Computer Science 431

Final Exam

Name _____

Friday, Nov. 5
200 pts.

Part I: Some philosophy

1. (15 pts.) Descartes said that it would be impossible to design an automaton which could fool people into thinking that it was human because it (the automaton) would not be able to respond appropriately "... to whatever is said in its presence, as the dullest of men can do." In this context, describe and discuss the Turing test and say in particular how it can be viewed as a response to Descartes.

2. (10 pts.) What is a physical symbol system, and what are its components?

3. (10 pts.) State the physical symbol system hypothesis, explaining particularly what the terms “necessary” and “sufficient” mean in the context of the hypothesis.

Part II: Some Lisp

4. (5 pts.) Express as a list

(a . (b . (c . nil)))

5. (5 pts.) Write a Lisp expression to calculate

(x + y) / (x – y)

Where x and y are atoms with some given value

6. (10 pts.) Write a function in Lisp to calculate the average of three arguments. For example, (avg 3.0 5.0 2.0) should return 3.3333. (don't worry about data types).

7. (10 pts.) Write a recursive function to calculate the length of a list (i.e., mimic the built-in length function)

8. (10 pts.) Write a lisp function called **swap** which will interchange the first two elements of a list (returning the list with the first two items swapped)

9. (10 pts.) Suppose that **lst** is a list of lists. Each list in **lst** has a length. Use the built-in **length** function to calculate the sum of the lengths of lists in **lst**.

10. (10 pts.) In his home page for EE373, Professor Robert Givan has the following words:

Another Glitch in the Call

(Sung to the tune of a recent Pink Floyd song.)

We don't need no indirection
We don't need no flow control
No data typing or declarations
Did you leave the lists alone?

Hey! Hacker! Leave those lists alone!

Chorus:
All in all, it's just a pure-LISP function call.
All in all, it's just a pure-LISP function call.

What does he mean by this?

Part III: Search and Knowledge Representation

11. Newell and Simon claim that problem solving can be viewed as search. Consider the problem of proving a theorem in high school geometry.

a. (10 pts.) How might theorem proving in high school geometry be viewed as search? What corresponds to states? What corresponds to operators?

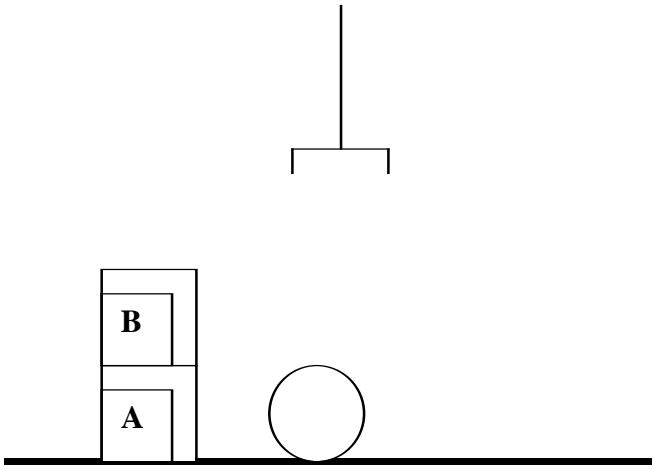
b. (5 pts.) In the same context, what would breadth-first search look like?

c.. (5 pts.) Heuristics can be used to estimate the distance from some goal state, or they can be used to prune away unproductive directions to take. When your geometry teacher asked you to prove something, your teacher suggested that you first draw a picture of the given situation. How might this be used as a heuristic?

12. (10 pts.) What is alpha-beta pruning, and to what search problem is it applied? Briefly, how does it work?

13. (15 pts.) A* search uses a heuristic which estimates a "distance" from a goal state. Explain how it works, giving brief definitions of the functions involved and way what it means for the heuristic to be a good heuristic.

14. (20 pts.) We have studied a number of knowledge representation techniques, including basic slot-and-filler structures (deftemplates in CLIPS), IS-A hierarchies (as a simple form of semantic networks), and logic (Prolog and the predicate calculus). Consider the blocksworld scene below (A and B are blocks, the ball is labeled C):



Using two of these three schemes, give a brief description of this situation, including the facts that A and B are blocks, that C is a ball, that A and C are on the table, that B is on A, that blocks and tables are supporting-objects, and that the robot arm is not grasping anything. Your scheme should be adaptable. That is, you should be easily able to add objects and change the status of relationships. Some additional workspace is provided on the next page.

Additional workspace from problem 14

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15. (10 pts.) In Wumpus world our agent has entered the system of rooms at [1,1] (lower left-hand corner), and has traveled through [1,2] and into [2,2] where it is currently facing up. Along the way the agent has discovered

S11 (a smell in [1,1])
B12 (a breeze in [1,2])
S22 (a smell in [2,2])

Given this,

a. Where is the Wumpus?

b. How do you know? Use the predicates discussed in the text as much as possible.

c. How can you kill the Wumpus (please be specific)

d. You now know the location of one of the pits. Where is it?

Part IV: Neural networks and expert systems

16. (20 pts.)

a. Briefly describe the steps involved in training a feed-forward neural network using backpropagation and a set of training vectors

b. What rule determines the output of a node in a feed-forward neural network with backpropagation.

c. Training a neural network is a problem in search. What variety of search is being used?

17. (10 pts.)

a. Write a CLIPS deftemplate for an alarm object with slots for type and status.

b. Using your template above, write a rule that says that if we have an alarm object with type = fire and status = alarm, then we should assert into the database the fact (call fire-department).