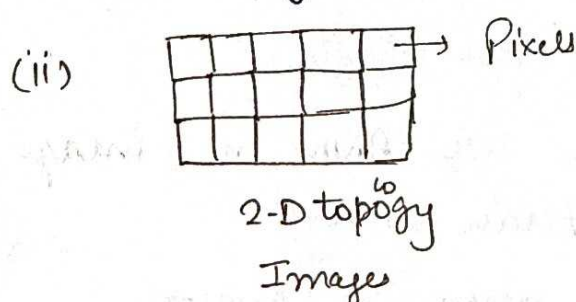
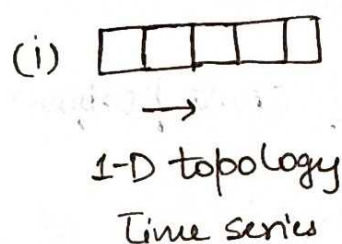


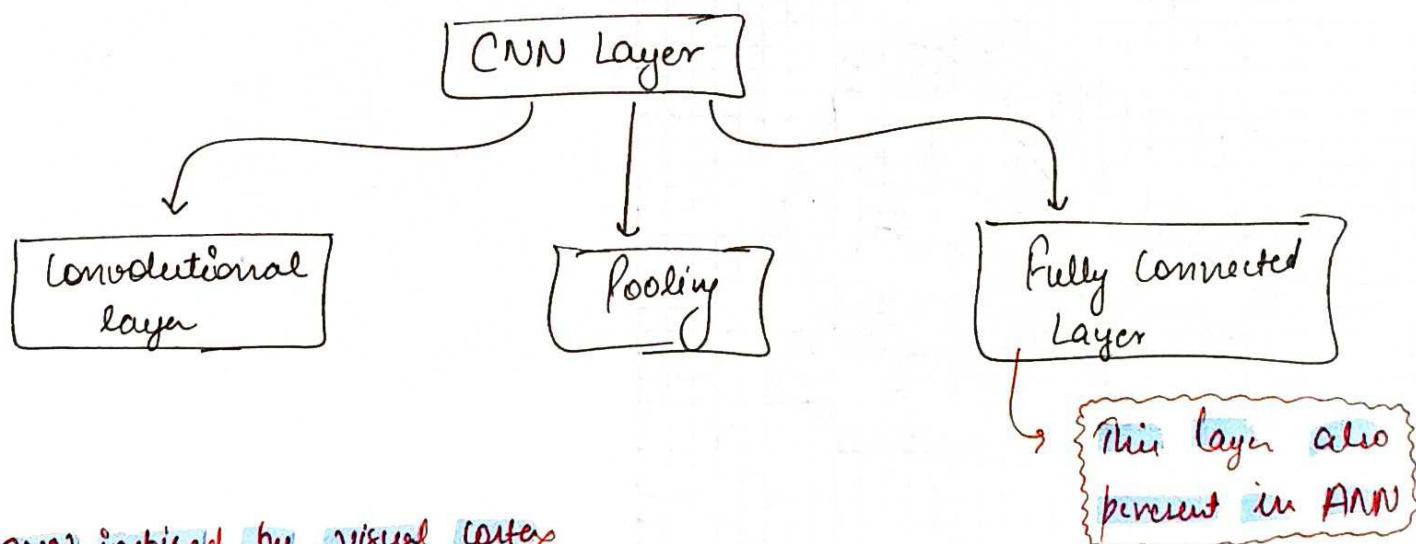
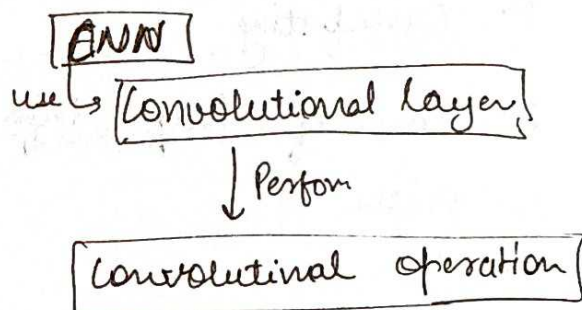
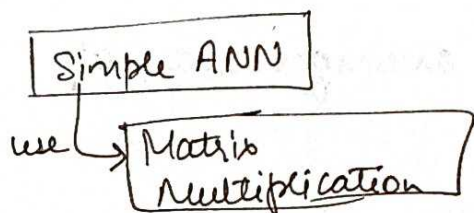
Convolutional Neural Network (CNN)

What is CNN?

Convolutional Neural Networks, also known as convnets, or CNNs, are a special kind of neural network for processing data that has a known grid-like topology like time series data (1D) or images (2D).



Comparison



CNN inspired by visual cortex

↳ The part of our brain that allows us to see

History

⇒ 1998 → Yann LeCun → in AT&T Lab → made for scan bank checks

⇒ Microsoft → build OCR reading and hand writing tool.
recognition

Now, from facial recog to self-driving car every use
CNN. CNN one of the most popular and successful.

Why Not use ANN?

We can use ANN on image data but CNN perform better than ANN.

Problem when use ANN?

→ 1. High Computation Cost

2. Overfitting

3. Loss of imp info like spatial arrangement of pixels

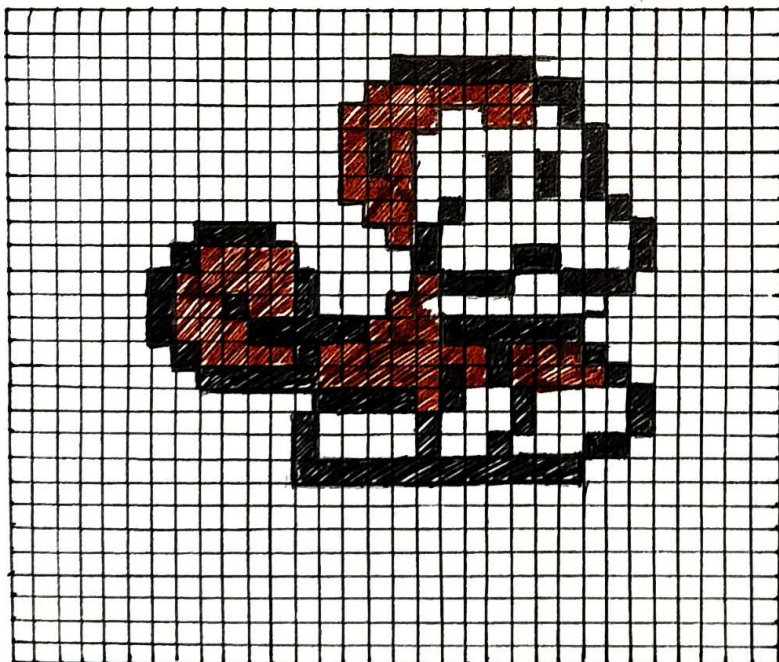


Image in
2-D

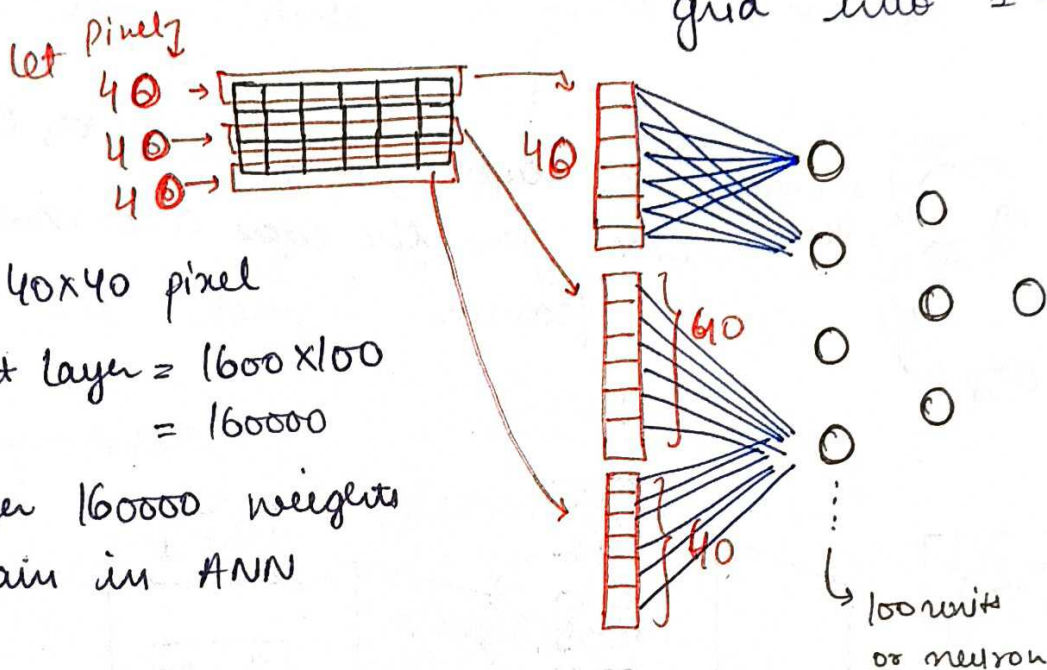
ANN Structure

-
-
- ○
-
-

Problem →

How to use Image data in ANN?

Solution 1 → Convert 2-D grid into 1-D



→ Image size = 40×40 pixel

Weight of first layer = 1600×100
= 160000

In first layer 160000 weights need to train in ANN

→ Image size = 1000×1000 pixel

then weights are also increase and then complexity of model are also increased.

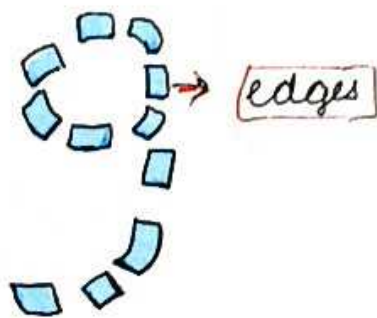
That's why ANN not use .

Weight $\uparrow \uparrow \rightarrow$ training $\uparrow \uparrow$ time

CNN Intuition

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→ CNN try to extract some primitive features like edges.



9

complex feature

Now, layer by layer CNN join the edges and make complex features.



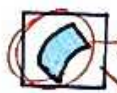
Image



① This filter kind of move on this Image

And find the pattern

Patterns



Activate



Activate



Activate



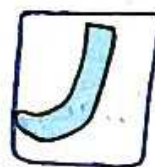
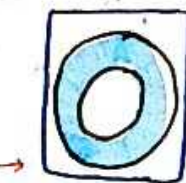
②

Activate those pattern which is matched



Repeat step ② and ③

many times and find pattern.



③ Activated pattern send to next filter and filter combine those activated and create new pattern. This method run many time

Roadmap

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- Biological Concepts
- Convolution
 - ↳ Padding + Stride
- Pooling
- Dog Vs Cat Classification
- Data Augmentation
- Popular CNN Architecture
 - ↳ LeNET
 - ↳ Alex NET
 - ↳ VGG NET
 - ↳ RESNET
 - ↳ Exception
- Transfer learning

} → CNN Architecture
→ CNN Vs ANN

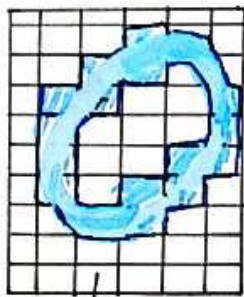
Convolutional Operation

Basic Image

grey scale \rightarrow Black / white image

RGB \rightarrow Colored image

Greyscale \rightarrow 1 channel



\rightarrow every grid

represent number

betⁿ $\frac{0}{}$ to $\frac{255}{}$ \rightarrow

black \downarrow white

After Normalize \rightarrow 0 to 1

black \downarrow white

MNIST Data (0)

low resolution
image \rightarrow 28x28 pixels

RGB \rightarrow

3 Channels

Red

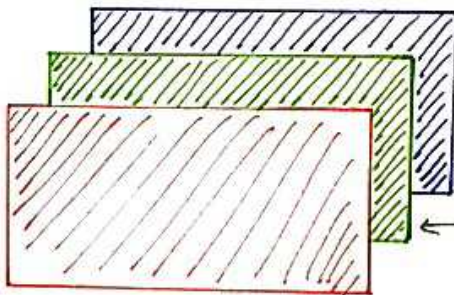
Green

Blue

Basically these three colors are primary and we make any colour with the help of these 3 color.

$228 \times 228 \times 3$

\downarrow 3 layer



\leftarrow Blue component image plane

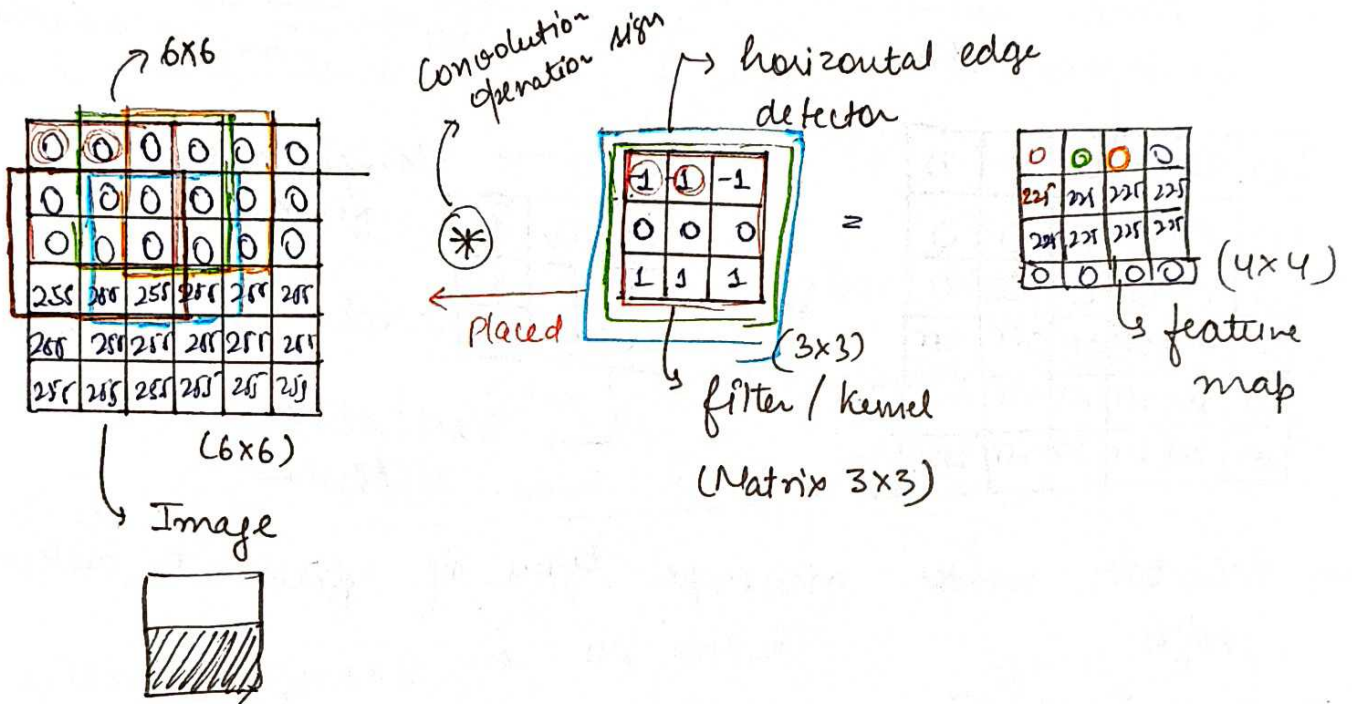
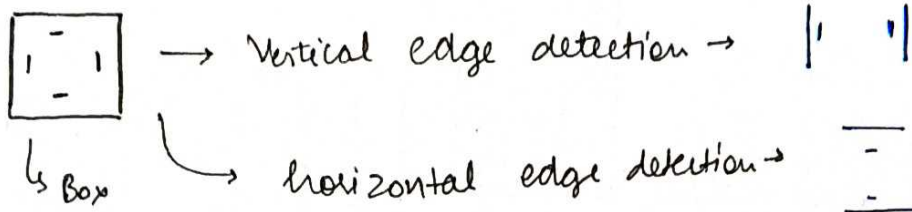
\leftarrow Green component image plane

\leftarrow Red component image plane.

RGB three layered image

Edge Detection (Convolution Operation)

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① - filter placed on Image

→ And Multiply filter to Image →

0×1
 $\swarrow \quad \searrow$
 $(1,1) \quad (1,2)$

0×-1
 $\downarrow \quad \downarrow$
 $(1,2) \quad (1,2)$

→ After Multiply all filter with Image then add all multiplication

$0 \times 1 + 0 \times -1 + 0 \times -1 + \dots + 0 \times 1 = 0$

→ After Addition, Answer place on feature map

② → Again filter placed on Image and left first row, placed from second row.

→ Multiply and Add →

$0 \times -1 + 0 \times -1 + \dots + 0 \times 1 = 0$

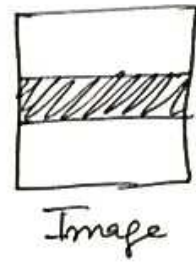
③ → follow same step like ① and ② step

$$0 \times -1 + \dots + 255 \times 1 + 255 \times 1 + 255 \times 1 = 765$$

but image pixel value is 255. So, we convert 255 as a 225. ^{larger}

depending on the training data \rightarrow filters values are changed just like weights in ANN with the help of backpropagation.

0	0	0	0
255	255	255	255
255	255	255	255
0	0	0	0



(Horizontal edge detection)

0	0	0	0	0	0
0	0	0	0	0	0
0	0	0	0	0	0
255	255	255	255	255	255
255	255	255	255	255	255
255	255	255	255	255	255

*

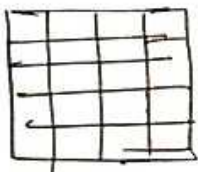
-1	0	1
-1	0	1
-1	0	1

change this filter

Vertical edge detection

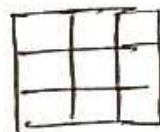
\rightarrow Scientist made multiple types of filter to detect edges.

[deepvizard.com] \rightarrow Visual understanding of filters.



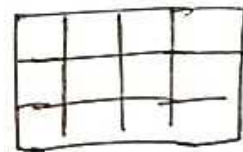
(6x6)

*



(3x3)

=



(4x4)

if

(28x28)

(n x n)

(3x3)

(m x n)

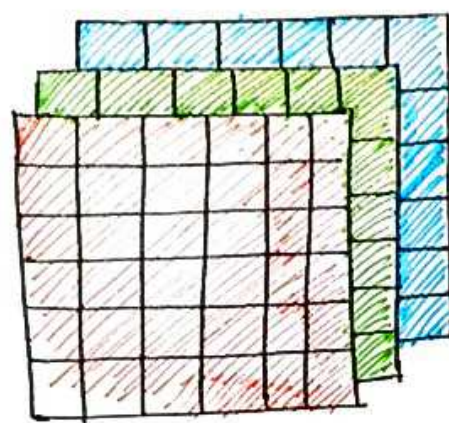
=

(26x26)

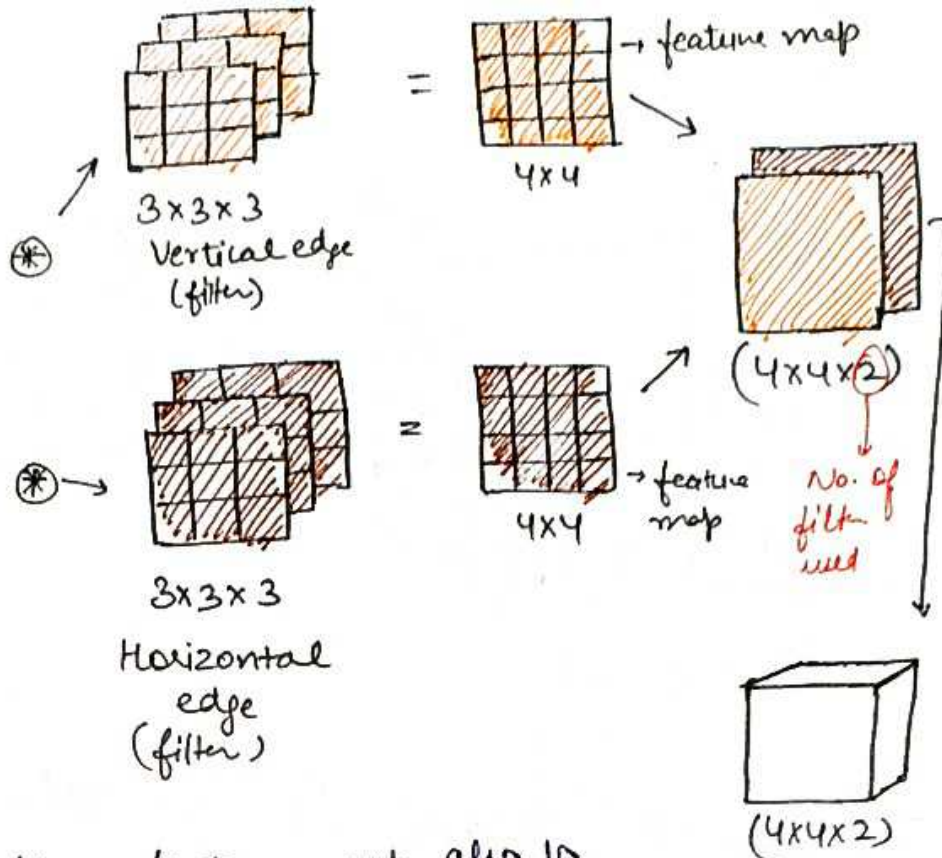
\downarrow

(n - m + 1) x (n - m + 1)

Multiple Filters



$(6 \times 6 \times 3)$



\rightarrow If filter is 10 then feature map also 10
 $(n \times n \times 10) \rightarrow$ According to upper example $\rightarrow (4 \times 4 \times 10)$