

IMAGE RECOGNITION

Task in general (in the end of the document I have prepared a full list of tasks):

1. Color images are given
2. One object to be recognized in each image, so train classifiers to identify the class of an image:
 - kNN
 - Regularized linear model
 - Multi-layer perceptron MLP
3. Estimate the performance of the classifier

Python and Keras should be used for the task. Please, comment the code widely.

Data

Three sets of image URLs provided as textfiles separately:

- Bird nests
- Lighthouses
- Honeycombs

Forth image set should be selected freely (some animal or mountains photos would be nice).

Data import

Read the URLs from the text files given and do the same for the forth freely selected set.

Data preparation

- Crop and resize the images into same size
- For GLCM (described further)
 - Change the images into grayscale
 - Reduce the quantization level (for example, 8 levels)

Feature extraction

- First order texture measures
 - Mean for each RGB color channel
 - Variance for each RGB color channel
- Second order texture measures (relationship among neighboring pixels)
 - Gray-Level Co-Occurrence GLCM matrix
- Select some other feature (please, include a reference and a brief description in the report)

Gray-Level Co-Occurrence Matrix

A way to measure texture. As the number of rows and columns equals the quantization level of the image, reduce the quantization level (please, see data preparation part). Also, for the texture calculations, the matrix should be symmetric and normalized.

Texture measures to be used:

- Contrast
- Dissimilarity
- Homogeneity
- Angular Second Moment (ASM)
- Correlation

Make illustrations of the feature relationships (as a part of the report):

- SOM

- PCA

Estimate the classifier accuracy

Estimate the accuracy of a classification method with nested leave-one-out cross validation:

- Optimize the hyper-parameters of the method in the inner loop
- Test the method using the optimal parameters with unseen data in the outer loop
- Facilitate the comparison between different methods

Task in detail overview

1. Import the images and prepare them for analysis
 - a. Read the URL-lists and open the images
 - b. Size the images properly
2. Feature extraction
 - a. Choose at least 10 features
 - i. RGB mean
 - ii. RGB variance
 - iii. Features derived from GLCM matrix
 - iv. Some other features
3. Standardization of the feature values
4. Make illustrations of the feature relationships
 - a. SOM
 - b. PCA
5. Try different classifiers, and optimize their parameters
 - a. K nearest neighbors
 - b. Regularized linear model with ridge regression
 - c. Multi-layer perceptron with 1 hidden layer and early stop committee
 - i. Output function Softmax
6. Estimate the classifier accuracy
7. Discuss which method performs the best? Why? What are the limitations? How the result could be improved?

Reporting

Sample structure, which could be used:

- Introduction
- Data set
- Methods
- Data preparation
- Calculations
- Results
- Discussion

FINAL RESULT: COMMENTED SOURCE CODE + REPORT