

Computer Vision:

Computer vision enables computers to understand the content of images and videos.

- Process of reading and playing film fragments
- Make decision on each pixel
- Neural Networks (NN) fails at large size of image
- We filter the image to get important pixels (information)
- Final decision will be based on NN.
- Filtering is the prior process of NN.

Mathematical Steps:

1. Input image

Input image (6-by-6)

Where 0 represent the value for color part and 10 for white part in the image

10	10	0	0	10	10
10	10	0	0	10	10
10	10	0	0	10	10
10	10	0	0	10	10
10	10	0	0	10	10
10	10	0	0	10	10

2. Applying filter:

Now we have applied the 3-by-3 filter on the image to convolve the values.

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

Output after applying filter on the input image.

Horizontal filter:

10	10	0	0	10	10
10	10	0	0	10	10
10	10	0	0	10	10
10	10	0	0	10	10
10	10	0	0	10	10
10	10	0	0	10	10

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

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30	30	-30	-30
30	30	-30	-30
30	30	-30	-30
30	30	-30	-30

Vertical filter:

10	10	0	0	10	10
10	10	0	0	10	10
10	10	0	0	10	10
10	10	0	0	10	10
10	10	0	0	10	10
10	10	0	0	10	10

*

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

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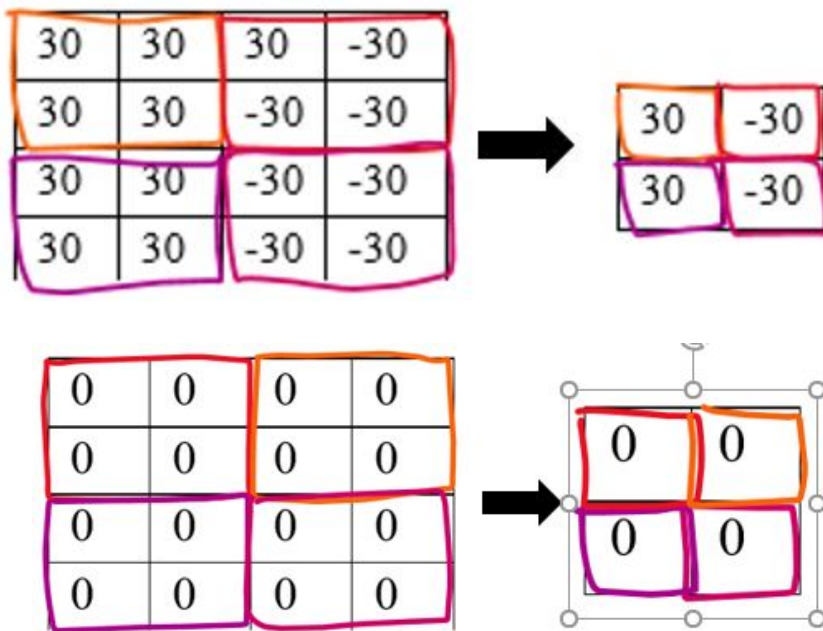
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0

Formula for window size:

$$\text{window size} = \frac{\text{pixel} - \text{filter} + \text{padding}}{\text{stride}} + 1$$

3. Pooling:

By applying max pooling



Output:

30	30	-30	-30	0	0	0	0
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Applying weights:

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

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30	30	-30	-30	0	0	0	0
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Output:

30	30	30	30	0	0	0	0
0	0	0	0	0	0	0	0

- Value for vertical pixel is 120
- Value for horizontal pixel is 0

Image Process:

Image processing is a method to perform some operations on an image, in order to get an enhanced image or to extract some useful information from the image for prediction.

Image processing mainly include the following steps:

1. Importing the image via image acquisition tools;
2. Analysing and manipulating the image;
3. Output in which the result can be altered image or a report which is based on analysing that image.

Difference between image processing and computer graphics:

Image Processing	Computer Graphics
In image processing the image/data is converted into digital values (mathematical computer model)	It is the process of conversion of a computer/mathematical abstract model to an image.
Image processing is associated with low level processing	CV, computer graphics (Image Synthetic) is associated with high level processing.

Computer Vision:

Computer vision is the combination of image processing and computer graphics.

For vision:

Machines work better for vision but humans can understand the more complex things (multiple objects with multiple properties).

For Computational:

Computers work better than humans.

Levels of processing in Digital Image Processing:

DIP has 3 levels of Processing:

- Low level processing
- Mid level processing
- High level processing

Low level processing:

involves primitive operation such as image preprocessing to reduce noise, contrast enhancement, image sharpening, etc. In low level processing, both **input** and **output** are **images**.

Low level processing is generally associated with image processing.

Mid level processing:

involves tasks such as image segmentation, description of images, object recognition, etc. In the mid level processing, **inputs** are generally **images** but its **outputs** are generally **image attributes**.

High level processing:

involves ‘making sense’ from a group of recognized objects. In high level processing **inputs** are generally **image attributes** but its **outputs** are generally the **information** (i.e. scenario understanding) extracted from the image.

Mid+ High level processing mostly associated with computer vision.

Image Processing:

Things observe in the picture:

For image processing following things in the image needed to be observe:

- Objects (i.e. human, animals)
- Properties of objects (object is living, non living)
- Interaction (relation between things in the image like **man** is writing on the **white board** with the help of **marker**, in this example man is interacting with the white board by using marker)
- Scene Settings (place/ set of the scene)

Types of scene setting:

Scene setting is of two types:

1. Synthetic (it gives limited information -> understanding meaning directing from the picture.)
2. Semantic (it has deep meaning -> doesn't give direct background information)

Focus i IP:

The major focus on 5 'W's) in image processing are:

1. What (happened)
2. Where (place)
3. Who (involved object/person)
4. When (time)
5. Why (reason)

Pixel (digital values):

In image the intersection point of row and column is called pixel.

OR

Concatenation of one row and column of an image is called pixel

Important things in pixel:

- Pixel location
- Size of the pixel
- Height of the pixel
- Opacity

Goals of image processing::

- Improvement of image quality (for human understanding)
- Processing of data for storage, transmission and representation.
- For autonomous machines.

Applications of Image processing:

IP use for following purposes:

- Quality improvement
- In the film industry (special effects)
- Medical industry (i.e. brain tumor detection)
- For geographical and satellite images (enhancement)
- Industry (garment printing, beverages industries)
- Technical domain (3D housing scheme)
- Optical Character Recognition (OCR)
- Face Detection
- Iris Detection

