CALIFORNIA INSTITUTE OF TECHNOLOGY

ME/CS 132b, Spring 2011

Problem Set #3 (rev. 2) Due: 21 Apr 11

1. [20 points] LaValle, Chapter 2, Problem 6(a)
(reading: Section 2.1, 2.2, 2.3.3)

2. [15 points] LaValle, Chapter 15, Problem 5
(reading: Section 15.3)

3. [15 points] Consider the 3x4 grid shown in lecture #5. Run the A* search by hand.

   Produce a table where each row corresponds to one iteration, and whose columns contain the following:

   - The iteration number.
   - The node selected from OPEN.
   - A list of the nodes in OPEN, after having expanded the children.
     For each node, indicate:
     - The node's parent.
     - The node's label (best cost-to-come)
     - The node's f function (cost-to-come + estimated cost-to-go based on heuristic)
   - The target node's label (d_t).

4. [50 points] Implement A^*.

   (a) Apply it to the same problem above that you solved by hand, and verify that it follows the same steps.

   Print out the same values specified by the previous question.

   (b) Apply it to the cost map generated in the homework #2 (available for download).

   - **Actions:** assume that the grid is 4-connected. (fancier solutions using an 8-connected grid will be accepted as well)
   - **Actions cost:** Let i, j be the indices of two cells. Let c_i, c_j be the values of the cost map for these two cells. The edge cost a_{ij} is defined as

   $$a_{ij} \triangleq \|x_i - x_j\| \left(1 + \alpha \frac{c_i + c_j}{2}\right),$$

   where α is a parameter that trades-off the importance of path length and traversal cost. Let $\alpha = 1$.
   - **Traversability**: The cells with value equal to 255 are considered non-traversable.
   - **Heuristics:** Design a suitable heuristics function for this problem, based on the Euclidean distance. Make sure that it respects all the conditions needed.

   Plan a path from the lower-right corner to the upper-left corner.
   Report:

(a) The number of actions in the plan.

(b) The total cost.

(c) A plot of the path.

Tip: also try the value $\alpha = 0$ for a sanity check.