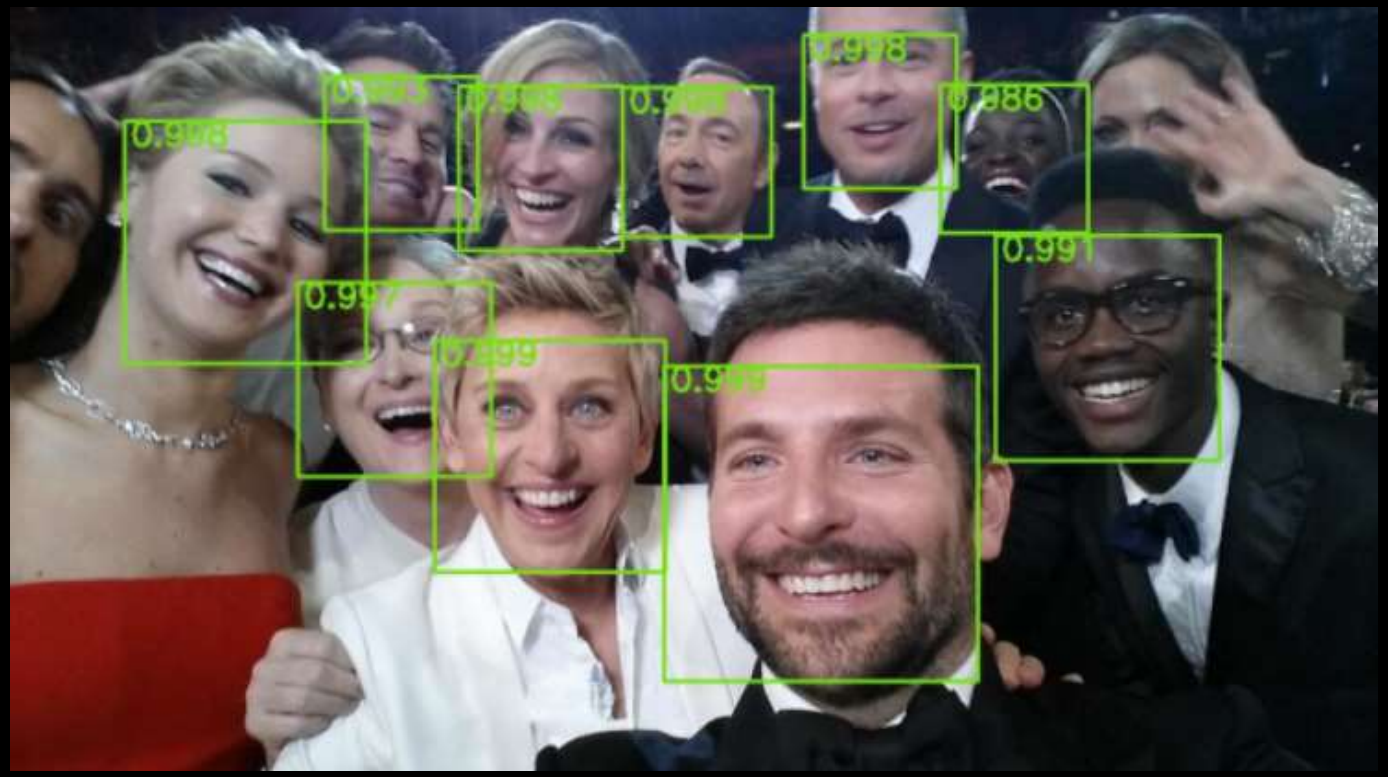
Face Detection

What is Face Detection?



https://www.technologyreview.com/2015/02/16/169357/the-face-detection-algorithm-set-to-revolutionize-image-search/

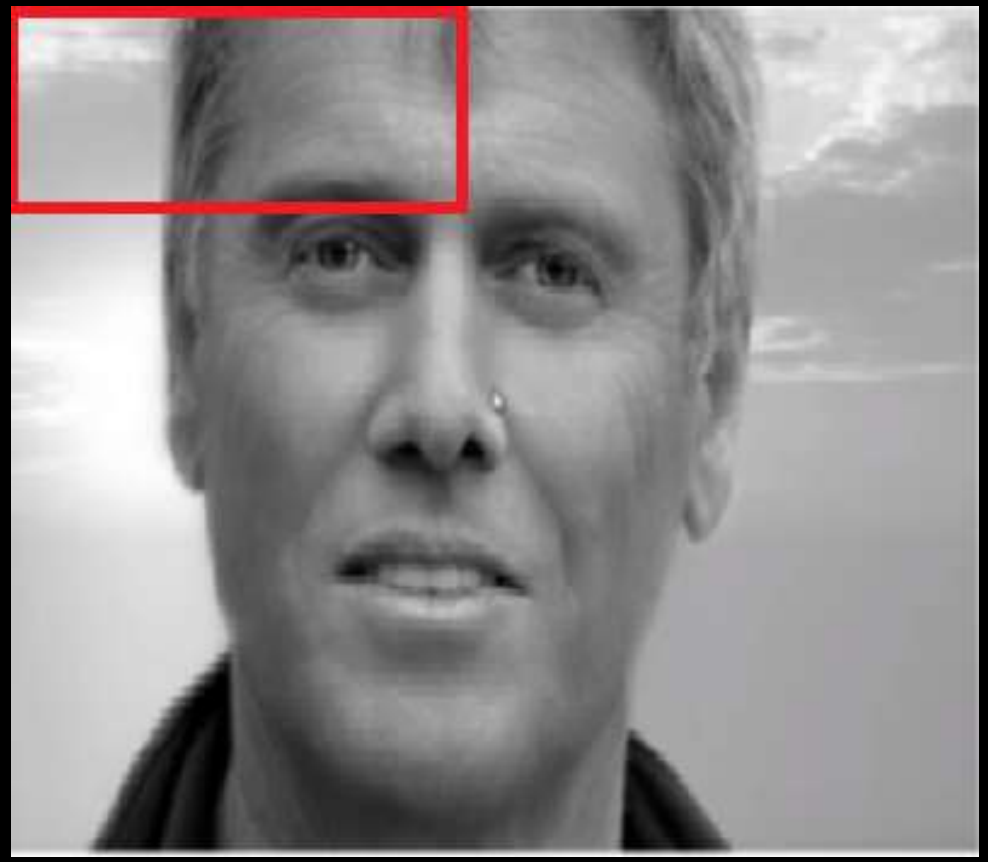
Frontal Face Detection

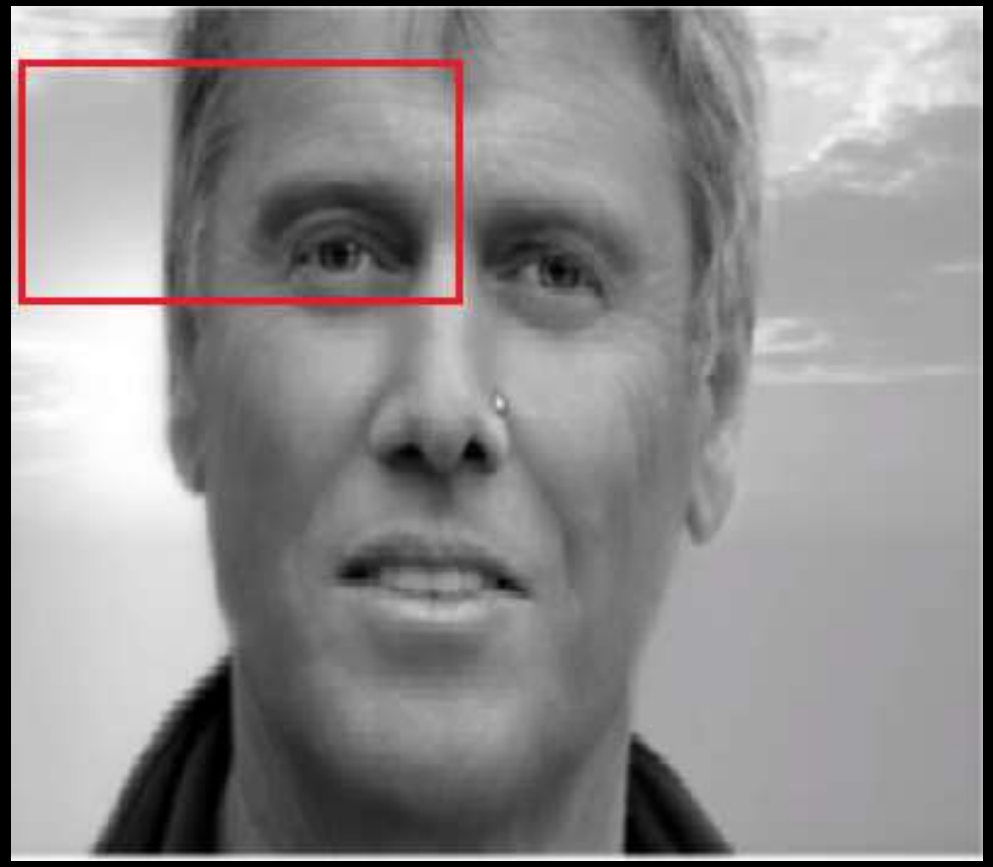
Applications of Face Detection

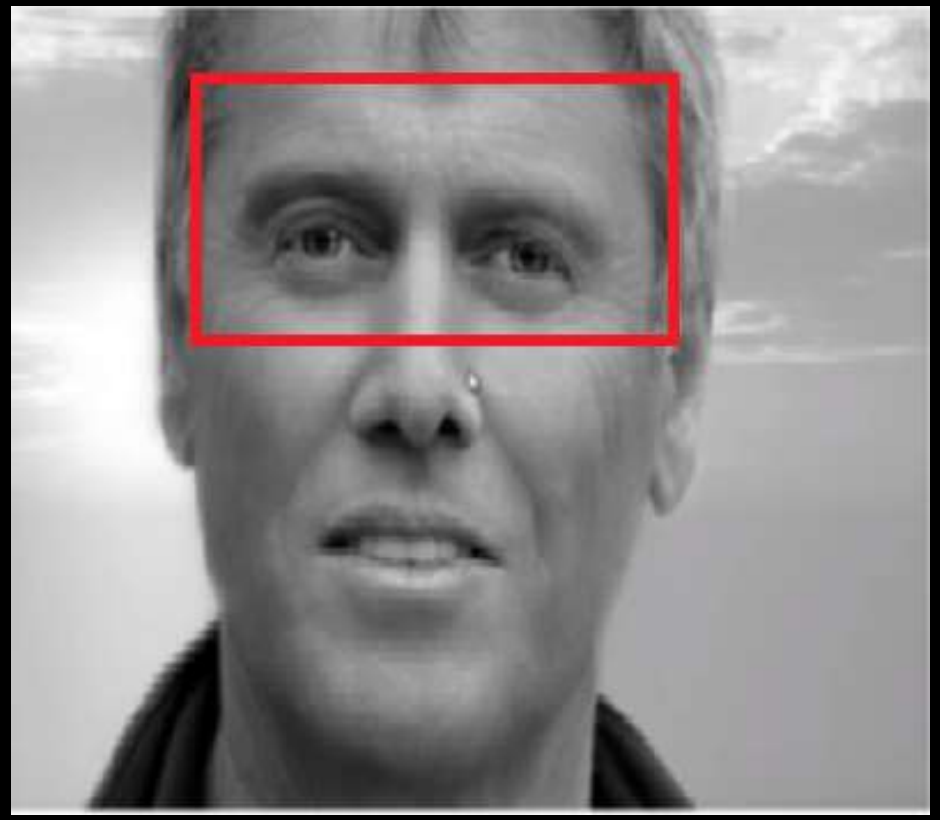
- Camera in our smart phones has face detection working.
- Vending machine guess your age and gender based on face detection and offer products based on your age and gender.
- Face detection system in a mall helps you to iinvestigate that which part of the mall people visited more.
- Biometric Security

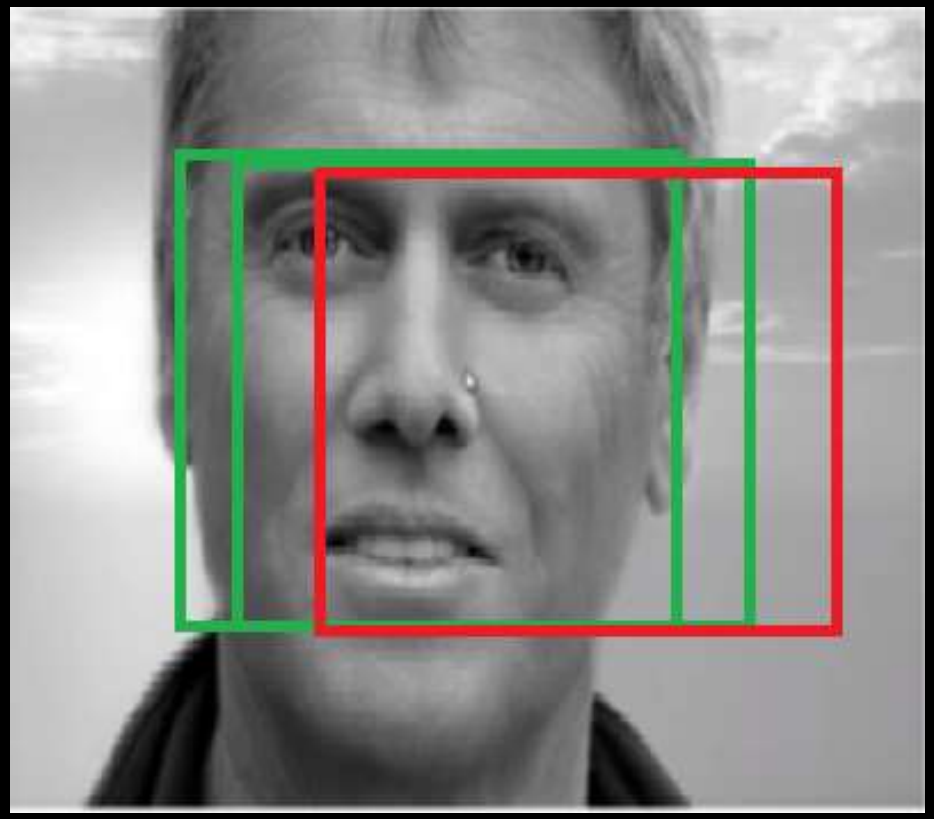
Viola-Jones Algorithm

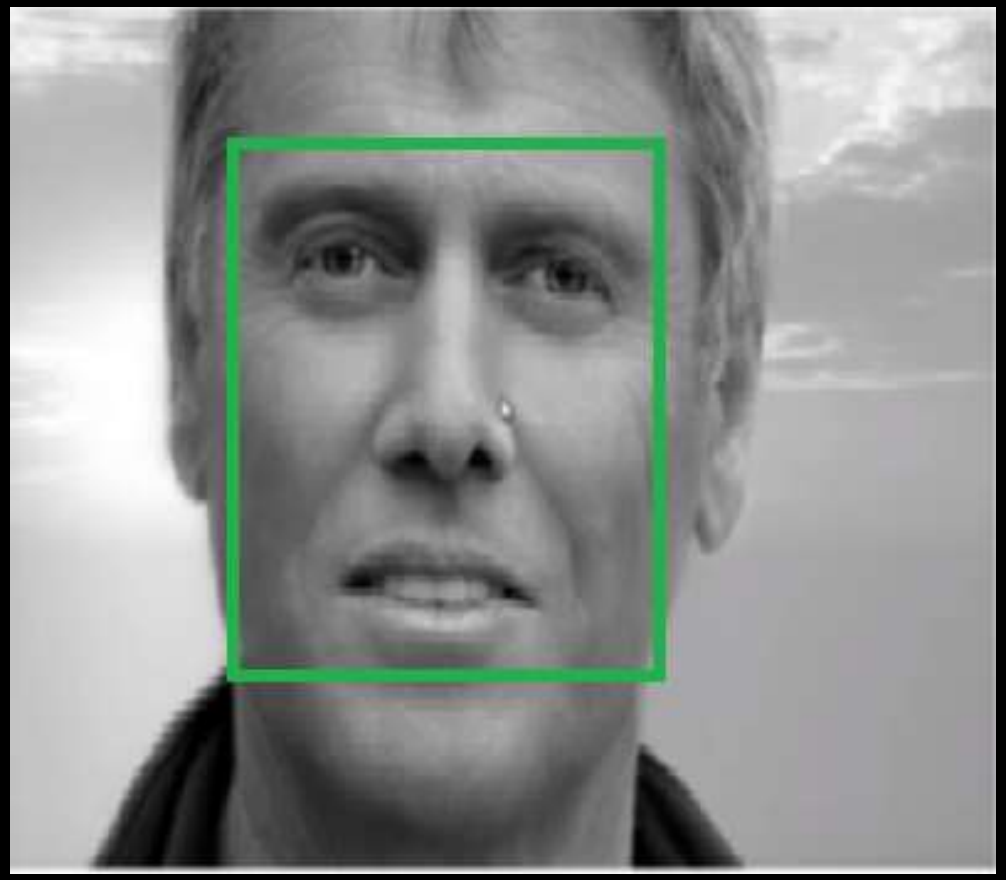
https://cvexplained.wordpress.com/2020/08/24/haar-cascades/











Haar Features

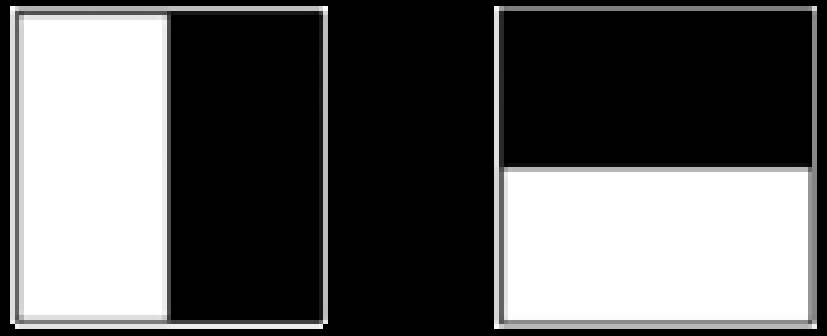
Alfred Haar

Haar Features

We require features that should be very computationally efficient so that we can use them in real time application such as taking a photo with our smart phone camera.

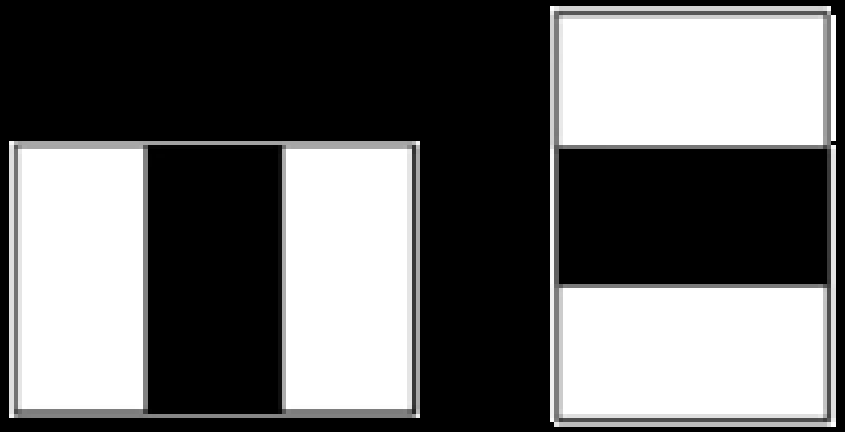
We use Haar filters. The advantage of Haar filters is that they are two valued filters and they extract computationally efficient features.

Haar Features



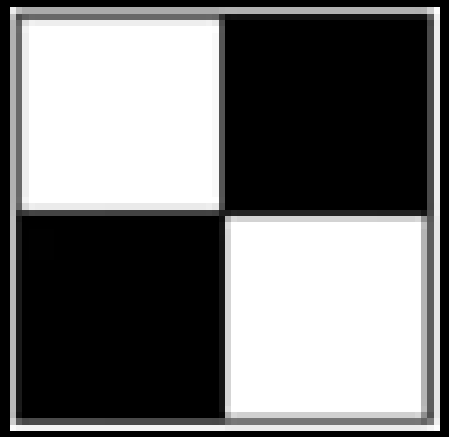
Edge Feature / Filters

Haar Features



Line Feature / Filters

Haar Features

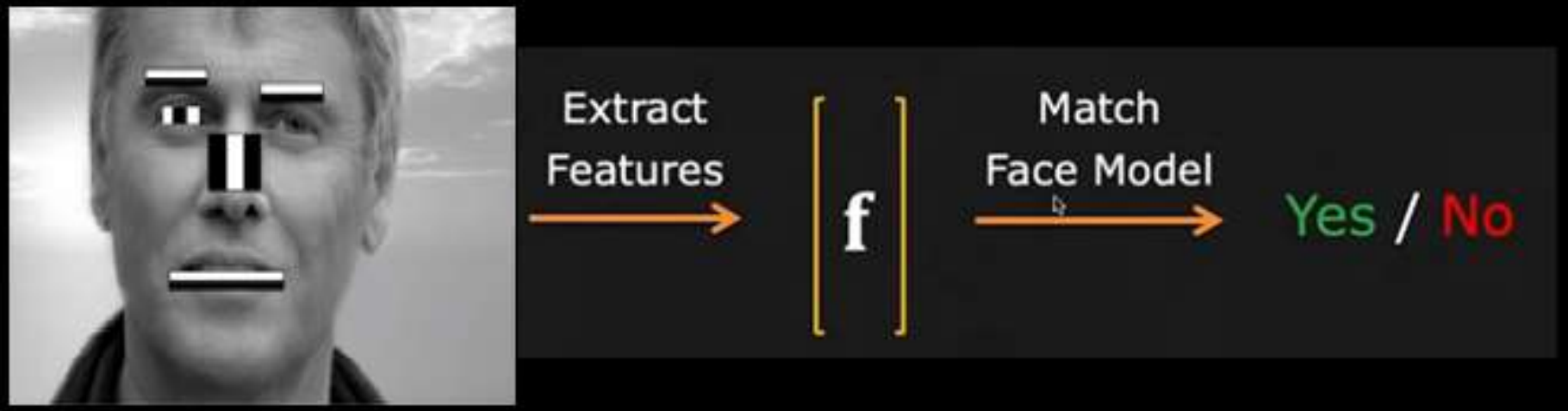


Corner Feature / Filter

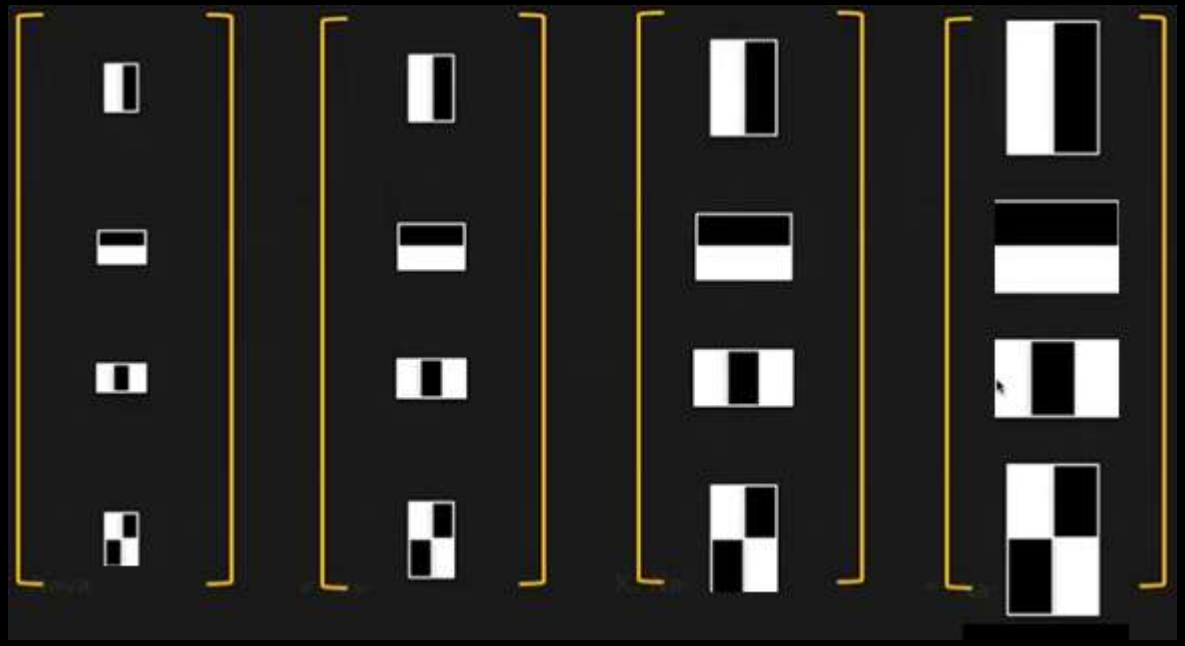
Haar Features

Haar Features for Face Detection

Feature Extraction and Face Detection



Haar Features of Different Scales for detecting Faces of different size



Integral Image

An Image that holds the sum of all pixel values to the left, and top of the given pixel uncluding the given pixel itself.

96	110	121	125	122	129
99	110	120	116	116	129
97	109	124	111	123	134
98	112	132	108	123	133
97	113	147	108	125	142
95	111	168	122	130	137

98	208	329	454	576	705
197	417	658	899	1137	1395
294	623	988	1340	1701	2093
392	833	1330	1790	2274	2799
489	1043	1687	2255	2864	3531
584	1249	2061	2751	3490	4294

Integral Image

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Sum within Rectangle

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966

98	208	329	454	576	705
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392	833	1330	1790	2274	2799
489	1043	1687	2255	2864	3531
584	1249	2061	2751	3490	4294

208 + 2255 - 454 - 1043 = 966

Sum within Rectangle

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1429

		0		0	
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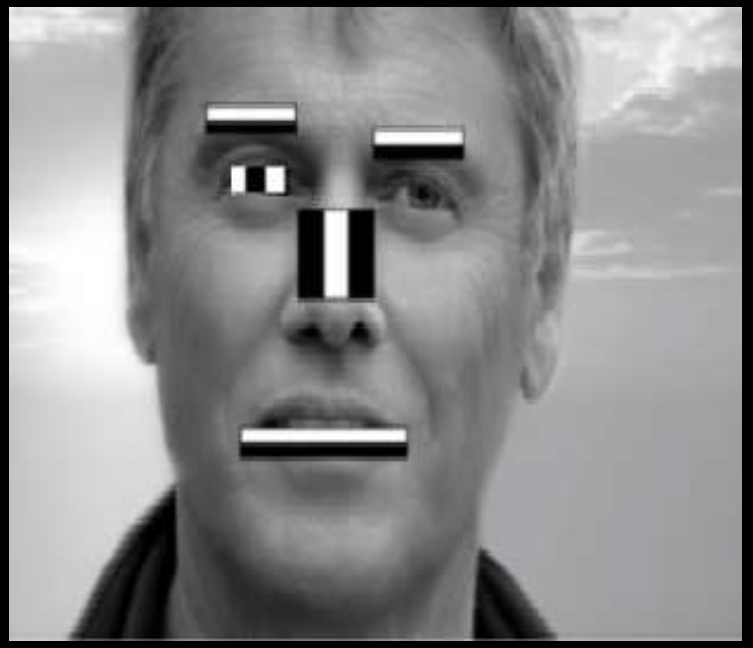
3490 + 0 - 0 - 2061

Haar Features Using Integral Image



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96	104	172	130	126	130

98	208	329	454	576	705
197	417	658	899	1137	1395
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489	1043	1687	2255	2864	3531
584	1249	2061	2751	3490	4294
680	1449	2433	3253	4118	5052

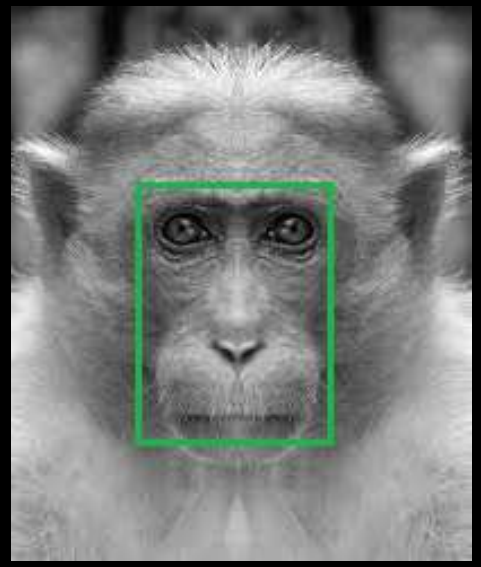
$$feature = \sum(Pixels\ in\ white) - \sum(Pixels\ in\ Black)$$

Training Data

Faces Training Data

Non-Faces Training Data

Large False Positive Values



In non facial training images if there are images that resemble with our face training images, then there is a chance of getting very large False Positives. If large False Positive appears then we have to increase non-facial training samples with these kind of images to reduce False positive Rate

Cascading Classifier

Adaptive Boosting

- In adaboost, we ensemble weak learners to make a strong classifier using weighted sum mechanism.
- A weak learner is the simple form of model that can perform well individually.

Cascading Classifier

$$H(x) = \sum_{i=1}^{k} \alpha_i h_i(x)$$

$For\ k = 3$

$$H(x) = \alpha_1 h_1(x) + \alpha_2 h_2(x) + \alpha_3 h_3(x)$$

Thank you !

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