Sabanci University, FENS
CS419 Digital Image and Video Analysis
Fall 2023-24
Assignment 3 v2

The mpeg7ShapeB dataset is an old and simple dataset back from the days of feature engineering. It consists of 70 different types of shapes and each type/class has exactly 20 samples. Half of the samples of each class are set aside for training/developing a recognition model, and the other half has been set aside for testing it. The images are 8-bit grayscale and contain only the binary shape mask, the name of which takes place in each file's name.

Your task is to develop a solution using the data in the training set, that will maximize recognition performance with the testing set.

Let's break it down to steps.

a) You'll use a global shape descriptor D to convert each sample into a numerical feature vector.
b) For every test sample Y, you'll calculate the distance between Y's feature vector and the feature vectors of every training sample X_i, to determine the training sample that is closest to Y.
c) You'll assign the class of the closest training sample to Y. And once you have repeated this for every testing sample you'll calculate the ratio of correctly classified test samples and report it (i.e. you'll perform nearest neighbour classification). **(25 points)**

- You'll repeat all of your experiments with 4 distinct distance functions: Euclidean, Manhattan, Chi-squared, and Mahalanobis. This way you'll be able to assess if/and by how much the distance function choice affects performance **(25 points)**.

- You'll implement and explore various shape descriptors presented during our lectures **(50 points)**:

    * Basic shape descriptors: area, perimeter, convexity, circularity, rectangularity, eccentricity (various combinations thereof)
    * Fourier descriptor: try various numbers of coefficients.
    * Shape histograms (various lengths)
    * Moment invariants (i.e. Hu's 8 moments) (various combinations)
    * Arbitrary combinations of all of the above.

You'll compile all your findings into well formatted table(s) and report the performance of each run. Let's see which features are the best and how high you can get.

Instructions

1. Integrity: Plagiarism is strongly prohibited and may lead to failure of this course.

2. Questions: Contact the TA for any questions you might have.

3. Write-up: Please submit your answers as a zip file containing the documented **python notebook** of your implementations (**as ipynb files**) and a single **pdf file** type-set with LateX containing your answers to the various questions. Do not submit scans or photographs of handwritten documents, or pdfs prepared in word/libreffice, they will not be accepted for evaluation.

4. Collaboration: You can work in groups, however each student must submit their own work.

5. **You are free to use any software library.**

Good luck.