A brief description of CNN principles

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A few words about Convolutional Neural Networks

Motivation :

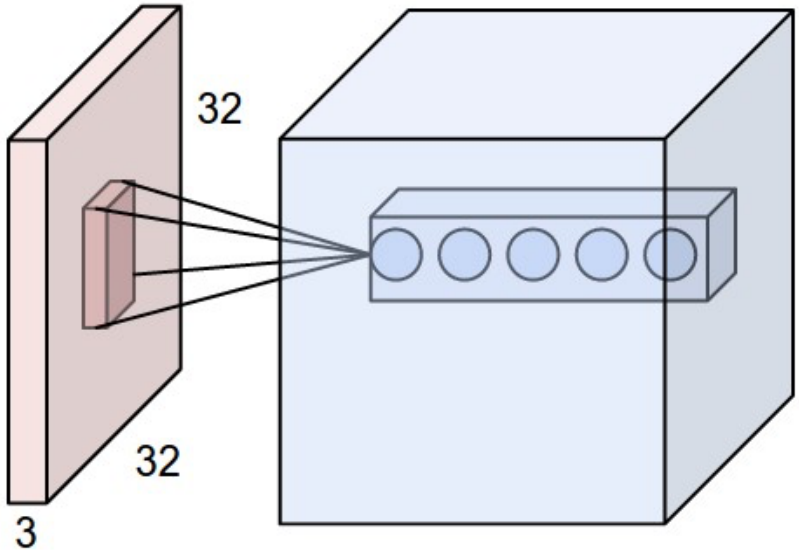
MLP can require a lot of parameters :

256x256 image x3 channels and 1000 nodes in first hidden layer

MORE than 200 MILLION parameters !

The MLP hidden layer ignore all the spatial structure !

Convolutional layers associate each of their nodes with a weighted window («receptive field », « filter kernel »)



www Sources for figures & examples

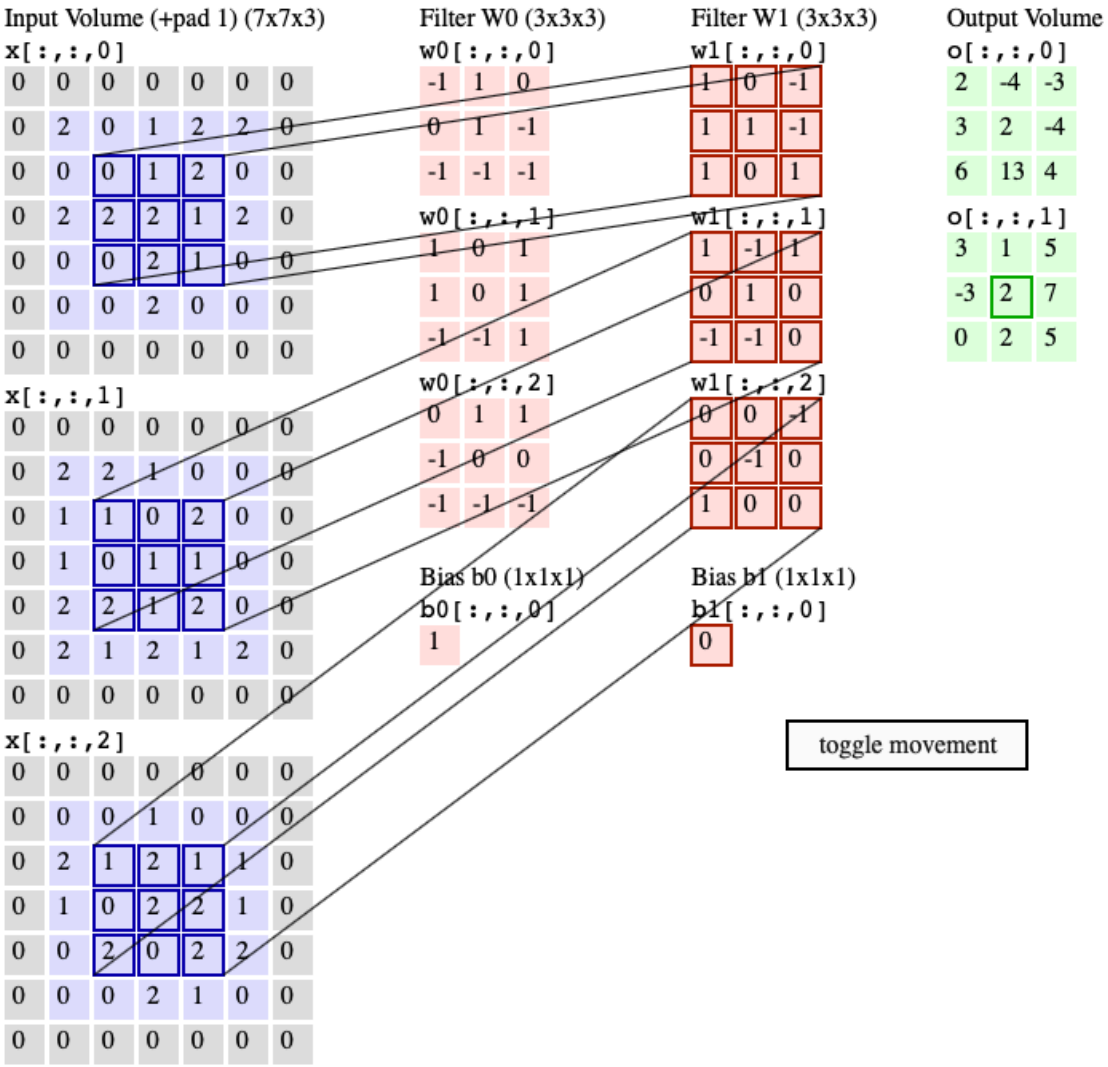
https://scikit-learn.org/stable/

https://gluon.mxnet.io/index.html

https://skymind.ai/wiki/

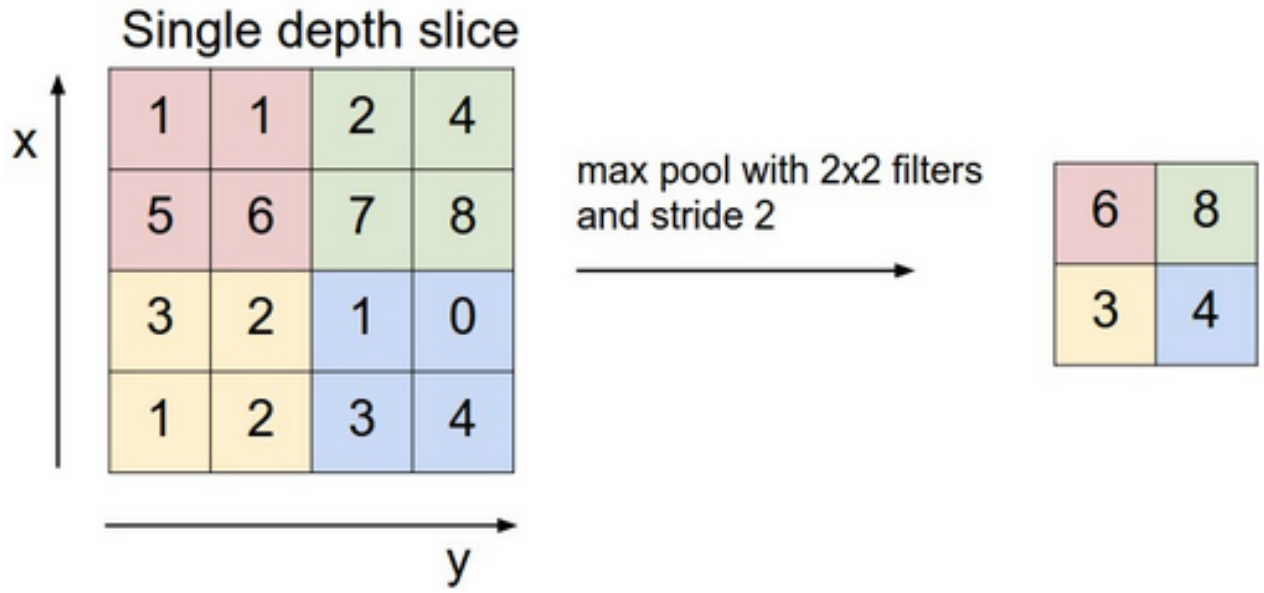
CNN CONVOLUTIVE LAYER example

RGB channels Filter 1 Filter 2 Output stack



Pooling / Downsampling with CNNs

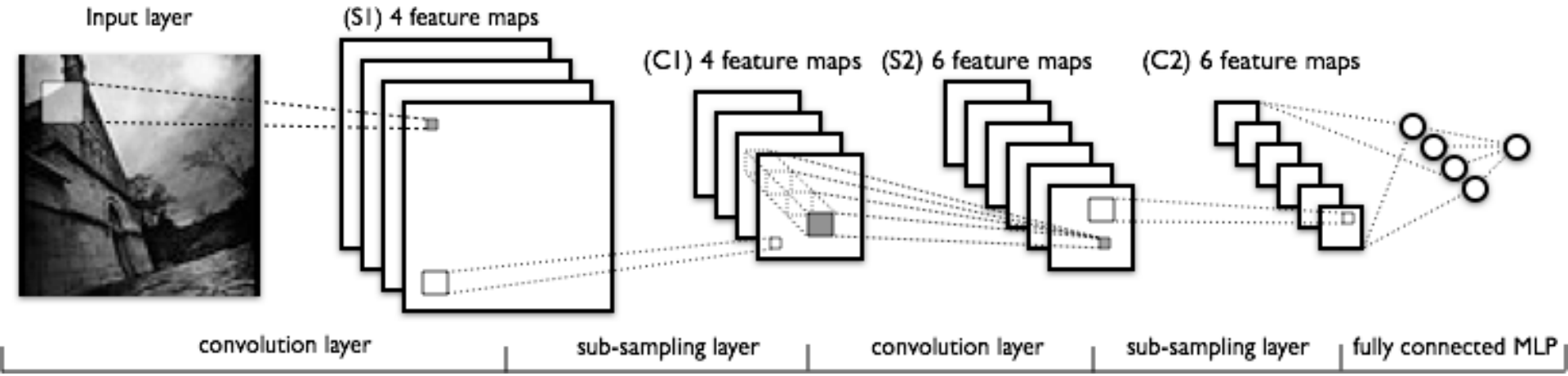
Example Max pooling :



→ Only the locations on the image that showed the strongest correlation to each feature (the maximum value) are preserved, and those maximum values combine to form a lower-dimensional space.

→ Decreases the amount of storage and processing requirements but at the price of loss of information about lesser values

Example of alternating sequences of transformations involved in CNNs



How/why does it work?

Deep CNN compute pregressively more powerful invariants as depth increases (but relations with weights and non linearities are complex).

Computation of invariants involves

- Multiscale contractions
- Linearization of hierarchical symmetries
- spare separation