Exercise 1. (2 points)

You want to drive from Strasbourg to Munich. You are using the map below. The numbers in brackets $(x, y)$ denote the coordinates of the different cities (ignore the numbers annotated at the roads between cities, these will be used in a later exercise). Use the greedy best-first tree search algorithm (i.e., no detection of repeated states), as given in the lecture, to find your route. As the heuristic function, use straight line distance, defined here by $dist(A, B) = \sqrt{(x_B - x_A)^2 + (y_B - y_A)^2}$ where A and B are cities with coordinates $(x_A, y_A)$ and $(x_B, y_B)$ respectively. Write down the order in which the nodes are expanded. Draw the search tree, annotating each node with its $h$ value.
Exercise 2.  

(a) Formalize the search space for the alien tiles puzzle described at: 

http://www.alientiles.com

Consider the goal described, on that web page, as “FirstGoal”.

Hint: Use the formalization of the missionaries and cannibals problem, as presented in the lecture, as a guideline.

(b) Specify the total runtime and memory requirement of a breadth-first search, for search depths 1–15, in the search space defined in part (a). Assume a memory requirement of 64 bytes and a search duration of 1 microsecond per node.

(c) Specify the total runtime and memory requirement of an iterative deepening search, for search depths 1–15, in the search space defined in part (a). Assume a memory requirement of 64 bytes and a search duration of 1 microsecond per node.

Exercise 3.  

In many search spaces, one can reduce the runtime by avoiding symmetric sub-solutions.

(a) Every permutation of a move sequence in the alien tiles puzzle results in the same state. Why?

(b) Describe how one can modify a depth-limited depth-first search algorithm so that it considers only a single one of a move sequences many possible permutations.

(c) How does this optimization change the answer to Exercise 2 (c)?