Convolution Neural Network

Thursday, October 26, 2023 10:10 PM

Convolution is the process involving **combination of two functions that produces the other function** as a result. In CNN's, the input image is subjected to convolution with use of filters that produces a **Feature map**.

Filters / Kernels

Filters /kernels are randomly generated vectors in the network consisting of weights and biases.

CNN Applications

Thursday, October 26, 2023 9:14 PM

Applications of CNN

OBJECT DETECTION

SELF DRIVING CARS

FACIAL RECOGNISTION

Automatic Colorization of Black and White Images

Up-scaling low-resolution images

BREAST CANCER DETECTION

LEAF DISEASE DETCTION

Input
Low
Intermedium
High

32
32
32
F.m
64

32x3x3

$6-3+1$

4

32

O_H maxpoo

O_W

2×2

$\frac{O_H}{2}$

$\frac{O_W}{2}$

64

poolin

$\frac{15-3+1}{15-2=13}$

$32-3+1$

$= \underline{\underline{30}}$

64

$n_W - F_W + 1$

Limitations of ANN

Thursday, October 26, 2023 10:24 PM

1. High Computation Cost
2. Overfitting
3. Loss of important info like spatial features

29*29=841

-1	-1	-1	-1	-1	-1	-1	-1	-1
-1	1	-1	-1	-1	-1	-1	1	-1
-1	-1	1	-1	-1	-1	1	-1	-1
-1	-1	-1	1	-1	1	-1	-1	-1

-1	-1	-1	-1	-1	-1	-1	-1	-1
-1	-1	-1	-1	-1	-1	1	-1	-1
-1	1	-1	-1	-1	1	-1	-1	-1
-1	-1	-1	-1	-1	-1	-1	-1	-1

-1	-1	1	-1	-1	-1	1	-1	-1
-1	-1	-1	1	-1	1	-1	-1	-1
-1	-1	-1	-1	1	-1	-1	-1	-1
-1	-1	-1	1	-1	1	-1	-1	-1
-1	-1	1	-1	-1	-1	1	-1	-1
-1	1	-1	-1	-1	-1	-1	1	-1
-1	-1	-1	-1	-1	-1	-1	-1	-1

-1	1	-1	-1	-1	1	-1	-1	-1
-1	-1	1	1	-1	1	-1	-1	-1
-1	-1	-1	-1	1	-1	-1	-1	-1
-1	-1	-1	1	-1	1	1	-1	-1
-1	-1	-1	1	-1	-1	-1	1	-1
-1	-1	1	-1	-1	-1	-1	-1	-1
-1	-1	-1	-1	-1	-1	-1	-1	-1

Convolution Operations

Thursday, October 26, 2023 10:40 PM

https://indoml.com/2018/03/07/student-notes-convolutional-neural-networks-cnn-introduction/

$F_H < n_H$

$F_W < n_W$

5 6 5 4 7 8
5 7 7 9 2 1
5 8 5 3 8 4
$n_H \times n_W \times n_C = 6 \times 6 \times 3$
Parameters:
Size: $f = 3$
#channels: $n_C = 3$
Stride: $s = 1$
Padding: $p = 0$
2 = * +
https://indoml.com

Input Image
5 x 5
Red
Green
Blue
Filter 3
Filter 2
Filter 1

Padding
p=1
Red
Green
Blue
Filter 3
Filter 2
Filter 1
0+0+0+0+0+1+0+0+0=1
0+0+0+0+0+0+0+0+0=0
0+0+0+0+1+0+0+2+0=3
Convoluted Output
1+0+3=4
$O_W = n_W + 2(p) - F_W + 1$
$= 5 + 2(1) - 3 + 1$
$O_W = 5$
$O_H = 5$
$O_H = n_H + 2p - F_H + 1$
$= 5 + 2(1) - 3 + 1$

No of feature map
= no of filters

PADDING and STRIDES

Thursday, October 26, 2023 11:22 PM

Pixel Values

0	0	0	0	0	0	0	0
0	1	0	4	2	125	67	0
0	8	2	5	4	34	12	0
0	20	13	25	15	240	2	0
0	76	8	6	6	100	76	0
0	34	66	134	223	201	3	0
0	255	123	89	55	32	2	0
0	0	0	0	0	0	0	0

Kernel 3 x 3 Pixels

1	2	1
2	4	2
1	2	1

Convoluted Image

22	27	36	313	722	576
91	110	120	522	984	576
284	257	198	755	1360	798
507	567	687	1312	1689	955
1061	1288	1496	1911	1659	702
1400	1480	1269	1249	870	279

$$O_W = \frac{n_W + 2(P) - F_W + 1}{S} = \frac{6 + 2(0) - 3 + 1}{2} = \frac{6 + 0 - 2}{2} = \frac{4}{2} = 2$$

$$O_H = \frac{n_H - 2P - F_H + 1}{S} = 2$$

edge detection part detect

Intensity of color

granuality.

If we consider padding $\underline{P}$ & stride $\underline{S}$ then shape of feature map would be

$$O_H = \frac{n_H + 2P - F_H}{S} + 1$$

$$O_W = \frac{n_W + 2P - F_W}{S} + 1$$

Max or Average Pooling

Thursday, October 26, 2023 11:35 PM

$wx + b = \text{conti}$

$-ve$

0

$+ve$

$$\frac{31+15+0+100}{4}$$

36.5

Lower

manipulate

Translational Invarience

Left

Right

Before Flattening

Thursday, October 26, 2023 11:38 PM