Image descriptors

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Polytech SI4

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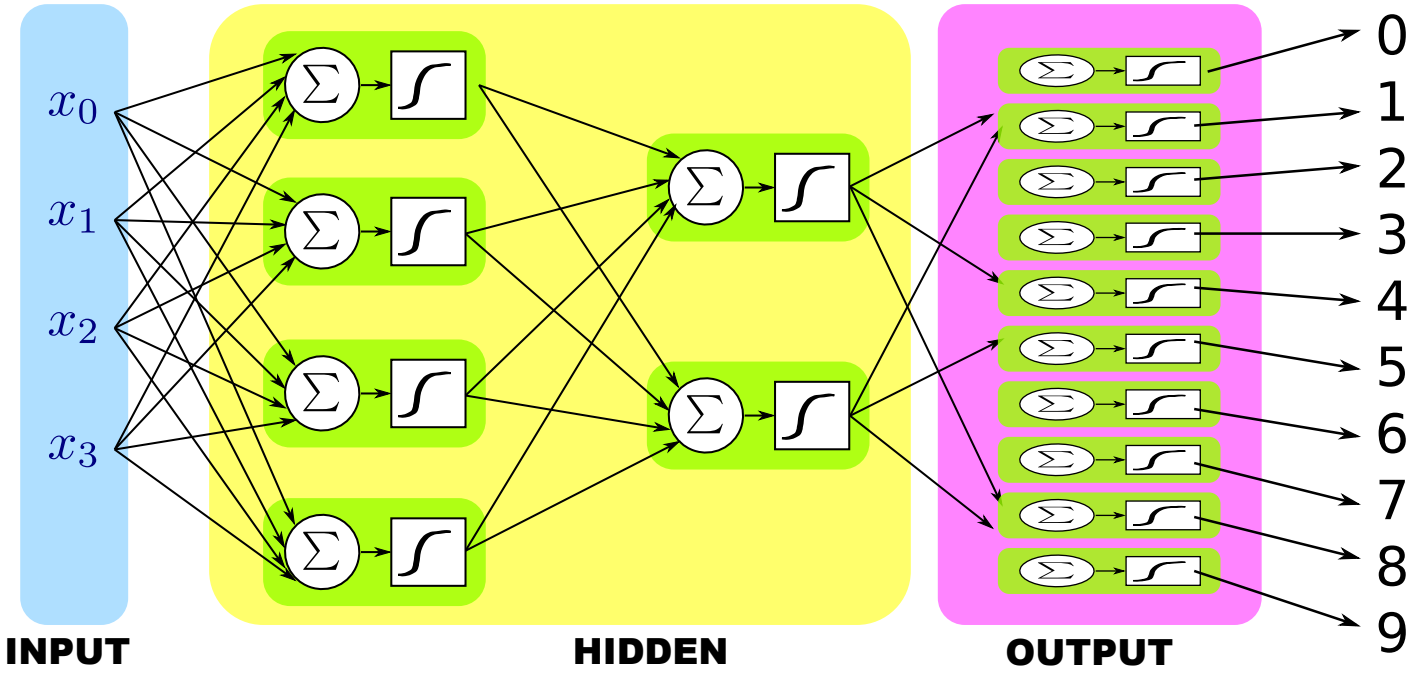
Problematic

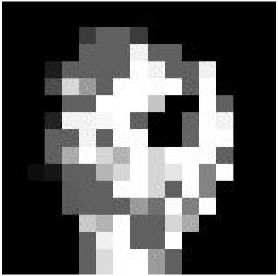
?



Menu

- Bag of Words / Bag of Features
  - using SIFT, SURF, ...
- HOG
- Deep features

Very basic idea : image as a pixel array



0.alexandre.hiltcher.009.txt

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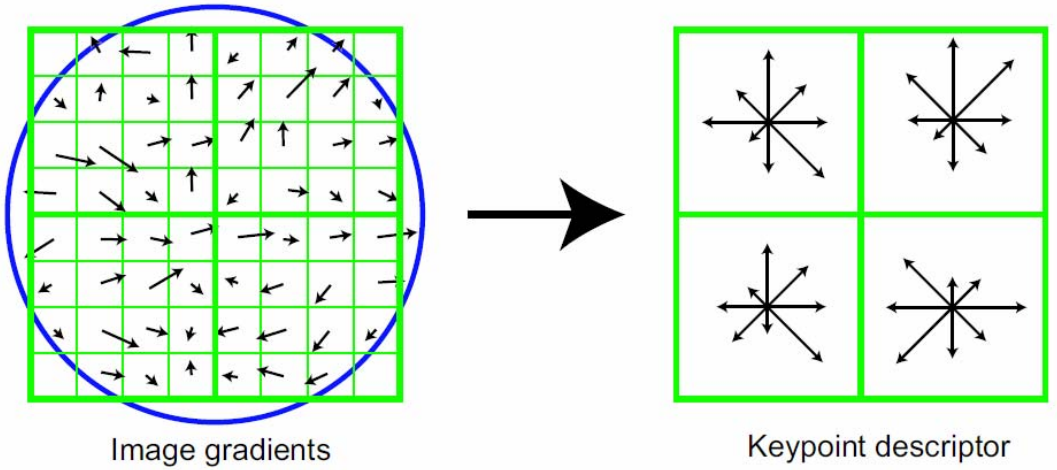
SIFT (Lowe 1999)

SIFT = Scale Invariant Feature Transform

- Detector
  - multi-scale
  - DOG laplacian (Difference Of Gaussians)
- Descriptor
  - edges orientations in the neighborhood

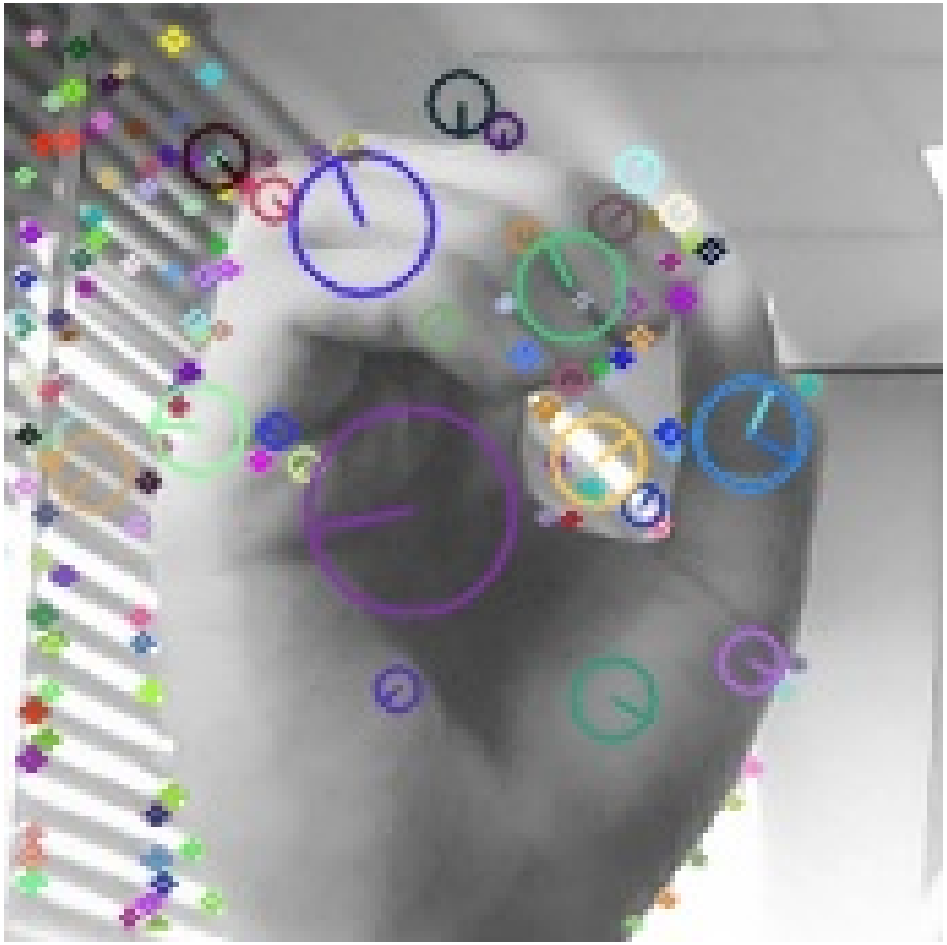
SIFT descriptor



- vectors of 128 integers
- 4 steps :
  - interest points detection
  - gradients orientation in the neighborhood (16x16 pixels divided in 16 blocks of size 4x4)
  - orientation histogram (quantified on 8 values in blocks of 4x4 pixels)
    - $8x4 * 4 = 128$
  - normalisation

SIFT descriptor

`0.alexandre.hiltcher.006.png`
252 descriptors



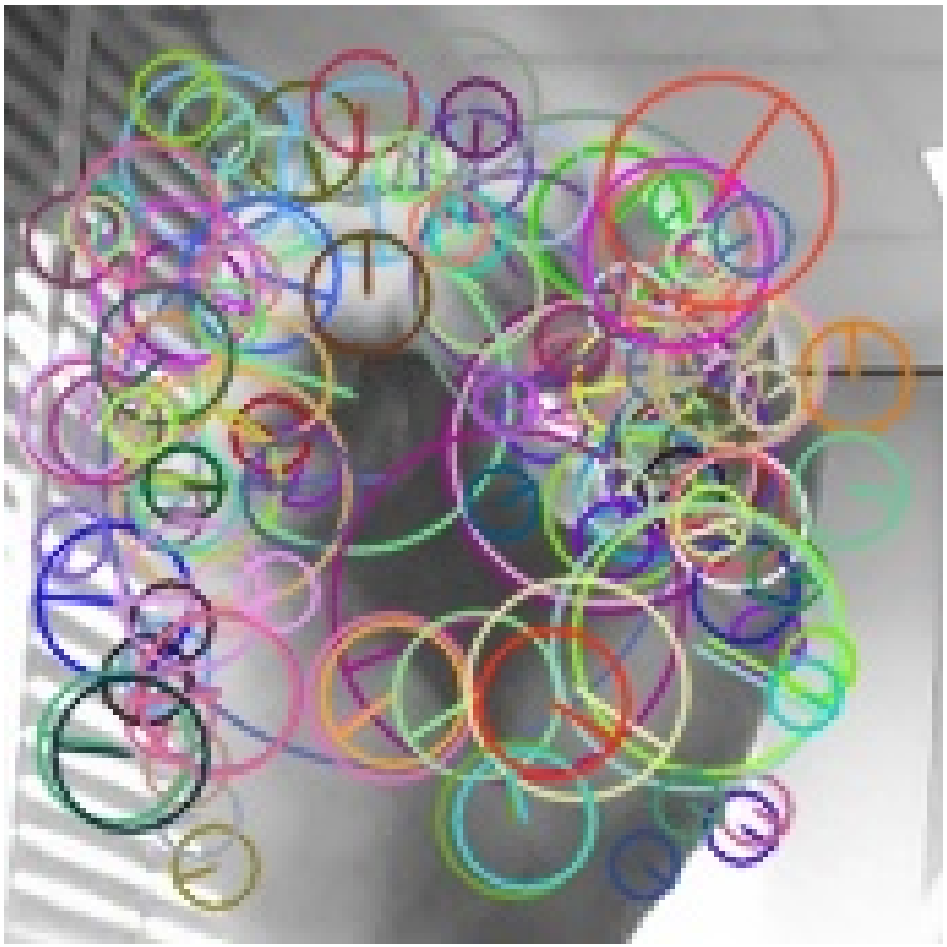
`0.alexandre.hiltcher.009.png`
182 descriptors

SURF descriptor (Bay etal 2006)

SURF = Speeded-Up Robust Features

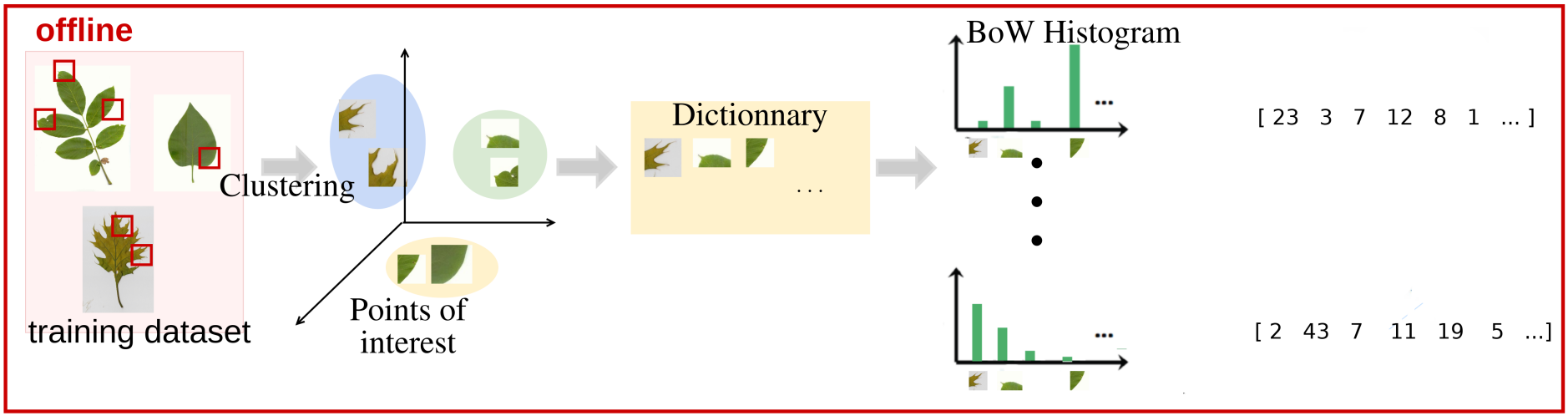
default size : 64

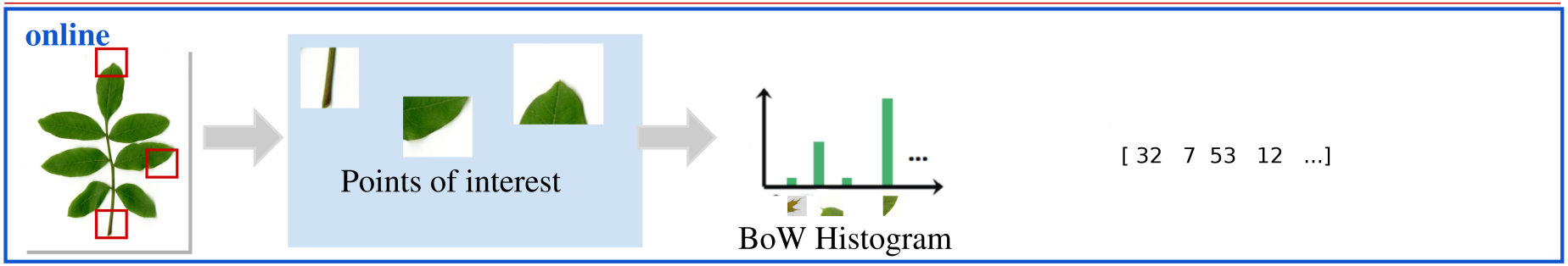
`0.alexandre.hiltcher.006.png`
184 descriptors



`0.alexandre.hiltcher.009.png`
121 descriptors

Bag Of Words (BOW)

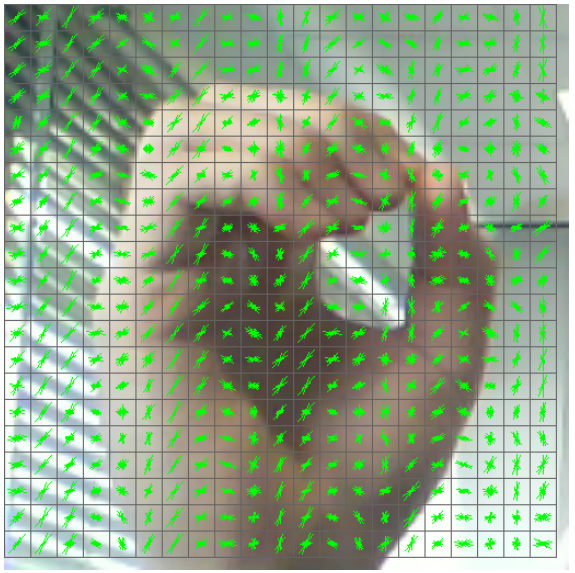




HOG : Histogram of Gradients

- gradient computation ([-1 0 1] et [-1 0 1] T)
- histogram construction
  - squared cells (from 4x4 to 12x12 pixels)
  - discretisation on 9 angle values
  - pixel votes proportional to gradient amplitude
- blocks construction
  - 1 block = several cells
  - normalisation of blocks
- HOG = concatenation of histograms

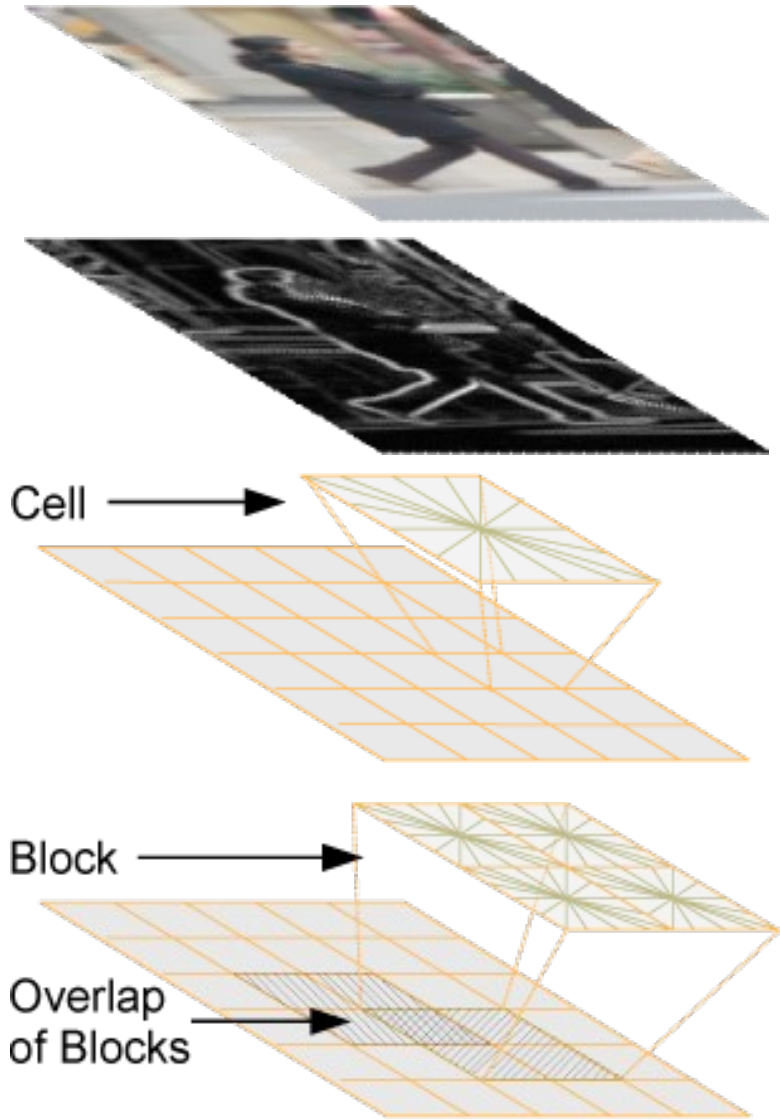
Next slides from presentation by Seeman.



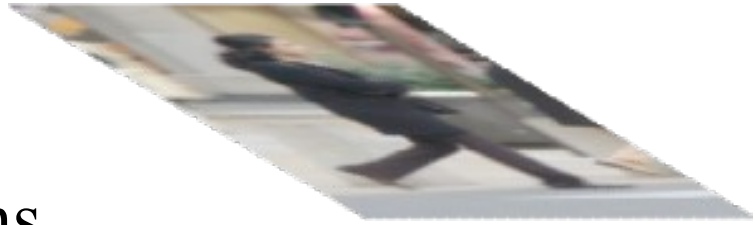
`0.alexandre.hiltcher.009.png`

Descriptor

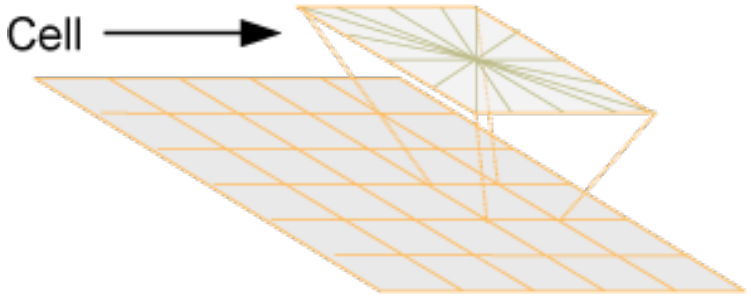
1. Compute gradients on an image region of 64x128 pixels
2. Compute histograms on ‘cells’ of typically 8x8 pixels (i.e. 8x16 cells)
3. Normalize histograms within overlapping blocks of cells (typically 2x2 cells, i.e. 7x15 blocks)
4. Concatenate histograms



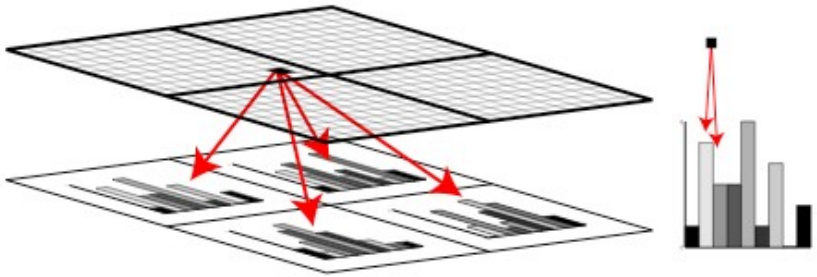
Cell histograms



- 9 bins for gradient orientations (0-180 degrees)
- Filled with magnitudes

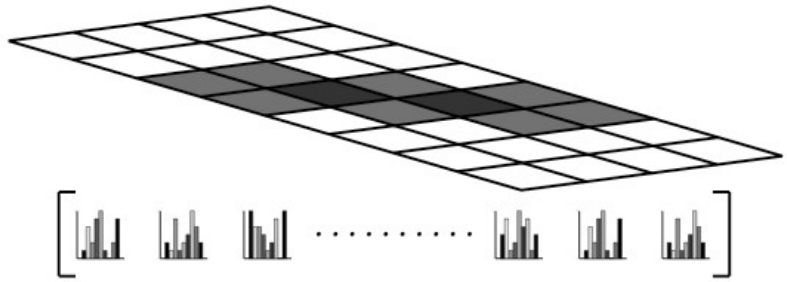


- Interpolated trilinearly:
  - Bilinearly into spatial cells
  - Linearly into orientation bins

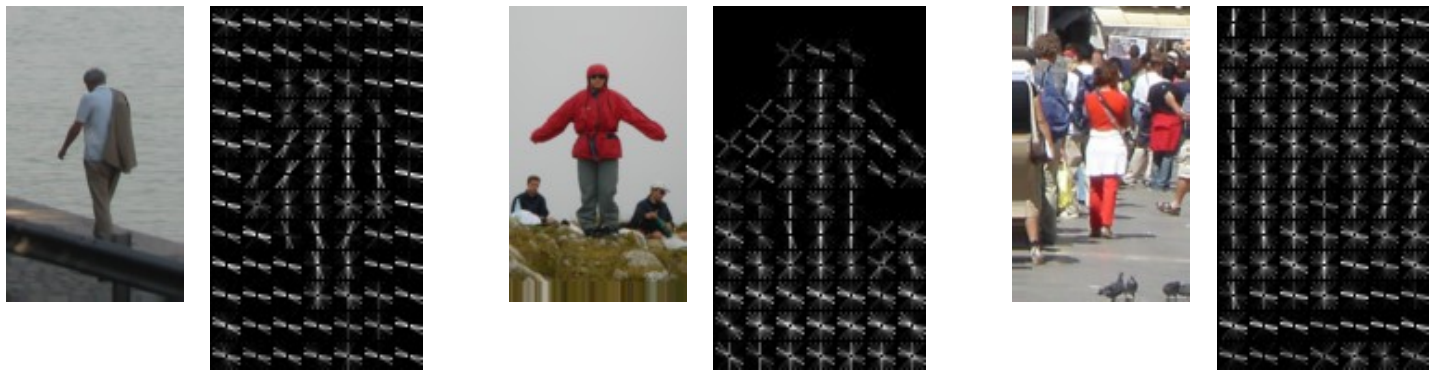


Final Descriptor

- Concatenation of Blocks



- Visualization:



Deep descriptor from GoogLeNet Inception v1

- already trained CNN :
  - try *GoogLe Net* by downloading the CNN topology [1], the learned weights [2] and categories [3]
  - and the OpenCV example [4]
- output of convolutional layer `inception_5b/pool_proj`
  - Using code :
    `net.forward(outputBlobs,"inception_5b/pool_proj");`
- 1 image $\leftrightarrow$ 1 vector of 6272 floats

1. `http://dl.caffe.berkeleyvision.org/bvlc_googlenet.caffemodel`
2. `https://raw.githubusercontent.com/ludv1x/opencv_contrib/master/modules/dnn/samples/bvlc_googlenet.prototxt`
3. `https://raw.githubusercontent.com/ludv1x/opencv_contrib/master/modules/dnn/samples/synset_words.txt`
4. `https://docs.opencv.org/3.2.0/d5/de7/tutorial_dnn_googlenet.html`

Other deep descriptors

- from an already trained CNN : Inception v3, VGG Net, ...
  - output of convolution layer (the last or the last before)
  - reduced size after convolution layers
- autoencoder
  - data specific encoding