Problem Set 1

a partial list

Please assume Markov property, fully-observability, time-invariance throught this set of problems.

Q-1) Consider $\langle S, A, R, T \rangle$, with finite state/action space. Let the reward R be a map from $S \times A$ to real numbers, i.e., $R(s, a) \in \mathbb{R}$. This is denoted by $R\colon S \times A \to \mathbb{R}$. Suppose $R(s, a) = c$, for all $s \in S$ and $a \in A$, where c is a constant. What are the *correct/best* agent functions?

Q-2) In the bunny problem and the vacuum bot problem in the first lab session. Please list down the following:

- Did you notice the difference between the agent function and the agent program? If so, explain it.
- How is the search procedure different from BFS?
- Using the search procedure that we derived in the lab, is it possible to arrive at the *correct/best* agent function?

Q-3) Consider the following version of the $n^2 - 1$ puzzle for $n = 4$ with 0s and 1s. The start state and goal state are :

1	0	1	0
1	0	1	0
1	0	1	0
1	1	0	

Table 1: Start State

1	0	1	0
1	0	1	0
1	0	1	0
1	0	1	

Table 2: Goal State

Is the goal reachable from the start state

Q-4) Consider the following example. Show that the complexity is $O(|A|^{|S|})$. What is the search tree? Does the complexity reduce if we have the *explored list* ?

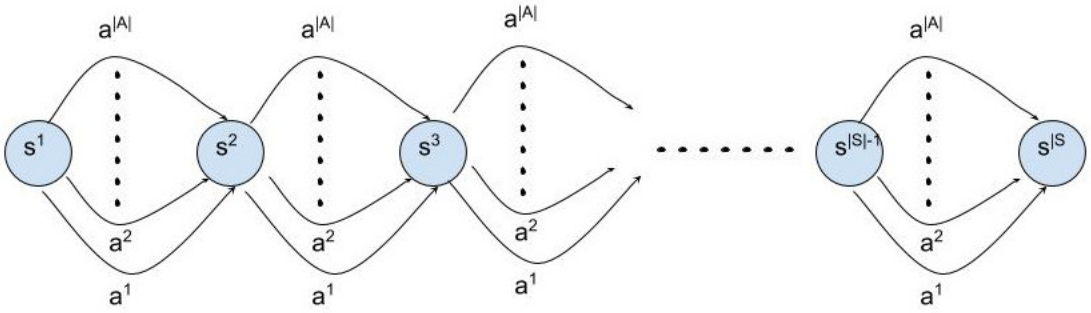

Figure 1: Show that complexity is $O(|A|^{|S|})$

Q-5) Let us think of a square as a graph with 4 edges and 4 vertices. Assign the weights of the edges to be $1, 2, 3, 4$ (any assignment is fine). Pick a start state and a goal state. Give examples of

- Consistent heuristic
- Admissible heuristic
- Admissible but not consistent heuristic

Q-6) Let us say that the Euclidean distance between two points is given. How would you use this to create a Heuristic for a given road network. What happens when roads are removed. What happens when new roads are added. Suppose, all the road distances are known, how will you use it to compute a heuristic for rail network. Suppose travelling times on these roads for a bus are given, how to use it for derive shortest path for auto-rickshaw (it goes faster than bus on narrower roads and slower than bus on wider roads), describe our approach.

Q-7) Let say two heuristics h_1 and h_2 are given. Write down ways you can combine them in an intelligent manner.

Q-8) If h_1 and h_2 are admissible is $\max\{h_1, h_2\}$ an admissible heuristics as well?

Q-9) If h_1 and h_2 are consistent is $\max\{h_1, h_2\}$ a consistent heuristics as well?

Q-10) What happens if the heuristic is not admissible? Can we still somehow use it? What happens if the heuristic for certain nodes are missing?

Q-11) Say $h(n)$ is a valid heuristic, then

- Say $h(n) \geq 0$, is $-h(n)$ a valid heuristic?
- Is $-h(n)$ a valid heuristic for any $h(n)$ (not necessarily $h(n) \geq 0$) ?