Practice Exam Problems

CSCI 561 Spring2016: Artificial Intelligence

Student ID: _____

Last Name: _____

First Name: _____

USC email: _____

Instructions:

1. Date: Tuesday **2/16/2016 from 5:00pm – 6:20 pm**
2. Maximum credits/points for this midterm: 100 points.
3. Credits/points for each question is indicated in the brackets [ ] before the question.
4. **No books** (or any other material) are allowed.
5. Attach extra sheets (available upon request) if required (write full name on each extra sheet).
6. **Write down name, student ID and USC email address.**
7. No questions during the exam.
8. **Be brief: a few words are often enough if they are precise and use the correct vocabulary studied in class.**
9. When finished raise completed exam sheets until approached by proctor.
10. **Adhere to the Academic Integrity code.**

[15%] General AI knowledge.

For each of the statements below, write **T** if the statement is always and unconditionally true, and write **F** if it is always false, sometimes false, or just does not make sense:

(i) [1%] ____ The Turing test defines the conditions under which a machine can be said to be “intelligent”.

(ii) [1%] ____ My office is not an accessible/observable environment.

(iii) [1%] ____ A contingency problem involves a nondeterministic and accessible/ observable environment.

(iv) [1%] ____ During search, one usually applies the goal test onto newly expanded children, before queuing-up these children.

(v) [1%] ____ If the cost of applying an operator once is always 1, then BFS is optimal.

(vi) [1%] ____ A* is an admissible algorithm.

(vii) [1%] ____ DFS is faster than BFS.

(viii) [1%] ____ DFS has lower asymptotic space complexity than BFS.

(ix) [1%] ____ When using the correct temperature decrease schedule, simulated annealing is guaranteed to find the global optimum in finite time.

(x) [1%] ____ Alpha-beta pruning accelerates game playing at the cost of being an approximation to full minimax.

(xi) [1%] ____ Genetic algorithms use a step called “failover”.

(xii) [1%] ____ Hill-climbing is an entirely deterministic algorithm.

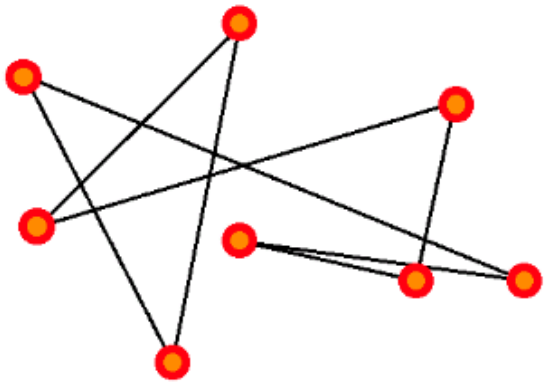
(xiii) [1%] ____ The exact evaluation function values do not affect minimax decision as long as the ordering of these values is maintained.

(xiv) [1%] ____ A perfectly rational backgammon-playing agent never loses

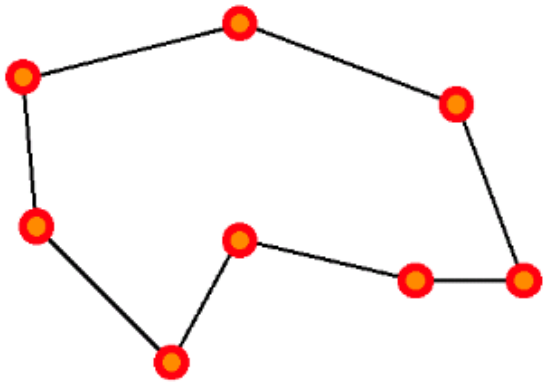
(xv) [1%] ____ Hill climbing search is best used for problem domains with densely packed goals

[15%] Search Algorithms Concepts.

Let's formalize the traveling salesman problem (TSP) as a search problem. Remember that the goal in this problem is to find the shortest possible route that visits every city on a map exactly once, as exemplified below:



Suboptimal solution (long path)



Optimal solution

Assume that we have *n* cities forming a set $C=\{c_1, \ldots, c_n\}$. Also assume that you can travel from any city in that set to any other city, and that the distance between any two cities c_i and c_j is given by $d(c_i, c_j)$. Please be concise but precise in your answers. Define:

(a) [5%] A suitable representation for states:

(b) [2%] The initial state of the problem:

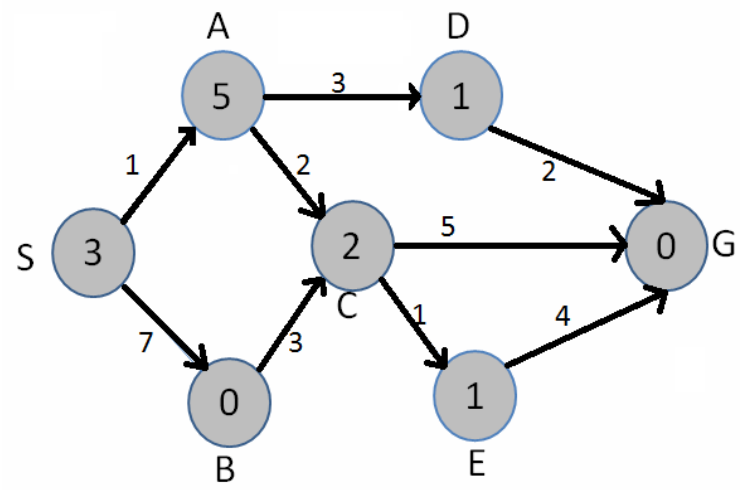
(c) [3%] A good goal test to use in this problem:

(d) **[3%]** Good operators to use for search:

(e) **[2%]** Which search algorithm would be the most appropriate to use here if we want to minimize the distance of the tour found?

Graph Search (20 points)

The following figure shows a graph. Each arc between nodes is labeled with the cost of traversing the link. Nodes are labeled with the heuristic estimate of the cost *h* of getting from the node to the goal. (Break the ties in alphabetical order)



1. In what order are nodes expanded by each of the following search algorithms, assuming each does loop check? (S = Start node, G = Goal node) (2 points each)

a. Depth-first search	
b. Breadth-first search	
c. Uniform-cost search	
d. Greedy search	
e. A* search	

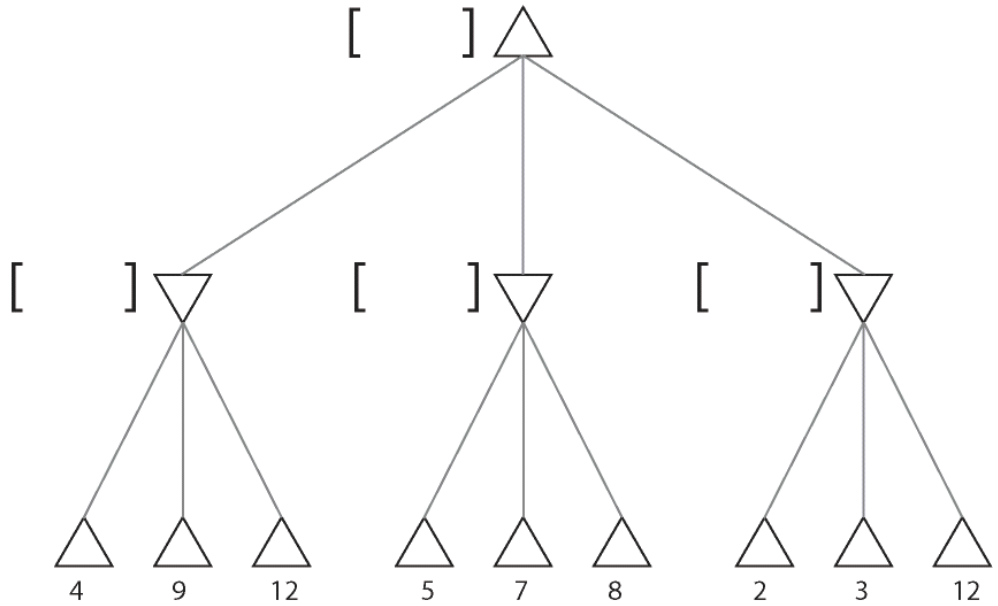
Graph Search continued

2. Can we decide whether h (as shown in the diagram) is an admissible heuristic function? Say why it is admissible or not and explain the reason. (5 points)

3. Can we decide whether it's a consistent heuristic function? Say whether or not it is and explain the reason. (5 points)

[10%] Game Playing.

Consider the following game tree in which the evaluation function values are shown below each leaf node. Assume that the root node corresponds to the maximizing player. Assume that the search always visits children left-to-right.



(a) [4%] Compute the backed-up values computed by the minimax algorithm. Show your answer by writing values at the appropriate nodes in the above tree.

(b) [6%] Which nodes will not be examined by the alpha-beta pruning algorithm? Mark them on the tree above.

[10%] Constraint Satisfaction

Given the constraint graph for the 4-queens problem for the board below.

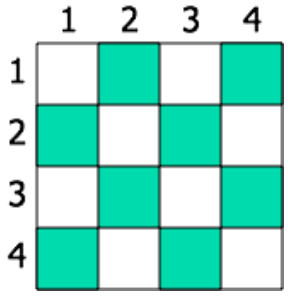
(a) [1%] List the variable names

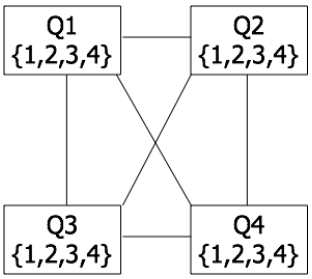
(b) [1%] What do the variables represent?

(c) [1%] What are the domain values?

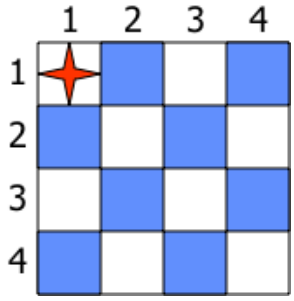
(d) [1%] How do the constraints (edges) affect the variables for this problem?

(e) [1%] How many binary constraints are there?





(f) [5%] Draw the constraint graph again after performing Arc Consistency on this 4 queens board, given the first queen's position is square 1.



Constraint Satisfaction [15pts]

You are designing a menu for a special event. There are several choices, each represented as a variable: (A)ppetizer, (B)everage, main (C)ourse, and (D)essert. The domains of the variables are as follows:

A: (v)eggies, (c)aviar

B: (w)ater, (s)oda, (m)ilk

C: (f)ish, (b)eef, (p)asta

D: (a)pple, (i)ce cream, (ch)eese

Because all of your guests get the same menu, it must obey the following dietary constraints:

(i) Vegetarian options: The appetizer must be veggies or the main course must be pasta or fish (or both).
(ii) Total budget: If you serve the caviar, you cannot afford any beverage other than water.
(iii) Calcium requirement: You must serve at least one of milk, ice cream, or cheese

(a) [5 pts] Draw the constraint graph over the variables A, B, C, and D.

(b) [4 pts] Imagine we first assign A=c. What values remain for each variable after forward checking?

(c) [4 pts] Again imagine we first assign A=c. What values remain for each variable after arc consistency has been enforced.

(d) [2pts] Give a solution for this CSP or state that none exists.

[20%] AI Applications.

Circle the best choice for each question:

(a) [5%] Which AI application has a static environment?

a. Robocup Soccer robots
b. Google Self-driving car
c. IBM's Deep Blue
d. All of the above
e. None of the above

(b) [5%] Virtual agents Ada and Grace have this ability in common with IBM Watson?

a. Text-to-speech synthesis
b. Natural language processing
c. Knowledge representation
d. All of the above
e. None of the above

(c) [5%] In building a poker-playing agent, what is most important?

a. It should pass the Turing Test
b. It should be able to hold the cards
c. It should be able to reason in a dynamic, continuous environment
d. All of the above
e. None of the above

(d) [5%] An admissible heuristic for route planning in Google Maps could be?

a. Straight-line distance
b. Manhattan distance
c. h(n)=1
d. All of the above
e. None of the above