SCXT 350

Final Exam

Name ________________________________

Friday, May 13
8:00 AM
200 pts.

We begin with the primary question we have been examining this semester: Is cognition (in any of its various forms) computable? In search of an answer (or, perhaps more exactly, in search of a framework in which to discuss this question), we have first discussed what it means for something to be computable, and have then discussed various approaches taken so far in search of an answer. This exam is organized roughly along those lines. We begin with a discussion of what it means to be computable, then move to a series of readings in which the idea is considered generally, and then move to various attempts in artificial intelligence to provide some examples for the discussion.

I. Computability

What does it mean for something to be computable (as in "cognition is computable")? We begin with the formal, and then move a bit to the practical.

1. (5 pts.) What is an algorithm? When we say that a computer is a machine that runs algorithms, what are we saying?

2. (10 pts.) A finite state machine is described by the following table:

State \ Input	A	B	C
S1	S2	Error	Error
S2	Error	S2	Error
S3	S3	Error	Error

a. Sketch the FSA described by this table. S1 is the start state, and S3 is the only final state.

b. Give an example of a string of a's, b's, and c's accepted by this FSA.

3. (10 pts.) Give a brief description of a Turing Machine.

4. (10 pts.) What does it mean for something to be Turing-computable? What does the Turing-Church hypothesis say?

5) (5 pts.) Combining your answers to problems 3 - 4 above, what does this say about the statement “cognition is computable”?

6. (10 pts.) Give an architectural model of a computer, labeling and briefly describing such things as the ALU, control unit, etc.

7. (10 pts.) When we write programs for a computer, we use a computer language of some sort. In LISP, write a function (using defun) for a function which will take three arguments a, b, c and which will return a * (b + c)

II. Commentaries

The question under consideration has been with us for quite some time.

1. (10 pts.) We began the semester with an assertion of **Descartes** that we would never be fooled by an automaton that appeared as a human. What was "Descartes' Test" and why did he believe that no automaton would ever pass it?

2. (10 pts.) **Turing**, in his 1950 paper, gave us a response to Descartes in his description of the "Turing Test" and his belief that it would eventually be passed. Describe the Turing Test (making sure not to describe instead the "Imitation Game").

3. (5 pts.) In our discussions of knowledge representation systems and again more recently, we discussed the idea of a grammar. How does a grammar give a response to Descartes?

4.) (10 pts.) Searle has a response to Turing (with a response to Shank's Yale group as well). Describe Searle's Chinese Room experiment (including what the inputs and outputs are), and why Searle thinks of this as an argument against the Turing Test.

5) (15 pts.) One of the tenets of cognitive science is that we can view cognition in terms of information processing. David Marr gave us a way to view information processing on several levels. In his discussion, Marr presented Chomsky's theory of grammars as an explanation on the level of computational theory. Considering this, suppose that we have a computer and computer program that can pass the Turing Test. Briefly describe Marr's three levels, and say something about the way in which explanations at each level might differ if we are discussing the performances of the computer/computer program and of the human subject (not the interrogator) in the Turing Test .

A chief proposition of cognitive science is that cognition is computational. While it is important to discuss what that mean in theory, it is also important to run experiments to see how likely the proposition is to be true. An important side-effect of this effort, and one which we should all remember, is the discovery of just how difficult it is to do the things that come naturally to a five-year old child.

III. Artificial Intelligence

Artificial Intelligence is generally divided into two (sometimes competing) camps. After a quick introductory question, we'll explore both in turn.

1. (10 pts.) What is the goal of artificial intelligence?

2. (10 pts.) Symbolic AI is characterized by the Physical Symbol System Hypothesis and the idea of search in problem solving. Briefly describe what a physical symbol system is and state the physical symbol system hypothesis.

3. (5 pts.) How is a computer running an expert system a physical symbol system?

4. (10 pts.) We have examined several knowledge representation (KR) schemes, including slot-and-filler structures and the use of productions (rules) in CLIPS. What is a slot-and-filler structure? What are productions/rules? Draw some examples from CLIPS in your responses.

5) (5 pts.) Some knowledge is stored in productions. In CLIPS, write a production (rule) which says that if we have in our database a fact saying

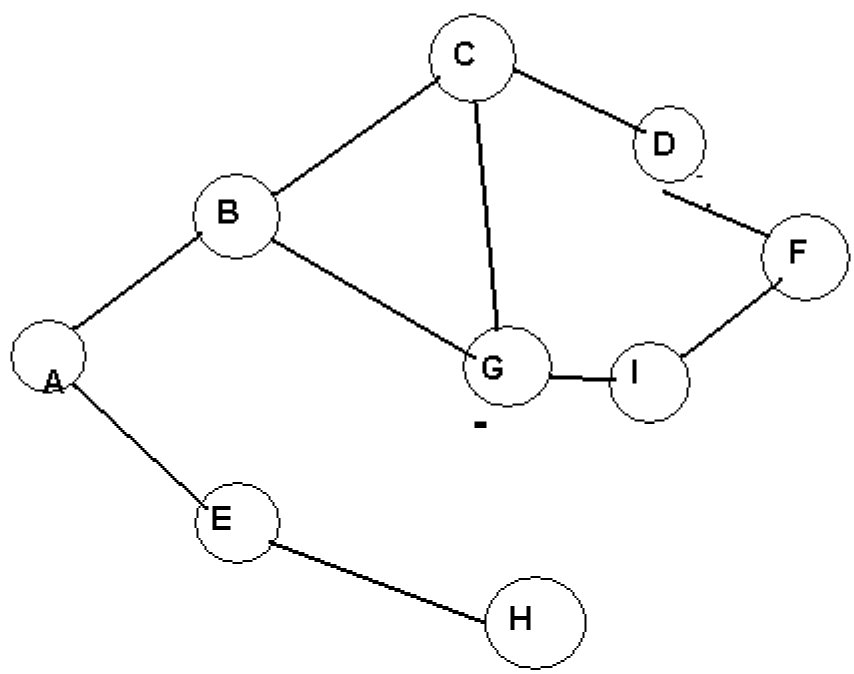
(animal (motion approaching) (teeth big) (food-status hungry) (size big))

then we should add to our database the fact

(run away)

Search plays a major role in symbolic AI. In fact, some characterize symbolic AI by the equation AI = KR + Search.

5. (10 pts.) Consider the following directed graph (edges going in a left-right direction):



Give a brief definition of depth-first search, illustrating your discussion by listing some of the nodes you might encounter in your search. I have left the next page blank if you need some more space for your answer.

(extra workspace for problem #5)

6. (5 pts.) Consider the following (From Moby Dick):

> Once more. Say, you are in the country; in some high land of lakes. Take almost any path you please, and ten to one it carries you down in a dale, and leaves you there by a pool in the stream. There is magic in it. Let the most absent- minded of men be plunged in his deepest reveries -- stand that man on his legs, set his feet a-going, and he will infallibly lead you to water, if water there be in all that region

In terms of search, what is the claim here? What feature of search is Melville claiming to be built-in?

7) (10 pts.) What is a **connectionist** architecture? That is, what approach do connectionists take in trying to write programs which appear to exhibit intelligent behavior?

8) (10 pts.) Draw a picture of a two-input (x_1, x_2) **perceptron** with weights given as $w_0 = 0.5$, $w_1 = 1$, $w_2 = -1$, and fill in the following chart for this perceptron. Out is either 0 or 1 in each case.

X1	X2	Out
0	0	
0	1	
1	0	
1	1	

9. (10 pts.) Finally, given the following grammar for algebraic expressions involving x, y, and z:

E -> E + T | E – T | T
T -> T * F | T / F | F
F -> x | y | z | (E)

Create a derivation and a parse tree for the expression

x * y + z