// FLATIRON SCHOOL

INTRODUCTION TO COMPUTER VISION

FACIAL DETECTION / RECOGNITION

PYTHON AND OPEN-CV

OBJECTIVES

In this webinar we shall cover:

The basics of face detection using Haar Feature based Cascade Classifiers

Use this approach to detect face, eyes and other features

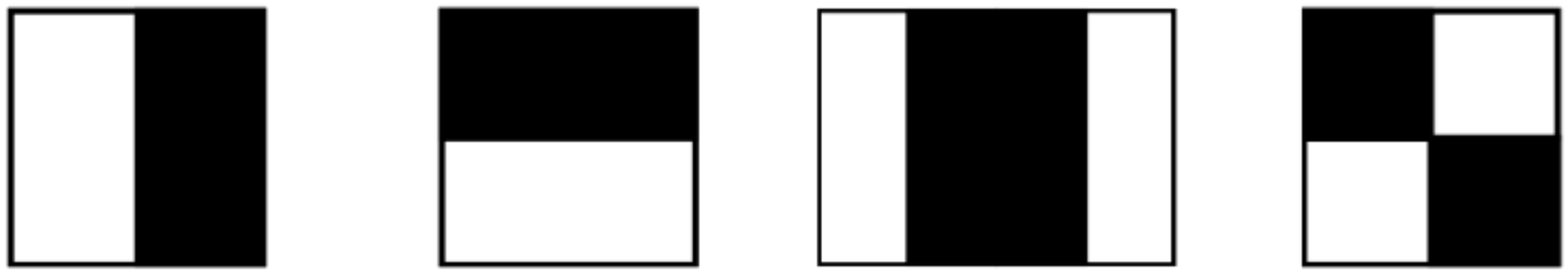
How to extend this experiment for facial recognition

INTRODUCTION

- Object Detection using Haar feature-based cascade classifiers is an effective object detection method proposed by Paul Viola and Michael Jones in their paper, *"Rapid Object Detection using a Boosted Cascade of Simple Features"*
- https://www.cs.cmu.edu/~efros/courses/LBMV07/Papers/viola-cvpr-01.pdf
- It is a machine learning approach where a cascade function is trained from a lot of positive and negative images. It is then used to detect objects in other images.
  - The Integral Image
  - Learning with adaBoost
  - Cascading to disregard unwanted objects

HAAR FEATURES

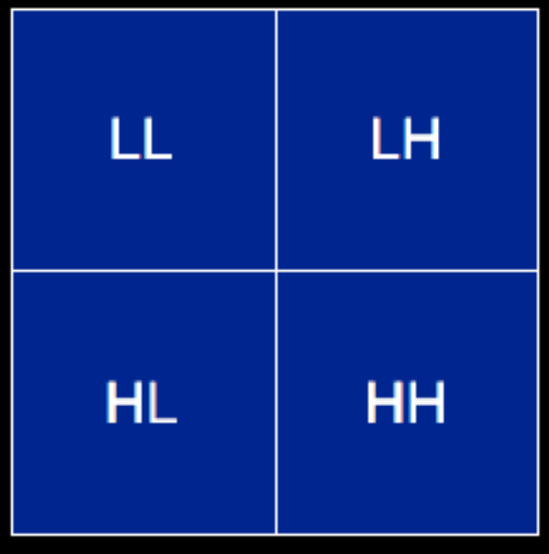
- In mathematics, the Haar wavelet is a sequence of rescaled "square-shaped" functions which together form a wavelet family or basis.
- A Haar-Feature is just like a filter with Fourier Analysis, or kernel in CNN, explained in detail at: http://setosa.io/ev/image-kernels/
- Here are some Haar-Features. The first two are “edge features”, used to detect edges. The third is a “line feature”, while the fourth is a “four rectangle feature”, most likely used to detected a slanted line.

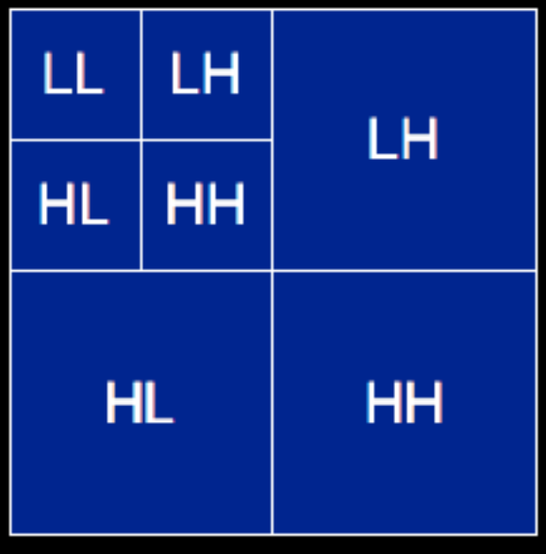


HAAR FEATURES (CONTD.)

Haar Feature Extraction

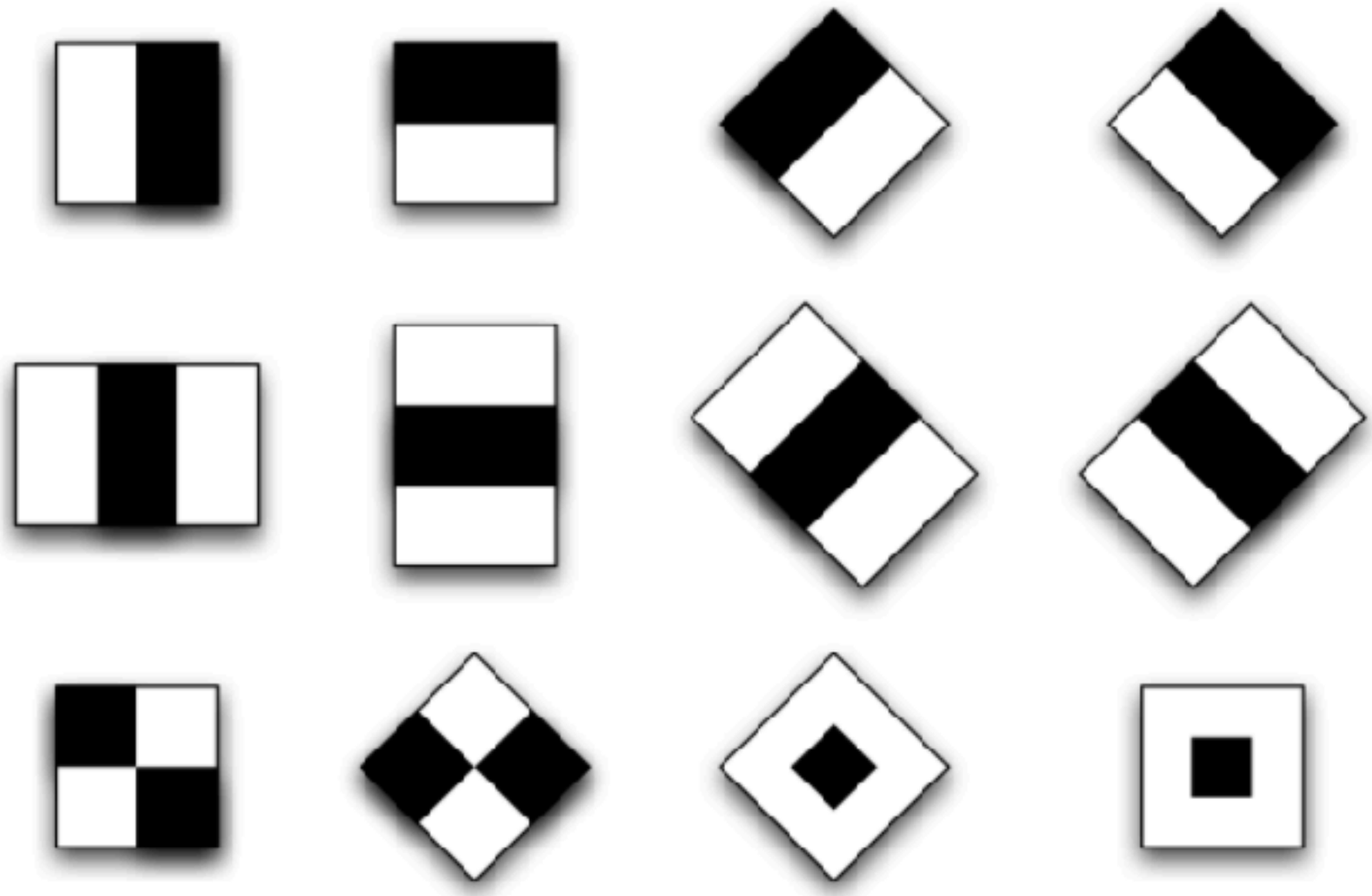
- Haar Wavelet
- Breaks down image into 4 sub-samples
  - HH High passed in vertical and horizontal direction
  - LH Low passed in vertical and high passed in horizontal
  - HL High passed in vertical and low passed in horizontal
  - LL Low passed in vertical and horizontal directions



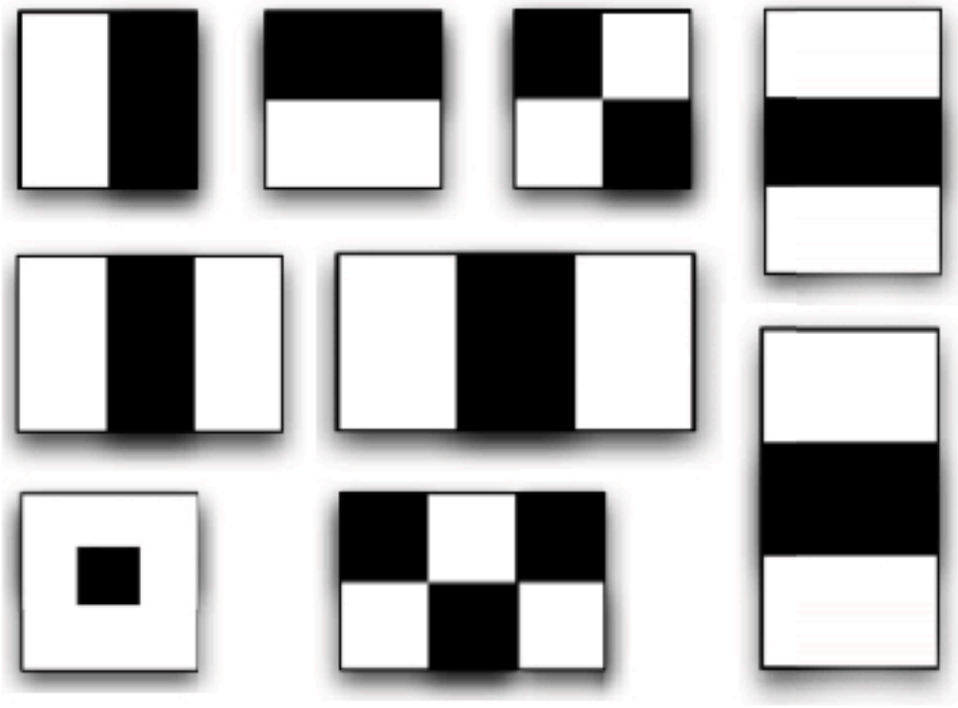


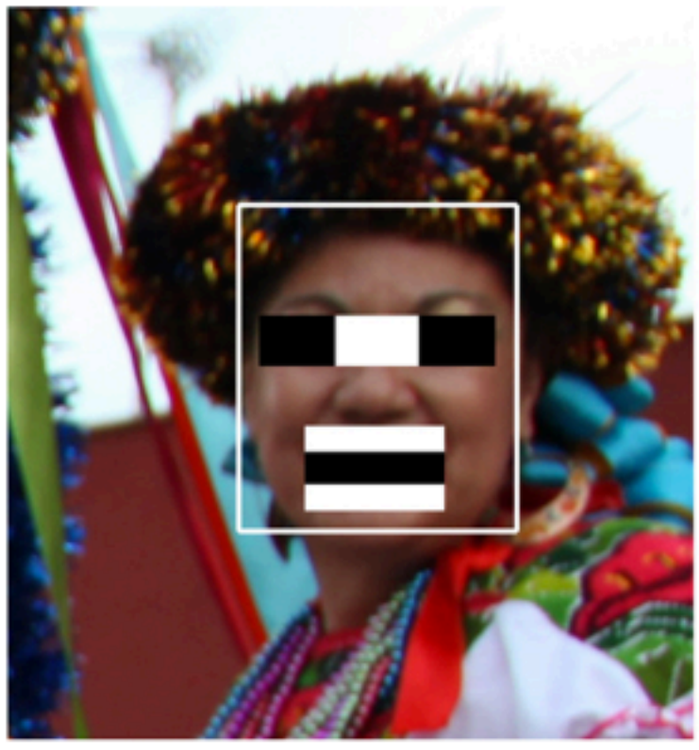
HAAR FEATURES (CONTD.)

- The filters are selected in a way to capture features in the face like nose, the distance between two eyebrows, etc.
- Every region of an image is classified with a number of hair wavelets



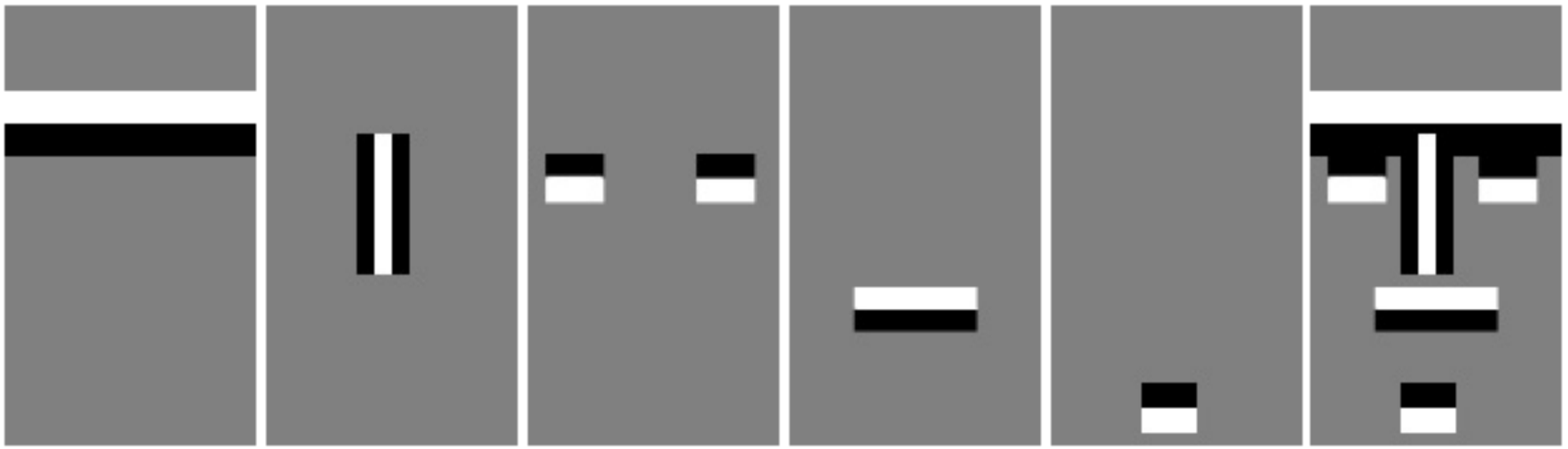
HAAR FEATURES (CONTD.)



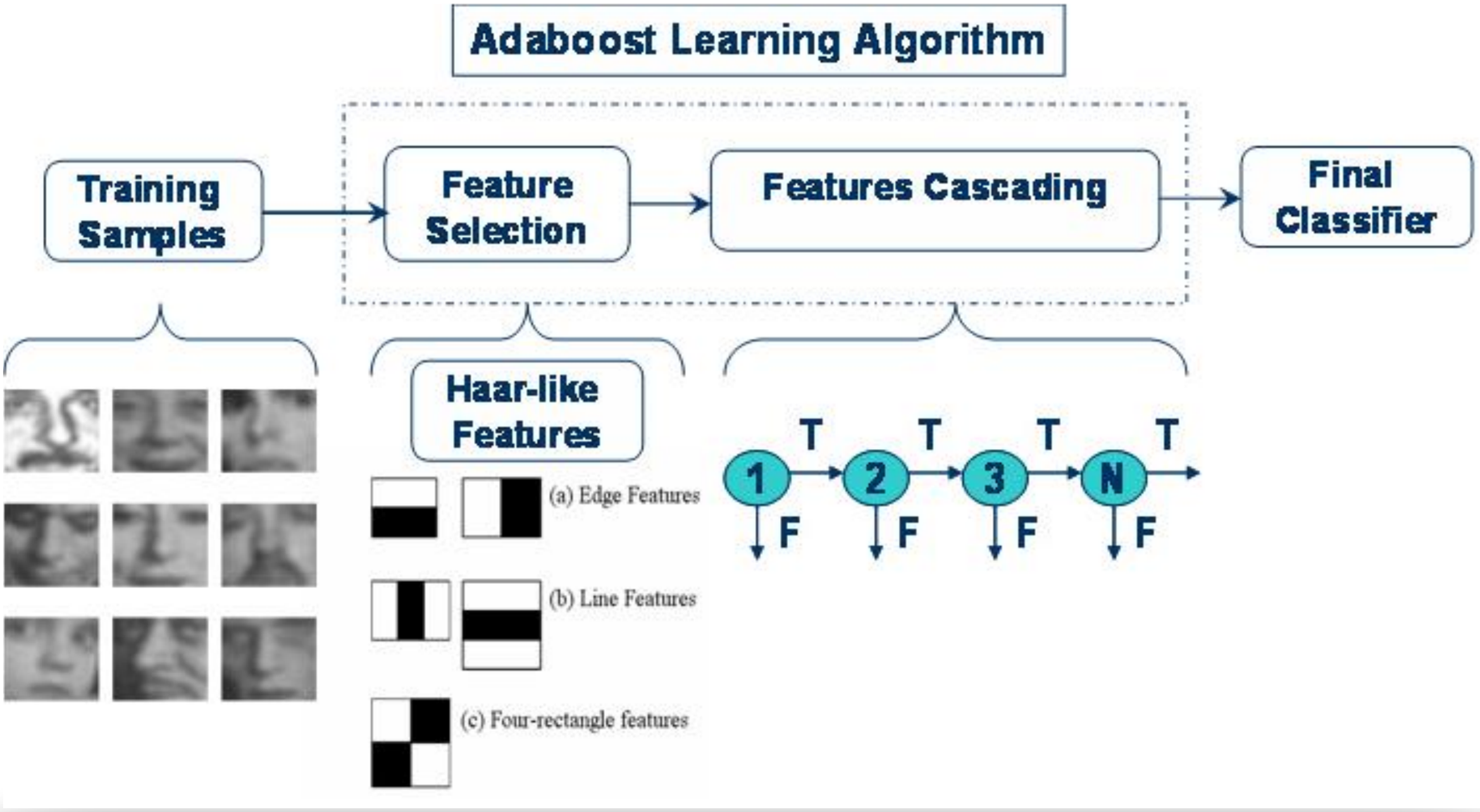


HAAR CASCADE

The Haar features integrate features of an image to a greyscale “CASCADE”, known as the HAAR-like Cascade



HAAR FEATURES (CONTD.)



FACE DETECTION

- For face detection, we use a an XML file as Haar cascade, which has been pre-trained on thousands of faces and carries common features found on these faces e.g. nose, lips, eyes etc.
- Initially, the algorithm needs a lot of positive images (images of faces) and negative images (images without faces) to train the classifier. (We are using a pre-trained classifier)
- Required features are then extracted from the classifier
- Haar feature XML files
  - https://github.com/sightmachine/SimpleCV/tree/master/SimpleCV/Features/HaarCascades

USE THE HAIR FEATURES TO DETECT OTHER OBJECTS !!
RECOGNITION AS WELL AS DETECTION

Future Directions