Tillämpad Artificiell Intelligens

(Applied Artificial Intelligence)

TENTAMEN 2005-05-31

08.00-13.00

You can give your answers in Swedish or English.
You are welcome to use a combination of figures and text in your answers.
You may use an English to Swedish glossary (or ask a teacher for the translation).
The result will be displayed on the webb and on the notice board with parts of your personal number masked out, why you should be careful to give your correct personal number on the cover.

1. (JM) What is an *utility based agent*? Draw an illustrative diagram and explain the functions of its elements. (2p)

2. (JM) Give an example of a *non-admissible heuristic function* (for any reasonable search problem of your choice) and show that A* search will not find the optimal solution for that problem given your heuristic function. (3p)

3. (JEL) a) Describe with a figure and explaining text the way the *alpha-beta algorithm* improves a minimax search. Try to give a simple example. Give an estimate of the improvement caused by alpha-beta in a general case and also explain the reason for the improvement. (3p)

b) Explain the concept of *heuristic evaluation function*. Give a simple example of a reasonably good evaluation function for either checkers, chess or othello. Also explain when an evaluation function is needed and when a minimax/alpha-beta search can provide a 100% correct result. (3p)

4. (JM) Consider a first order theory consisting of the following five statements:

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1. student(Kalle)
2. antagen(Lund,Kalle)
3. forall x {antagen(Lund,x) och student(x) -> bostadslös(x)}
4. forall y {bostadslös(y) -> uteliggare(y)}
5. forall z {uteliggare(z) och student(z) -> bor-i-Lundagård(z)}
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Prove that “bor-i-Lundagård” holds for Kalle, using:

- modus ponens and universal instantiation (3p)
- resolution (3p)

5. (JEL) Describe the similarities and differences between *forward and backward chaining reasoning* as used by rule-based expert systems. Give examples of reasoning problems that typically match one of the methods better than the other. (3p)

6. (JM) a) Define *rank-based selection* and *tournament selection*. What are the advantages and disadvantages of those selection methods? Compare them. (3p)

b) Propose a *cross-over operation* for genetic programming in Java (or C, or any other imperative programming language of your choice). What do you need to take care about? (3p)

TURN!

7. (EA) a) Explain how a single *perceptron* works by drawing a figure with named parts and denonations (sv. *beteckningar*) for the terms involved. Use your denotations to give a mathematical expression that formally defines the output value as a function of the input values. (2p)

b) What does it mean that a set of training examples is *linearly separable*? In what way is this important for the training of a one-layered perceptron net? Is it possible for a set of training examples with n attributes, where $n > 3$, to be linearly separable? You must explain why or why not! (2p)

8. (EA) In the context of the backpropagation algorithm:

a) Explain the role of the *momentum term* (alpha) and the *learning rate* (eta). Given an example set that you have no previous experience with: How would set the initial values of alpha and eta? Could there be any reason to change them during the learning process? You must motivate your answer! (2p)

b) Given an example set that you have no previous experience with: Describe two *stopping criteria* for the training process. (2p)

9. (EA) In the context of planning

a) Characterize a *STRIPS-operator* in formal terms. (1p)
b) What does it mean that a STRIPS-operator is *applicable* in a planning situation? (1p)

c) What constitutes a *solution* to a partial order plan? (2p)
d) How is a *planning graph* constructed? What is the idea of having a planning graph? (2p)

10. (EA) a) Using the construction procedure for ID3, construct the minimal (with respect to height (first) and number of nodes (second)) decision tree for the set of examples below. You don't have to compute any information theoretic measure. Just use a systematic approach.(2p)

A	B	C	Class
a1	b1	c1	Pos
a1	b1	c2	Pos
a1	b2	c2	Pos
a1	b2	c1	Pos
a2	b2	c1	Pos
a2	b1	c2	Neg
a2	b2	c2	Neg
a2	b1	c1	Neg

b) Construct the corresponding set of IF-THEN rules. (2p)

11. (EA) The chief editor of Encyclopedia Europa 2006 has asked you to write an entrance that explains the term *artificial intelligence (AI)*. You may use up to five links (underlined) to other entrances in the encyclopedia that explain some important concepts you want to refer to, i.e. you don't have to explain them yourself. The entrance should be at least 20 but not exceeding 40 words. (2p)

(Don't forget to fill in the course evaluation form before you leave)