End Semester Examination

Course Name: Artificial Intelligence

Code: CS 561

Full Marks-60

Time: 3 hours

Answer ALL the questions

Make reasonable assumptions as and whenever necessary. You can answer the questions in any sequence. However, the answers to all the components of any particular question should appear together.

Q1). We would like to design a probabilistic version of A* algorithm. The state space is assumed to be a tree.

For each state in the state space, the descendent states are given probabilities of transition. Thus if S is the start state and the states originating from S are A, B and C, then the probabilities are p_A, p_B and p_C. Obviously, $p_A+p_B+p_C=1$.

a. The probability function is given as $p(x)=[e^{-f(x)}/(1+e^{-f(x)})]$, where x is a state and $f(x)=g(x)+h(x)$ is the usual distance from source and estimated distance from goal as discussed in the class ($h(x)<=h^*(x)$, for all x). Justify the use of this function.
b. Give the probability of finding the optimal path when probabilistic A* terminates.
c. Give the expected number of nodes expanded before termination.
d. Compare the expression in (c) with the best case, worst case and average case performance of non-probabilistic A*.

5+4+6+9= 24

Q2). Prove rigorously the fact that if monotone restriction is satisfied, every node expanded (i.e., transferred to closed list) will not need parent pointer revision in future; that is, the path from S to an expanded node is the best now and later too. 6

Q3). From "Horses are animals", it follows that "The head of a horse is the head of an animal". Demonstrate that this inference is valid by carrying out the following steps

a. Translate the premise and the conclusion into a language of first order logic. Use the following predicates: HeadOf (h, x)- h is the head of x; and Horse (x) and Animal (x).
b. Negate the conclusion, and convert the premise and the negated conclusion into CNF.
c. Use resolution to show that the conclusion follows from the premise.

3+4+5=12

Q4). Suppose that an attribute splits the set of examples E into subsets E_i and that each subset has p_i positive and n_i negative examples. Show that attribute has strictly positive information gain unless the ratio $p_i/(p_i + n_i)$ is the same for all i (**hint**: use decision tree and explain each step clearly). 8

Q5). *Genetic Algorithm is a special case of Stochastic Hill Climbing* - prove or disprove this statement with proper examples and justifications. *Allowing bad solutions sometimes helps to come out of local optima*- discuss this phenomenon with respect to hill climbing and simulated annealing. How is local beam search different from parallel random re-start search?

4+4+2= 10

5