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Learning for Life

Working with Images

Computer Vision

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Agenda

- Basics of Images
- Understanding filtering
- Hands-On

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Image basics

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Images

PIXELS are ATOMIC ELEMENTS of a digital image.

it is the smallest element of an image represented on the screen.

A pixel can have value ranging from 0 to 255.

Where 0 is black and 255 is white.

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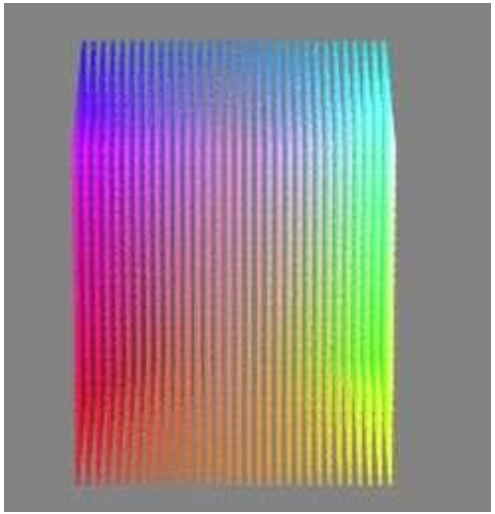
Images - Channels

Images can have different channels.

Examples- RGB, BGR

Here R - Red, G - Green and B-Blue

Grayscale image has just one channel.



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RGB Channels

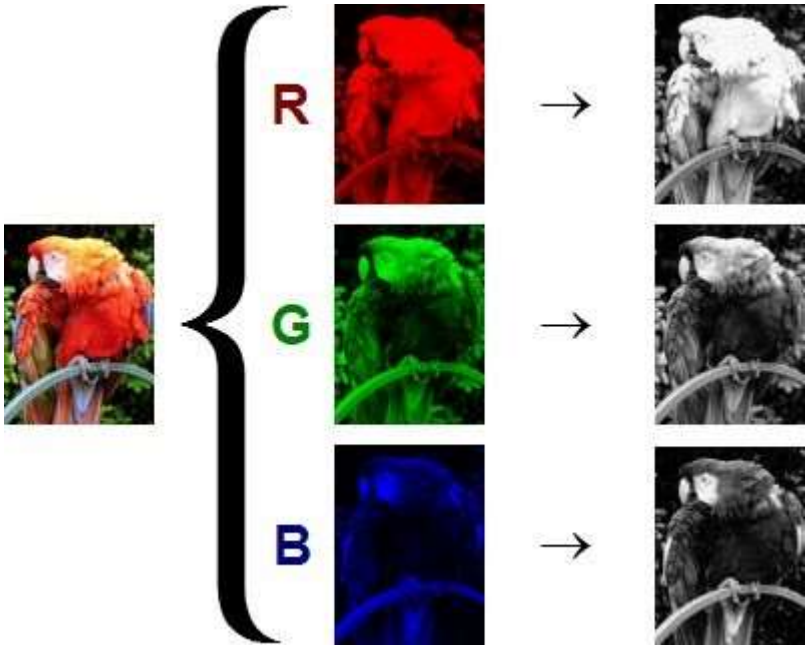

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Image - Formats

Some formats: GIF, JPEG, PNG, RAW, TIF, PGM, PBM etc.

Medical Images: DICOM, Analyze, NIFTI etc.

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Image representation

This image has 3 channels.

And one channel can be represented like this-

2	15	22
33	34	4
21	24	44

Note - this matrix is just for representation purpose, it doesn't truly indicate the numbers and shape of the given image.

Image Shape- (194, 259, 3)

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Image Transformation- Filtering

Filtering can be used to transform images like sharpening, blurring, scaling etc.

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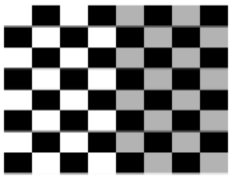
Affine transformations

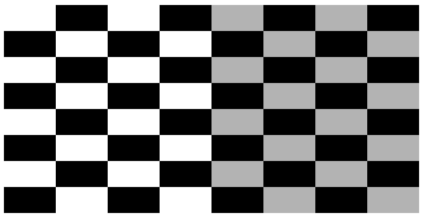
Basic image transformations like scale, rotate, translate, mirror etc.

1.



3.

2.



Examples -

1. Identity
2. Reflection
3. Scaling

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Feature Extraction from Images- Convolution

How to extract features from images?

Manual feature creation- Old techniques

- SIFT (Scale-Invariant Feature Transform)
- HOG (Histogram of Oriented Gradients) etc.

This is hard and have some issues.

So, We will discuss about a method here-
Convolution

It is the most important component of CNNs

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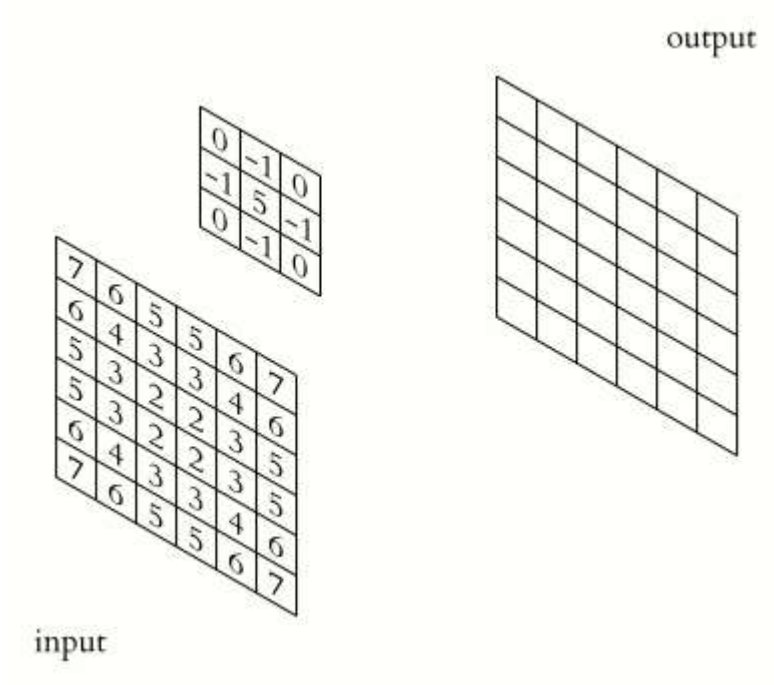
Convolution and Kernels

Convolution is the process of adding each element of the image to its local neighbors, weighted by the kernel.

This is related to a form of mathematical Convolution operation.



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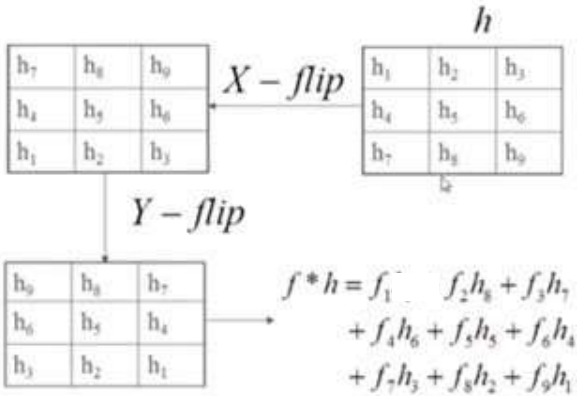
Convolution vs Correlation



Convolution:

$$G = h * F \qquad G[i,j] = \sum_{u=-k}^{k} \sum_{v=-k}^{k} h[u,v]F[i-u, j-v]$$

Correlation:

$$G = h \otimes F \qquad G[i,j] = \sum_{u=-k}^{k} \sum_{v=-k}^{k} h[u,v]F[i+u, j+v]$$

Convolution is basically flipping the kernel via-Xaxis and Y-axis and then performing a correlation with the resultant kernel

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Features from kernels

Kernel is also called convolution matrix or mask.
Convolution with different kernels can be used for different image transformations/filtering.

You can use different kernels for different Feature extraction like edge detection, Sharpen, blurring etc.

Operation	Kernel ω	Image result g(x,y)
Identity	$\begin{bmatrix} 0 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 0 \end{bmatrix}$	
Edge detection	$\begin{bmatrix} 1 & 0 & -1 \\ 0 & 0 & 0 \\ -1 & 0 & 1 \end{bmatrix}$	
	$\begin{bmatrix} 0 & 1 & 0 \\ 1 & -4 & 1 \\ 0 & 1 & 0 \end{bmatrix}$	
	$\begin{bmatrix} -1 & -1 & -1 \\ -1 & 8 & -1 \\ -1 & -1 & -1 \end{bmatrix}$	
Sharpen	$\begin{bmatrix} 0 & -1 & 0 \\ -1 & 5 & -1 \\ 0 & -1 & 0 \end{bmatrix}$	

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Features from kernels

Original

Sharpen

Edge Detect

Stronger Edge Detect

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Thank you!

Happy Learning
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