CAP 5415- Assignment 3

Computer Vision

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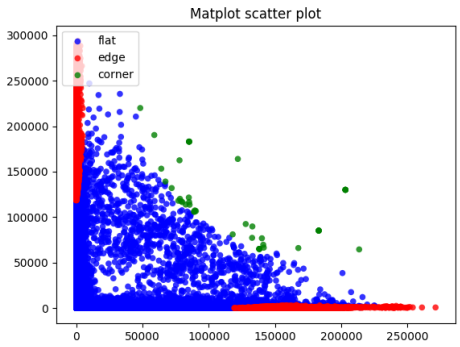
1. Harris detector and feature classifier:

During our previous implementation in PA2, for a given image (input_hcd1), we first obtained image derivatives along x and y direction, obtained Hessian Matrix using the derivatives, applied the window function, computed the cornerness measure and applied Thresholding, to get points of interest. In this question, you would utilize these points of interest and perform the below steps:

a) For each point of interest, define a 2 x 1 vector using the eigenvalues (lambda1 and lambda2).

b) Find the distribution of the feature vector.



Also, I have created distribution based on lambda based classification as well. This is scatter plot is thresholded on R values.

c) Find the parameters of normal distributions that best fit the i) edges, ii) corners, and iii) flat regions.

I am using the fisher classifier in the dataset and dividing the data into 4 sets, creating edge_lef t and edge_right for classifying the left and right edges.

class	mean	covariance
corner	[[58495] [163120]]	[[2880794798 79880910] [79880910 870388409]]
edge_left	[[-77788][147763]]	[[180048457 -340179094] [-340179094 643756563]]
edge_right	[[163517][104750]]	[[365648519 230515184] [230515184 145503288]]
flat	[[643][3458]]	[[182574109 29782999] [29782999 217473840]]
edge	[[42864] [126257]]	[[272848488, -54831954], [-54831954, 394629925]]

d) Classify each point using the estimated distributions and find the error rates for each category.

class_predicted	corner	edge	flat	error_rate
Actual: corner	44	0	0	0
Actual: edge	436	11911	0	0.0353
Actual: flat	5154	5320	303335	0.0333

Total error = 3.3% Accuracy = 96.6%

1. DigitDataset Classifier:

Given the dataset of digits with 10 classes (0 – 9), obtain image features by making use of your Harris Corner Detection algorithm, and implement the following:

a) Select the first 100 images of each class for training and testing a classifier. You will use the first 50 images for training and the remaining 50 images for testing purposes.

b) For each image, create a 20 x 1 feature vector using the 10 most positive and 10 most negative R scores.

c) Using the training feature vector for each class, design a Bayes linear discriminant function for recognizing each class. Since there are ten classes, you will have such 10 LDFs.

d) Evaluate the classifier performance for both the training and test data. What is the overall probability of correct recognition and probability of error for each case?

Training confusion matrix:

actual/predicted	0	1	2	3	4	5	6	7	8	9	Error rate
0	30	1	2	0	0	2	7	1	3	4	40%
1	0	18	6	4	3	7	1	7	1	3	64%
2	0	5	16	5	6	2	0	6	3	7	68%
3	0	6	5	13	9	6	0	2	6	3	74%
4	0	1	3	9	23	4	0	2	5	3	54%
5	1	5	3	5	8	15	3	5	2	3	70%
6	9	2	4	1	0	2	12	2	12	6	76%
7	0	10	5	2	2	6	1	18	1	15	64%
8	3	1	2	3	1	1	4	0	31	4	38%
9	5	0	1	0	2	1	6	2	10	23	54%

Testing confusion matrix:

actual/predicted	0	1	2	3	4	5	6	7	8	9	Error rate
0	34	0	0	0	0	0	7	1	5	3	32%
1	0	15	8	6	5	2	0	10	2	2	70%
2	2	7	7	3	4	8	3	10	1	5	86%
3	0	3	4	11	11	3	2	4	8	4	78%
4	0	0	5	8	23	6	4	1	3	0	54%
5	2	10	6	3	4	9	4	2	7	3	82%
6	8	3	4	3	1	2	12	2	8	7	76%
7	2	13	4	6	3	5	3	8	3	3	84%
8	4	1	3	5	2	4	5	1	22	3	56%
9	10	3	7	2	1	1	5	1	9	11	78%

Training accuracy : **199/500 = 0.398,** Training error : **0.602**
Testing accuracy: **152/500 = 0.304,** Testing error : **0.696**

Mean Vector and Covariance matrix