

AIGC 5502

Image Processing
and
Computer Vision

Name : Zeeshan Ahmad

Email : zeeshan.ahmad@humber.ca

Highest degree : Ph.D. (Computer Engineering)

Specialization : Deep Learning for Computer Vision
and
Sequential Data

Critical Path

Academic Integrity!!!!

Academic integrity is essentially honesty in all academic endeavors. Academic integrity requires that students avoid all forms of academic misconduct or dishonesty, including plagiarism, cheating on tests or exams or any misrepresentation of academic accomplishment

Late Assignment Policy

Assignments submissions must meet the deadlines given by Instructor.
Late submission means 10% deduction per day, to a maximum of 30%.
Assignments submitted after 3 days late will get a grade of zero.

Quizzes, Tests, Midterm and Project Presentation Policy

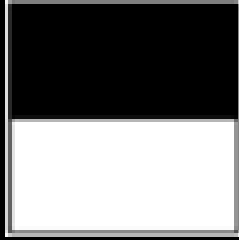
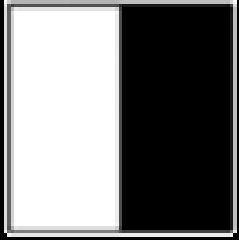
All activities will be held at the start of the class. Make sure that you are present in the class in time. This is in-person course, therefore, your physical presence is mandatory for all activities.

Project

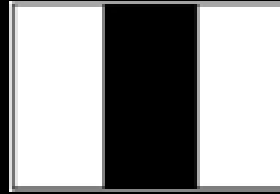
Why Image Processing and Computer Vision?

Extract information from images and interpret these informations precisely and efficiently are the key requirements from Image Processing and Computer Vision.

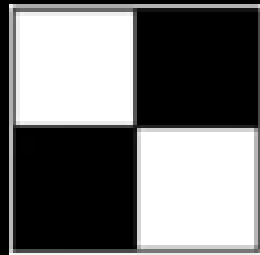




Edge



Line



Corner

Fields benefitted from IP and CV

- Deep Learning
- Medical Imaging
- Robotics
- Computer Graphics
- Face detection / Object detection

Digital Image Processing

Digital image processing is the science of modifying images using algorithms and a digital computer. Since both the images and the computers that process them are digital in nature, therefore, in this course, image processing is actually a digital Image processing.

Image processing rely on carefully designed algorithms and the changes or modifications that take place on the images are usually performed automatically and rely totally on the algorithm.

There is another scenario called Image manipulation which is done by photo editing software,in which images are processed manually and the success of the task depends on human ability.

Typical Image Processing System



What is an Image?

An image is a visual representation of a person or an object produced by optical device through reflection or refraction. The optical devices are mirror, lens, prism or a camera.

This visual representation is usually 2D. However, Higher order representations are also possible like 3D.

2D Images



Gray Scale Image



Color Image
3-channel Image
RGB Image

Image Formation

How are signals generated ?



How are signals generated ?

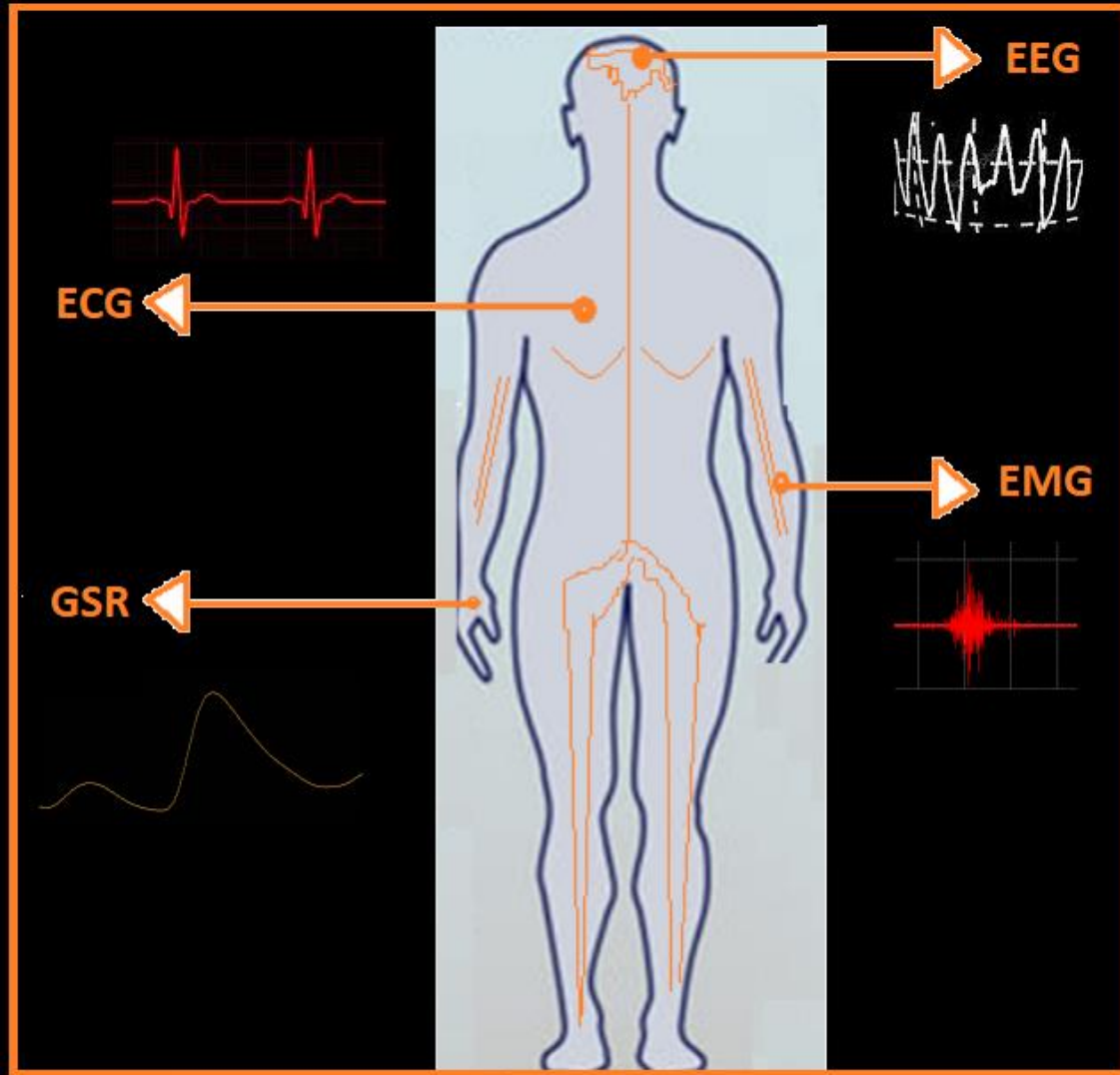


Image Formation

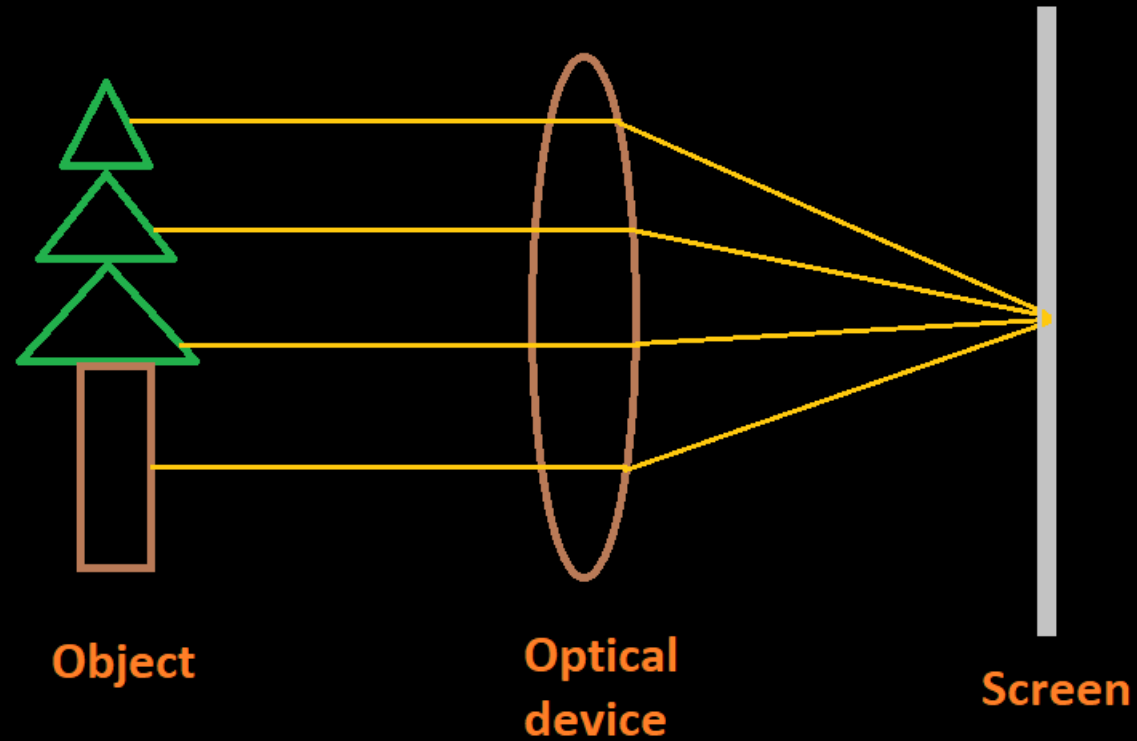
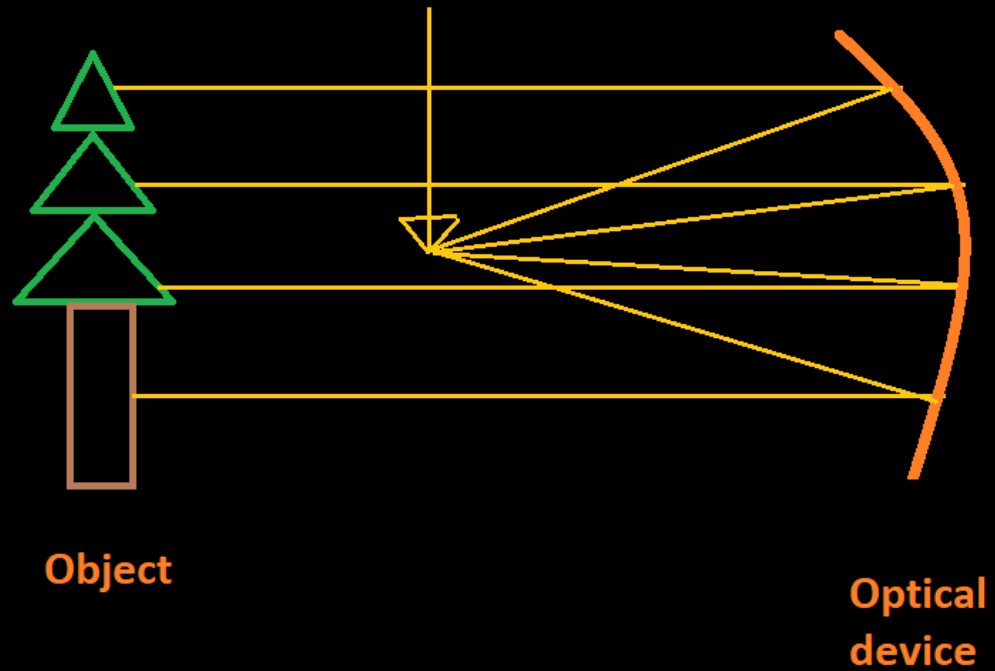


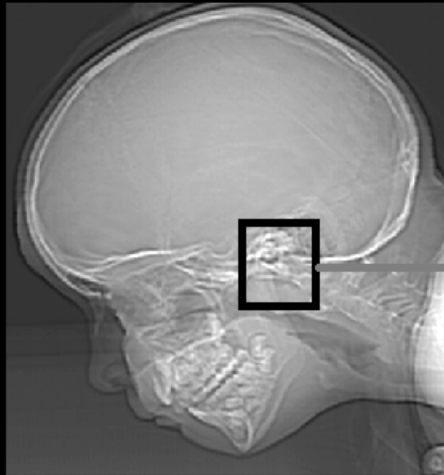
Image Formation



Digital Image

A digital image is a 2D representation having a finite number of display points. Each point is called picture element or pixel. Pixel is the smallest unit in a digital display of an image. Each pixel is represented by one or more numerical values. For gray scale images, every single value represents the intensity of the pixel (usually in a $[0, 255]$ range). For color or 3-channel (red (R), green (G), and blue (B)) three values corresponding to each channel are used.

Gray Scale Image



What we see

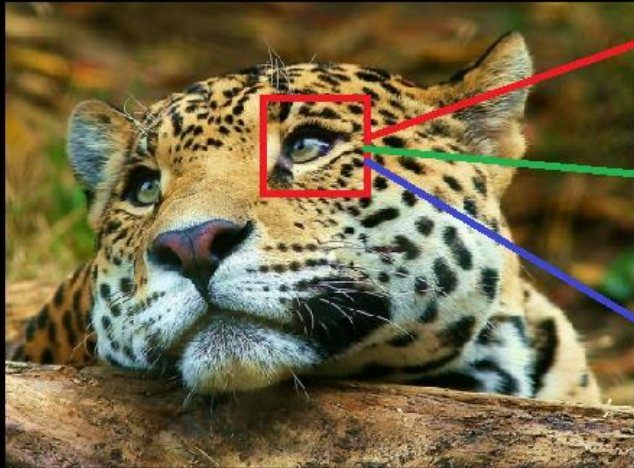
255	255	238	30	62	241	255
255	255	218		64	241	255
255	255	145		64	241	255
255	255	81		72	244	255
255	255	72		128	255	255
255	255	73		146	255	255
255	255	64		184	255	255
255	255	63		188	255	255

What computer sees

Spatial Domain Representation of an Image

An Image of size $M \times N$ can be spatially represented by the following way

$$I(x, y) = \begin{bmatrix} f(0, 0) & f(0, 1) & \dots & f(0, N-1) \\ f(1, 0) & f(1, 1) & \dots & f(1, N-1) \\ \vdots & \vdots & \ddots & \vdots \\ f(M-1, 0) & f(M-1, 1) & \ddots & f(M-1, N-1) \end{bmatrix}$$



3 Channel Image

35	36	37	38
46	47	48	49
101	102	103	104
131	132	133	134
65	66	67	68

R

121	122	123	124
33	34	35	36
77	78	79	80
213	214	215	216
19	20	21	22

G

251	252	253	254
71	72	73	74
181	182	183	184
39	40	41	42
113	114	115	116

B

Important Image Processing Techniques

- Image Deblurring OR Sharpening
- Noise Removal
- Contrast Enhancement
- Edge Detection

Image Deblurring OR Sharpening



Blurred Image



Sharp Image

Image Deblurring OR Sharpening



Original Image



Sharp Image

Images from Practical Image and video processing by OGE MARQUES

Noise Removal



Noisy Image



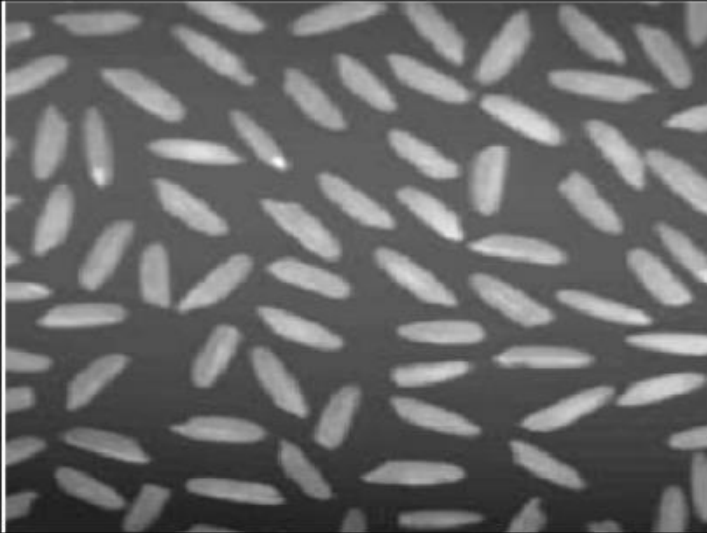
Filtered Image

Noise Removal

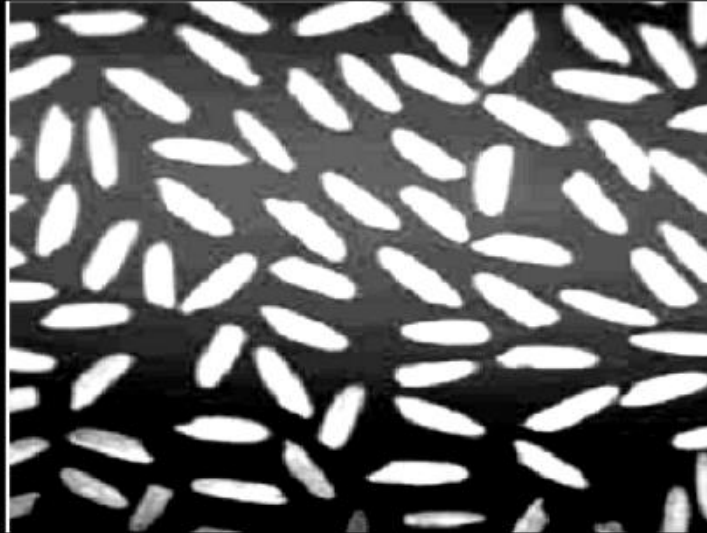


Images from Practical Image and video processing by OGE MARQUES

Contrast Enhancement



Low Contrast Image



High Contrast Image

Image from Practical Image and video processing by OGE MARQUES

Contrast Enhancement



Low Contrast Image



High Contrast Image

Image from Practical Image and video processing by OGE MARQUES

Edge Detection



Original Image

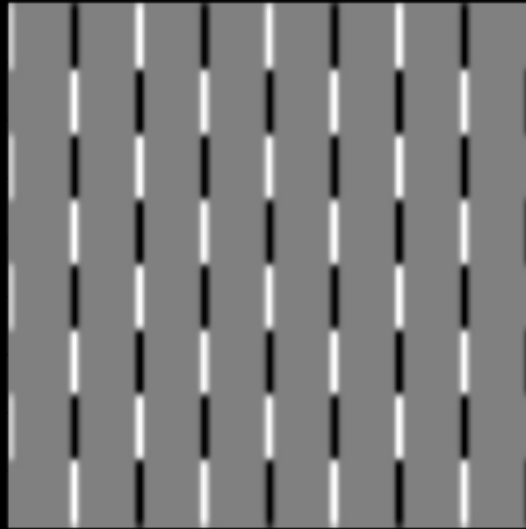


Edge Detection

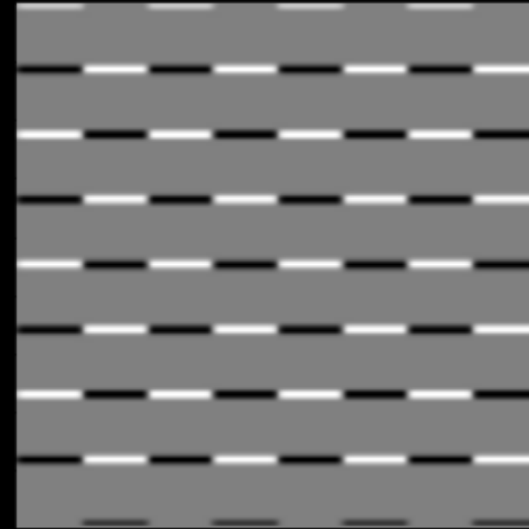
Edge Detection



Image



Vertical Edge Detection



Horizontal Edge Detection

Computer Vision

Computer Vision is an interdisciplinary field in which we enable computers to understand what is present in images and videos and derive meaningful information / features and take actions or make recommendations based on the information.

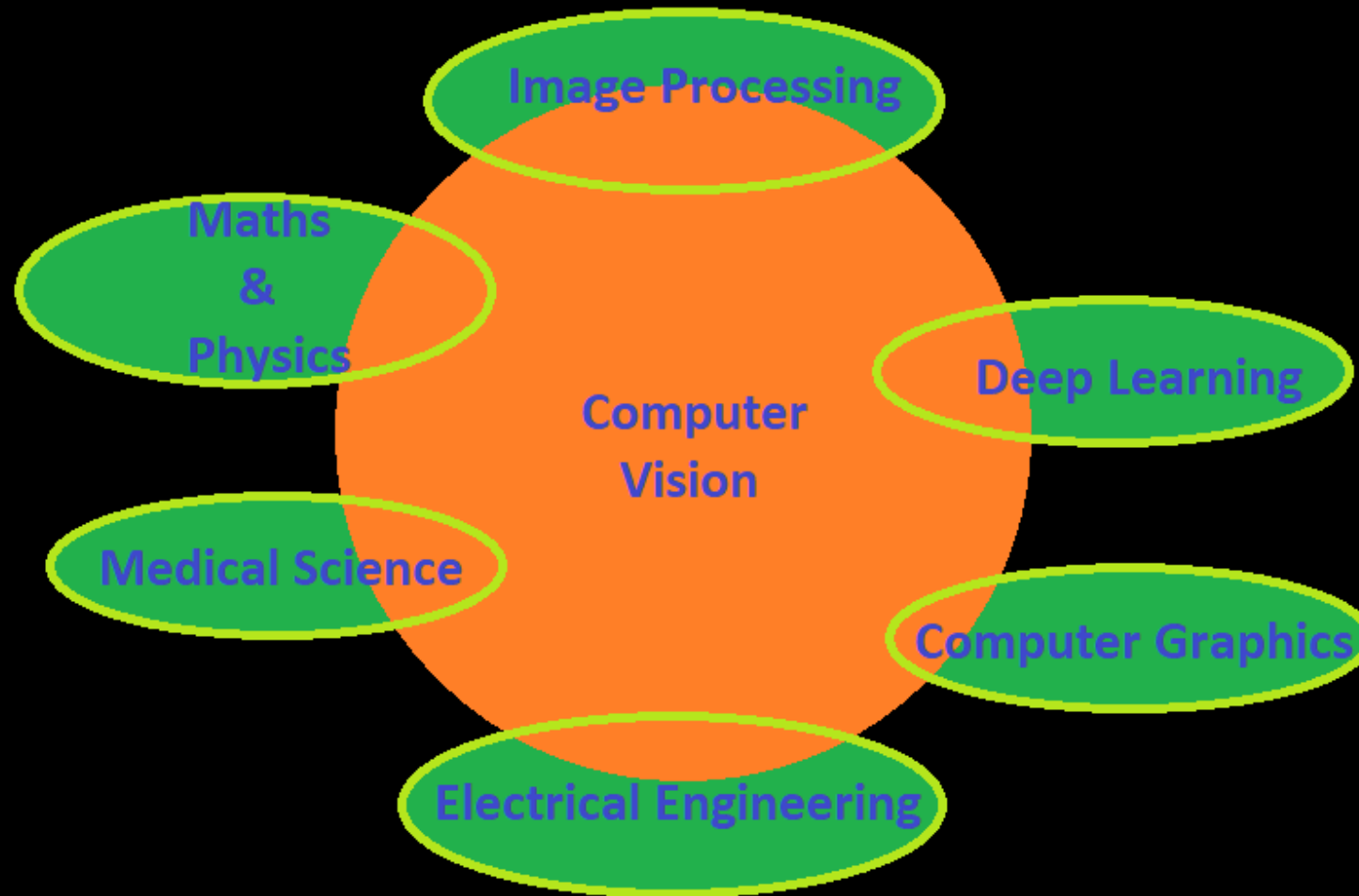
Is Computer Vision an AI?

Computer Vision, is a Vision AI, enables computers to interpret and analyze the visual world, and trains computers to replicate the human vision system.

Image Processing and Computer Vision

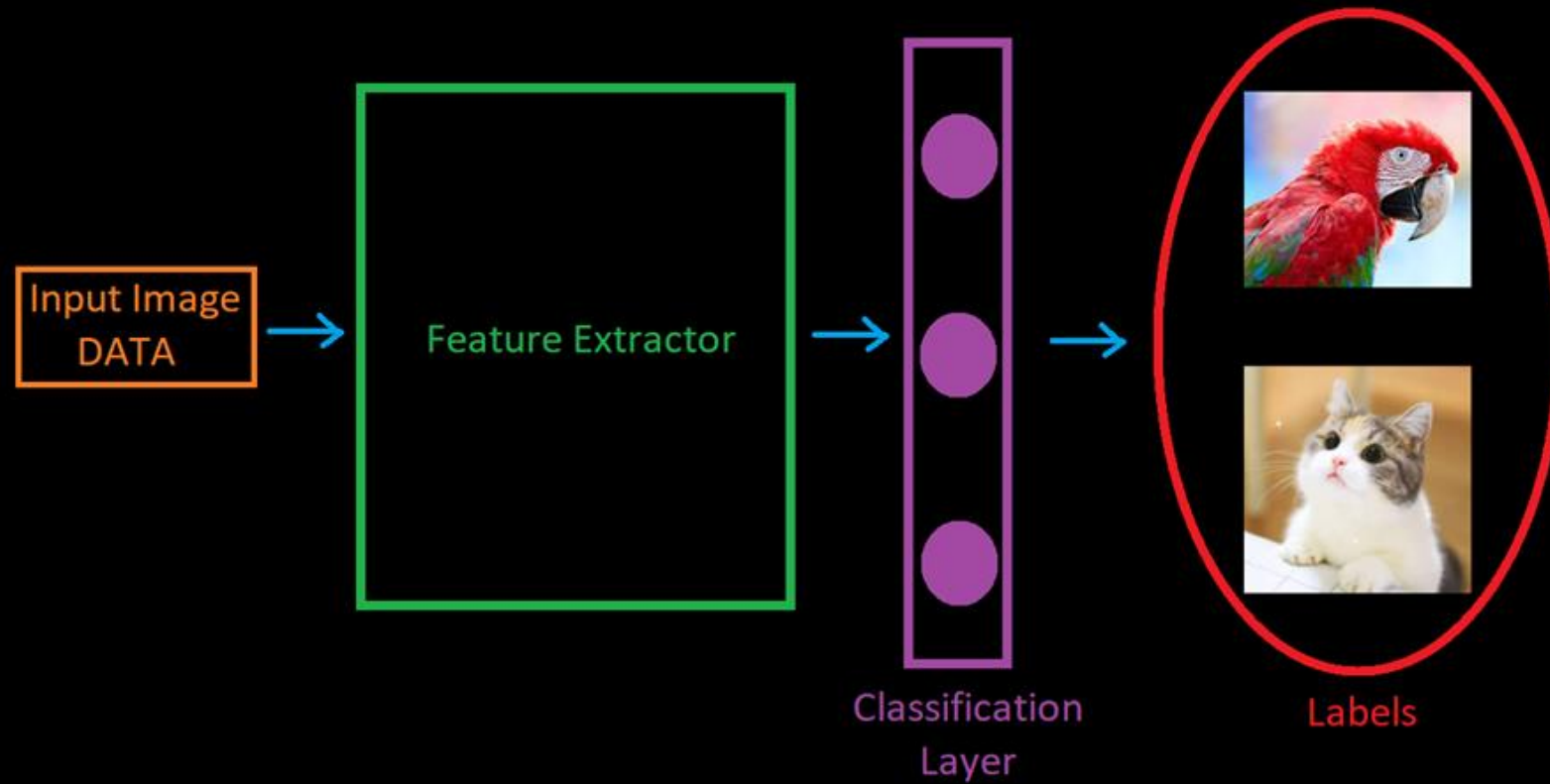
Image processing is just one of the many techniques that are employed in computer vision like other approaches such as Machine Learning, Deep Learning and Video Processing.

Computer Vision and Allied Fields

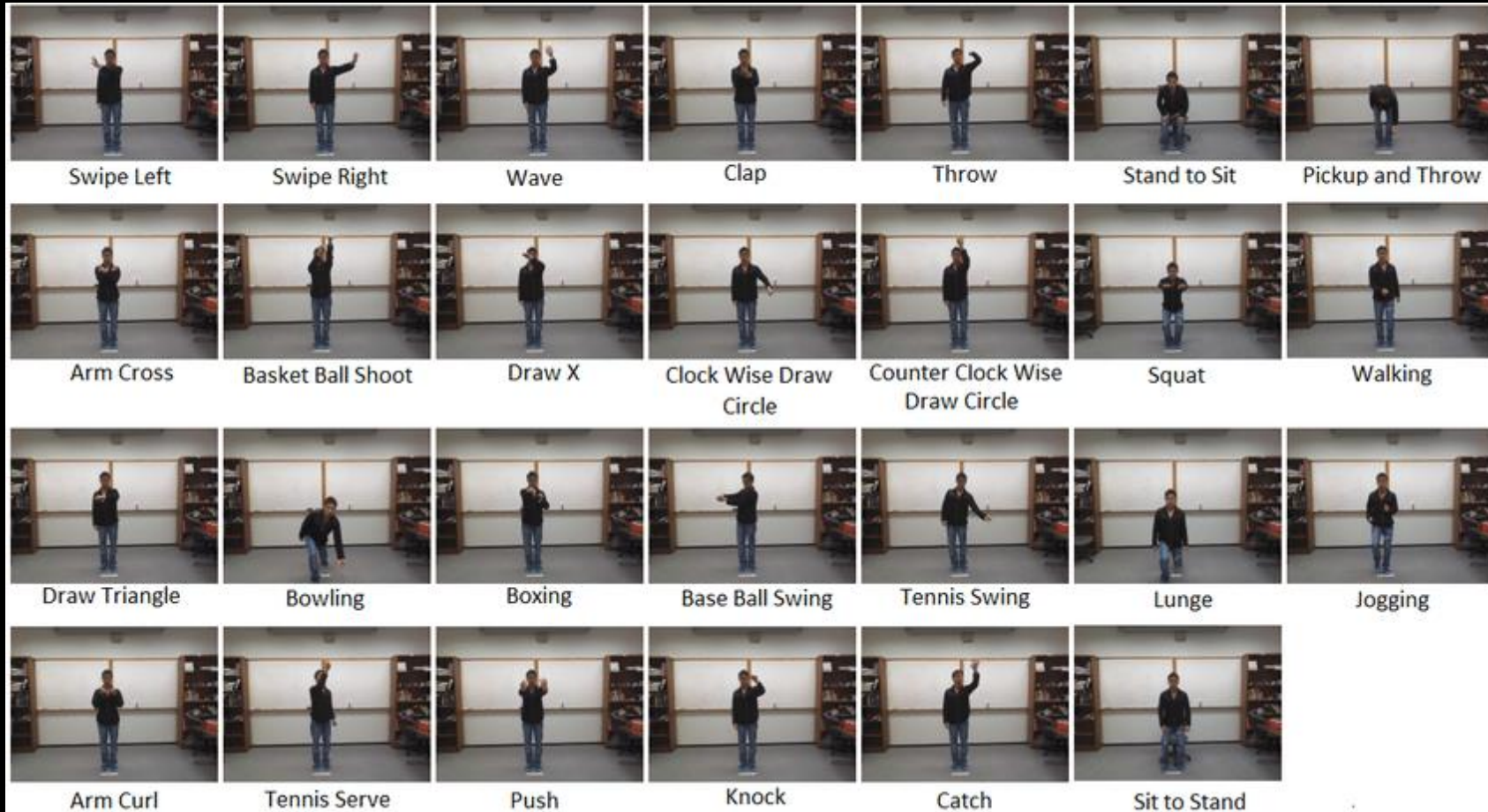


Applications of Computer Vision

Image Classification



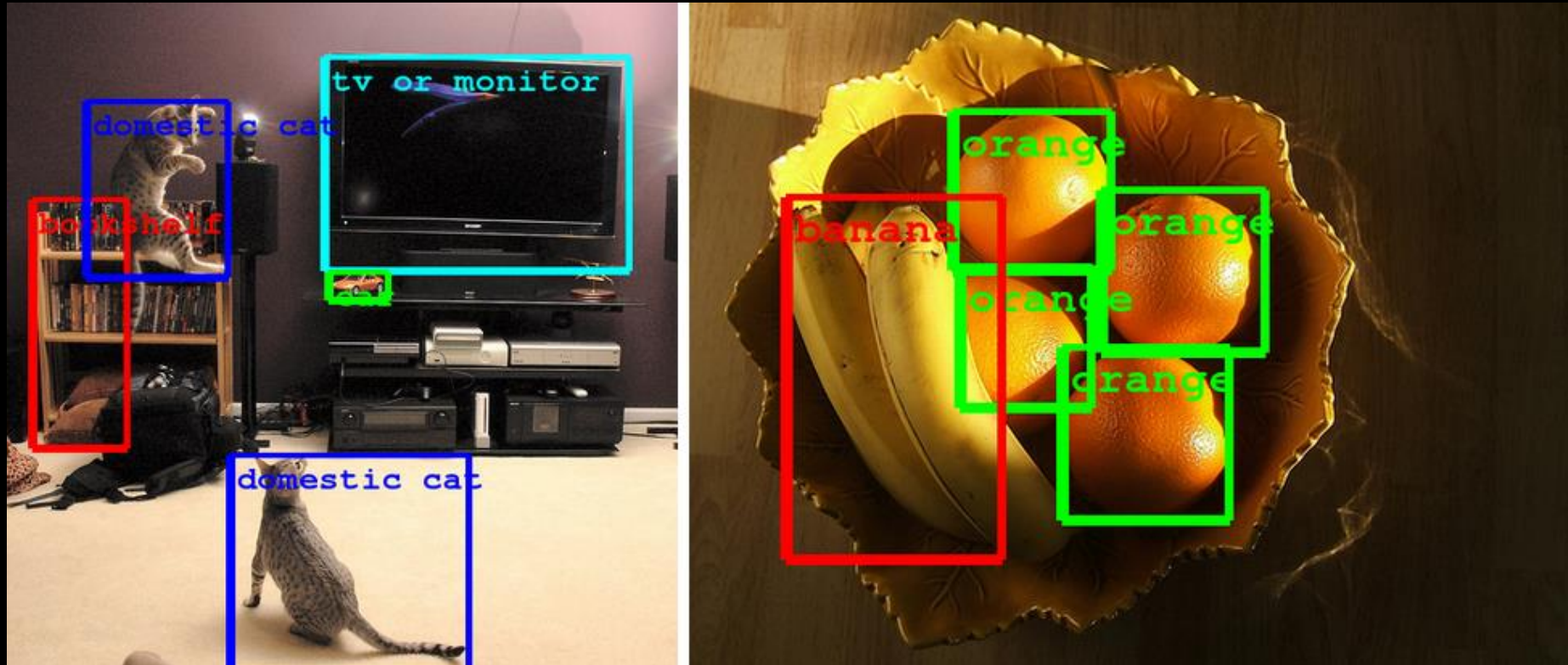
Human Action Recognition



Face Detection

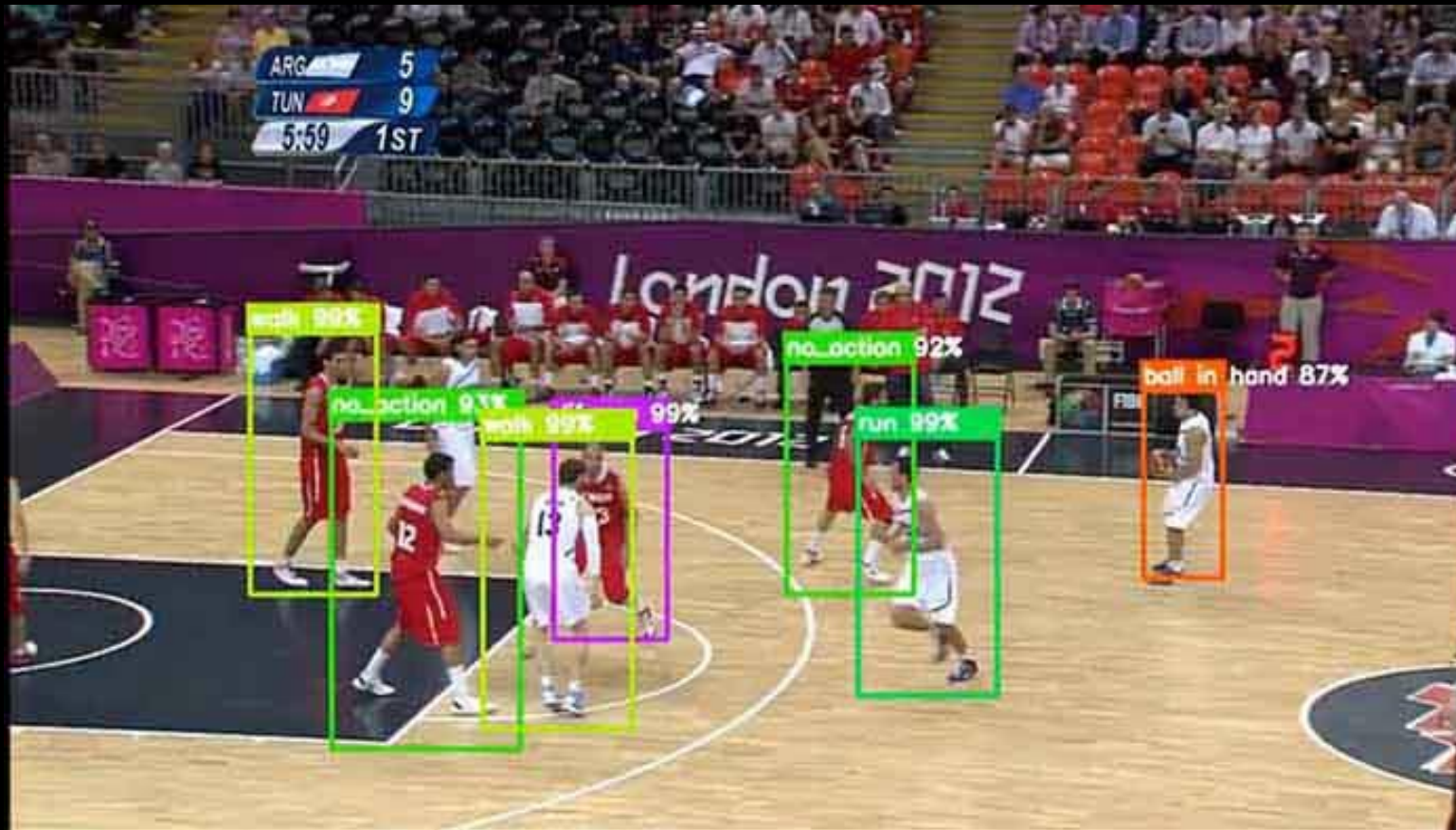


Object Detection



. Szegedy Et Al, Going Deeper with Convolutions , CVPR 2015.

Sports Analysis



Sports Analysis

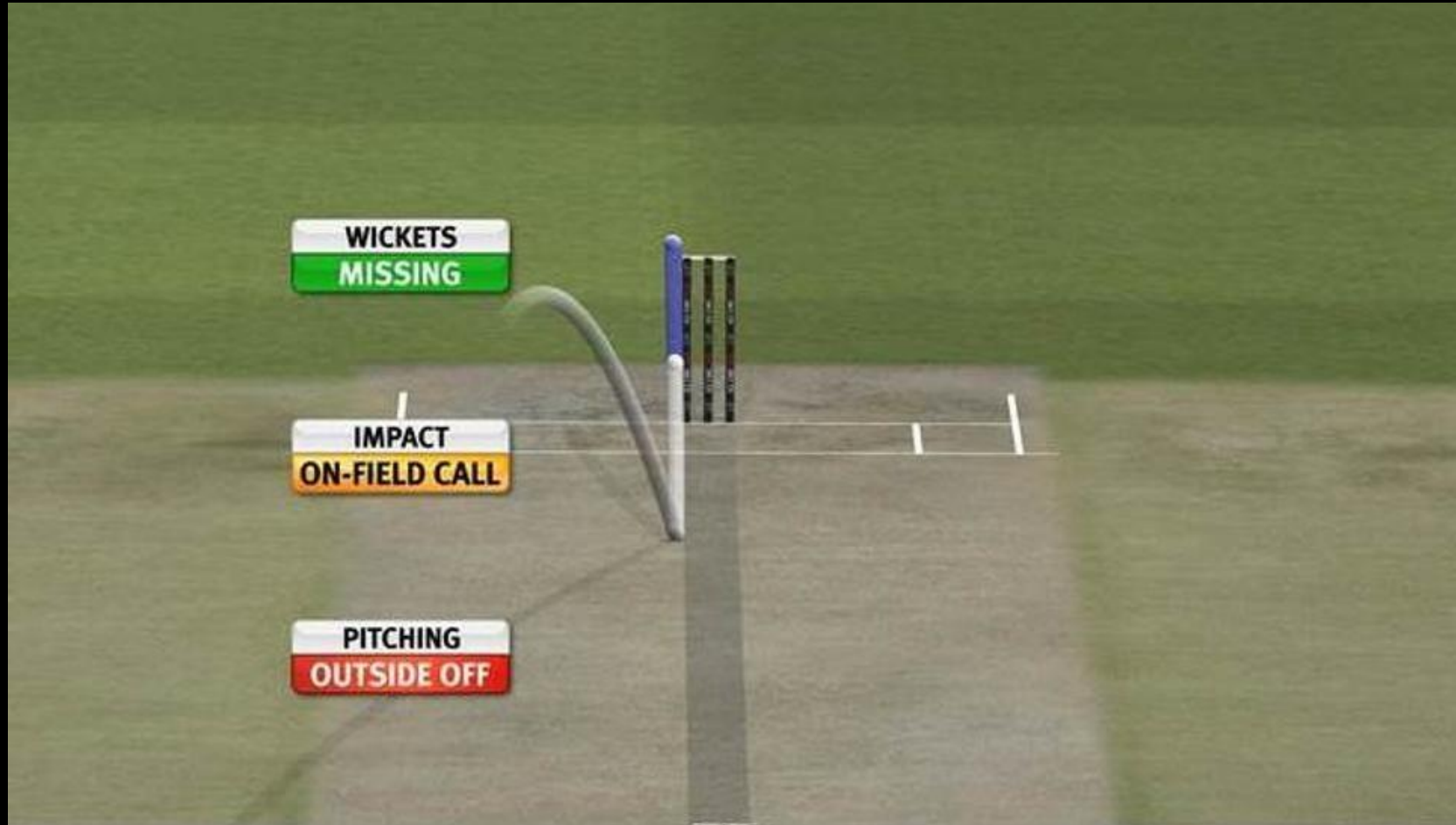
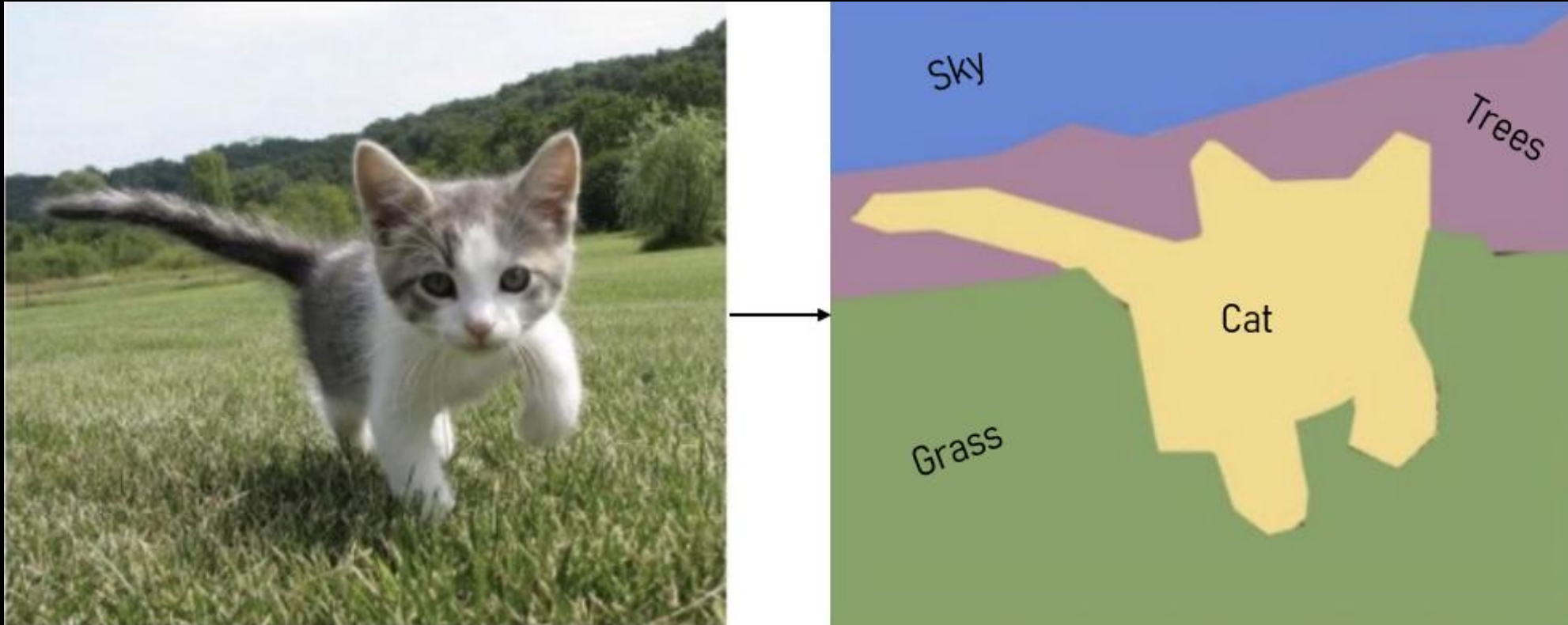


Image Segmentation



Google Images

Medical Image Segmentation



Google Images

Neural Style Transfer



Content

Style

Generated

<https://www.javatpoint.com/style-transferring-in-tensorflow>

Why Computer Vision is challenging ?

View Point Variation

View point variation means capturing the same instance of object from different angles.



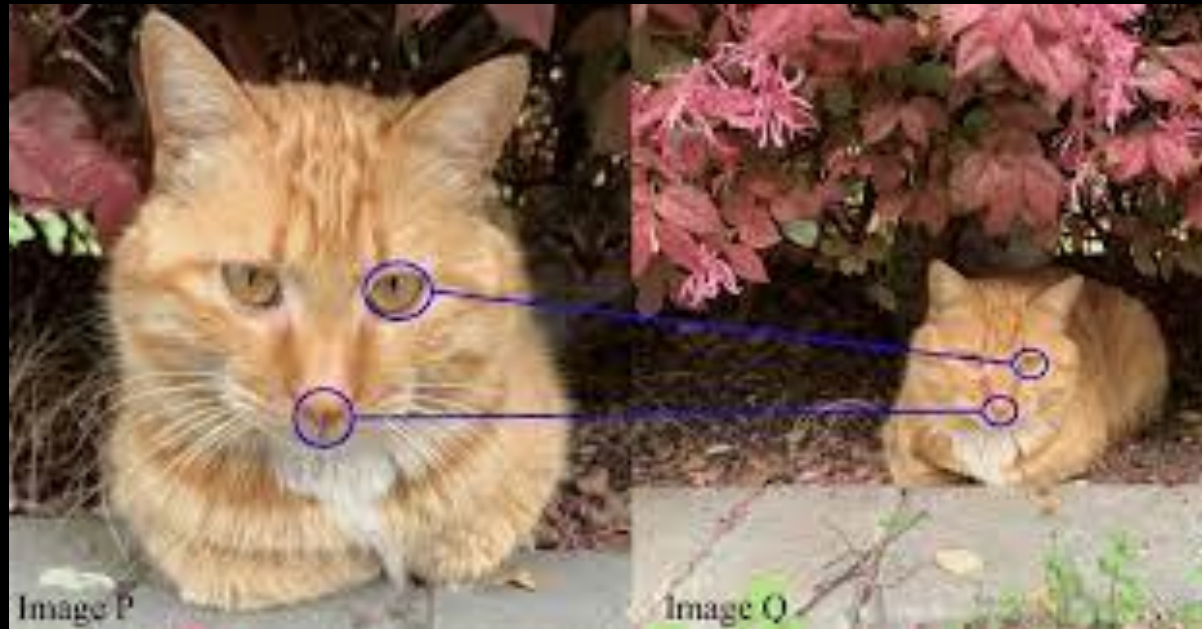
View Point Variation



Changing Lighting Condition



Scaling



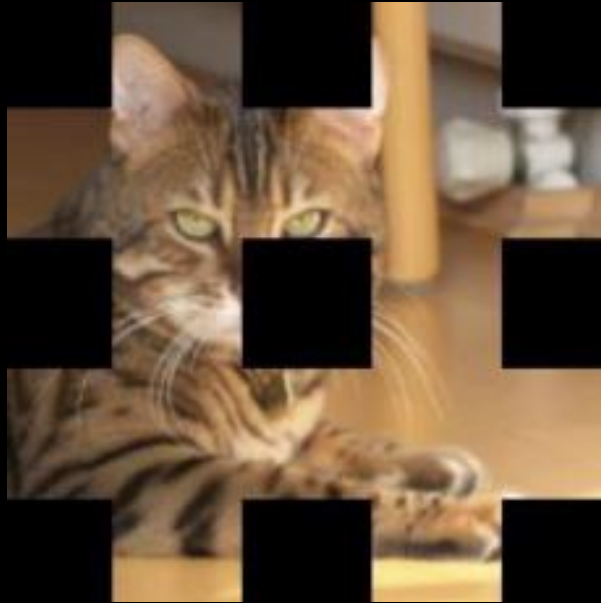
Deformation

Change in shape due to force is called deformation. Deformation is a measure of how much an object is stretched, and strain is the ratio between the deformation and the original length.



Occlusion

If the object of interest / to track is hidden (occluded) by another object then this problem is called occlusion.



Clutter



Intra-class Variation



Thank you!

Thank you!