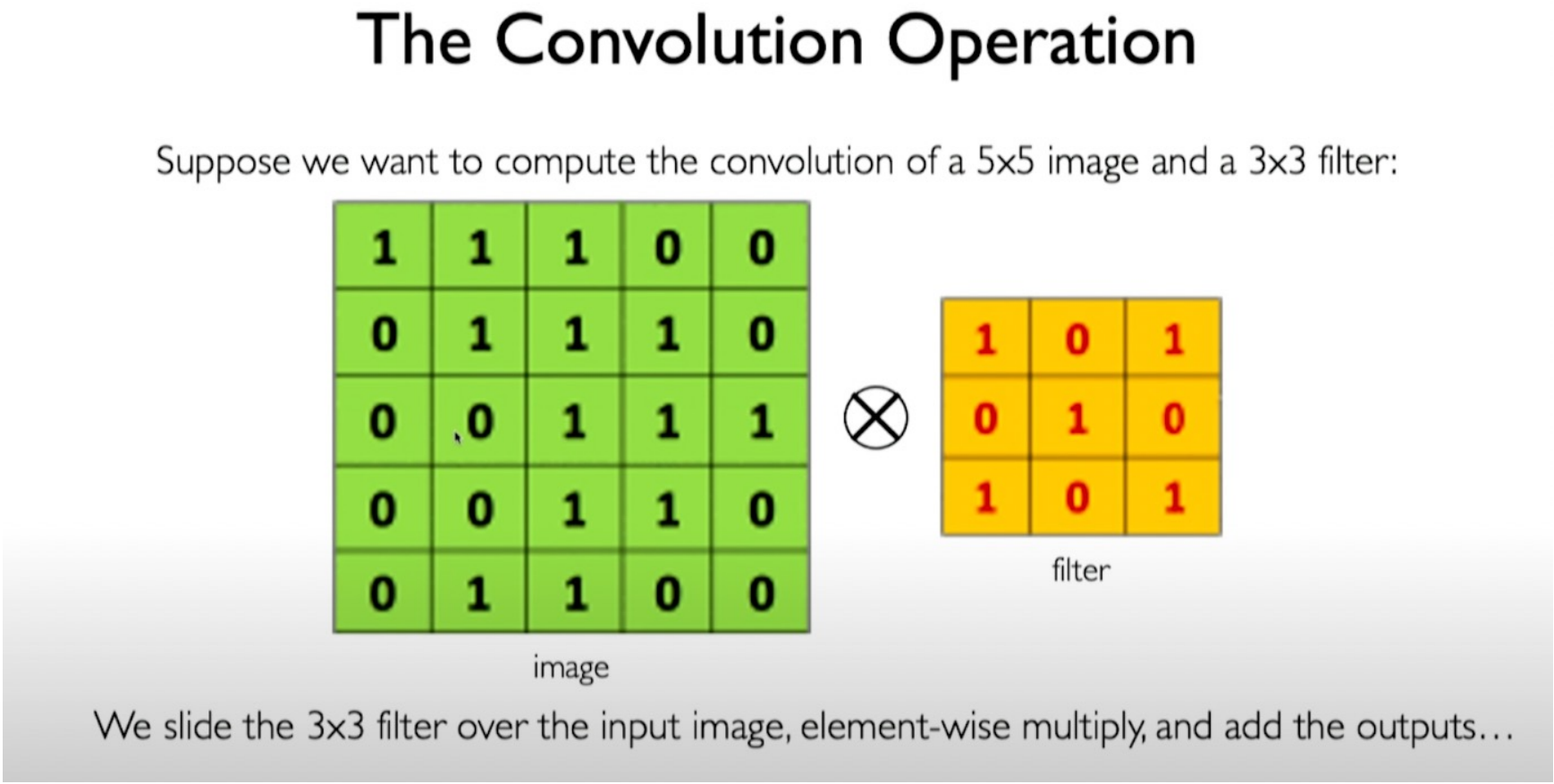
Convolutional Kernel filters



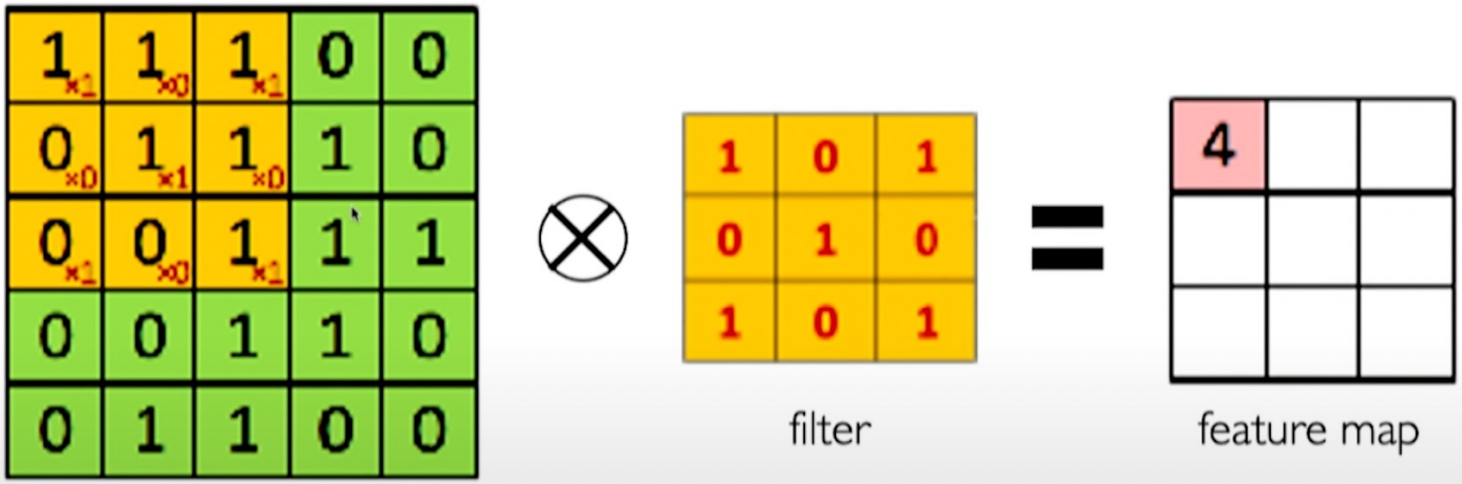
CONVOLUTION LAYER



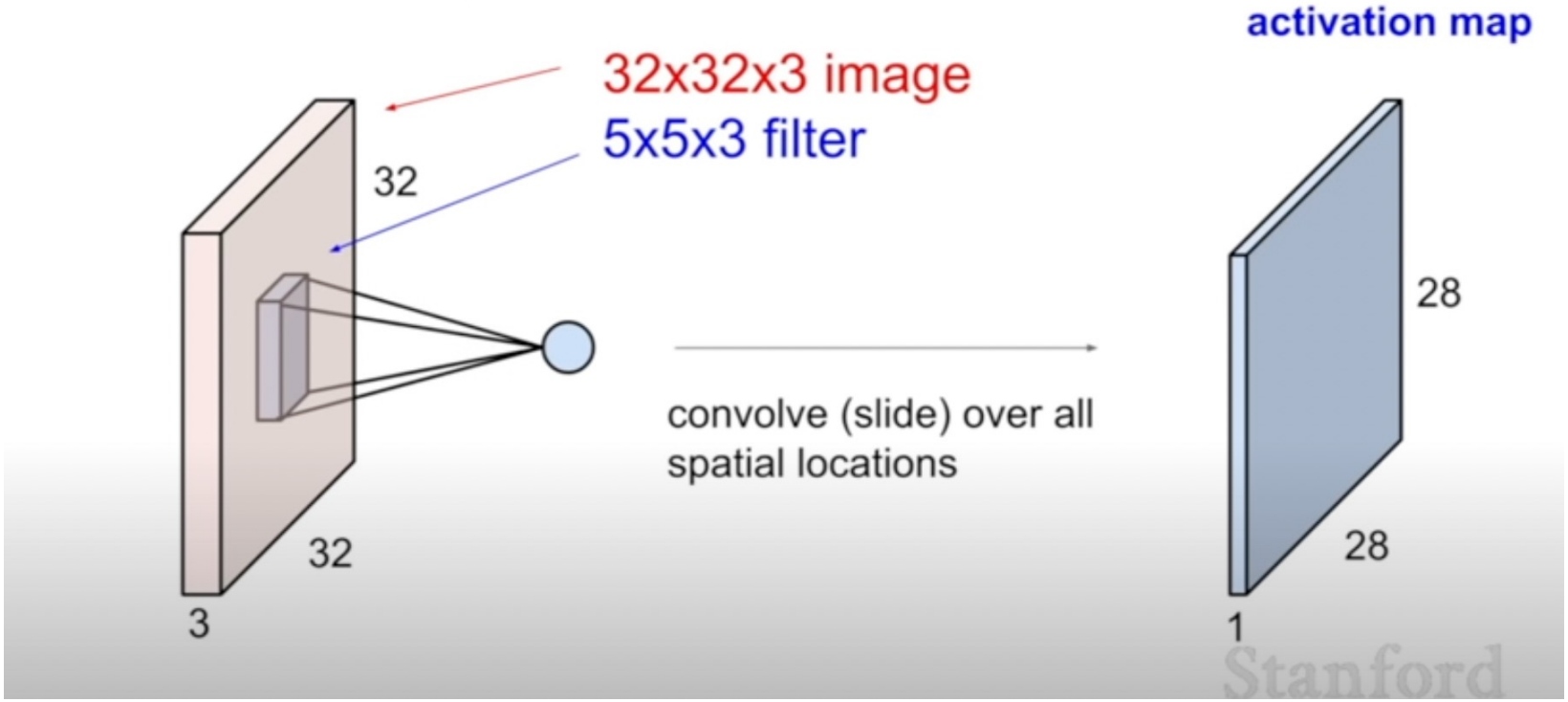
CONVOLUTION LAYER

The Convolution Operation

We slide the 3x3 filter over the input image, element-wise multiply, and add the outputs:



Convolution Layer



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Learning Resources

- Charu C. Aggarwal, Neural Networks and Deep Learning, Springer, 2018.
- Eugene Charniak, Introduction to Deep Learning, MIT Press, 2018.
- Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, MIT Press, 2016.
- Michael Nielsen, Neural Networks and Deep Learning, Determination Press, 2015.
- Deng & Yu, Deep Learning: Methods and Applications, Now Publishers, 2013.
- https://www.youtube.com/watch?v=uapdILWYTzE&t=2172s
- https://www.youtube.com/watch?v=bNb2fEVKeEo&t=2949s

Thank you