Mid 2 Solutions

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1.)

Caltech Dataset Using VL-Feat Library.

Categories: 101

Method 1

Steps

- Compute vl_hog feature for each image.
- Train using hog feature for all categories by using libsvm library.
- Optimize svm_train parameters.
- Test new image using svm_predict

Method 2

Steps

- PHOW features (dense multi-scale SIFT descriptors)
- Elkan k-means for fast visual word dictionary construction
- Spatial histograms as image descriptors
- A homogeneous kernel map to transform a Chi2 support vector machine (SVM) into a linear one
- SVM classifiers

2.)

Lets try and solve foreground background segmentation using alpha beta expansion.

$$E(x) = \sum_{i=1}^{N} \sqrt{(xi - L)(xi - L)} + \sum_{i,j} K\sqrt{(xi - xj)(xi - xj)}$$

x I are grayscale intensity values.

L are labels.

K is smoothness factor

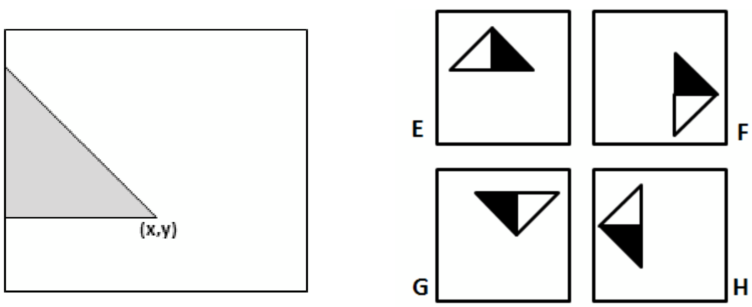
Given an input image of size m x n.

$\boldsymbol{N}$ = m x n

Steps

- Given a image.
- Define each pixel location as a node. We initialize N Nodes.
- Initialize labels foreground (L = 255) and background (L = 0)
- Unary Term: (Xi – L)
- Compute weights between the neighbours as
  Pairwise Term: (Xi-Xj)

3.)



(a) (b)

Figure 3: Notion of triangular integral value at pixel (x, y)

(Figure (a)) and type of proposed features (figure (b)).

Figure 3b illustrates the four types of triangle feature E, F, G and These are equilateral triangles with four different orientations (respectively top, left, down and right), being each one divided into two rectangular triangles (dark and light sub-regions of the triangles of figure 2b). These can be of four types, whose we labeled respectively North-West (nw), North-East (ne), South-West (sw) and South-East (se) due to the image corner adjacent to the triangle rectangular angle. As an example, the E triangular feature is divided into a se (light sub-region) and a sw (dark sub-region) rectangular triangle.

For a base resolution of 24 × 24 windows and allowing varying sizes and locations for each type of features it is possible to build an exhaustive set of 76 000 features, all of them based on the notion of triangular integral im age (ti). Figure 3a illustrates the sw triangular integral at point (x, y), which sums the intensities of the pixels contained within the dark triangular region. Formally, let i be an intensity image with H rows and W columns and i(x, y) be the intensity value of the pixel located at column x and row y. The four types of triangular integral images are given by

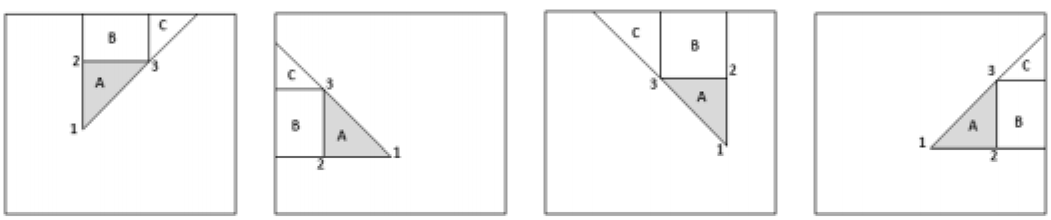
$$ti_{sw}(x,y) = \sum_{r=1}^{x}\sum_{c=1}^{r} i(c, y-x+r) \quad (4)$$

$$ti_{se}(x,y) = \sum_{r=1}^{W-x}\sum_{c=1}^{r} i(W-c, y-W+x+r) \quad (5)$$

$$ti_{nw}(x,y) = \sum_{r=1}^{x}\sum_{c=1}^{r} i(c, y+x-r+1) \quad (6)$$

$$ti_{ne}(x,y) = \sum_{r=1}^{W-x}\sum_{c=1}^{r} i(W-c, y+W-x-r) \quad (7)$$

considering, by definition, $i(x,y) = 0$ if $x <= 0$ or $y <= 0$ or $x > W$ or $y > H$.



(a) (b) (c) (d)

Figure 4

Computing integral image with single scan

ne Triangular Integral Images

$s_{ne}(x, y) = s_{ne}(x, y-1) + i(x, y)$

$ti_{ne}(x, y) = ti_{ne}(x-1, y-1) + s_{ne}(x, y)$

nw Triangular Integral Images

$s_{nw}(x, y) = s_{nw}(x, y-1) + i(x, y)$

$ti_{nw}(x, y) = ti_{nw}(x+1, y-1) + s_{nw}(x, y)$

se Triangular Integral Images

$s_{se}(x, y) = s_{se}(x, y + 1) + i(x, y)$

$ti_{se}(x, y) = ti_{se}(x - 1, y + 1) + s_{se}(x, y)$

sw Triangular Integral Images

$s_{sw}(x, y) = s_{sw}(x, y + 1) + i(x, y)$

$ti_{sw}(x, y) = ti_{sw}(x + 1, y + 1) + s_{sw}(x, y)$

For instance, the triangular area labeled with ”A” in figure 4a is given by

$ti_{nw}(1) - (ii(3) - ii(2) - ti_{nw}(3))$.