CS410: Artificial Intelligence 2021 Fall
Homework 3: Local Search & Adversarial Search & MDP
Due date: 23:59:59 (GMT +08:00), November 6 2021

1. **Local Search**. The traveling salesman problem (TSP) is the problem of finding the shortest route to visit a set of cities exactly once and return to the starting city. Describe how to use genetic algorithm for TSP. Propose a state representation, the corresponding crossover and mutation, and the fitness function.

2. **Game Tree**. Prove that with a positive linear transformation of leaf values (i.e., transforming a value x to $ax + b$ where $a > 0$), the choice of move remains unchanged in a game tree, even when there are chance nodes.

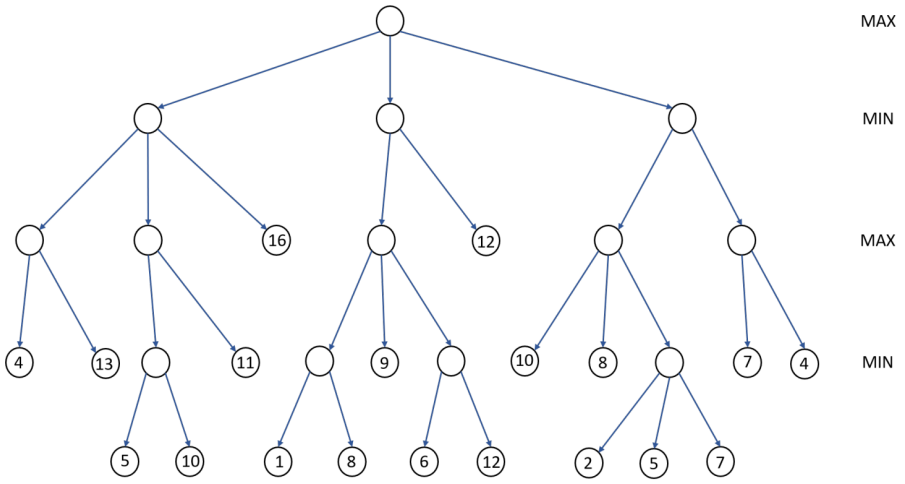

Figure 1: Problem 3.

3. **Alpha-Beta Pruning**. Consider the above game tree.
   (a) Compute the minimax value for each node using Minimax algorithm.
   (b) Prune the game tree using Alpha-Beta pruning algorithm. Provide the final alpha and beta values computed at the root, each internal node visited, and at the top of pruned branches. Provide the pruned branches. Assume child nodes are visited from left to right.

4. **Racing Problem**. Consider the racing problem in Page 17, Lecture 6.

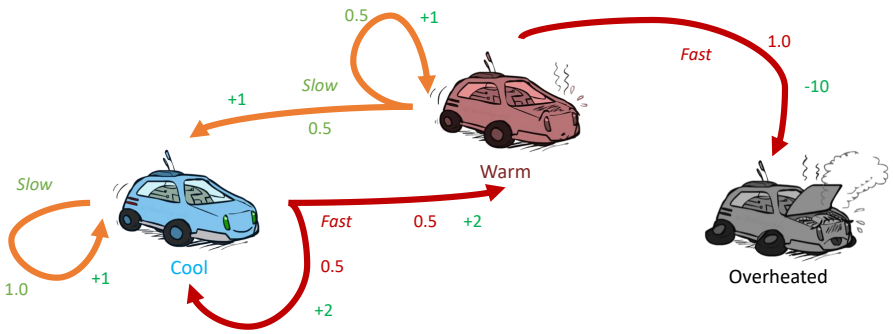

Figure 2: Problem 4.

Assume there is a discount factor $0 < \gamma < 1$ in the MDP of this problem. Calculate $V^*(s)$ for each state s and $Q^*(s, a)$ for each q-state (s, a) in this problem.

5. **Convergence of Policy Iteration**. Prove the policy improvement method can indeed improve policies and then prove the convergence of policy iteration.