DLCV hw1
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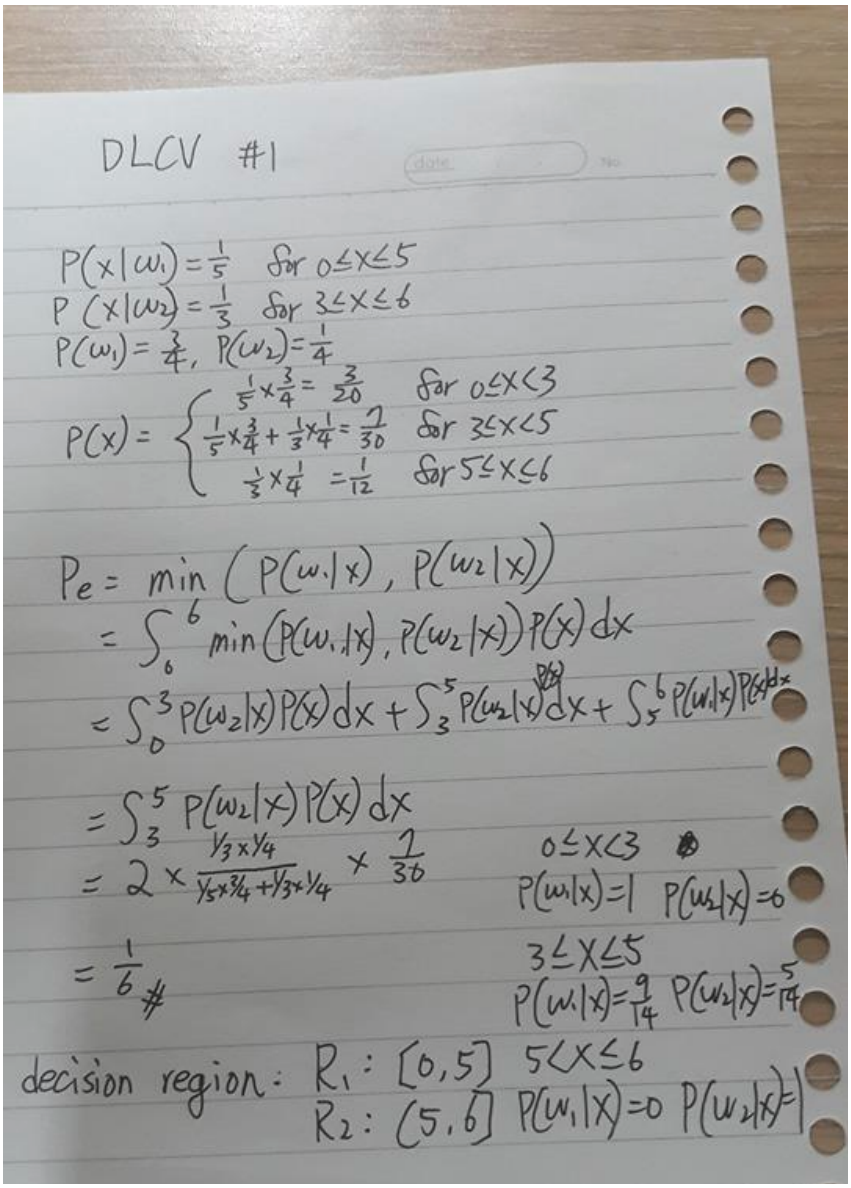
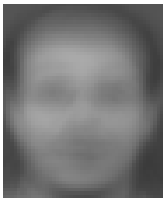
Problem 1: Bayes Decision Rule (30%)



Problem 2: Principal Component Analysis and k-Nearest Neigh-bors Classification (70%)

(a) (10%) Perform PCA on the training set. Plot the mean face and the first three eigen-faces.

The mean face:



The first three eigen-faces:

(first,second, and third)

(b) (25%) Take person 1 image 1 , and project it onto the above PCA eigenspace. Reconstruct this image using the first n = 3, 50, 100, 239 eigenfaces. For each n, compute the mean square error (MSE) between the reconstructed face image and person 1 image 1 . Please plot these reconstructed images, with the corresponding MSE values.

The original image from 1_1.png

n	3	50	100	239
reconstructed image				
MSE	663.04	213.06	82.32	0.5093

(c) (35%) To apply the k-nearest neighbors classifier to recognize test set images, please determine the best k and n values by 3-fold cross-validation. For simplicity, the choices for such hyperparameters are k = {1, 3, 5} and n = {3, 50, 159}. Please show the cross-validation results and explain your choice for (k, n). Finally, use your hyperparamter choice to report the recognition rate on the test set.

k\n	3	50	159
1	78.75% / 72.5% / 68.75%	95% / 88.75% / 96.25%	95% / 90% / 95%
3	63.75% / 62.5% / 52.5%	87.5% / 82.5% / 81.25%	87.5% / 82.5% / 81.25%
5	56.25% / 55% / 47.5%	81.25% / 76.25% / 75%	80% / 75% / 71.25%

The table shows the accuracy of cross-validation. From the table, (50,1) and (159,1) both result in highest accuracy in average. Thus, I chose both of them to report the recognition rate on the test set.

(1/50): 96.25%
(1/159): 94.375%

As shown, the choice of (50,1) lead to higher accuracy