Lunds Universitet / Lunds Tekniska Högskola
Institutionen för datavetenskap

DATE15/EDA132
VT2008

Tillämpad Artificiell Intelligens

(Applied Artificial Intelligence)

TENTAMEN 2008-05-29

14.00-19.00

You can give your answers in Swedish or English.
You are welcome to use a combination of figures and text in your answers.

1. (JM) Explain the term *utility-based agent*. Name and describe its modules. (2p)

2. (JM) Explain the following concepts: a) well-formed formula b) satisfiability c) inference rule . How are they related to knowledge representation? (4p)

3. (JM) a) Show how much is *iterative deepening* slower than *depth-first search*. The answer should show exact calculations, O(f(n)) is not sufficient. (2p)

   b) What is an *admissible heuristic function*? Give an example of an admissible heuristic function for a search problem of your choice different from road travel in Romania and an example of a non-admissible heuristic function for the same problem. (2p)

   c) *Bonus question:* Write or describe a heuristic function that A* would use in searching for a plan in STRIPS. Is your function admissible? Why or why not? (2p)

4. (JEL) a) Explain the search heuristic killer moves, how it works, and why it improves the efficiency of an alpha-beta search. Illustrate with an example and give pseudo code. (3 p)

   b) Also explain how alpha-beta search works, and why it is more efficient than minmax search. How much more efficient is alpha-beta for maximally good move ordering? How much for maximally bad move ordering? (3 p)

5. (JEL) a) Explain what forward chaining is in the context of rule-based expert systems. Give an example of a simple fact base, rule base and how the algorithm is executed. (3 p)

   b) What is Feigenbaum's Bottleneck? Define and explain. (3 p)

6. (JM) a) Explain the purpose of the following mechanisms/concepts in the context of genetic algorithms (GA):

   (i) *cross-over* (ii) *mutation* (iii) *fitness* (iv) *rank-based-selection* (2p)

   b) A fellow student works on a GA project. The student uses a binary representation of the genes. The first four bits represent the colour of an object. Each bit represent a different colour and only one bit should be set. In this way, four colours could be chosen. Why is this a bad representation? Suggest an alternative better representation. (2p)

7. (JM) a) Describe the main steps in the *backpropagation algorithm* for two-layered (one hidden layer) perceptron nets. It is not required that you give the detailed mathematical expressions for the updating of the units and the weights, but explain what happens in each step. (3p)

   b) Given a fairly large example set to be used to train a multi-layered perceptron net with the backpropagation algorithm. How would you use the examples in a clever way to be sure to avoid *over training* the net? (1p)

8. (PN) Describe the two main syntactic formalisms: constituents and dependency. Illustrate them with the sentence: *The boy hit the ball*. (2p)

9. (PN) Describe what a definite clause grammars (DCG) are and write rules to give an example of a grammar. Ideally, your rules should be able to parse the sentence: *The boy hit the ball*. (3p)

10. (PN) Describe conceptually Nivre's parser. You don't need to give all the details, but the objects it uses and an overall view on how it operates. Describe its relation with machine learning. (3p)

11. (JM) In the context of partial-order planning:

    a) What is a *linearization* of a partial-order plan? (1p)
    b) What is the role of the *causal links*? (1p)
    c) What constitutes a *consistent* partial-order plan? (1p)
    d) Give a formal definition of a *solution* to a partial-order plan. (1p)

12. (JM) The following example set characterizes some sausages sold at the Lunda Karneval:

colour	**taste**	**shape**	**size**	***recommend***
lightbrown	spicy	round	large	***yes***
lightbrown	smoked	oval	large	***no***
darkbrown	spicy	round	small	***yes***
darkbrown	hot	oval	medium	***yes***
lightbrown	hot	oval	medium	***no***
reddish	spicy	round	small	***no***
reddish	hot	round	large	***no***
darkbrown	smoked	oval	medium	***yes***

   a) Construct a *decision tree* that agrees with the example set. The goal attribute is *recommend*. (2p)
   b) Construct the *IF-THEN-rules* corresponding to the decision tree. (1p)