Faculties Wiskunde en Informatica Vrije Universiteit, Amsterdam Joris Hulstijn	**Exam Part I Knowledge-based Systems** Thursday 2nd of May, 2002, 18.45 - 20.30 h

Assessment:

Question:	1a 1b	2a 2b	3	4a 4b	5a 5b	Extra
Score:	10 10	10 10	10	10 10	10 10	10

Exercise 1: Basic Concepts

a. Knowledge-based systems can be applied successfully, provided a number of basic conditions is are met. List five *success conditions* for knowledge based systems.

b. The *travel planner* of the Dutch Railways (NS) gives advice about the departure and arrival times of train services in the Netherlands. A knowledge-based system can be described at different levels. Give a description of the aspects of the travel planner at the *knowledge level*.

Exercise 2: Knowledge Acquisition

a. There are several methods for knowledge acquisition: *unstructured interviews, structured interviews, protocol analysis, comparison with scenarios of usage* and *circulating documents for criticism*. These methods are applied in different phases of the development process. Indicate for each method, whether it is suitable for the following phases: *identification, conceptualisation, checking completeness, refinement and improvement of knowledge.*

b. In the CommonKADS method for the development of knowledge-based systems, there is a library of standard solutions for particular tasks. What are the advantages of using standard solutions?

Exercise 3: Time and Space

What is the difference between *Quadtree* and a *hierarchical* representation of locations in space, such as for example a map of the VU-campus?

Exercise 4: Production rules

The following rules are used to categorise sailing ships.

Rule1:	**if** shape(hull, flat) $\wedge$ has(dagger board)	**then** isa(flat bottom)
Rule2:	**if** shape(hull, V-shape) $\wedge$ has(keel)	**then** isa(yacht)
Rule3:	**if** isa(flat bottom) $\wedge$ colour(black) $\wedge$ shape(bow, high)	**then** type(Botter)
Rule4:	**if** isa(flat bottom) $\wedge$ length > 10 m $\wedge$ form(bow, round)	**then** type(Tjalk)
Rule5:	**if** isa(yacht) $\wedge \neg$ has(cabin) $\wedge$ shape(rear, slender) $\wedge$ has(gaff rig)	**then** type(Regenboog)

Suppose we have a ship with the following visible characteristics:

has(gaff rig), NOT has(cabin), colour(black), has(dagger board), shape(hull ,flat)
shape(bow, high)

a. Draw a diagram with the logical relationships among these rules and characteristics.

b. There are several ways to determine the type of ship. Show which method is more efficient in this example: *forward chaining* or *backward chaining*.

Exercise 5: Uncertainty and Vagueness

In this exercise we deal with *certainty factors*. Suppose that the observations E1, E2, E3 are given with certainty. From these we can derive intermediate results A1, A2, A3, which may lead to final results B1 or B2. We use the following rules:

Rule1:	**if** E1 $\wedge$ E2, **then** A1 (0.6).
Rule2:	**if** E2, **then** A2 (0.2).
Rule3:	**if** E3, **then** A3 (0.4).
Rule4:	**if** E1 $\vee$ E2, **then** A2 (0.3).
Rule5:	**if** A1 $\vee$ A2, **then** B2 (0.9).
Rule7:	**if** A2, **then** B1 (0.4).

a. Calculate the certainty factors (CF) of A1, A2 and A3, and subsequently of B1 and B2.

b. Probability calculus is difficult to use in practice. In applications one often has to assume that all sources of evidence are independent. This is usually not the case, or may lead to inconsistent assumptions. Explain how *Bayesian Networks* can partly solve this problem.