Computational Vision.
Master in Artificial Intelligence.

January 14th, 2014

Name :

Answer the following questions in separate sheets. The score for all questions is 0.5 points.

1 Linear operators and segmentation of images

Exercise 1.1. Explain the model of image pixel formation. What are the variables it depends on?

Exercise 1.2 What is the image convolution? What is the cost of applying it on an image of N by M pixels with a mask of size n by m?

Exercise 1.3 What is the Canny operator? Explain the procedure of applying it on an image. What are its advantages with respect to its alternatives?

Exercise 1.4 Given a color video, define an algorithm to segment an object that is a red ball in the video frames using k-means. What are the advantages and disadvantages of this procedure?

Exercise 1.5. Compare the snakes and level sets as segmentation techniques, explaining common aspects and differences. What are the advantages of level sets compared to the snakes?

2 Feature detection and matching

Exercise 2.1. Briefly comment how can descriptors be detected at different scales.

Exercise 2.2. Let r1 and r2 be the autovalues associated to the autocorrelation matrix at a certain point. How can you know if the point is significative ?

Exercise 2.3. In the context of feature matching, which are the advantages of using the nearest neighbor distance ratio with respect of simply using the nearest neighbor.

Exercise 2.4. Assume the problem of panoramic image creation and two models, linear and affine model. What kind of photographs can each of the model handle ?

Exercise 2.5. Which is the basis of the RANSAC method? Briefly comment on it in the context of panoramic image creation.

3 Face detection, recognition and matching

Exercise 3.1. Define the rectangle features, presented by Viola Jones method, using an equation and explaining the terms.

Exercise 3.2 Define the Integral Image used by Viola Jones method.

Exercise 3.3 In the context of face detection, what are cascade of classifiers useful for?

Exercise 3.4. Explain the main differences between PCA and LDA.

Exercise 3.5. How the Active Shape Models generate a plausible shape? Write an equation and explain the terms on it.

4 Max margin visual object processing

Exercise 4.1. What is the hinge loss function? Draw a graph of this function and a graph of the 0-1 loss function.

Exercise 4.2. Why do we say that the sliding window approach to object detection must be based on linear SVM and not on non-linear SVM's? Justify the answer.

Exercise 4.3. Why do we say that a linear SVM-based object recognition system (trained with positive and negative examples) cannot deal with problems such as object truncation or object occlusion?

Exercise 4.4. Explain the Exemplar-SVM approach to object detection. Which are its advantages?

Exercise 4.5. Explain how to implement a multiclass classifier with the Structured-SVM approach.