KMITL BEYOND THE LIMIT

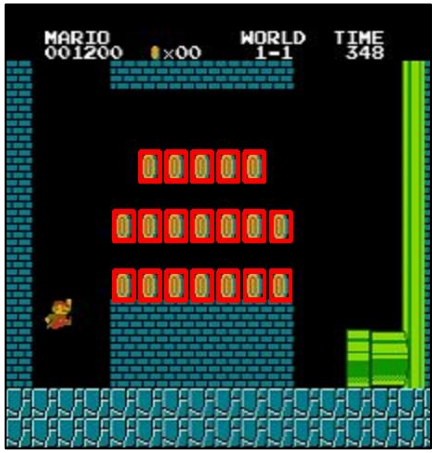
COMPUTER VISIONS

01416500
Course Code

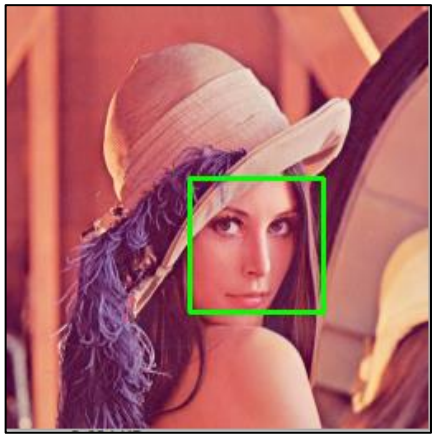
Image Recognition

Overview

1. Template Matching



2. Face Detection



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1. Template Matching

What is template matching?

Template matching is a technique for finding areas of an image that match (are similar) to a template image (patch).

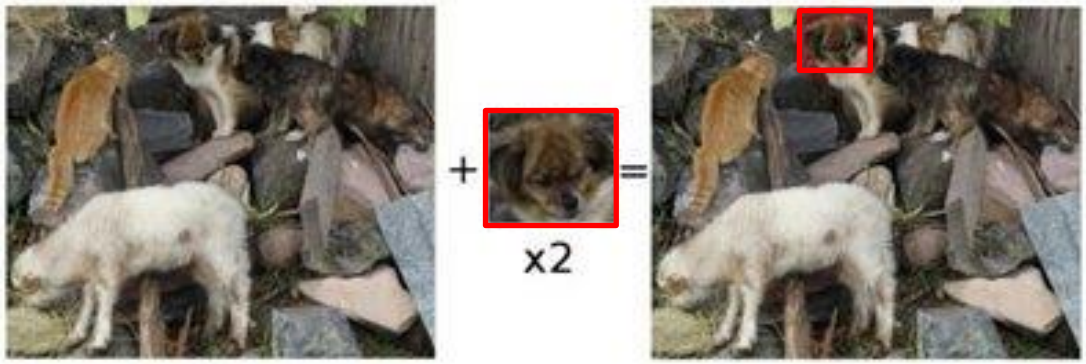
We need ***two*** *primary components*:

I. **Source image (I):** The image in which we expect to find a match to the template image

II. **Template image (T):** The patch image which will be compared to the template image

1. Template Matching

Our goal is to detect the highest matching area:



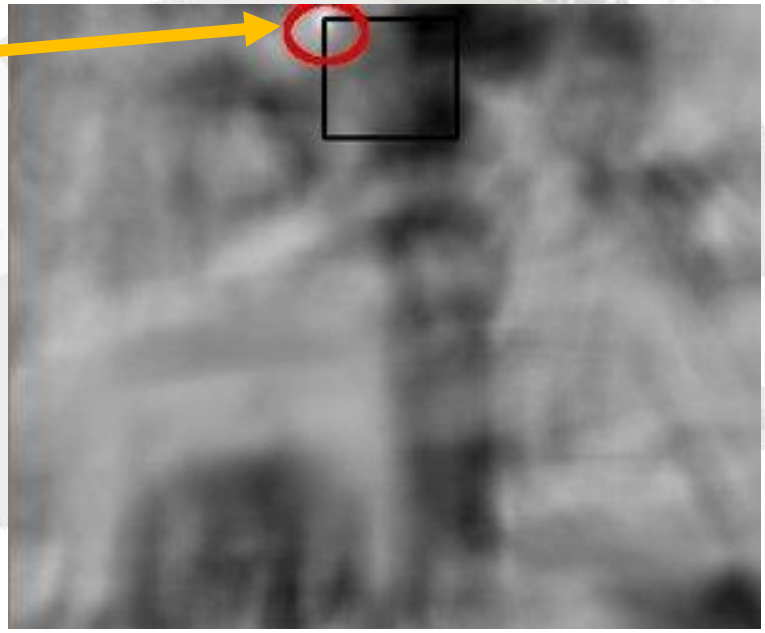
By **sliding**, we mean moving the patch one pixel at a time (left to right, up to down).

To identify the ***matching area***, we have to *compare* the template image against the source image by sliding it:

1. Template Matching

- **Several comparison methods** are implemented in OpenCV,
- It returns a grayscale image, where each pixel denotes how much does the neighborhood of that pixel match with template.

Some location maximum result



For each location of T over I, you store the metric in the result matrix (R). Each location (x,y) in R contains the match metric:

1. Template Matching

Which are the matching methods available in OpenCV

1. **method=CV_TM_SQDIFF**

$$R(x,y) = \sum_{x',y'} (T(x',y') - I(x+x',y+y'))^2 \quad \text{(Min)}$$

2. **method=CV_TM_SQDIFF_NORMED**

$$R(x,y) = \frac{\sum_{x',y'} (T(x',y') - I(x+x',y+y'))^2}{\sqrt{\sum_{x',y'} T(x',y')^2 \cdot \sum_{x',y'} I(x+x',y+y')^2}} \quad \text{(Min)}$$

3. **method=CV_TM_CCORR**

$$R(x,y) = \sum_{x',y'} (T(x',y') \cdot I(x+x',y+y')) \quad \text{(Max)}$$

1. Template Matching

4. method=CV_TM_CCORR_NORMED

$$R(x,y) = \frac{\sum_{x',y'}(T(x',y') \cdot I(x+x',y+y'))}{\sqrt{\sum_{x',y'} T(x',y')^2 \cdot \sum_{x',y'} I(x+x',y+y')^2}}$$ **(Max)**

5. method=CV_TM_CCOEFF

$$R(x,y) = \sum_{x',y'} (T'(x',y') \cdot I(x+x',y+y'))$$ **(Max)**

where

$$T'(x',y') = T(x',y') - 1/(w \cdot h) \cdot \sum_{x'',y''} T(x'',y'')$$
$$I'(x+x',y+y') = I(x+x',y+y') - 1/(w \cdot h) \cdot \sum_{x'',y''} I(x+x'',y+y'')$$

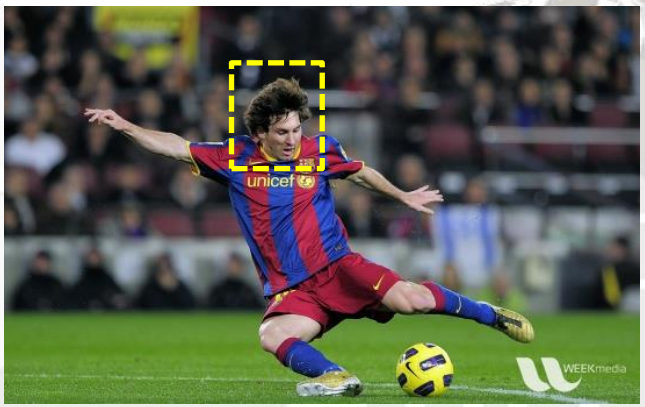
6. method=CV_TM_CCOEFF_NORMED

$$R(x,y) = \frac{\sum_{x',y'}(T'(x',y') \cdot I'(x+x',y+y'))}{\sqrt{\sum_{x',y'} T'(x',y')^2 \cdot \sum_{x',y'} I'(x+x',y+y')^2}}$$ **(Max)**

1. Template Matching

Here, as an example, we will search for Messi's face in his photo.

So if created **a template** as below:



We will try all the comparison methods so that we can see how their results look like:

1. Template Matching

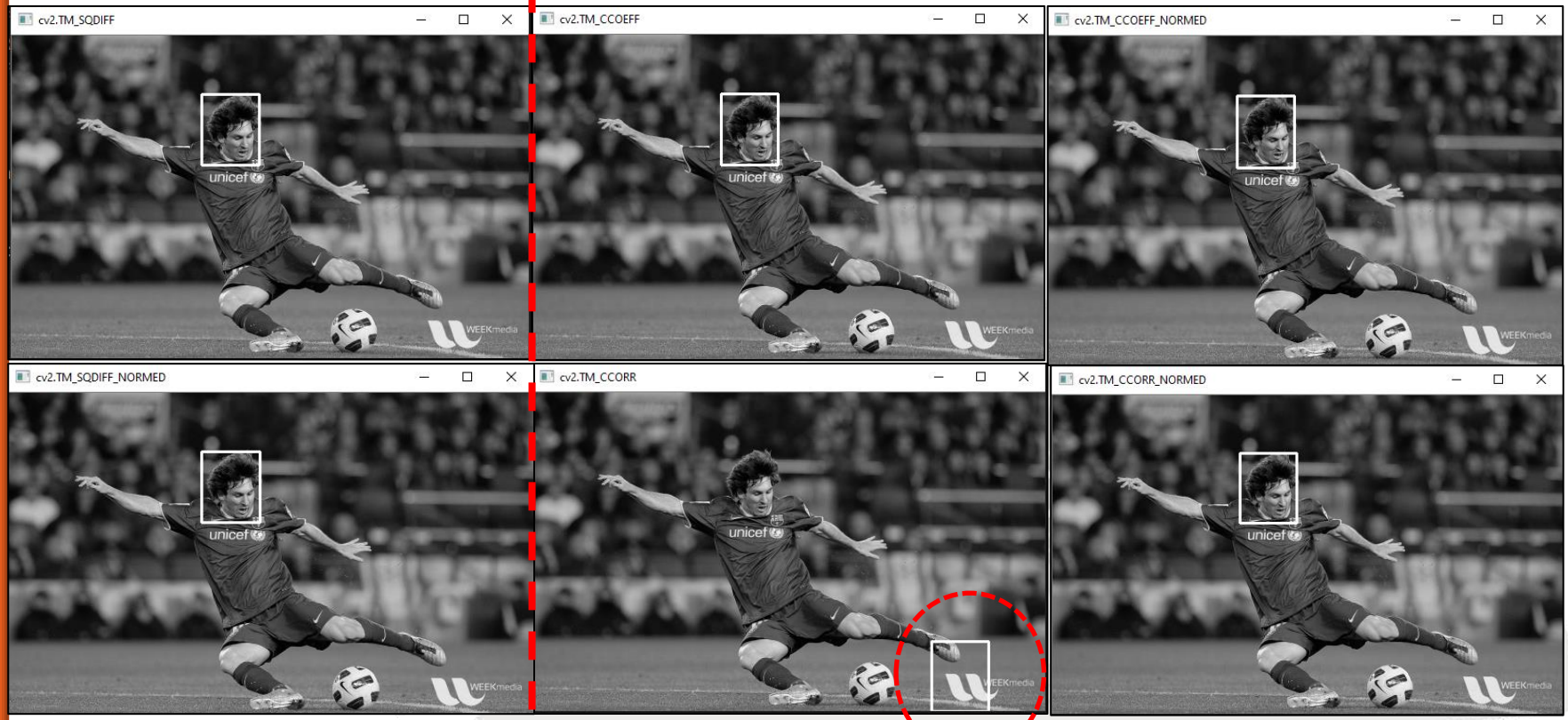
OpenCV function :

cv2.matchTemplate()

```python
import cv2
import numpy as np
from matplotlib import pyplot as plt

img = cv2.imread('dataset/messi.jpg',0)
template = cv2.imread('dataset/template.jpg',0)
w= template.shape[1]
h= template.shape[0]

method = cv2.TM_SQDIFF

res = cv2.matchTemplate(img,template,method)
min_val, max_val, min_loc, max_loc = cv2.minMaxLoc(res)

top_left = min_loc
bottom_right = (top_left[0] + w, top_left[1] + h)
cv2.rectangle(img,top_left, bottom_right, 255, 2)

# cv2.imshow("Gray",res)
cv2.imshow("cv2.TM_SQDIFF",img)
cv2.waitKey()
cv2.destroyAllWindows()
```

Template image

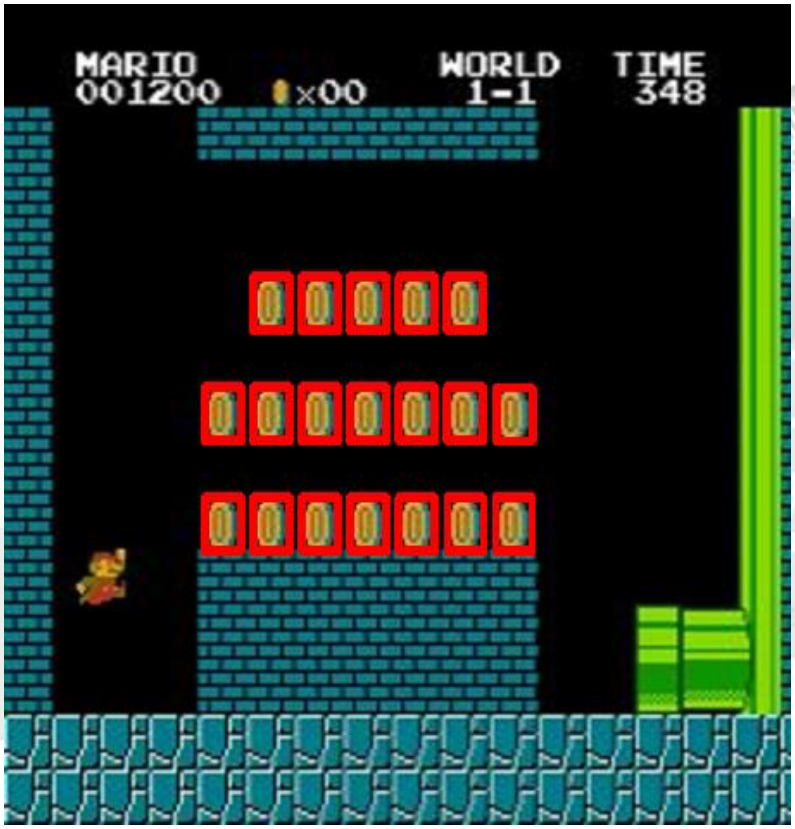
1. Template Matching



Quiz 1 (15 min)

Let you show the location of coins in "**mario.png**" and template image "**mario_coin.png**" (free to select template matching method)

Output image



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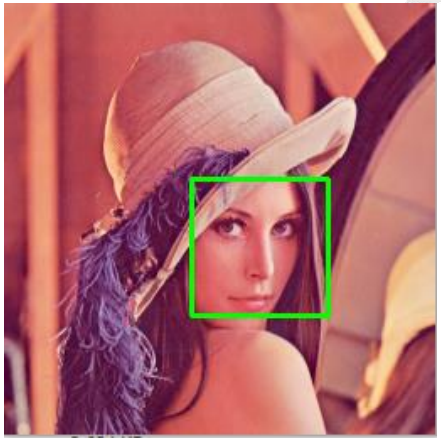
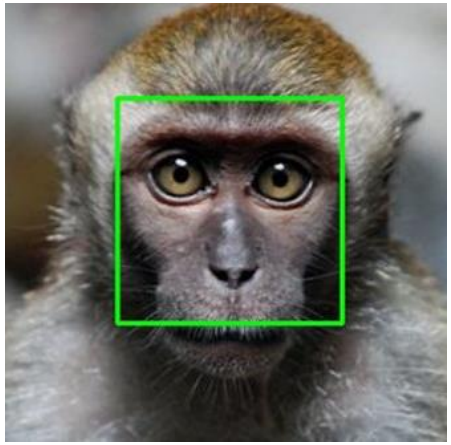
KMITL ROBOTICS and AI International Program

Image Recognition





Face Detection

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2. Face Detection

What is “Face Detection”?

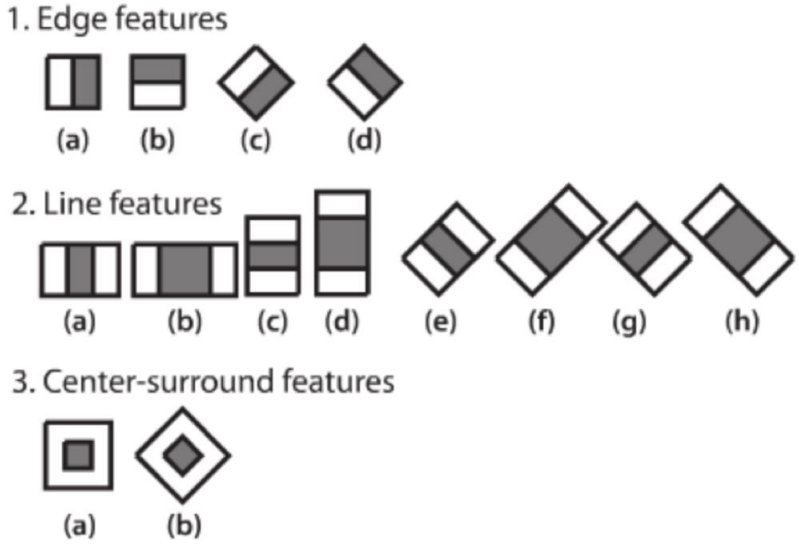
Face detection is a type of application classified under “**computer vision**” technology. It is the process in which algorithms are developed and trained to properly locate faces or objects (in object detection, a related system), in images.

Face detection uses ***classifiers***, which are algorithms that detects what is either a face(1) or not a face(0) in an image. Classifiers have been trained to detect faces using thousands to millions of images in order to get more accuracy.

2. Face Detection

Understanding Haar Cascades

A sequence of rescaled "**square-shaped**" functions which together form a wavelet family or basis.

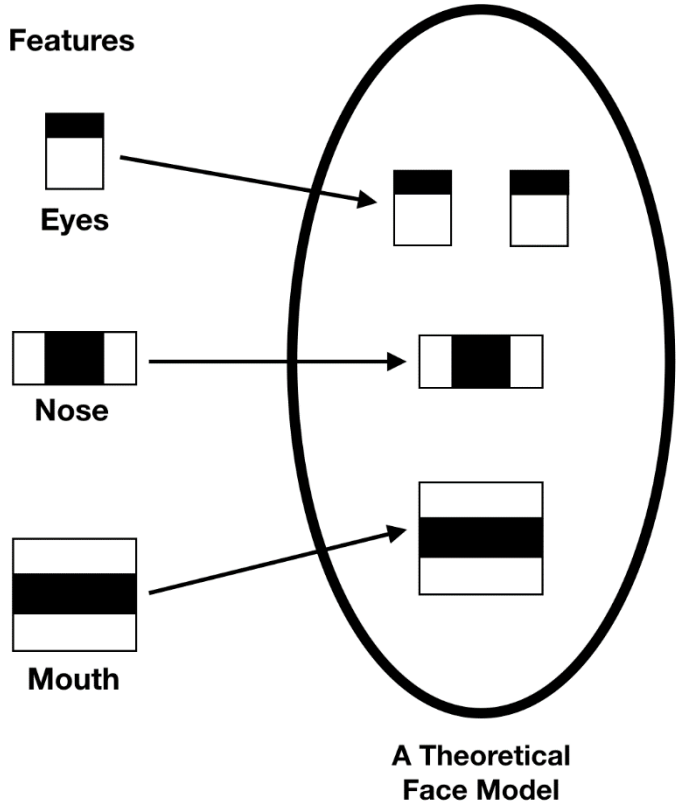


Face Detection determines the locations and sizes of human faces in arbitrary (digital) images.

In **Face Recognition**, the use of Face Detection comes first to determine and isolate a face before it can be recognized.

2. Face Detection

Feature Extraction



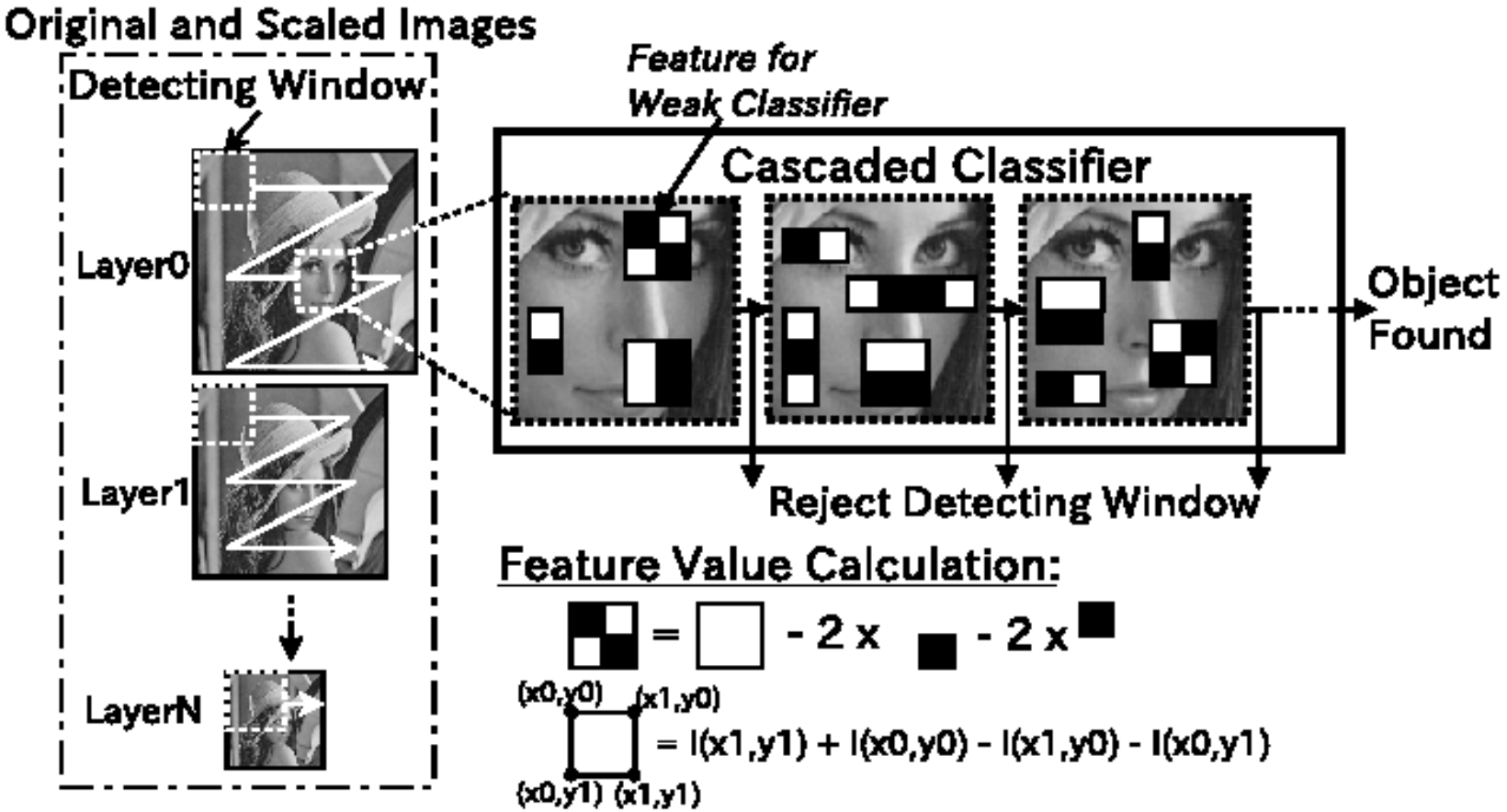
Haar Cascades use machine learning techniques in which a function is trained from a lot of positive and negative images.

This process in the algorithm is feature extraction.

The training data used in this project is an XML file called:

haarcascade_frontalface_default.xml

2. Face Detection



Ref : A low-power Adaboost-based object detection processor using Haar-like features

2. Face Detection

This contains code parameters that are the most important to consider.

scaleFactor: The value indicates how much the image size is reduced at each image scale. A lower value uses a **smaller step for downscaling**. This allows the algorithm to detect the face. It has a value of x.y, where x and y are arbitrary values, you can set.

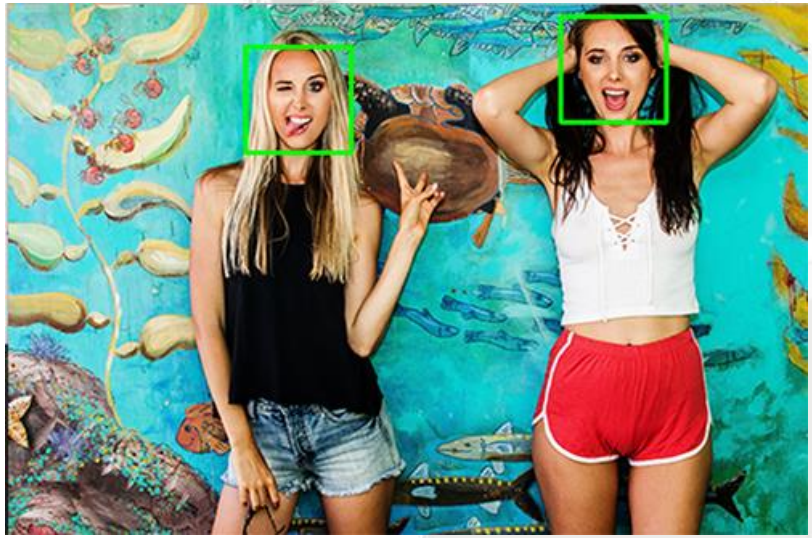
minNeighbors: This parameter specifies how many "**neighbors**" each candidate rectangle should have. A higher value results in less detections but it detects higher quality in an image.

minSize: The minimum **object size**. By default it is (30,30). The smaller the face in the image, it is best to adjust the minSize value lower.

2. Face Detection

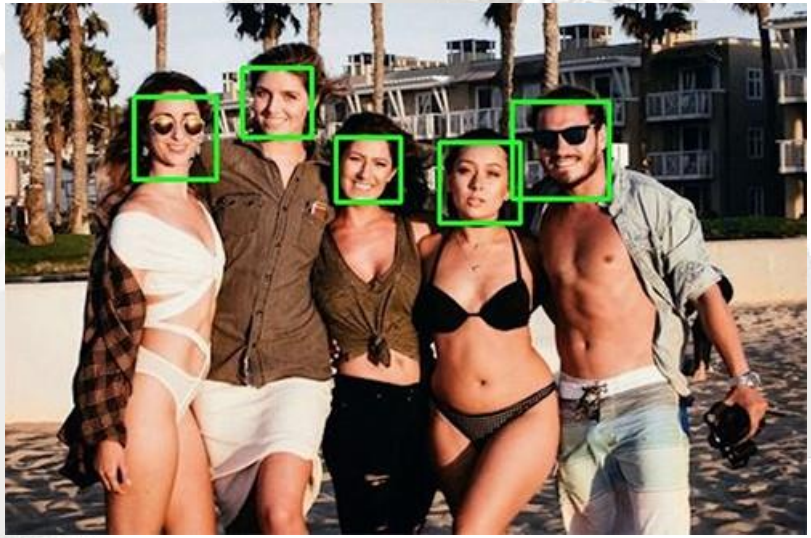
Parameters:

scaleFactor=1.4,
minNeighbors=1,
minSize=(10,10),



Parameters:

scaleFactor=1.6,
minNeighbors=2,
minSize=(20,20),



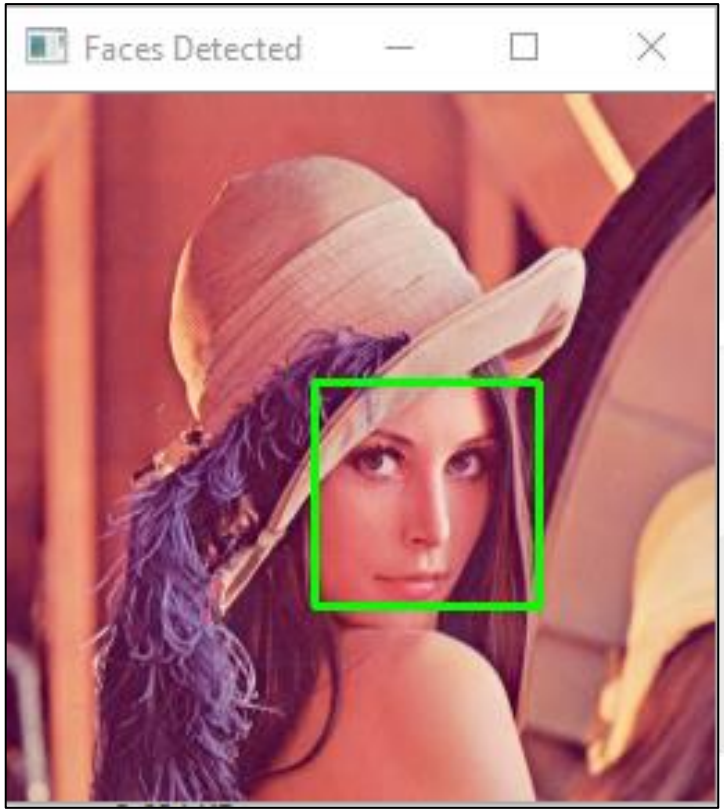
Ref : https://becominghuman.ai/face-detection-using-opencv-with-haar-cascade-classifiers-941dbb25177

2. Face Detection

Running OpenCV

OpenCV function :

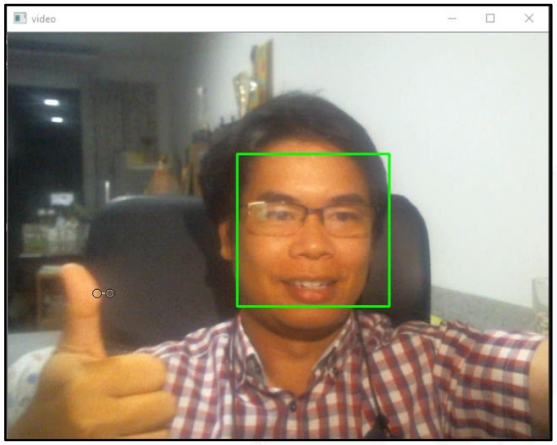
faceCascade.detectMultiScale()

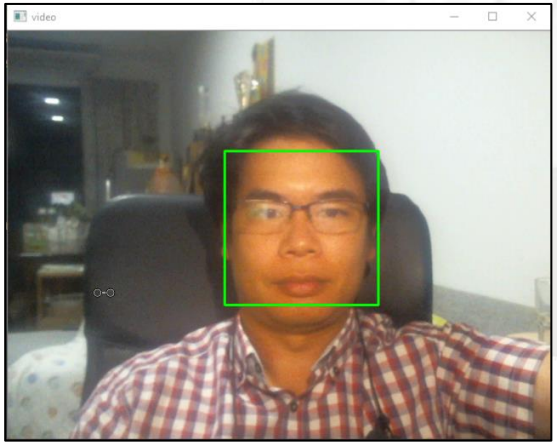



```python
import cv2

cascPath = "dataset/haarcascade_frontalface_default.xml"
faceCascade = cv2.CascadeClassifier(cascPath)

image = cv2.imread("dataset/lena_color_256.tif")
gray = cv2.cvtColor(image, cv2.COLOR_BGR2GRAY)

faces = faceCascade.detectMultiScale(
    gray,
    scaleFactor=1.1,
    minNeighbors=5,
    minSize=(1,1),
    flags = cv2.CASCADE_SCALE_IMAGE
)
print("Detected {0} faces!".format(len(faces)))

for (x, y, w, h) in faces:
    cv2.rectangle(image, (x, y), (x+w, y+h), (0, 255, 0), 2)

cv2.imshow("Faces Detected", image)
cv2.waitKey(0)
```

2. Face Detection

This example for video capture

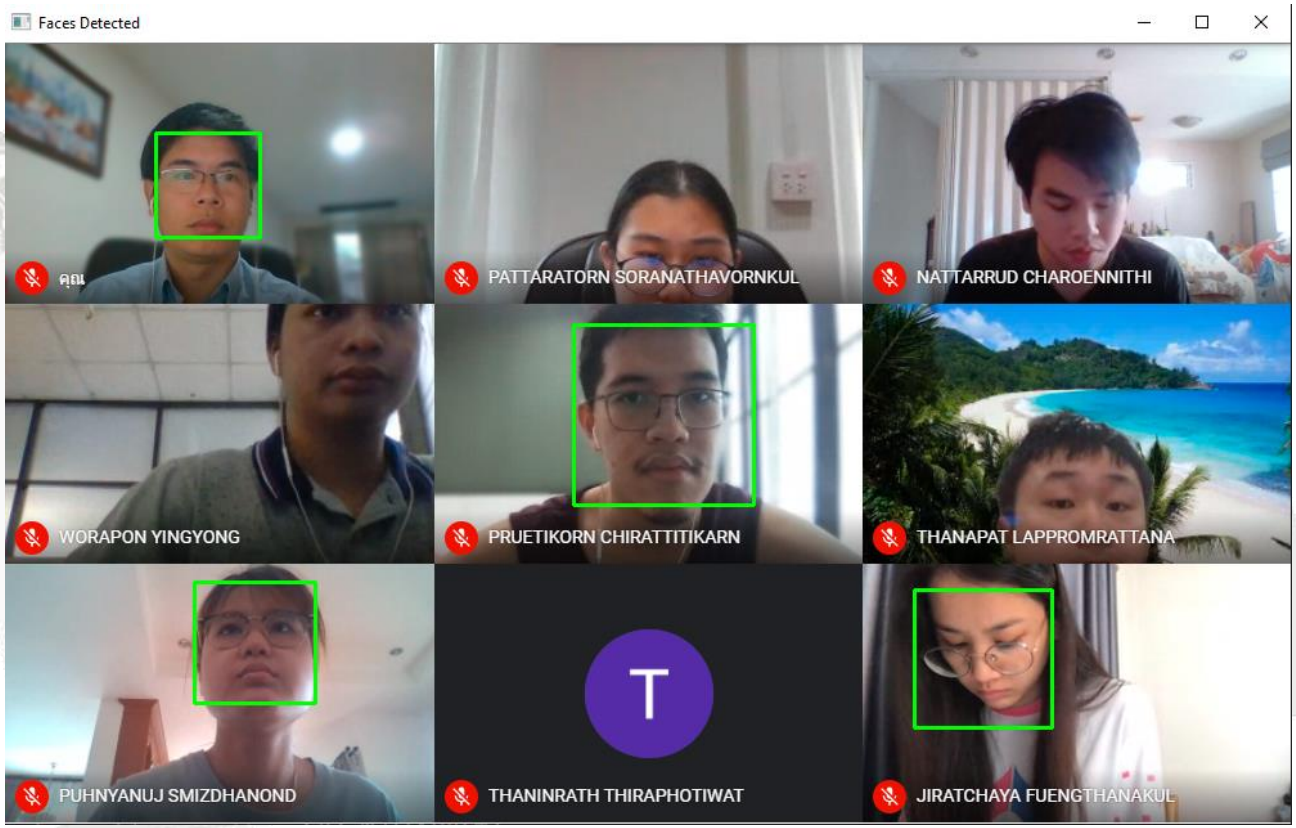





```python
import numpy as np
import cv2

faceCascade = cv2.CascadeClassifier(
    'dataset/haarcascade_frontalface_default.xml')
cap = cv2.VideoCapture(0)
cap.set(3,640) # set Width
cap.set(4,480) # set Height
while True:
    ret, img = cap.read()
    gray = cv2.cvtColor(img, cv2.COLOR_BGR2GRAY)
    faces = faceCascade.detectMultiScale(
        gray,
        scaleFactor=1.2,
        minNeighbors=5,
        minSize=(20, 20)
    )
    for (x,y,w,h) in faces:
        cv2.rectangle(img,(x,y),(x+w,y+h),(0,255,0),2)
        roi_gray = gray[y:y+h, x:x+w]
        roi_color = img[y:y+h, x:x+w]
    cv2.imshow('video',img)
    k = cv2.waitKey(30) & 0xff
    if k == 27: # press 'ESC' to quit
        break
cap.release()
cv2.destroyAllWindows()
```

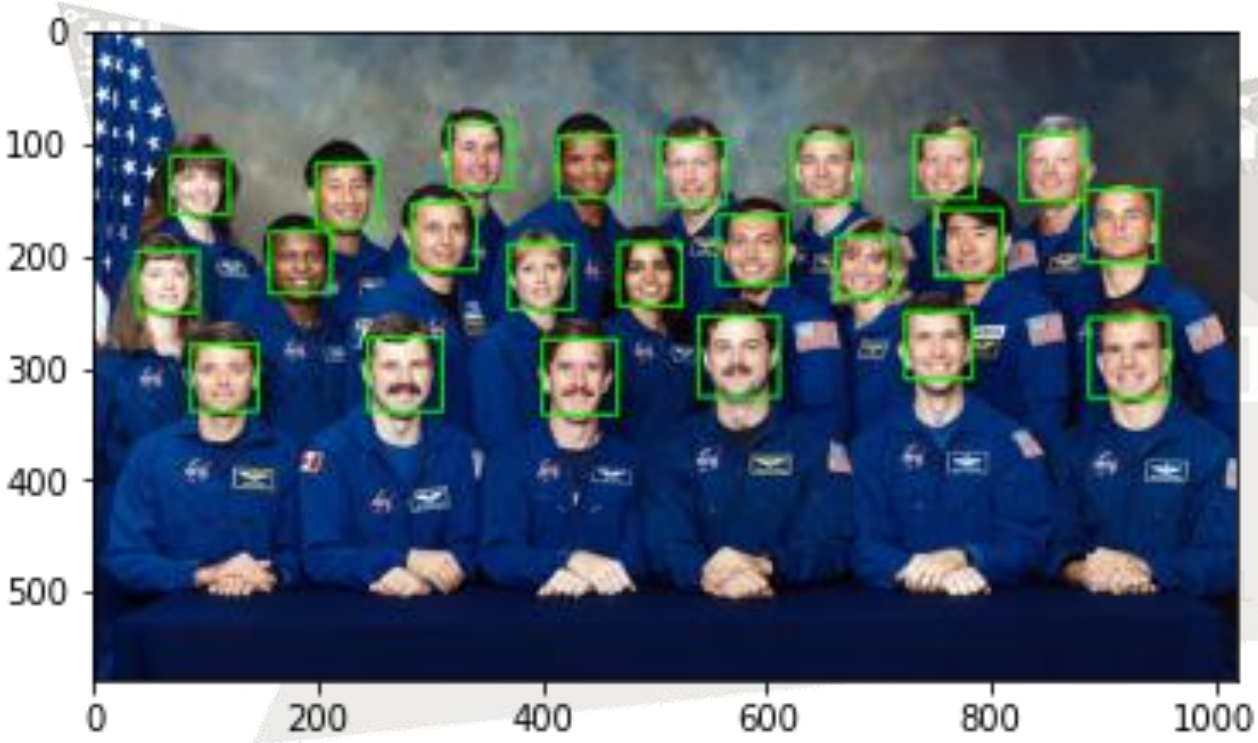
2. Face Detection

```
gray,
scaleFactor=1.2,
minNeighbors=6,
minSize=(20,20)
```



Quiz 2 (15 min)

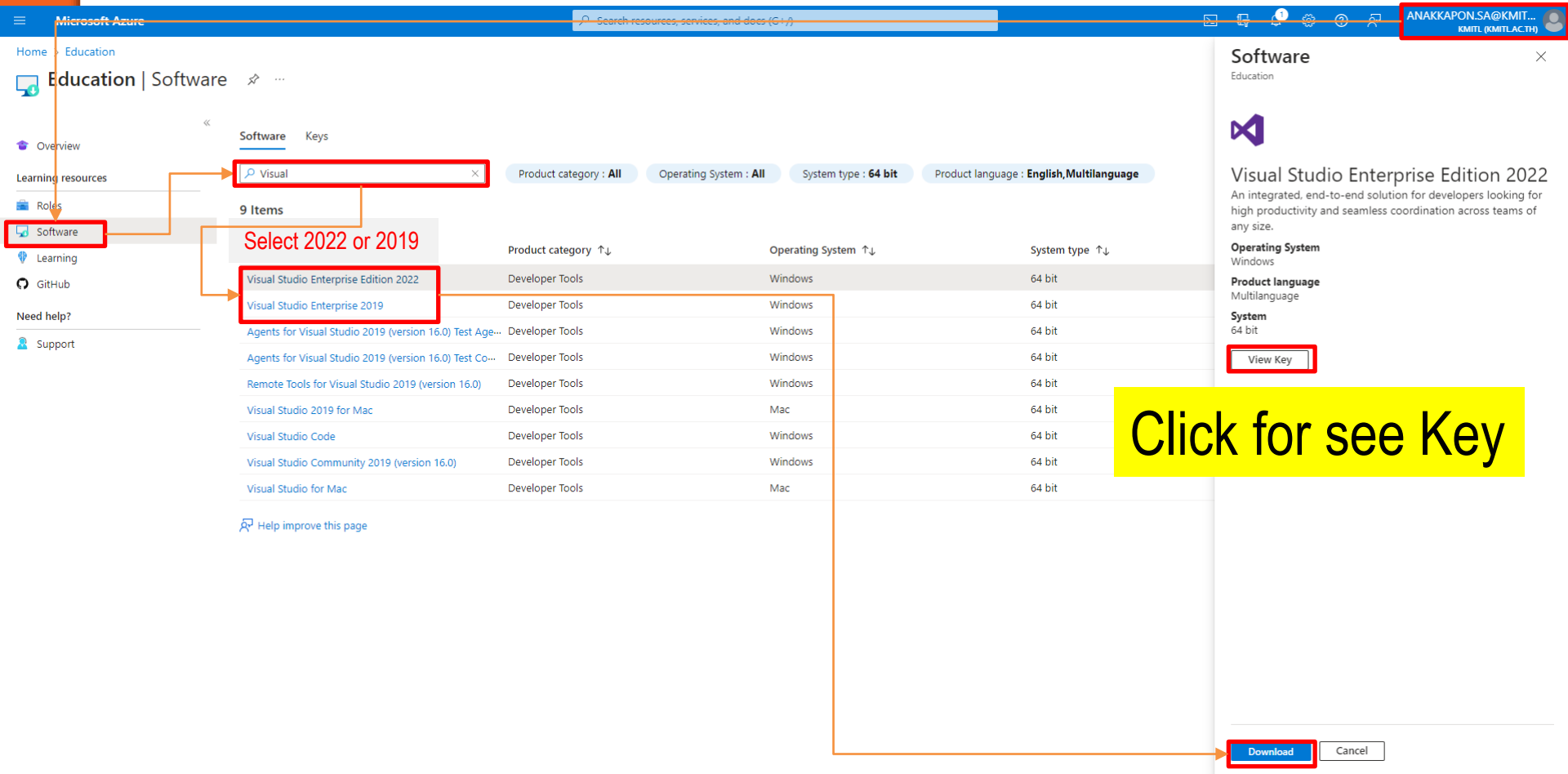
Find all face in "NASA.jpg" image

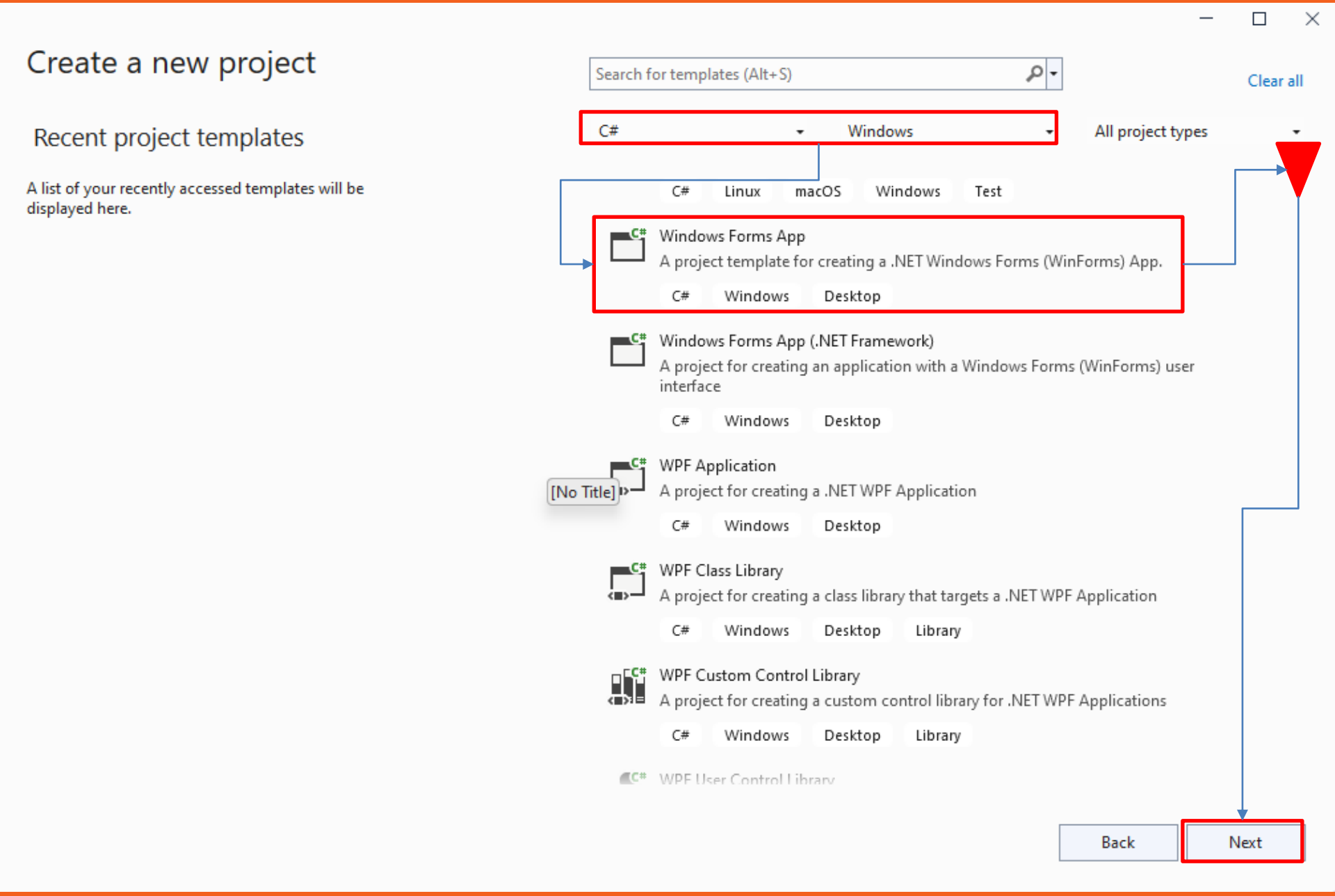


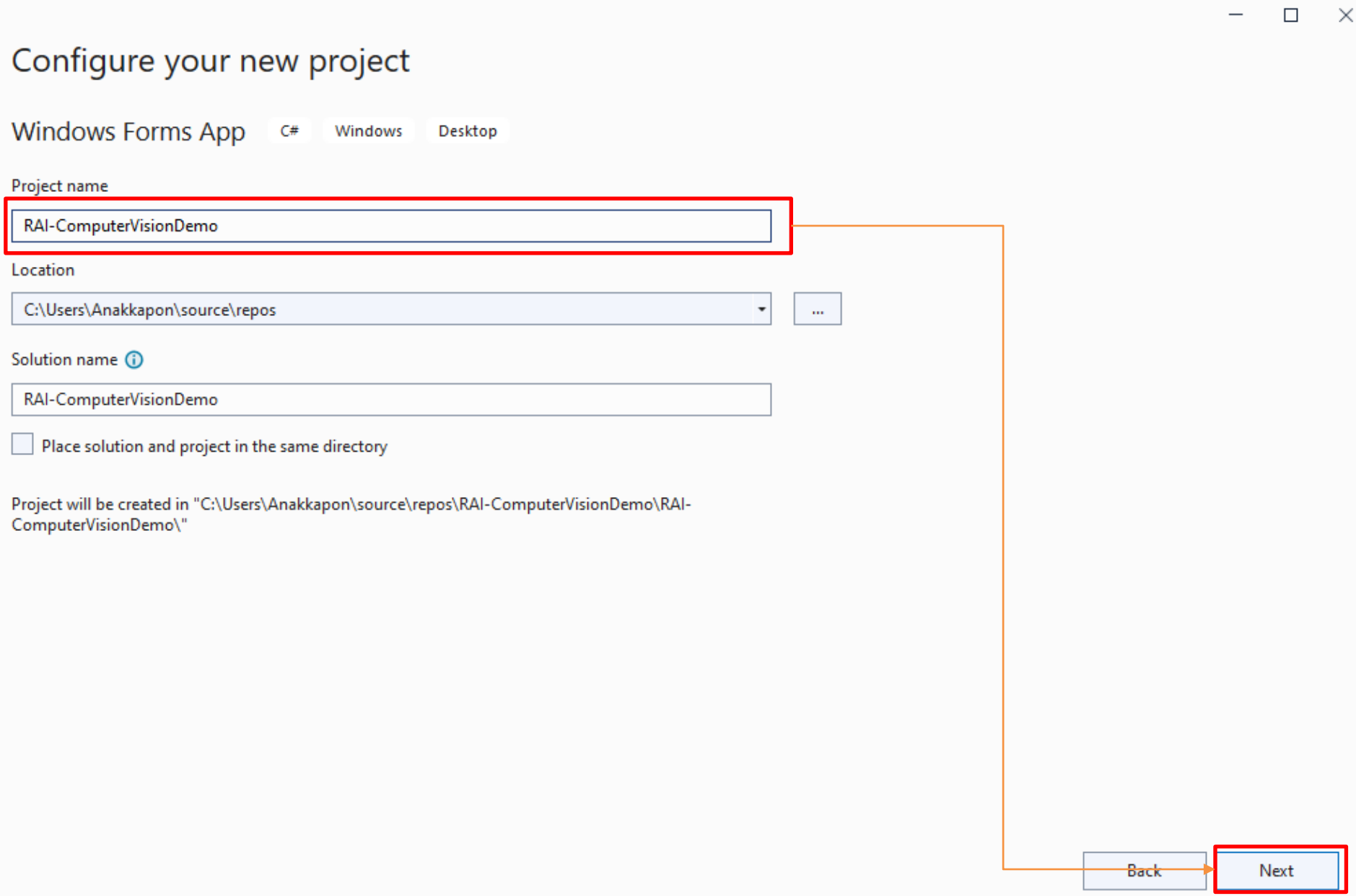
Next class

Download **Visual Studio C# .NET**
https://azureforeducation.microsoft.com/devtools

KMITL account login




Create a new project
Recent project templates
A list of your recently accessed templates will be displayed here.
Search for templates (Alt+S)
Clear all
C#
Windows
All project types
C# Linux macOS Windows Test
Windows Forms App
A project template for creating a .NET Windows Forms (WinForms) App.
C# Windows Desktop
Windows Forms App (.NET Framework)
A project for creating an application with a Windows Forms (WinForms) user interface
C# Windows Desktop
WPF Application
[No Title]
A project for creating a .NET WPF Application
C# Windows Desktop
WPF Class Library
A project for creating a class library that targets a .NET WPF Application
C# Windows Desktop Library
WPF Custom Control Library
A project for creating a custom control library for .NET WPF Applications
C# Windows Desktop Library
WPF User Control Library
Back
Next


Configure your new project
Windows Forms App
C#
Windows
Desktop
Project name
RAI-ComputerVisionDemo
Location
C:\Users\Anakkapon\source\repos
...
Solution name
RAI-ComputerVisionDemo
Place solution and project in the same directory
Project will be created in "C:\Users\Anakkapon\source\repos\RAI-ComputerVisionDemo\RAI-ComputerVisionDemo\"
Back
Next

Assignment#9.3

1. Preparation software of Visual Studio .NET C# (version 2019 or 2022)
2. Capture Visual Studio .NET C# screen
3. Submitting an image file to MS-TEAM