CSci 5511 Spring 2009

1st Midterm Exam

Wednesday February 25
75 minutes == 75 points
Open book and notes

1. *15 points*
   You are given the missionaries and cannibals problem, which states that there are 3 missionaries and 3 cannibals on one side of a river, along with a boat that can hold one or two people. The problem is to find a way to get everyone to the other side of the river without ever leaving a group of missionaries in one place outnumbered by the number of cannibals in the same place.

   1. Describe how you would represent the state space, including the states, successor function, and goal test.
   2. Is the search space a tree or a graph? What is the branching factor?
   3. What search algorithm would you use to solve the problem?

2. *10 points*
   Answer the following questions briefly but precisely:

   1. Can an agent that keeps no history of its percept sequence be rational? Please explain.
   2. Why it is important to know if an agent's environment is fully observable or if it is partially observable?

3. *15 points*
   Suppose you are given a CSP problem (for instance, a cryptoarithmetc problem) and you are interested in finding ALL the possible assignments of values to variables that satisfy the constraints.

   1. what algorithm would you use? Please explain.
   2. what representation (incremental formulation or complete-state formulation) do you think would work best? why?
   3. would you use the MRV and degree heuristics? why? or why not?

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4. *25 points*
   Answer the following questions explaining your reasoning briefly but precisely.

   1. Suppose you have several admissible heuristic functions for a problem. Can you use them to produce a better heuristic? how?
   2. What are the advantages of using a heuristic function for A* that is monotonic?
   3. Is it true that when $h = 0$ A* has always to search the entire search space before finding the optimal solution?
   4. What is the advantage of having independent sub-problems when solving a CSP?
   5. Why does IDA* require less memory than A*?

5. *10 points*
   Write a function in Lisp that takes as an argument a list, whose elements are either symbols or lists of a single symbol. The function should return a list that contains in the given order the symbols from the original list and sublists, each containing two copies of the symbol from the original sublist. For instance the sublist `(a)` will be replaced by `(a a)`.

   You can use the system defined predicate `listp` to see if an object is a list, or the predicate `atom` to see if an object is not a cons.

   Do NOT use any global variable, but you are free to use as many auxiliary functions as you like.

   The function should work like this:

```
(expand '(the (big) boat)) = (the (big big) boat)
(expand '((oh) (wow)))  = ((oh oh) (wow wow))
(expand '(hip))  = (hip)
(expand '(this is (very) nice)) = (this is (very very) nice)
```

You reached the end of the exam