M2R MoSIG

Computer Vision

Lecture 2 – Part 3 – Practical

Face Detection with a Pyramid

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Face Detection with a Pyramid

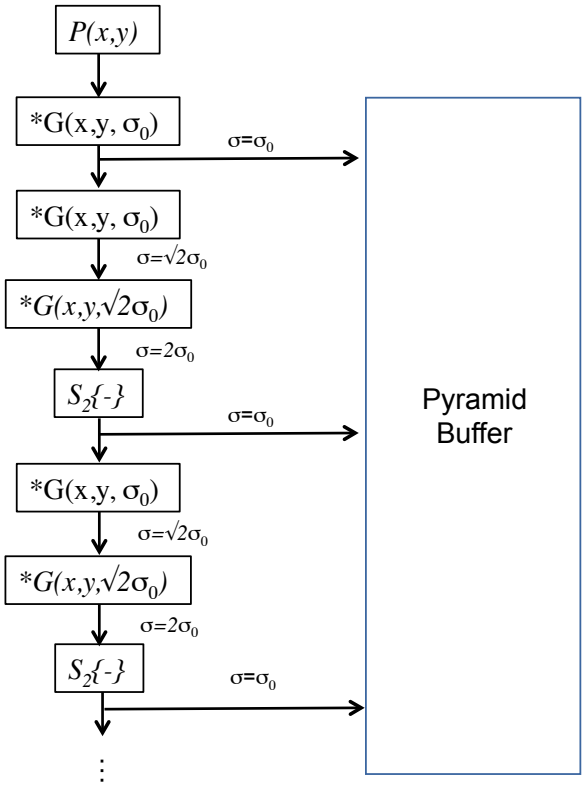
The objective for this exercise is to use your best MLP face detector constructed last week to detect faces at multiple scales using windows from a Gaussian Pyramid. You will first construct a sliding window face detector using your best MLP, and then optimize this detector using a full octave Gaussian Pyramid.

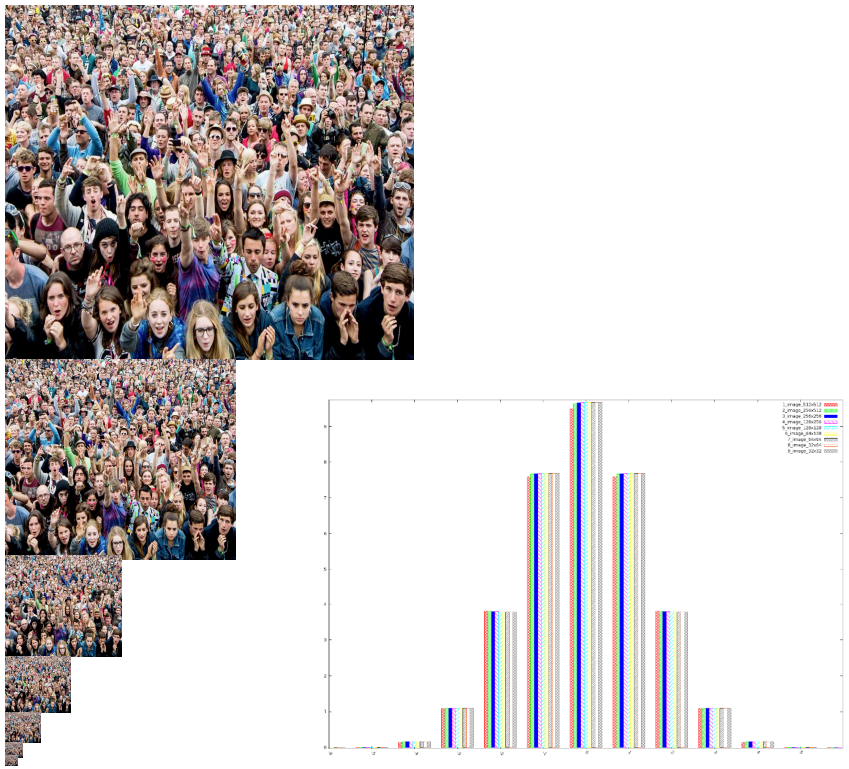
This exercise is composed of three parts.

1. Write a program to construct a scale-invariant full-octave Gaussian pyramid, using the algorithm shown in section 3.1 of the Lecture 4 course notes. Demonstrate the impulse response of your pyramid by creating a 512 x 512 image with a single non-zero pixel at the center position (256x256). Display the contents of central 13 columns (cols 250 to 262) from row 256 from each channel of each level of your pyramid. Do this for $\sigma_0=1$ and $\sigma_0=\sqrt{2}$ and compare the results.
2. Use the best MLP from project 2 to detect faces at multiple scales from a full octave pyramid with $\sigma_0=1$. Write a program to extract and flatten a sliding window from an image over a range of sizes from 16x16 to 100x100 using a scale factor of 1.2. Each window should be transformed to the standard size of input vector for your MLP face detector. Report, accuracy, precision, recall and computing time for evaluation with the images in folds 9 and 10 of FDDB.
3. Use the same MLP to detect faces from each level of your pyramid over a range of sizes from 16x16 to 33x33 using a scale factor of 1.2. Each window should be transformed to the standard size of input vector for your MLP face detector. Report, accuracy, precision, recall and computing time for evaluation with the images in folds 9 and 10 of FDDB.

1) Scale Invariant Gaussian Pyramid

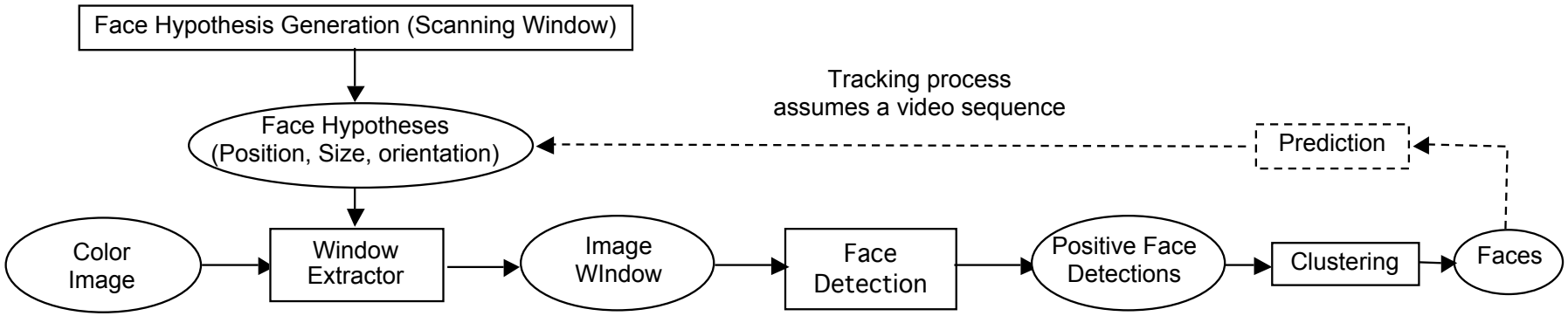
1) Write a program to construct a scale-invariant Gaussian pyramid, using the algorithm shown in section 3.2 of the course notes. Demonstrate the impulse response of your pyramid by creating a 512 x 512 image with a single non-zero pixel at the center position (256x256). Display the contents of central 13 columns (cols 250 to 262) from row 256 from each channel of each level of your pyramid. Do this for $\sigma_0=1$ and $\sigma_0=\sqrt{2}$ and compare the results.





Part 2) Sliding Window Extractor

A typical architecture for a sliding window detector looks like this:



Window Extraction Operations:

1) Crop the window at each scale
2) Resample (map) the window to the required input size for your detector
3) Flatten the window to a Vector

Part 2) Sliding Window Extractor

2. Use the best MLP from project 2 to detect faces at multiple scales from a full octave pyramid with s_0=1. Write a program to extract and flatten a sliding window from an image over a range of sizes from 16x16 to 100x100 using a scale factor of 1.2. Each window should be transformed to the standard size of input vector for your MLP face detector. Report, accuracy, precision, recall and computing time for evaluation with the images in folds 9 and 10 of FDDB.

Window	Window Size
1	16
2	19
3	23
4	28
5	33
6	40
7	48
8	57
9	69
10	83
11	99

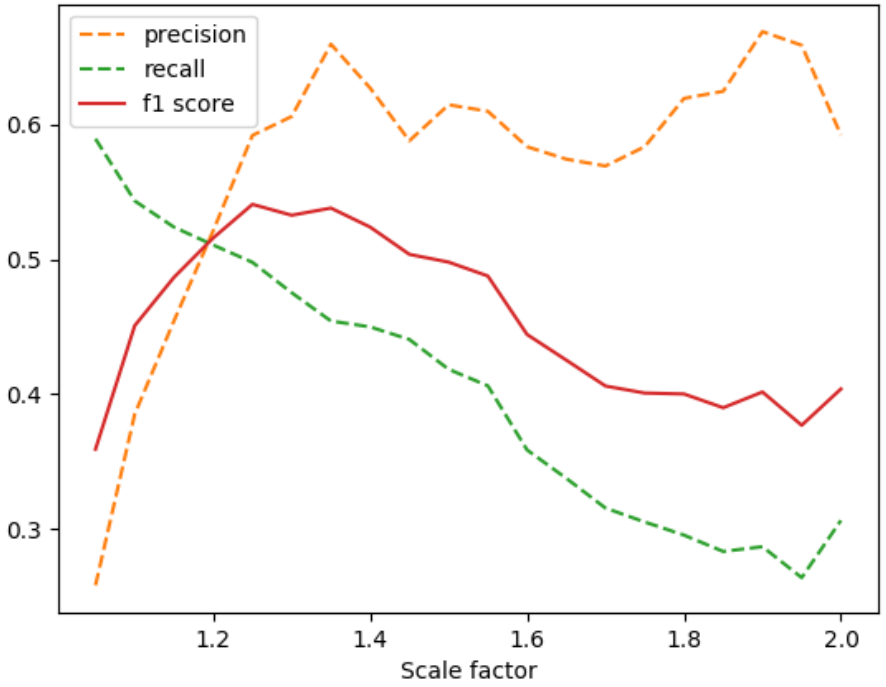
3) Sliding window dector with a Pyramid

3) Compute a Full Octave Pyramid for each image and detect faces from each level of your pyramid over a range of sizes from 16x16 to 33x33 using a scale factor of 1.2. Each window should be transformed to the standard size of input vector for your MLP face detector. Report, accuracy, precision, recall and computing time for evaluation with the images in folds 9 and 10 of FDDB.

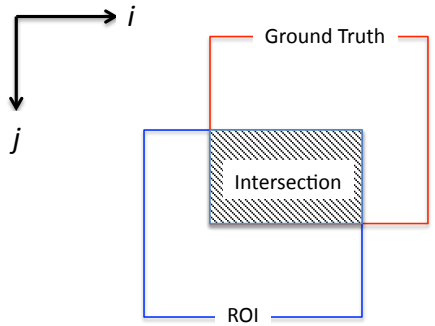
Window	Window Size
1	16
2	19
3	23
4	28

3) Evaluate the results

Compare results from image and from pyramid by computing, precision, recall and computing time for evaluation with the images in folds 9 and 10 of FDDB



Intersection over Union (IOU)



$$IOU_{12} = \frac{A_{I12}}{A_{U12}} = \frac{A_{I12}}{A_1 + A_2 - A_{I12}}$$

A typical threshold for TRUE Positive is IOU ≥ 0.5 . Note that a small window inside a larger window will likely have a small IOU. IOU test both for position and for scale.