A Brief Introduction to OpenCV and Computer Vision

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What this session is about

- Getting learner's acquainted with some basic concepts related to Image Processing
- Introduction to the OpenCV Library (using Python) and how to perform basic image processing operations
- Demonstration of a few applications of Image Processing in OpenCV

What this session is NOT about

- Explanation of the mathematics behind image processing / computer vision algorithms
- Applications based on Machine Learning / Deep Learning etc.

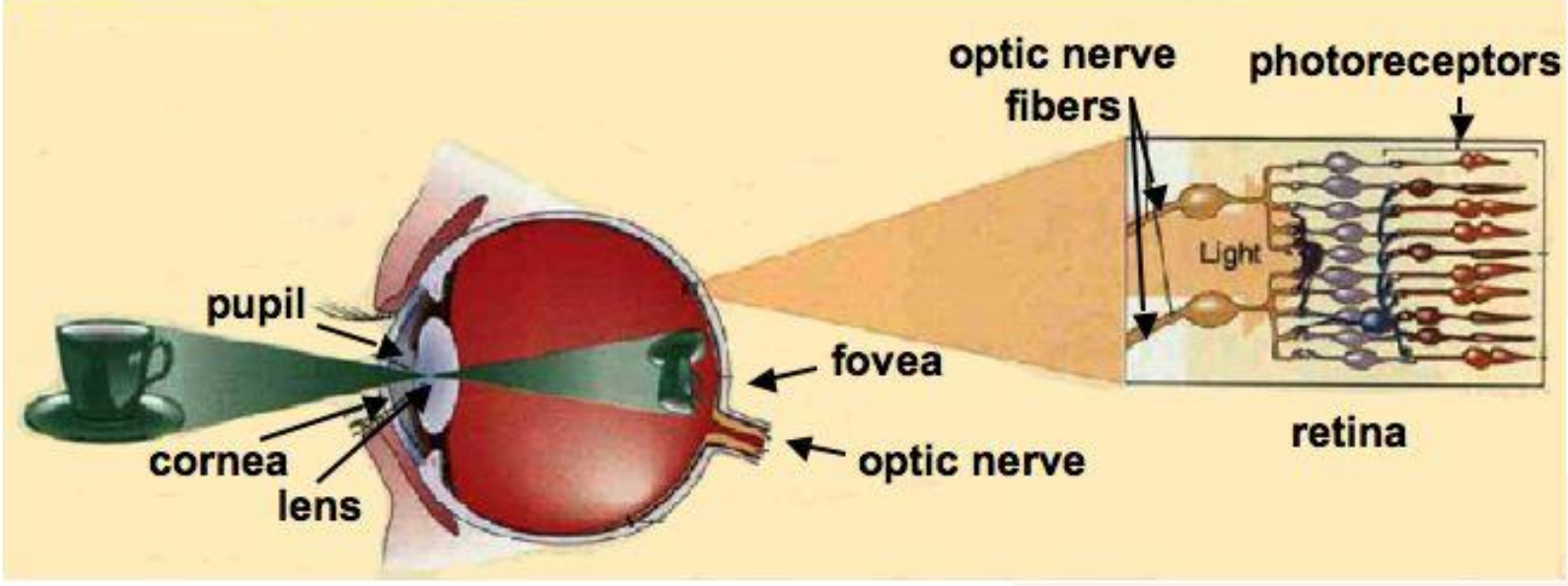
Prerequisites for this session

- Familiarity with Python syntax and the Numerical Python (numpy) library
- Software installation of all the required software for this session.
- A little bit of math

Agenda

- What is Image Processing and Computer Vision?
- Getting started with OpenCV (using Python)
- Demo #1 - Object Detection
- Demo #2 - Building an Invisibility cloak.

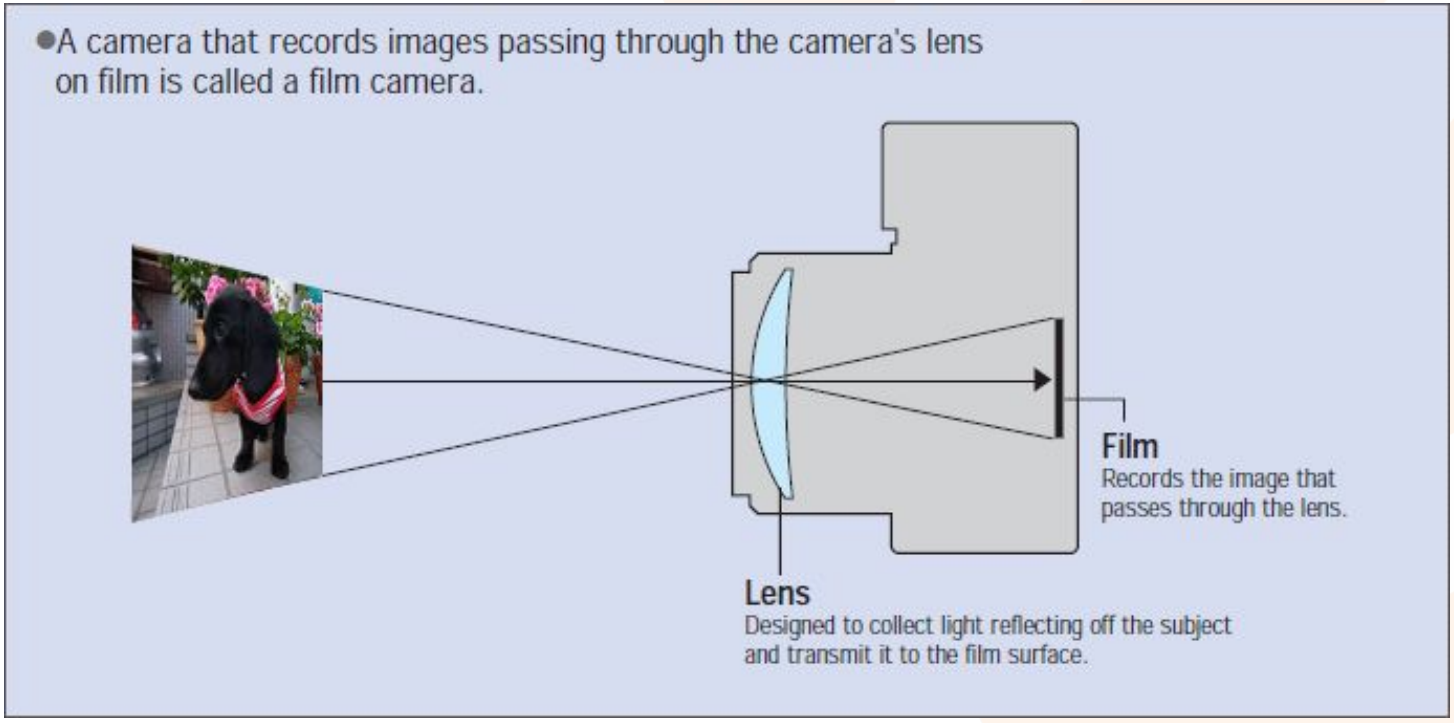
What is an Image ?



The human eye

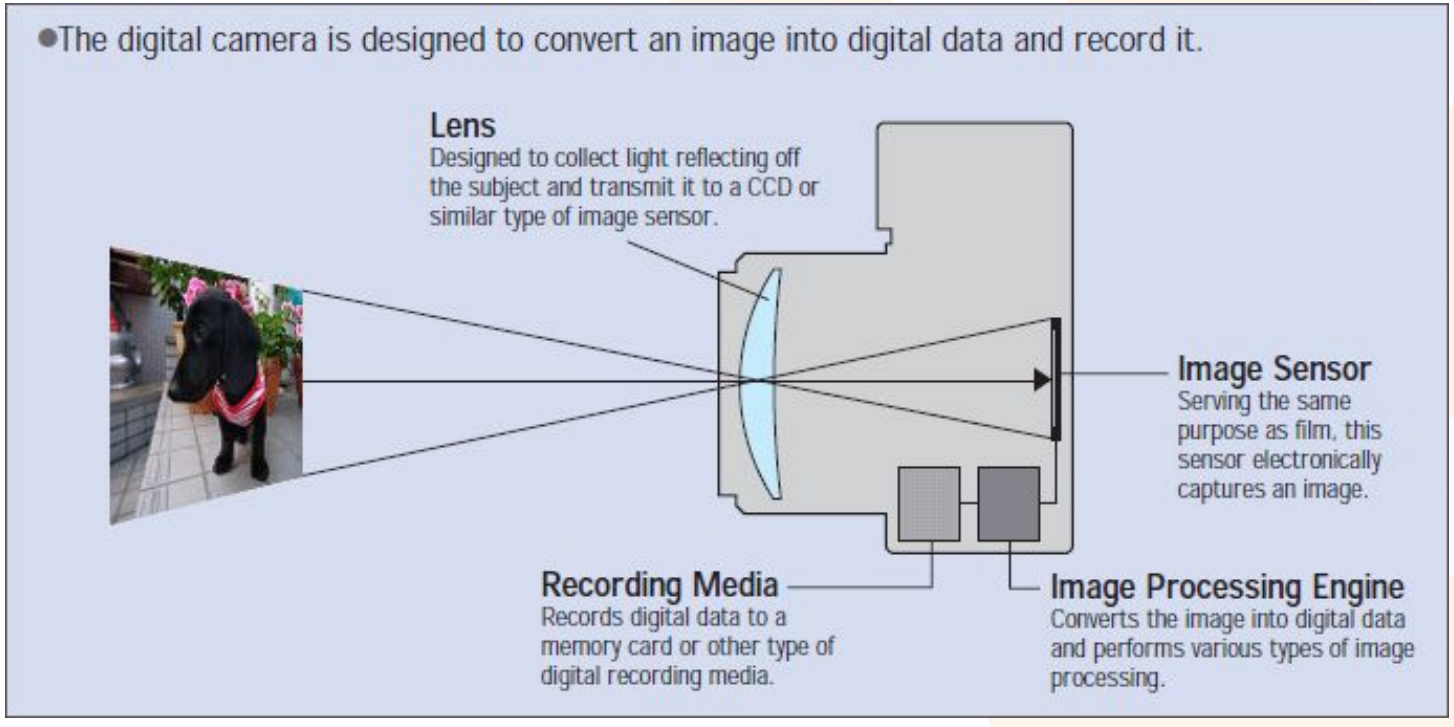
Image Source - https://www.cns.nyu.edu/~david/courses/perception

What is an Image ?



Camera - a “low tech” eye

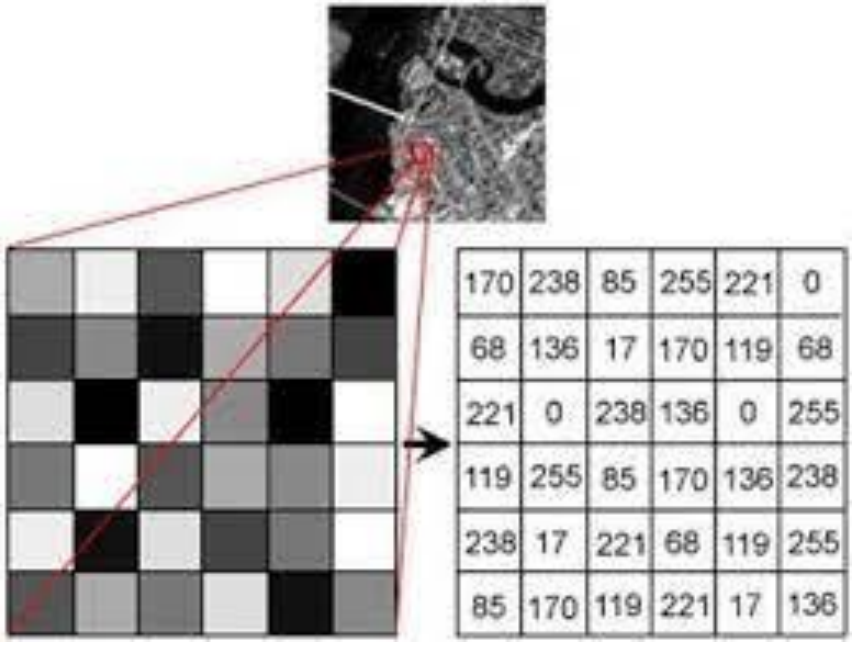
What is an Image ?



Modern Digital Cameras

Image Source - https://av.jpn.support.panasonic.com/

What is an Image ?



170	238	85	255	221	0
68	136	17	170	119	68
221	0	238	136	0	255
119	255	85	170	136	238
238	17	221	68	119	255
85	170	119	221	17	136

Image is a matrix

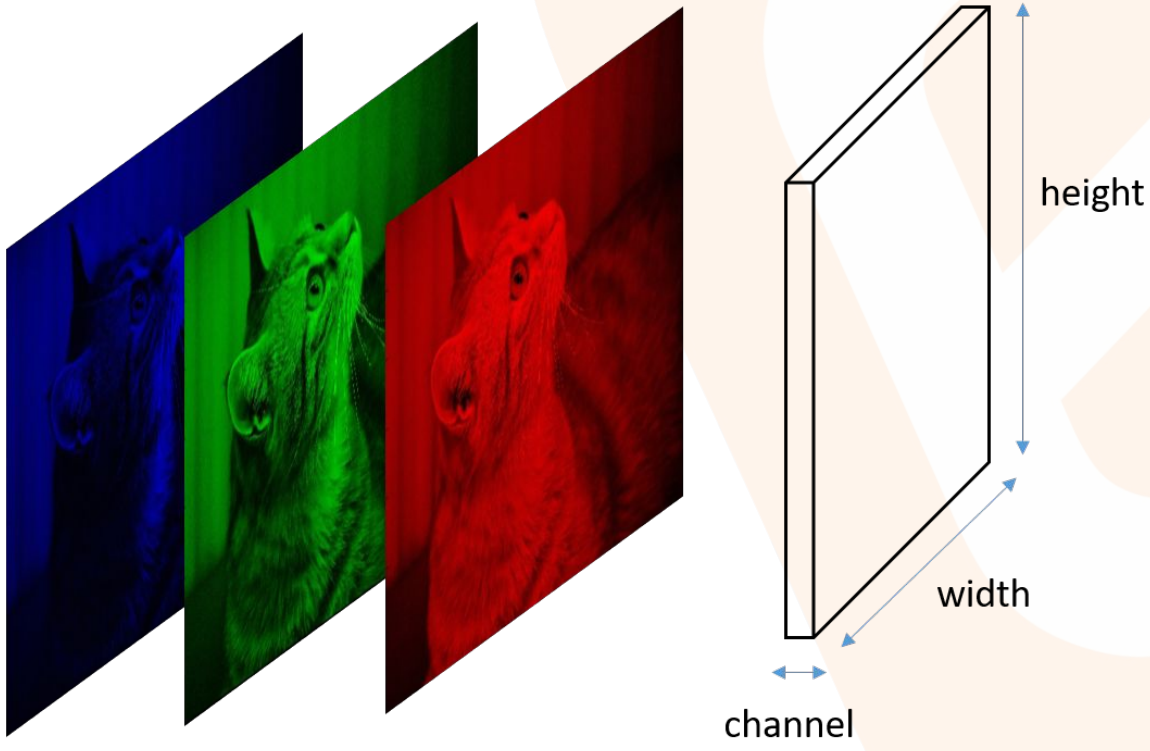
Grayscale Spectrum

Undergoes Quantisation

0 255

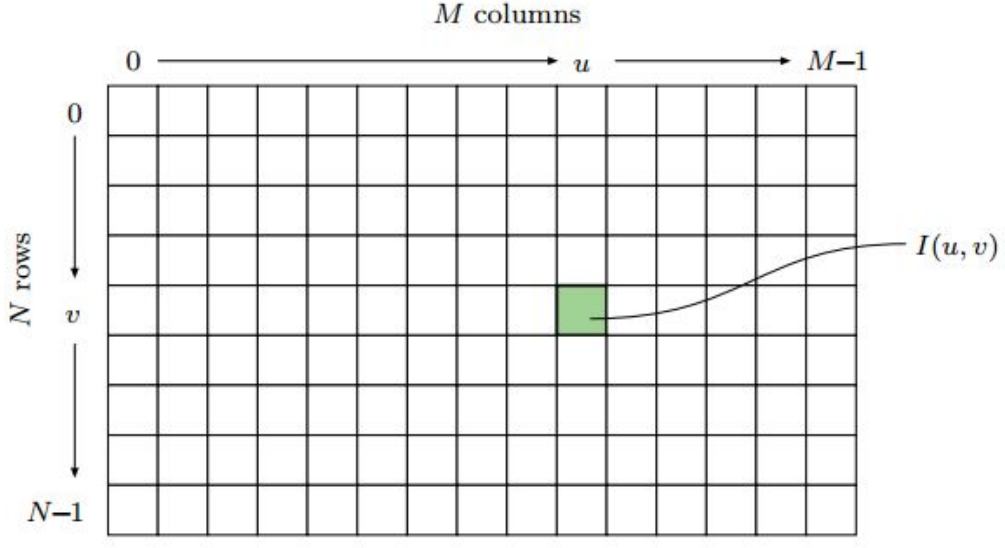
Image Source - https://rosettacode.org/

What is an Image ?



RGB images are represented in 3D matrices

What is a Pixel ?



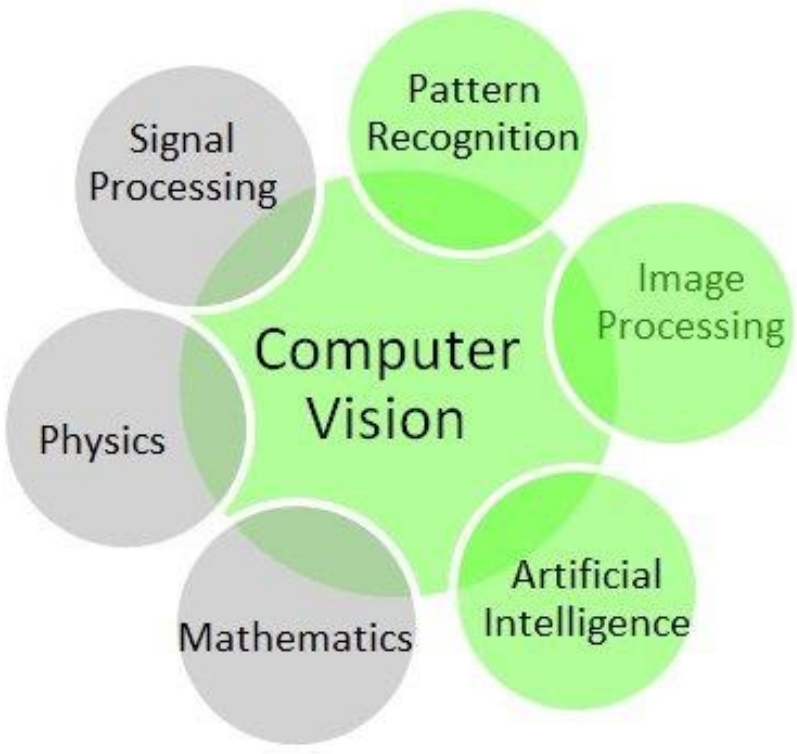
- Pixel represents the smallest unit of an image
- Each pixel has a value between 0-255 based on color (represented by 8 bits in binary)
- Grayscale images are represented by MxN matrices
- RGB images are represented by MxNx3 matrices

What is the size of a grayscale image with dimensions 32x32 pixels?

32 x 32 x 1 byte = 1024 bytes = 1 KB

Difference between Image Processing and Computer Vision

Difference between Image Processing and Computer Vision



- Computer vision refers to high-level understanding of images - detecting faces , object tracking etc.
- Image Processing refers to low-level processing such as detecting shapes, removing noises, detecting edges or corners etc.

Image Source - Quora

Let’s get down to coding...

Part - 1
Basic Image Processing Operations

Loading, Displaying and Saving Images

- Loading Image - cv2.imread( )
- Display Image - cv2.imshow( )
- Saving Image - cv2.imwrite( )

Image resizing and rotation

- Resize Image - cv2.resize( )
- Rotate Image - getRotationMatrix2D()

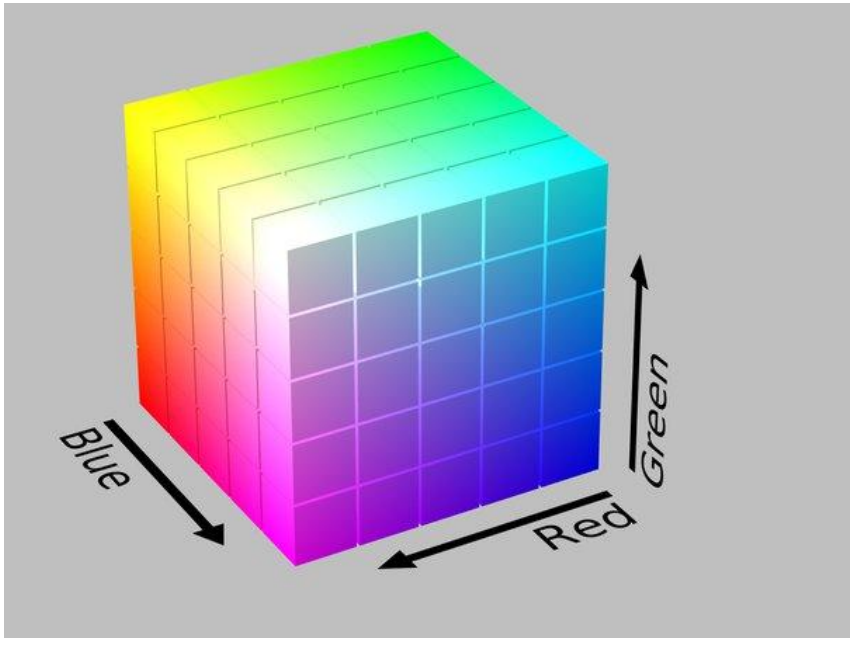
$$R'_\theta = \begin{bmatrix} \cos\theta & \sin\theta \\ -\sin\theta & \cos\theta \end{bmatrix}.$$

Drawing Functions in OpenCV

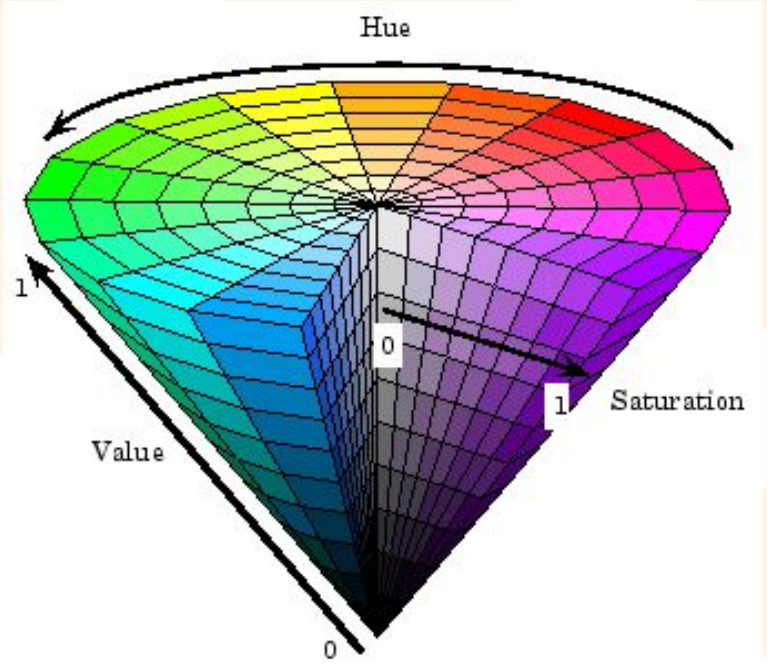
- Draw Line - cv2.line( )
- Draw Rectangle - cv2.rectangle( )
- Draw circle - cv2.circle( )
- Write Text - cv2.putText( )

Part - 2
Object Detection

Different Color spaces



RGB (Red, Green, Blue)



HSV (Hue, Saturation, Value)

Why use HSV over RGB?

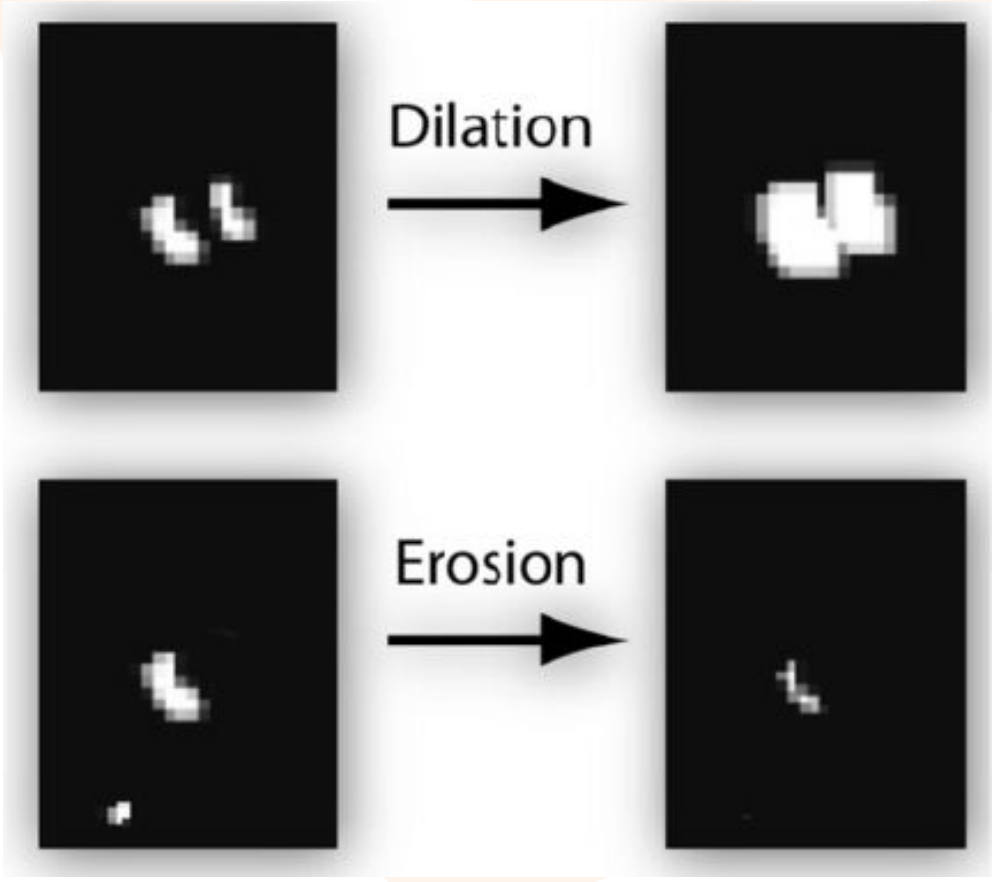
- Different shades of a colour fall in the same range for HSV while in RGB they might be completely different ranges. Hence it makes thresholding easy.
- HSV is less sensitive to external light while RGB is more sensitive.

Masking

Highlighting a specific object

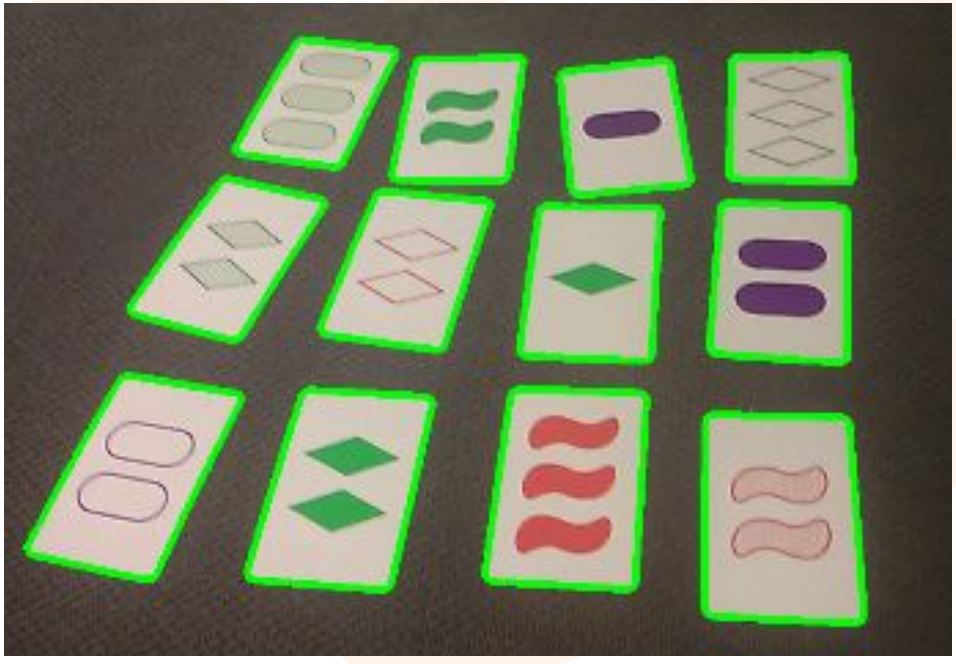
Erosion and Dilation

- Dilation expands the boundary of white areas
- Erosion decreases the boundary of white areas



Contour Detection

- Contours can be explained simply as a curve joining all the continuous points (along the boundary), having same color or intensity.
- Contours are always closed curves, never open.



Part - 3
Invisibility Cloak

Invisibility Cloak

- The same approach of colour filtering and noise reduction is used.
- A mask is created by applying colour filtering.
- All the area under the mask is replaced with the static background

Thank You !!