Intelligent Systems Qualifier, Fall 2007

CORE
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Answer 2 out of these 3 questions:

1. You are magically transported back in time to when you were taking
undergraduate Intro to AI. Your professor, an avid video game junkie,
requires you to create a game player for chess and will grade you on
how well your system plays against other students' systems in games
that last 30 minutes or less (15 minutes per player). You have a
limited amount of time to do the homework assignment because of a
weekend party that you want to attend. You already have minimax
implemented from a previous class. You could spend your time
implementing alpha beta, working on your evaluation heuristic,
implementing iterative deepening, or creating an algorithm that looks
for symmetries in the board so that less branches need to be searched.

How would you spend your time? Which technique(s) would you improve
first and why? Are there techniques other than the ones mentioned
above that might provide more game play improvement for the effort?
If so, which and why?

If the game was Connect Four, how should it change your answer?

If the game was Go, how should it change your answer?

2. In reading Russell and Norvig's book, a student might conclude that
AI is just about finding clever ways of applying and improving search
(i.e. constraint satisfaction problems, resolution in logic, Viterbi
decoding in hidden Markov models, and many more algorithms can be seen
as an application of search). Do you agree? Why or why not? Which AI
techniques are least like search? Attempt to describe your own past
research in terms of search.

3. AI is an empirical science. This means that AI has a methodology for
conducting experiments and evaluating hypotheses; or, since AI is so
broad, it has a set of methodologies: one methodology for evaluating a
AI model of a some aspect of cognition, another for evaluating a robot
architecture, and so on.

Take any AI program, agent, or model as an example and describe its
evaluation methodology. Alternatively, you may use an AI system you
have built as the example. In the latter case, note that we are
interested in the general evaluation methodology (and not so much in
any specific experiment you may have performed or might want to
perform).

KNOWLEDGE-BASED AI
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Answer 2 out of these 3 questions:

1. The question has several parts, each requiring a relatively short
but clear answer. Consider the following sentences.
Mary was in the hospital.
John took her flowers.

1a: If you think for a minute, you will find that the second sentence above has two meanings. What are they?

1b: A script for visiting friends in hospital may have difficulty understanding one of the two meanings of the second sentence. Describe the basic organization/representation of the script, and explain why it has this difficulty?

1c. How might one modify the organization/representation of the above script so that it can help understand both meanings of the second sentence?

1d. Would the use of MOPs address the difficulty the script has in getting both meanings of the second sentence? Describe the representation of the appropriate MOP, and explain the process of understanding.

1e. In what ways (if any) does your answer to 1c differ from 1d?

2. The use of AI agents as cognitive assistants to humans raises the critical issue of trust: humans are unlikely to use AI agents as cognitive assistants unless they can trust the agents, especially so for critical tasks such as medical diagnosis or drug design. It is sometimes claimed that knowledge-based AI may have a win when it comes to addressing the issue of trust because a knowledge-based agent can, at least potentially, explain its reasoning and justify its answers. However, if a knowledge-based agent simply provides a trace of its processing, it is unlikely to be comprehensible or persuasive to the human; after all a neural network for medical diagnosis or a generic algorithm for drug design can also provide a trace of its processing. So why should knowledge-based AI agents have a potential win in addressing the issue of trust?

Describe the representations and the reasoning that may help generate perspicuous self-explanations.

3. Many so-called "case-based reasoning" systems work as follows: They are provided a library of "cases" consisting of (1) a feature vector or other representation of a problem, and (2) a solution to that problem. The systems take a new problem represented in the same formalism as those in its library, find one or more nearest neighbors using a suitable similarity metric, and suggest a solution to the new problem based on a majority vote or weighted average of the solutions of the retrieved nearest neighbors.

a) Would you call this "case-based reasoning"? Why or why not?

b) Regardless of what you call it, is this process a reasonable model of how people solve problems?

COGNITIVE SCIENCE

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Answer 2 out of these 3 questions:

1. Tversky showed that human perception of similarity often does not follow a geometric metric (triangle inequality may be broken). For example, person A may look similar to person B and person C, but person B and C do not appear similar. Yet face recognition programs, such as eigenfaces, use metrics for determining similarity.

1a. Argue that face recognition researchers are "losing something" by not having a system that emulates human capabilities (certainly humans still seem better than computers at face recognition!).

1b. As a cognitive scientist, outline a 5 year program to investigate human face recognition with the goal of improving computer face recognition.

2. In his argument for distributed cognition, Hutchins maintains that the traditional view of cognition has "encourages us to mistake the properties of complex sociocultural systems for the properties of individual minds" (Cognition in the Wild, p.355).

2a. Explain what is the "traditional view" he is arguing against and describe his alternative position.

2b. From the perspective of a designing interactive intelligent systems, what, if any, difference would it make if one adopted the traditional view or the distributed cognition view. Take an example and compare and contrast the considerations that would figure in its development from each perspective.

3) Barsalou has developed a theory of mental representation he calls "perceptual symbol systems." He situates his theory in the movement advancing a embodied account of mental representation. How does this account differ from the traditional account of representation? What are its advantages? Its disadvantages? What do you see as the implications of "perceptual symbol systems" theory for an account of cognitive functions such as analogical problem solving or mental modeling?