SVKM'S NMIMS Deemed to be UNIVERSITY

Data Augmentation and CNN

M.Tech. Data Science, Second Year, NMIMS

By,

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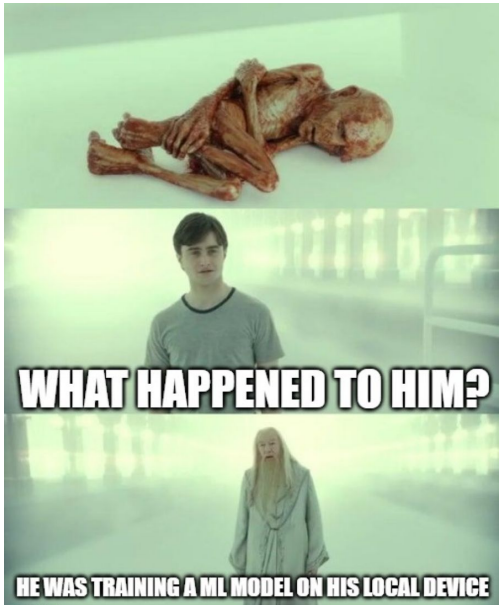
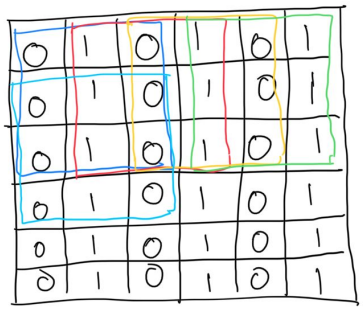
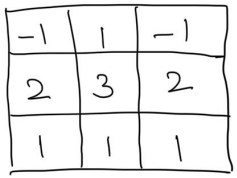


Convolution & operation



6×6 image

Filter (weights)



3×3 Filter

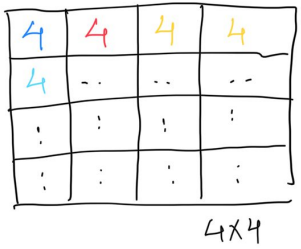
$n - f + 1$

$= 6 - 3 + 1$

$= 4$

Output Size

Output without padding



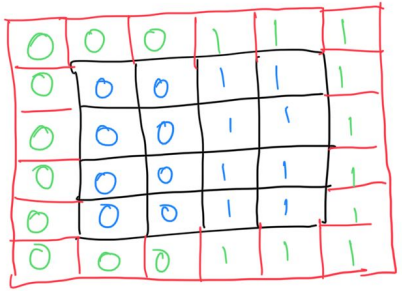
4×4

Stride = 1 (step size)

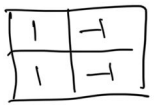
With Padding

$n - 2p - f + 1$

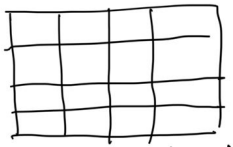
Padding



filter

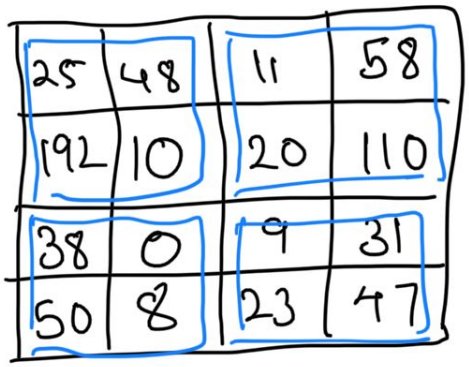


4×4 → 6×6 padding



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

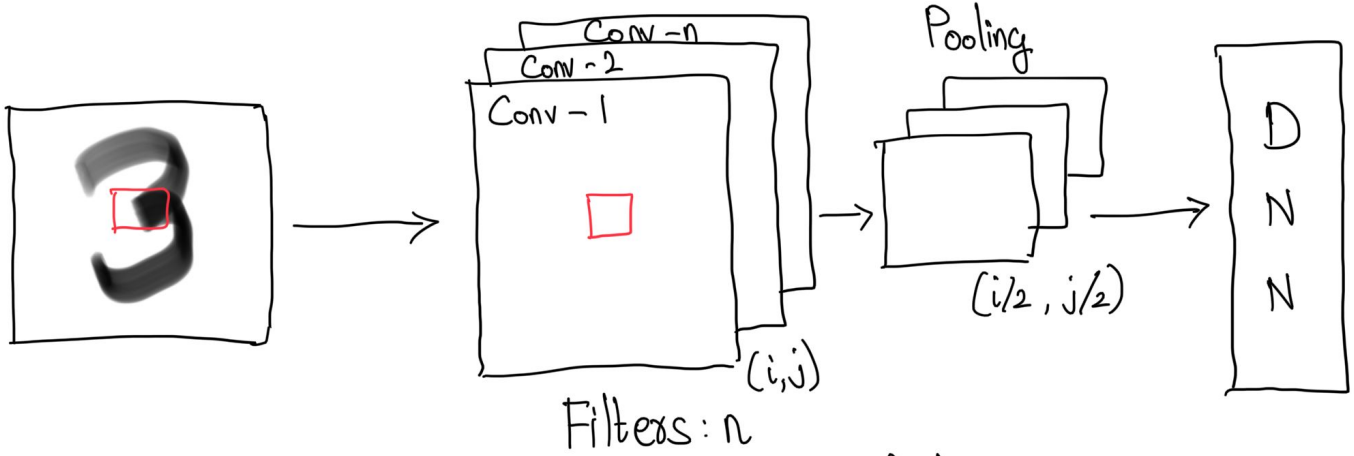
Average Pooling

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]

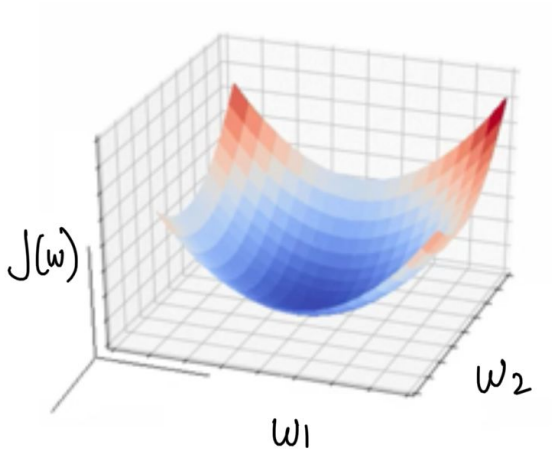
(rescale, fill_mode)

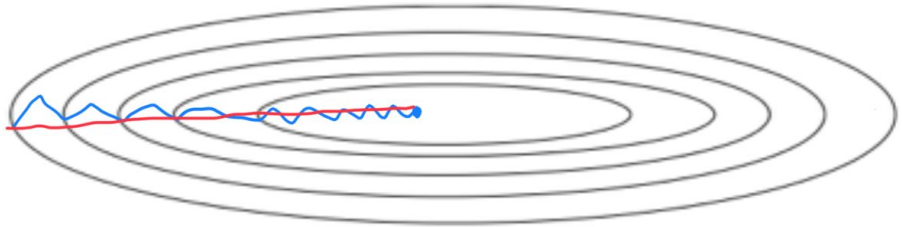
Adam Optimizer (Adaptive moment estimation)

- Momentum
- RMSprop

Exponentially weighted moving average

Momentum:





Momentum:

$$V_{dW} = \beta V_{dW} + (1-\beta)\, dW$$

$$V_{dB} = \beta V_{dB} + (1-\beta)\, dB$$

$$W := W - \alpha V_{dW}$$

$$B := B - \alpha V_{dB}$$

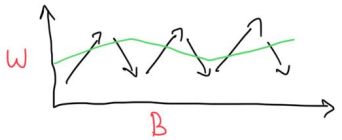
$[\alpha$ = learning rate$]$

$$W := W - \alpha\, dW$$

$$B := B - \alpha\, dB$$

$\beta = 0.9$

RMS prop (Root mean squared proportion)



$$S_{dW} = \beta S_{dW} + (1-\beta)(dW)^2$$

$$S_{dB} = \beta S_{dB} + (1-\beta)(dB)^2$$

$$W := W - \alpha \frac{dW}{\sqrt{S_{dW} + \varepsilon}}$$

$$B := B - \alpha \frac{dB}{\sqrt{S_{dB} + \varepsilon}}$$

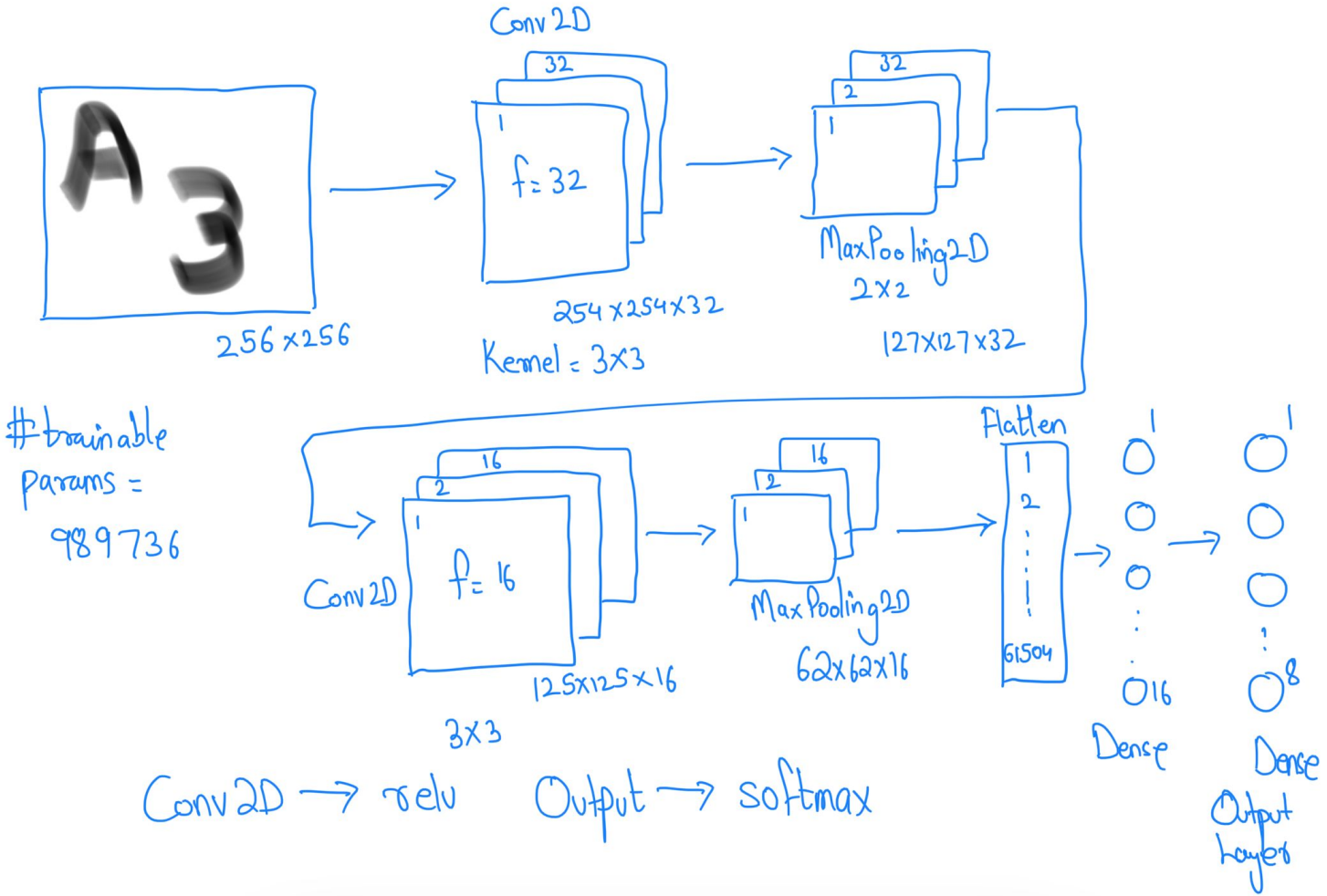
$\beta = 0.999$

$\varepsilon = 10^{-8}$

Adam:

$$W := W - \alpha \frac{V_{dW}}{\sqrt{S_{dW} + \varepsilon}} \qquad B := B - \alpha \frac{V_{dB}}{\sqrt{S_{dB} - \varepsilon}}$$

Momentum β will be β_1 | RMS prop β will be β_2


Conv2D
32
1
f=32
254x254x32
Kernel = 3x3
MaxPooling2D
2x2
127x127x32
256x256
#trainable
params =
989736
16
2
1
f=16
Conv2D
3x3
125x125x16
MaxPooling2D
62x62x16
Flatten
61504
Dense
16
Dense
8
Output
layer
Conv2D → relu
Output → softmax