EE150
Homework 3
Due: Tues, April 26 (Before Class)

1 Lowe Paper and the KD Tree

Read the David Lowe papers from the website (there are two on the lectures page and one on the HW page) and review the notes from class. This is one of the few systems within computer vision that actually 'works' in practice. It has been implemented and is being used within the real world.

1. (5 pts) What is a KD Tree? How does Lowe employ the KD Tree? What sort of computational savings does Lowe achieve by using it? Generate 7 random points in 2D and show how the tree would be constructed and the final tree which is constructed . No need to generate code for this, just draw the Tree(s) by hand. Will the KD Tree always find the optimal match in 2D? If not, illustrate an example where it fails to find the optimal match.

   (hint: see www.rolemaker.dk/nonRoleMaker/uni/algogem/kdtree.htm for inspiration on how to create the tree.)

2. (5 pts) Explain the concept of 'back-tracking' and how it can be used to find a better match. What information is being stored to perform the back-tracking? Which is the time complexity (big-O notation) of the new search assuming that you perform a maximum of 'k' back-tracking steps?

2 Constellation Model

We presented a model in class which aims to model an object by a collection of parts and their relative positions. It is known as the 'Constellation Model'. Note that we have only talked about the shape component of the model, we have not talked about how to model the appearance of each part. Below you will be asked to extend the model which was presented to make it translation invariant. That is, the model will be able to detect an object which has been translated to any position within an image.

1. (7 pts) How could you make the model presented in class translation invariant? Describe method(s) for achieving this invariance. Hint: One possibility, consider both ordering your detections along the x-axis as well as conditioning on the detection of a particular part.

2. (13 pts) Modify the code presented in class to make it translation invariant. You should provide plots which indicate this. I.e., generate translated versions of the model and show that the hypotheses corresponding to these translated points are achieving a high probability.