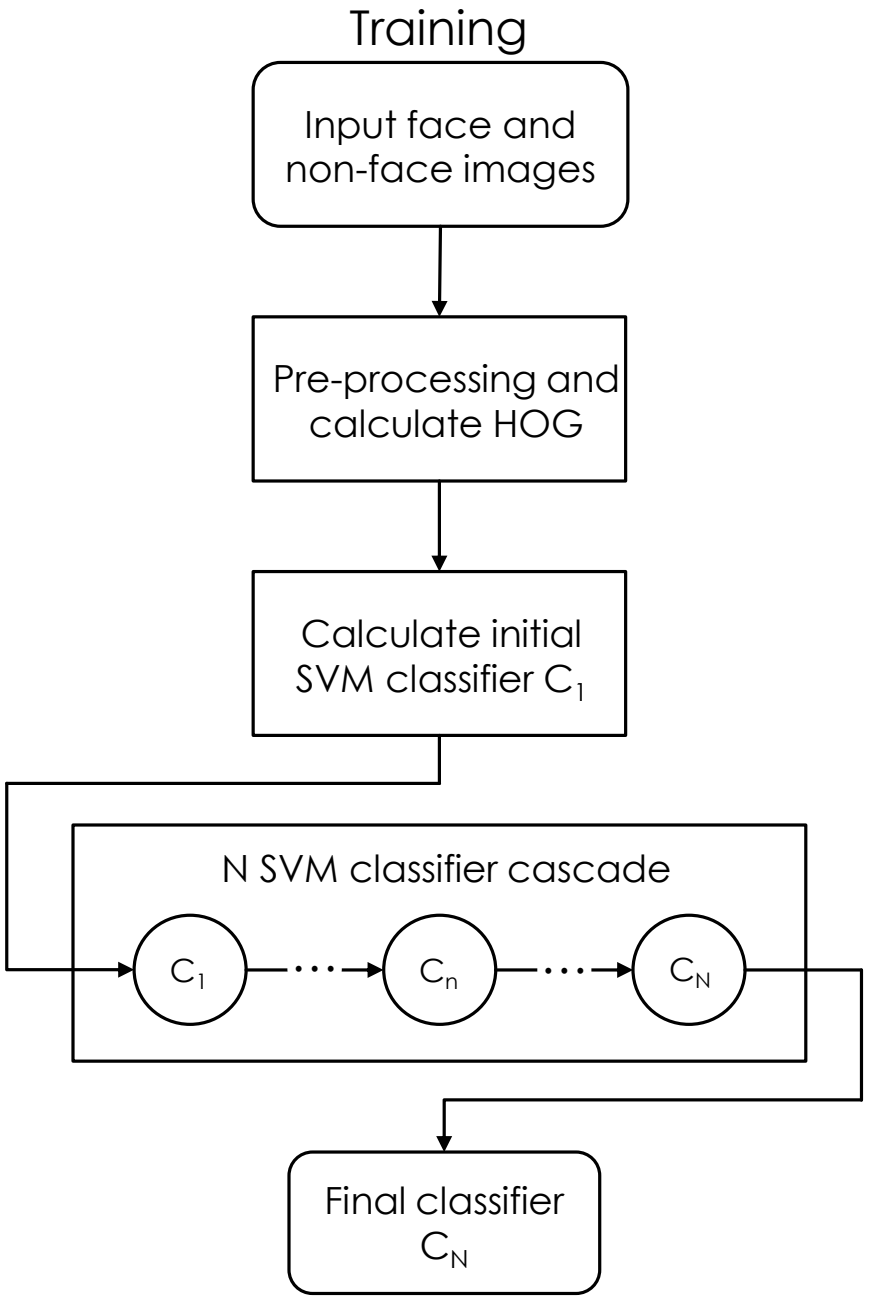
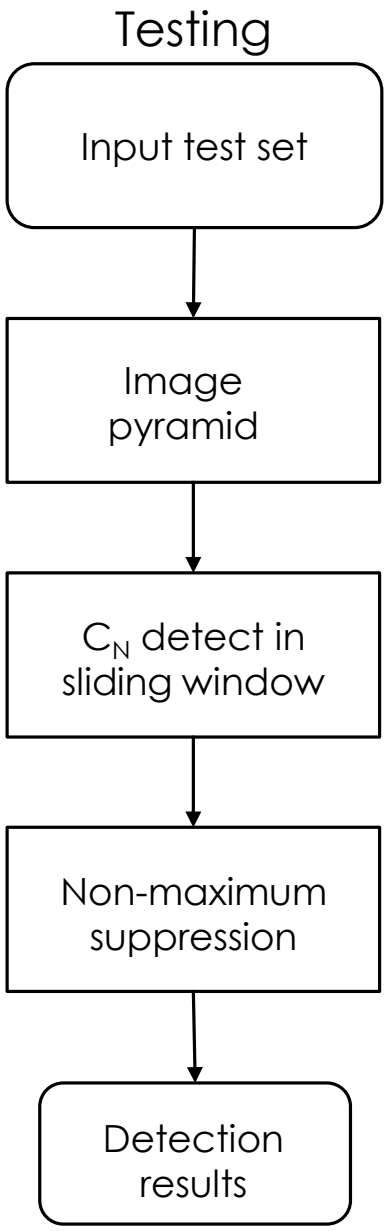
Face Detection with HOG and SVM

Face Detection





Face Detection

Preprocessing

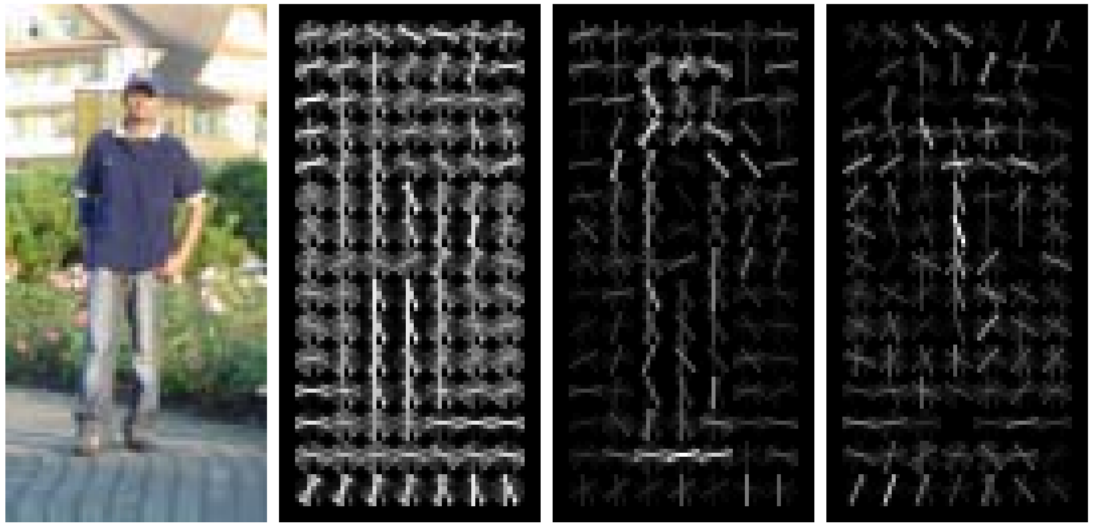
Face set (scaled as 36x36)

Non-Face set (scaled as 36x36 with different resolution)

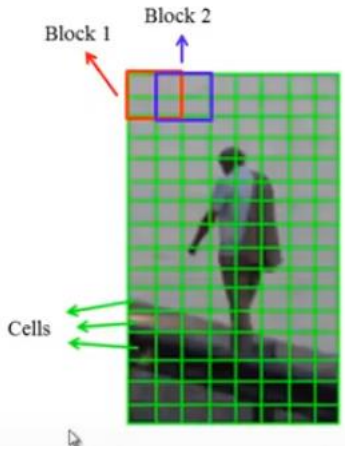
Face Detection

Histograms of Oriented Gradients for Human Detection

——Navneet Dalal and Bill Triggs

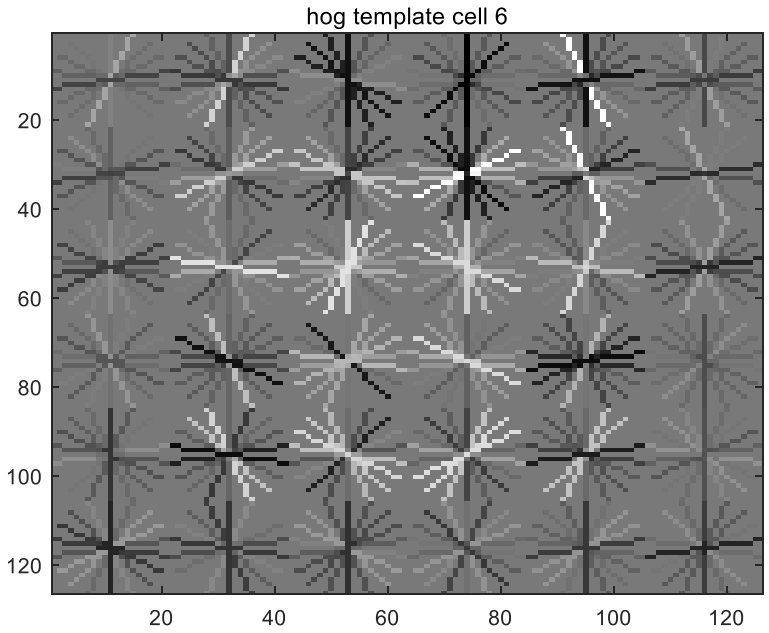


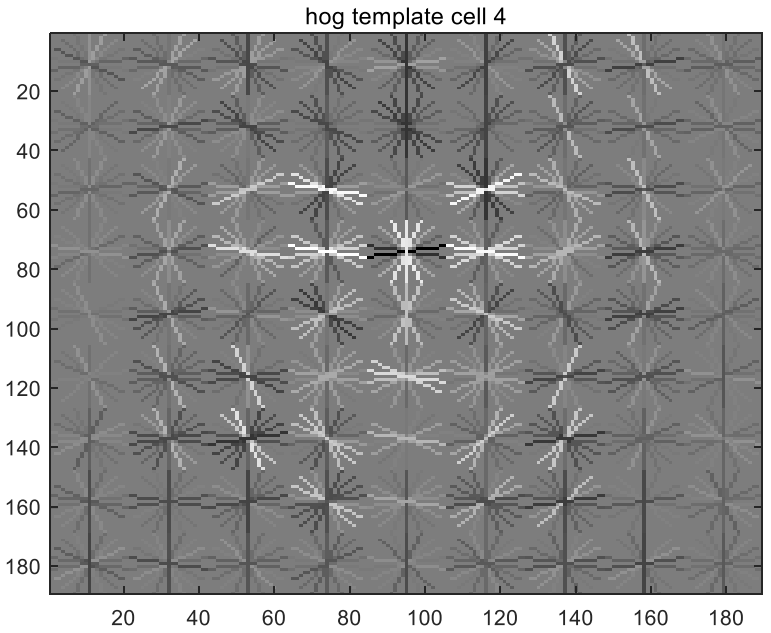
(d) (e) (f) (g)



Face Detection

Visualize HOG features



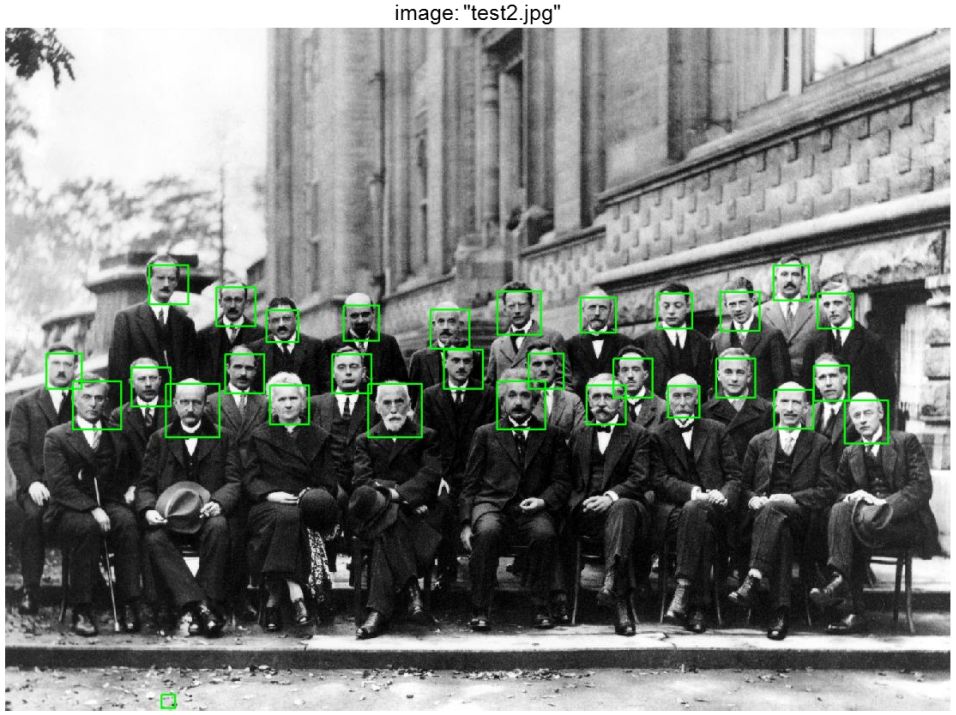


Face Detection

Different HOG size

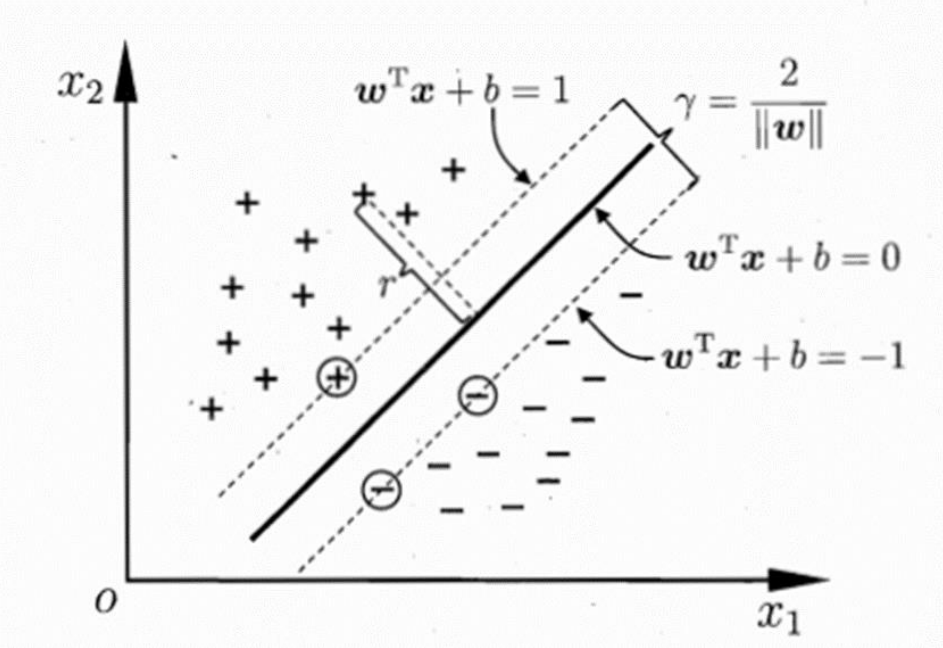
HOG size is 6 pixels

HOG size is 6 pixels



Face Detection

Support Vector Machine (SVM)



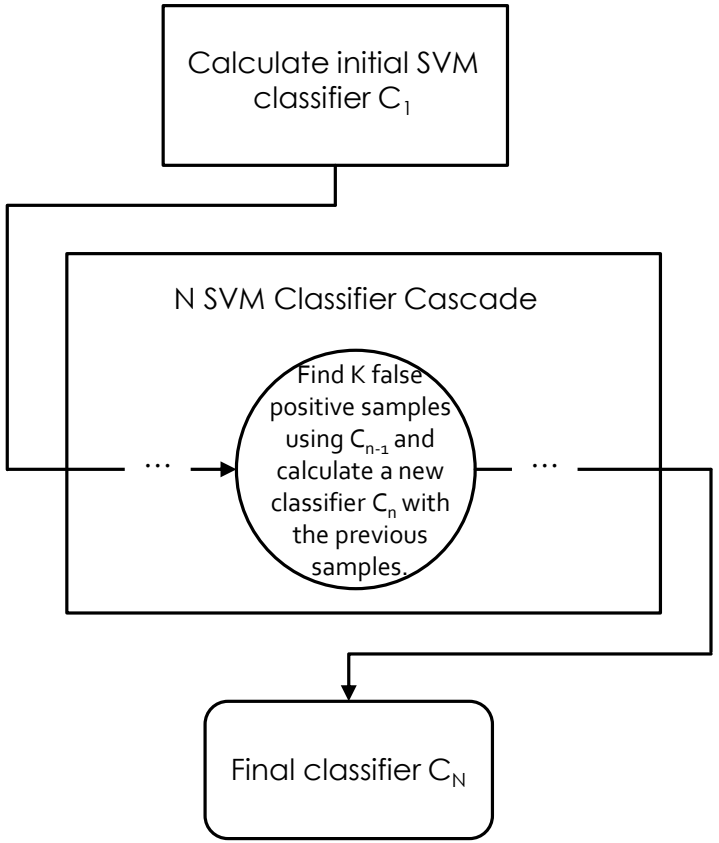
$$\min_{\boldsymbol{w},b} \ \frac{1}{2}\|\boldsymbol{w}\|^2$$

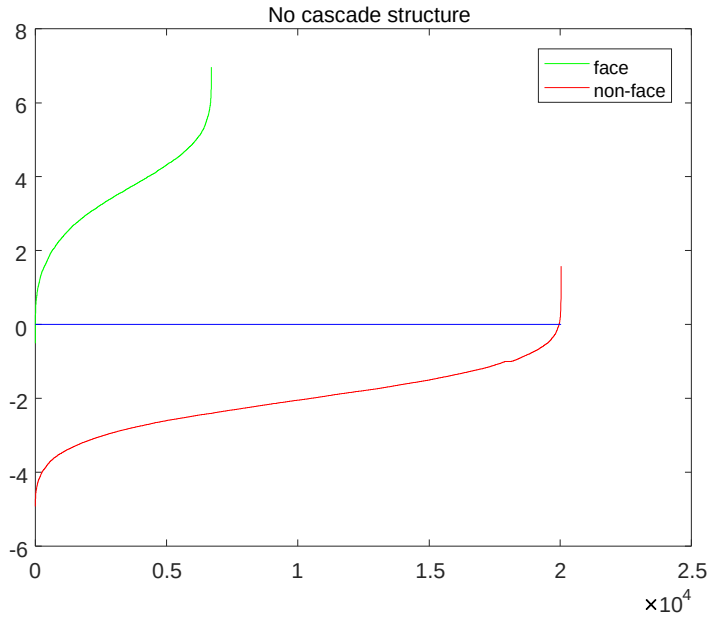
$$\text{s.t. } y_i(\boldsymbol{w}^{\mathrm{T}}\boldsymbol{x}_i+b)\geqslant 1, \quad i=1,2,\ldots,m.$$

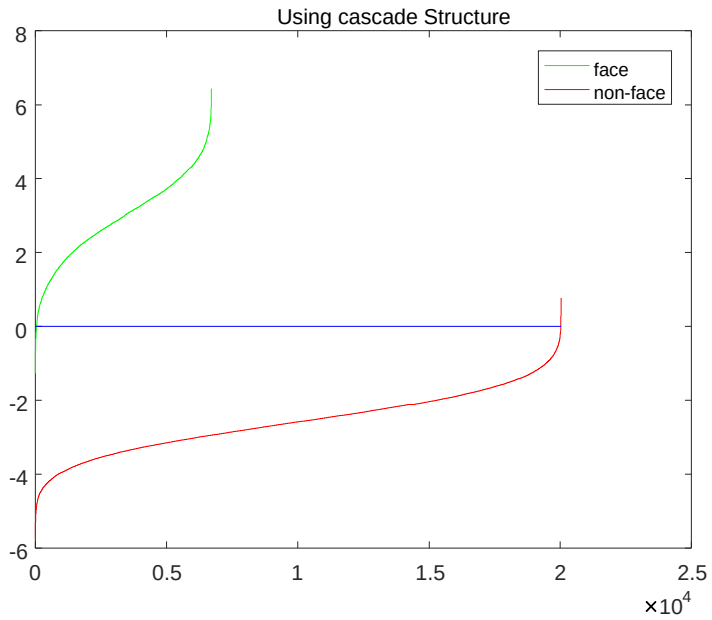
$$L(\boldsymbol{w},b,\boldsymbol{\alpha})=\frac{1}{2}\|\boldsymbol{w}\|^2+\sum_{i=1}^{m}\alpha_i\left(1-y_i(\boldsymbol{w}^{\mathrm{T}}\boldsymbol{x}_i+b)\right)$$

Face Detection

Cascade SVM Classifiers







Face Detection

HOG size is 6 pixels

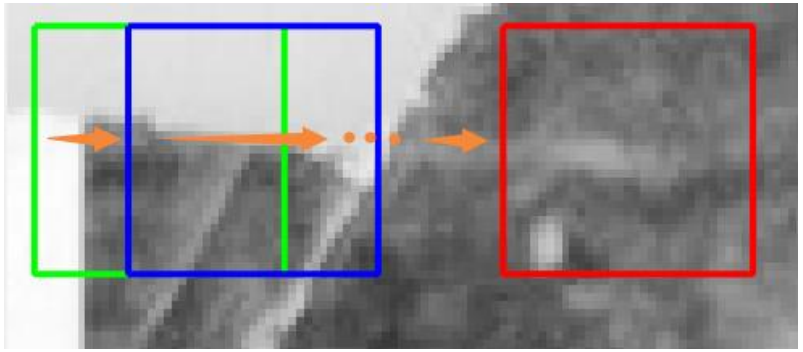
SVM Layers	1	2	3	4	5
Precision	0.56982	0.87126	0.90814	0.82268	0.84842
Recall	0.79061	0.74168	0.73581	0.78082	0.78865

HOG size is 4 pixels

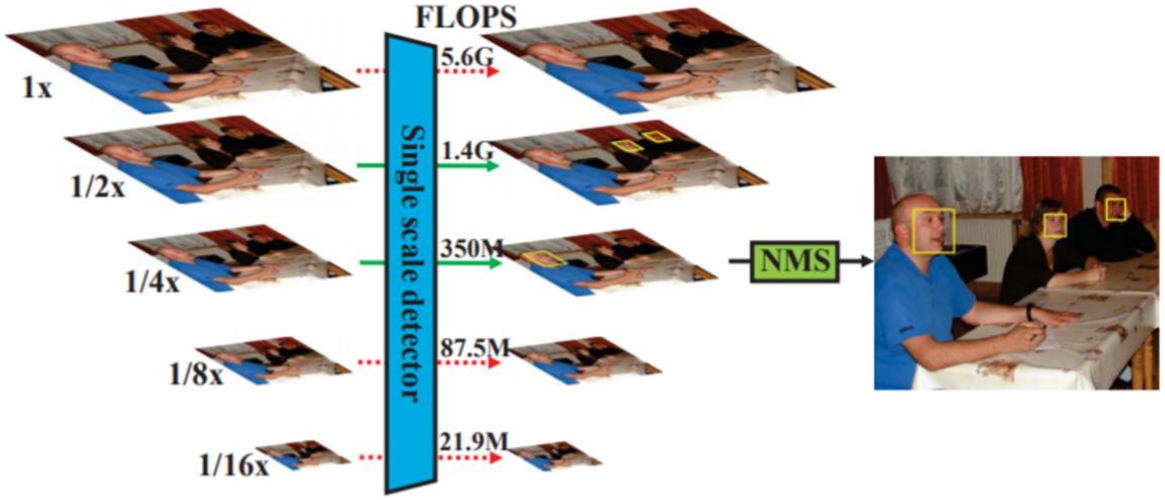
SVM Layers	1	2	3	4	5
Precision	0.75436	0.77757	0.77890	0.86667	0.97606
Recall	0.84736	0.82779	0.75147	0.78865	0.75930

Face Detection

Sliding Window and Image Pyramid



The window slides from the green frame to the right to the blue frame and slides to the red frame after multiple slides. Each time the window slides to a position, the image in the window will be detected whether it is a face or not.



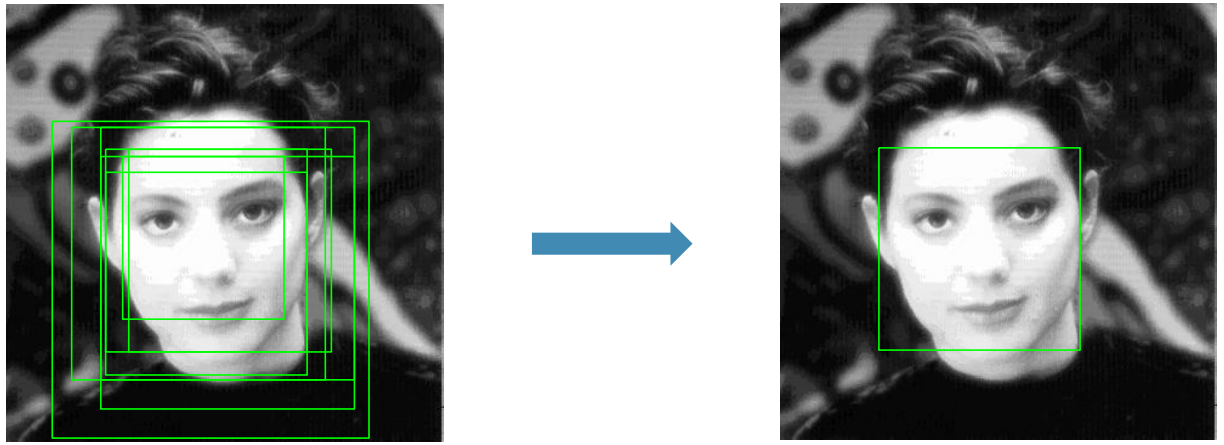
An image pyramid is a multi-scale image representation that stores different sizes of the same image. (In this program, the target image is continuously downsampled (smoothed with double cubes) during use until the image size is smaller than the sliding window size)

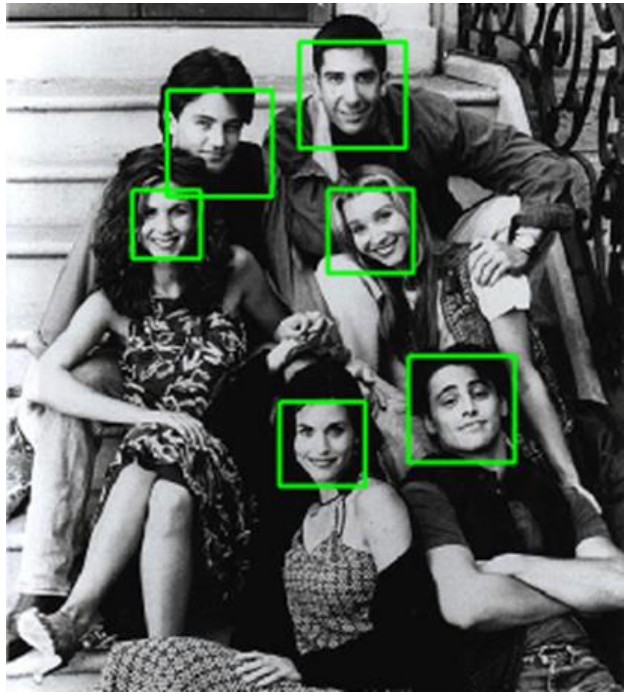
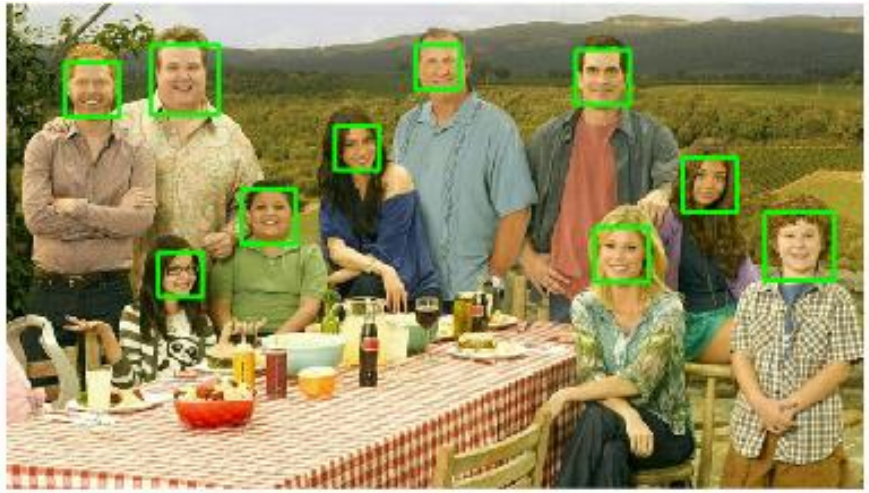
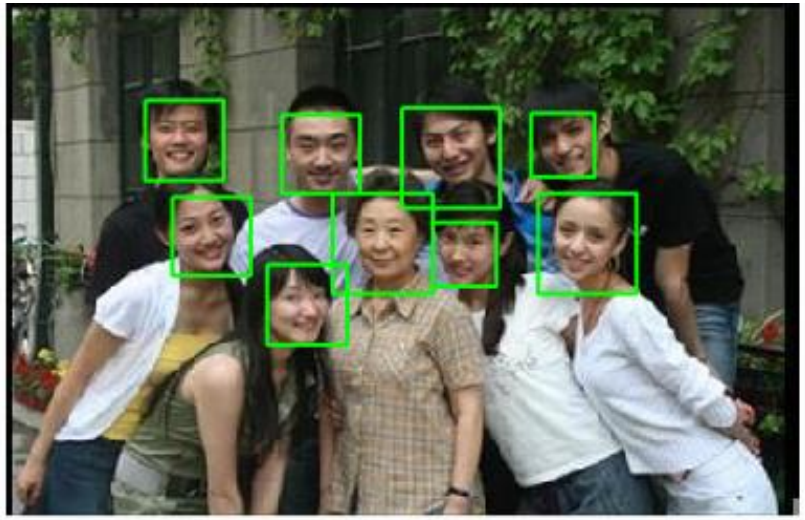
Face Detection

Non-Maximum Suppression

Filter the results according to the following rules:

1. The test result with high score is preferentially retained.
2. The test results can overlap partially, but not too much.
3. The center of one test result cannot be within the range of another test result.



Face Detection

Some Results