EE/CNS/CS-148 Homework 3

Due date 04/25/06 before class

April 18, 2006

1 Find a Project

Proposals for your final project have been posted in the class wiki. Select a short list of possible candidates (ideally only one, and no more than three) and be ready for discussing them next Thursday in class (04/20/2006). Since for all the remaining part of the class you will be working on your project and it also account for a large percentage of the final grade (60%), you should select your project carefully. You are suppose to work in teams of two, even if a student can work alone. If you have already decided who is going to be your team mate discuss with him about the projects and try to reach a common set of choices. Of course, if you (and possibly you team mate) want to work on a project not in the list you can add your own proposal directly on the class wiki. Make sure you have a clear and well define target for your project if not a complete idea of your solution. Pietro will decide about student proposals. Every accepted student proposal will also be available to the rest of the class.

2 David Lowe’s Paper (final part)

Read the (remaining part of) David Lowe’s papers and review the slides from the corresponding lectures.

- Question 1
  What is a KD Tree? How does Lowe employ the KD Tree? What sort of computational savings does Lowe achieve by using it? Show an
example of construction of a kD-tree in the plane for a limited number of point (7 for example).\(^1\).

- **Question 2**
  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? What is the time complexity (order of magnitude or \(O\)-notation) of the new search assuming that you perform a maximum of \(k\) back-tracking steps?

### 3 Constellation Model

We presented in class the *Constellation model* which aims to represent an object by a collection of parts and relative positions.

- **Question 1**
  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.

- **Question 2**
  Modify the code presented in class to make it translation invariant. You should provide plots which indicate this: generate translated versions of the model and show that the hypotheses corresponding to these translated points are achieving a high probability.

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\(^1\)You do not need to write code for creating a kD-tree, just draw the it by hand.