CS7GV1 Computer vision
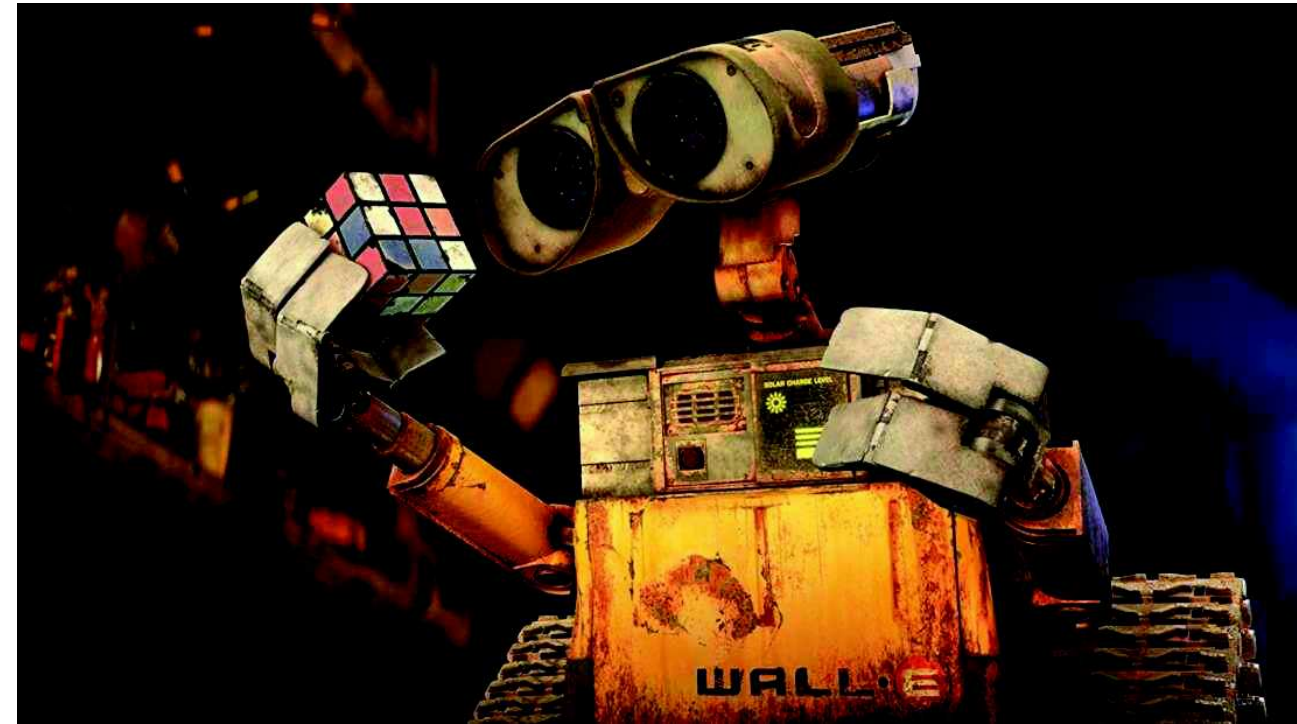## Introduction
Dr. Martin Alain

What is Computer Vision?

Computer vision originally aimed at computers mimicking what the human visual system can do in understanding images, as a stepping stone to endowing robots with intelligent behaviour.
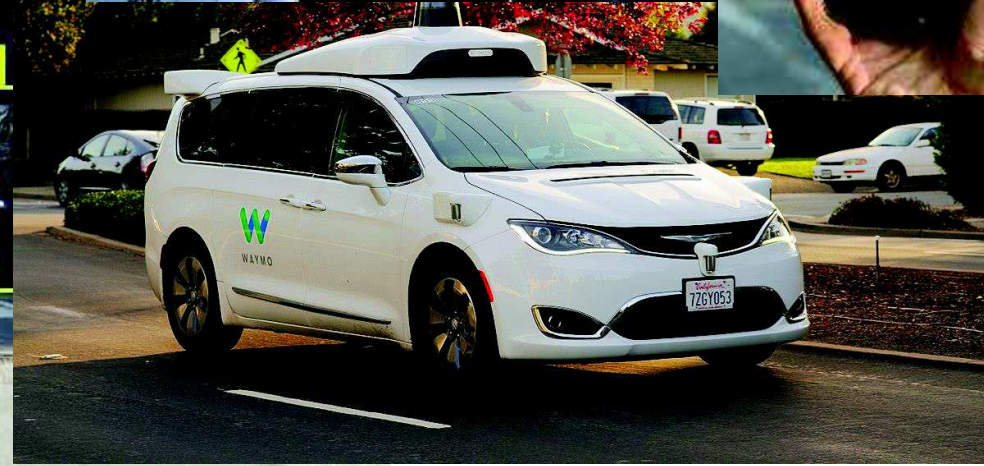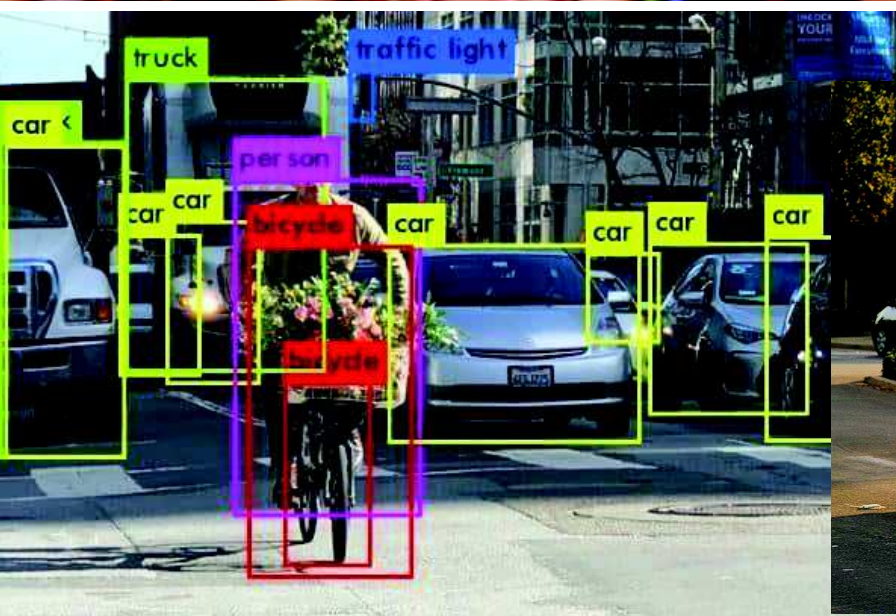

Animal visual system is also a source of inspiration for building intelligence

Computer vision Vs digital image processing:

CV originally aims to extract 3D structure from images with the goal of achieving full scene understanding.
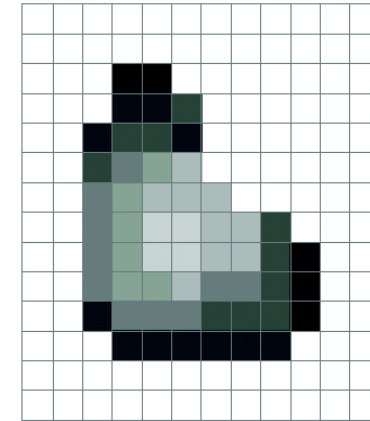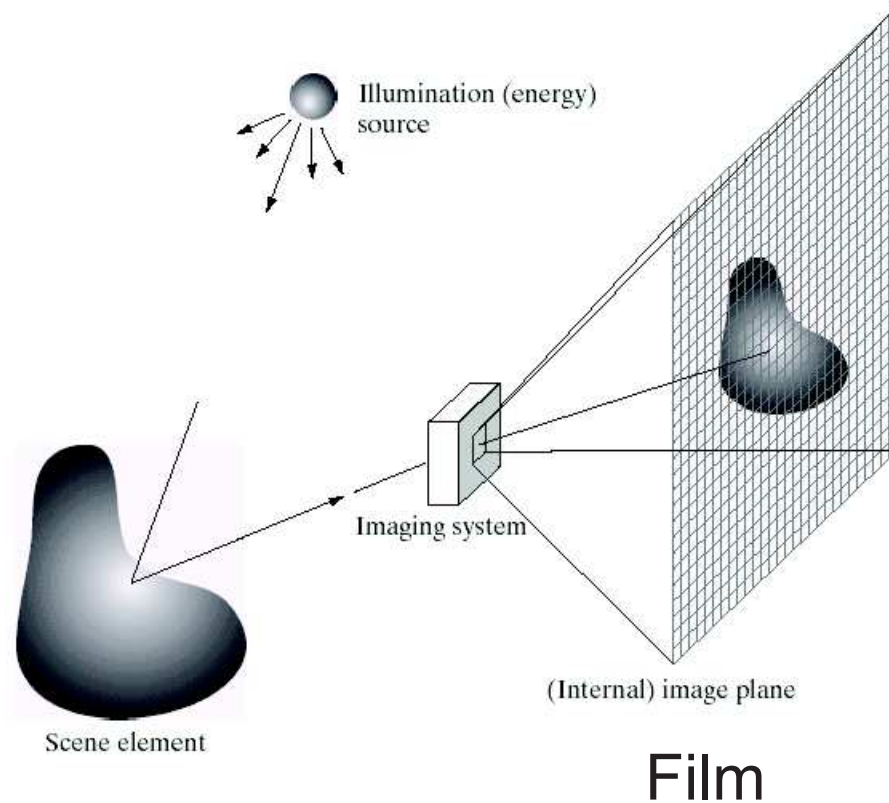
HR.26 BR.9044

truck
traffic light
car <
car car
per son
bicycle
car
car car car
bicycle

Nicole
Kate

TOWER BRIDGE

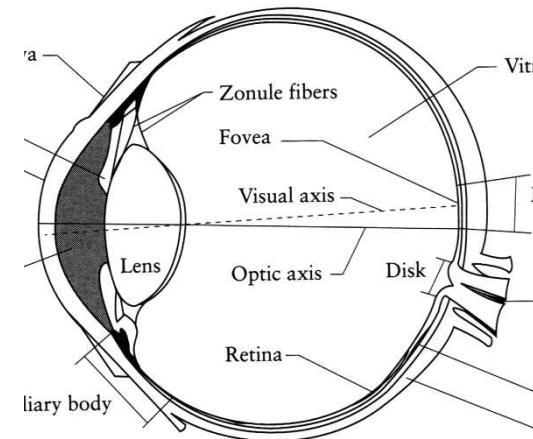# Underpinning fields of Computer Vision

- Mathematics
- Statistics
- Electronics
- Physics
- Computer science
- Psychology (Perception)
- …

Image Formation

Film

Digital Camera

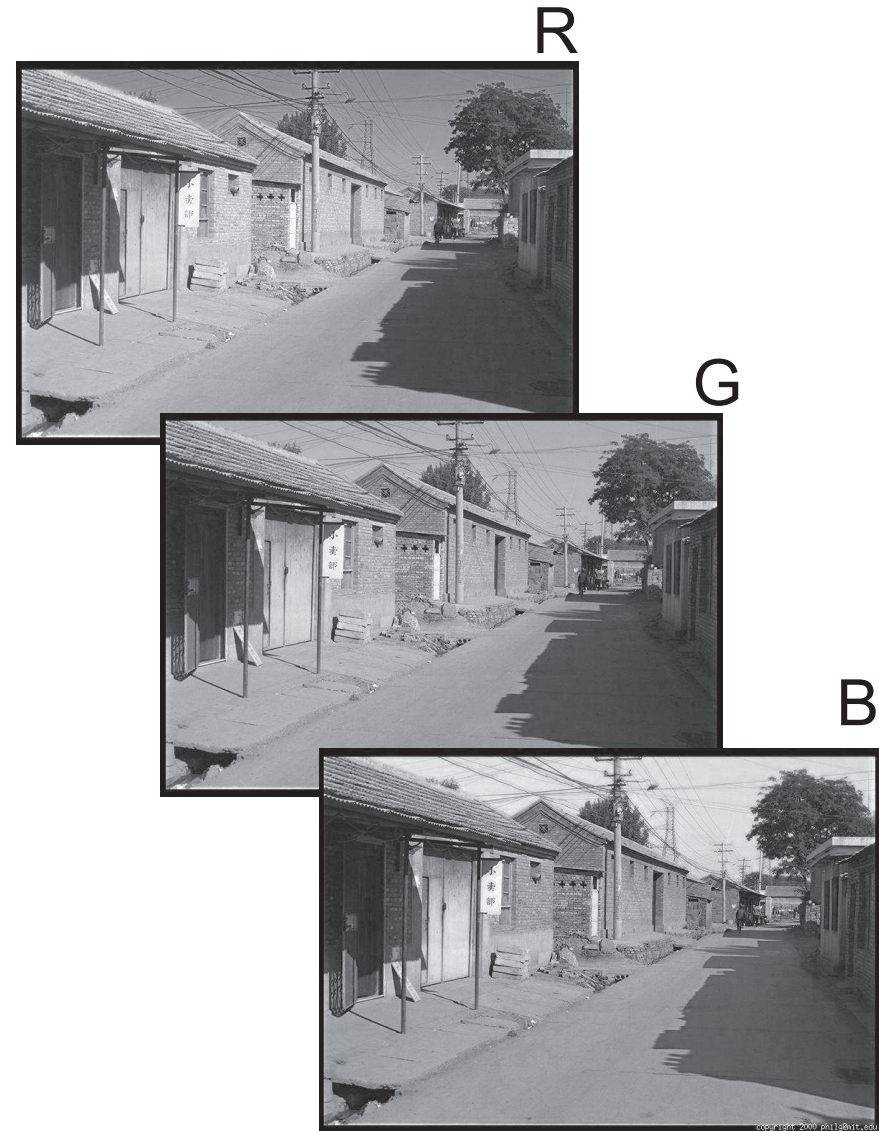The Eye

Digital camera

- A digital camera replaces film with a sensor array
  - Each cell in the array is light-sensitive diode that converts photons to electrons
  - Two common types
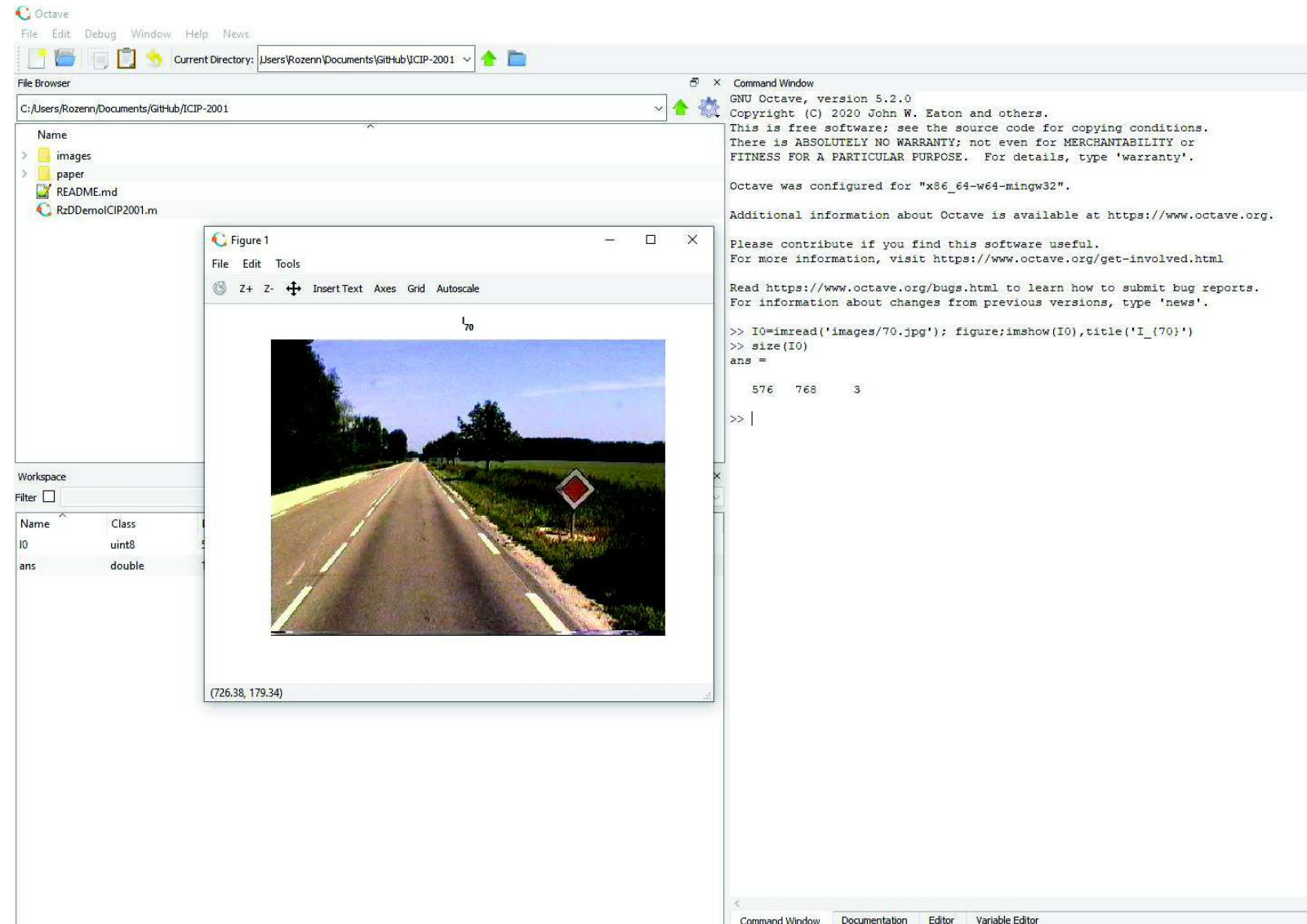   - Charge Coupled Device (CCD)
    - CMOS
  - http://electronics.howstuffworks.com/digital-camera.htm

Slide by Steve Seitz

Color Image

R

G

B

Pixel = Picture element

Octave-Matlab


```
I0=imread('images/70.jpg');
figure;imshow(I0),title('I_{70}')
```

Octave-Matlab
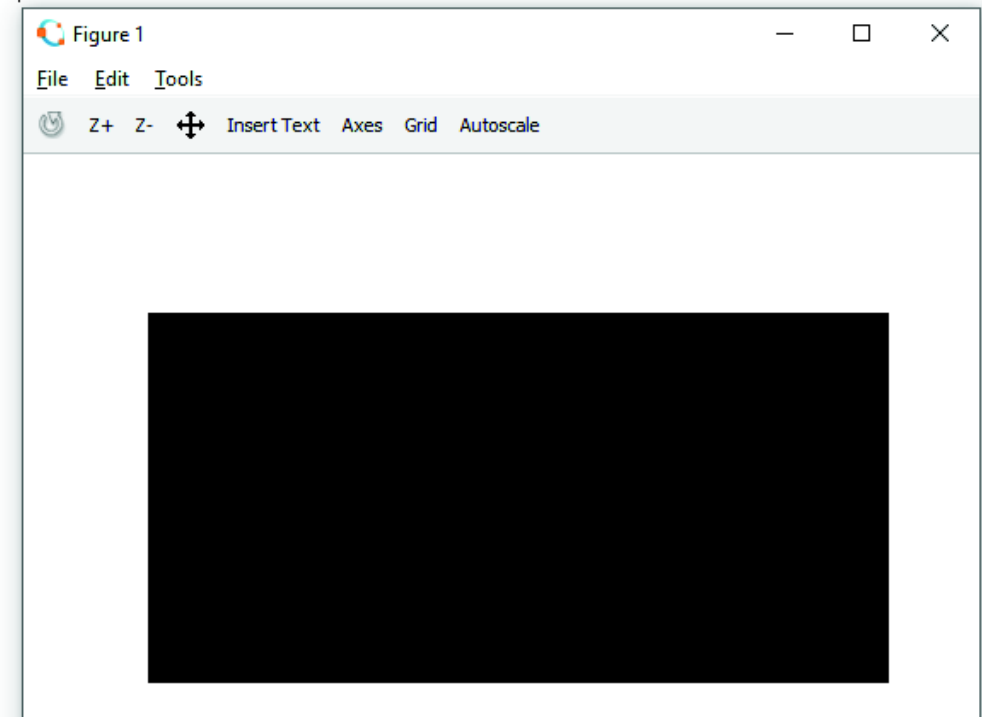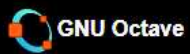
```
>> I0(1:10,1:20,3)
ans =

  43  56  64  60  57  58  60  58  55  67  65  48  39  47  57  58  71  64  59  56
  54  62  66  60  60  64  63  60  48  56  55  41  36  47  59  62  63  57  53  51
  35  35  34  32  34  40  40  33  44  50  47  39  41  53  65  67  51  46  44  46
  37  34  30  31  35  41  41  37  37  38  36  35  40  53  59  58  37  33  35  41
  47  44  42  46  50  52  50  51  28  24  22  25  33  42  42  35  26  26  28  35
  34  37  44  48  44  36  37  43  31  22  16  20  33  39  33  23  17  20  25  30
  32  42  56  59  46  28  29  40  45  29  16  18  32  38  32  22  10  15  19  22
  29  44  61  62  42  20  19  33  51  28   9  12  25  33  28  19   5  12  16  16
  16  31  49  51  35  19  21  32  66  53  31  19  24  35  39  34  34  30  24  18
  17  31  47  50  35  20  22  33  44  43  36  28  27  31  33  29  33  31  27  23

>> imshow(I0(1:10,1:20,3))
>>
```
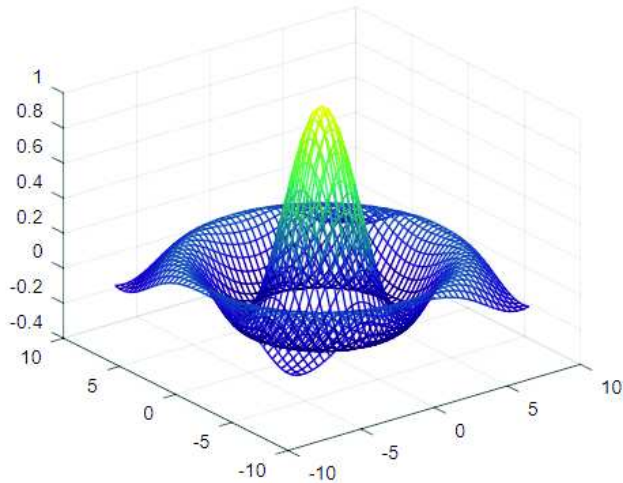
Red channel

```
figure;imshow(I0(:,:,1))
```

Blue channel

```
I0(1:10,1:20,3)
imshow(I0(1:10,1:20,3))
```

Figure 1

File   Edit   Tools

Z+ Z- ⊕ Insert Text   Axes   Grid   Autoscale

https://www.gnu.org/software/octave/

https://octave.sourceforge.io/packages.php

```python
1  import cv2
2  import numpy as np
3  import os
4  from random import shuffle
5  from tqdm import tqdm
6  import tensorflow as tf
7  import matplotlib.pyplot as plt
8  %matplotlib inline
9
10 train_data = '/TensorFlow/ImageData/Vehicles/train'
11 test_data = '/TensorFlow/ImageData/Vehicles/test'
12
13 def one_hot_label(img):
14     label = img.split('.')[0]
15     if label == 'car':
16         ohl = np.array([1,0])
17     elif label == 'truck':
18         ohl = np.array([0,1])
19     return ohl
20 def train_data_with_label():
21     train_images = []
22     for i in tqdm(os.listdir(train_data)):
23         path = os.path.join(train_data, i)
24         img = cv2.imread(path, cv2.IMREAD_GRAYSCALE)
25         img = cv2.resize(img, (64, 64))
26         train_images.append([np.array(img), one_hot_label(i)])
27     shuffle(train_images)
28     return train_images
29
30 def test_data_with_label():
31     test_images = []
32     for i in tqdm(os.listdir(test_data)):
33         path = os.path.join(test_data, i)
34         img = cv2.imread(path, cv2.IMREAD_GRAYSCALE)
35         img = cv2.resize(img, (64, 64))
36         test_images.append([np.array(img), one_hot_label(i)])
37     return test_images
```
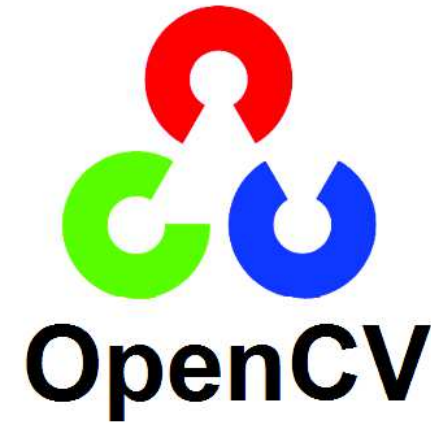
```cpp
29   //Opencv C++ Example of Operation on Arrays:absdiff
30   #include "opencv2/highgui/highgui.hpp"
31   #include "opencv2/imgproc/imgproc.hpp"
32   #include <iostream>
33
34   using namespace cv;
35   using namespace std;
36
37   int main( )
38   {
39
40       Mat image1,image2,dst;
41       image1 = imread("C:\\Users\\shourya\\Desktop\\opencv-logo1.jpg",CV_LOAD_IMAGE_COLOR);
42       if( !image1.data ) { printf("Error loading image1 \n"); return -1;}
43       image2 = imread("C:\\Users\\shourya\\Desktop\\opencv-testing.png",CV_LOAD_IMAGE_COLOR);
44       if( !image2.data ) { printf("Error loading image2 \n"); return -1;}
45
46       absdiff( image1,  image2,  dst);
47
48       namedWindow( "Display window", CV_WINDOW_AUTOSIZE );
49       imshow( "Display window", image2 );
50
51       namedWindow( "Display windo", CV_WINDOW_AUTOSIZE );
52       imshow( "Display windo", image1 );
53
54       namedWindow( "Result window", CV_WINDOW_AUTOSIZE );
55       imshow( "Result window", dst );
56
57       //imwrite("C:\\Users\\shourya\\Desktop\\opencv-dst.jpg",dst);
58       waitKey(0);
59       return 0;
60   }
```

- Share / archive code
- Essential for teamwork