SVKM'S NMIMS Deemed to be UNIVERSITY

Data Augmentation, and Auto-Encoders

B.Tech. Data Science, Second Year, NMIMS

By,

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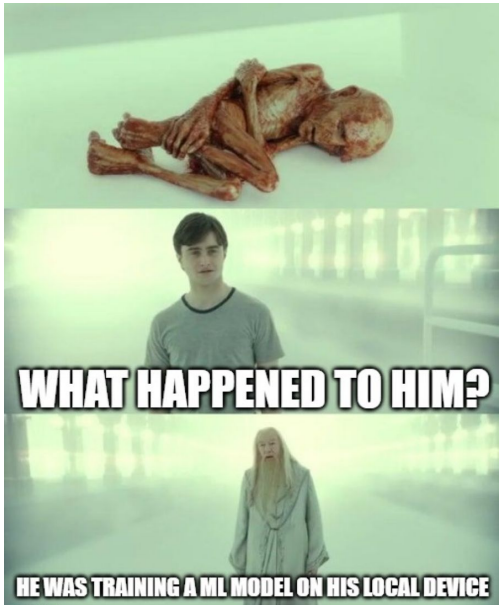
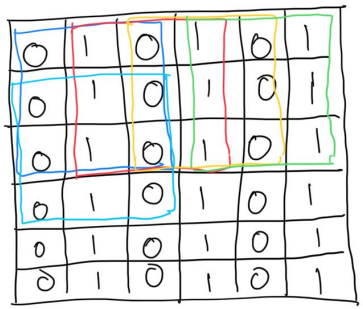
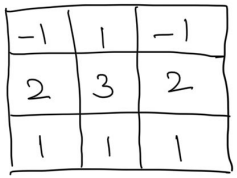


Convolution & operation



6×6 image

Filter (weights)



3×3 Filter

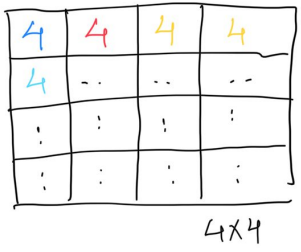
$n - f + 1$

$= 6 - 3 + 1$

$= 4$

Output Size

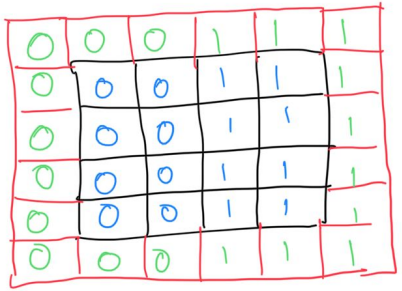
Output without padding



4×4

Stride = 1 (step size)

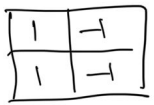
With Padding

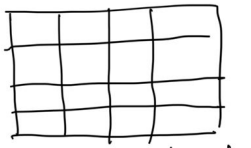


4×4 → 6×6 padding

Padding

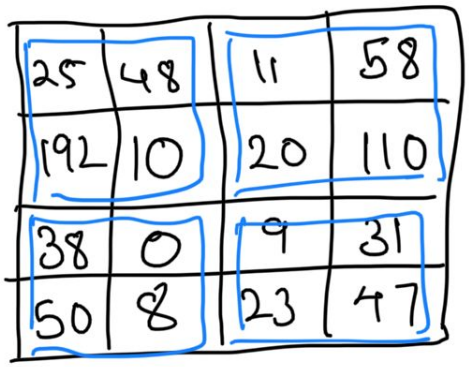
filter





4×4

Pooling



Stride = 2
(Recommended for Pooling)

25	48
192	10

11	58
20	110

Pooling ⇒

38	0
50	8

9	31
23	47

Max Pooling

192	110
50	47

69	50
22	28

Average Pooling

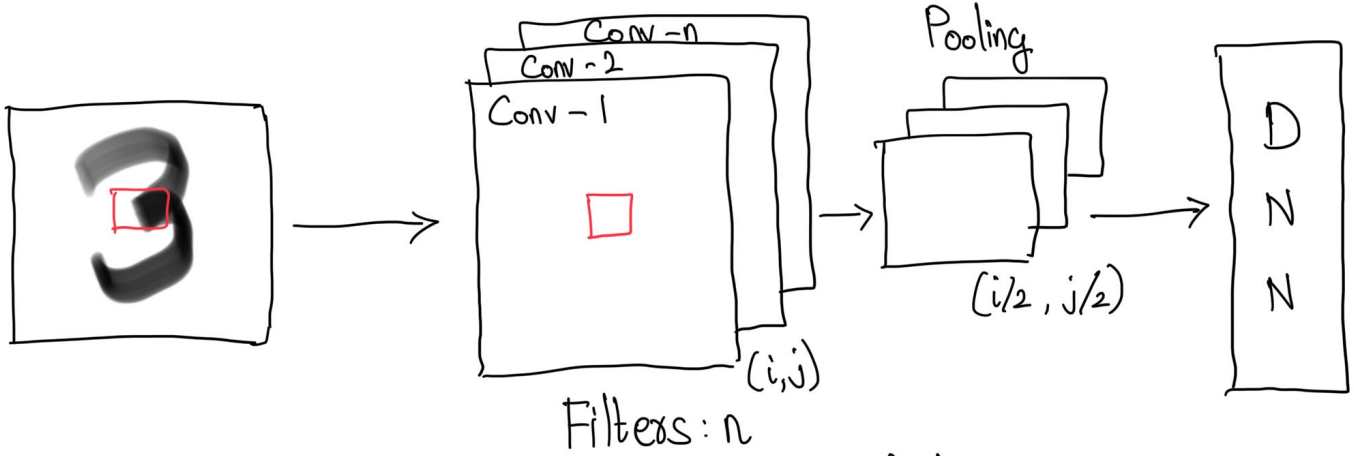
Backpropagation in CNN

Convolution Neural Network (CNN) for Classification

tf.keras.layers.Conv2D

tf.keras.activations.*

tf.keras.layers.MaxPool2D



1) Convolution: Filters to generate feature maps

2) Non-linearity: often relu

3) Backpropagation

4) Pooling: Downsampling feature maps

Image Augmentation

→ Simple and powerful tool to help you avoid overfitting

→ If data and its scope is limited then chance of potential future prediction is also limited

→ Example: You have a dataset of cats but in testing set you have a cat lying down. Thus making difficult for model to recognize

Solution: Rotating the images

Tensorflow Image Data Generator

→ rotation_range [0 - 180°]

→ width_shift_range
  height_shift_range
} Shifting [0 - 1] portion of shifting

→ shear_range [0 - 1]

→ Zoom_range [0 — 1]

→ horizontal_flip [True, False]

(rescale, fill_mode)

Auto-Encoders

→ It is a special type of neural network architectures in which the output is same as the input.

→ It is trained in an unsupervised manner in order to learn extremely low representations of an input data.

→ These low level features are deformed back to its actual data.

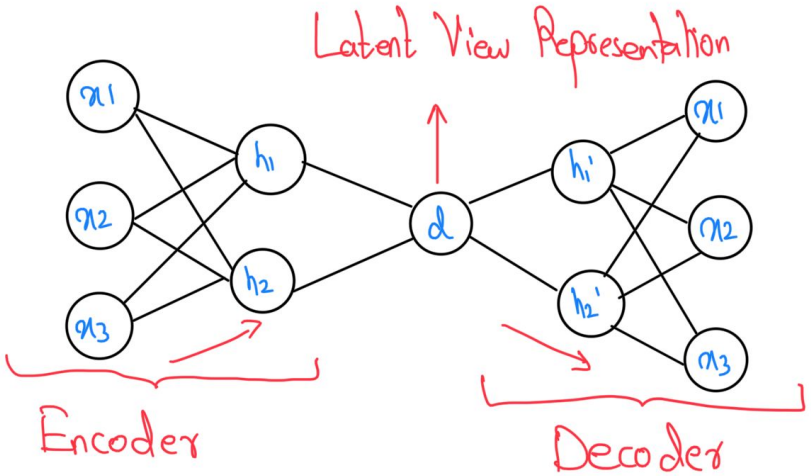
→ It is a regression task where the network is asked to predict its input (model identity function).

Auto - Encoders architecture

Encoding architecture: It comprises series of layers with decreasing number of nodes and ultimately reduces to a latent view representation

Latent View Representation: It represents the lowest level space in which the inputs are reduced and information preserved.

Decoding architecture: It is the mirror image of the encoder but in which number of nodes in every layer increases and ultimately outputs the similar (almost) input.



Encoders $z = f(Wx + b)$

Decoders $\hat{x} = f'(W'z + b)$

Loss $L(x, \hat{x}) = |x - \hat{x}|$

Use cases

- Image Reconstruction
- Image Enhancement
- Image Compression
- Image Denoising
- Feature Extraction
- Binary Classification

References

- https://towardsdatascience.com/understanding-variational-autoencoders-vaes-f70510919f73
- https://medium.com/analytics-vidhya/mathematical-prerequisites-for-understanding-autoencoders-and-variational-autoencoders-vaes-8f854025390e