Exam Knowledge-based Systems

March 29, 2006
13:15 - 18:00 h

This exam consists of 2 assignments on 2 pages.

Credits:

1a	1b	1c	1d	1e	1f	1g	2a	2b	2c	2d	2e	2f	2g	2h
5	5	10	5	5	5	5	8	5	5	12	5	5	5	5

Total credits = 90

Read all questions carefully and make sure that you answer all elements of the questions (for example, do not forget to give an explanation or an example if asked for it). Good luck!

Assignment 1: Public transport travel planner 9292ov.nl

The site 9292ov.nl is a very useful tool when planning a trip by public transport. The site tells you exactly how to get from A to B by train, bus and / or metro.
a) A number of possible advantages of applying a knowledge-based system are discussed during the lectures. List two advantages that are **not relevant** for the public transport travel planner.

When analyzing a knowledge-based system at the *knowledge level*, you describe – among other things – the task(s) that the system perform(s).
b) Give the name of the standard task that can be recognized in the travel planner.
c) List two other aspects of a knowledge-based system that are described at the knowledge level. Give a description of each aspect for the travel planner example.

When studying a system at the *symbol level*, you consider the way in which the knowledge is represented in a computer. The travel planner contains redundant representations of some knowledge in the system.
d) Explain what the advantage of using redundant representations is.
e) Use the criteria given in the book and the lecture to argue whether the representation of knowledge in the travel planner is *explicit* (also called *declarative*).

A potential problem in the task that the travel planner performs is the so-called *threshold effect*.
f) Explain what this problem is and give an example of this problem in the travel planner.
g) Describe how this problem is solved in general. Explain how this solution would work for the travel planner.

Assignment 2: Bicycle theft

Each year many bicycles are stolen in Amsterdam. The Amsterdam police try to reduce the number of thefts and to return as many stolen bikes as possible to their owners. For this, they could use a knowledge-based system. As a first task, this system should decide whether a bike is still a usable bike. A "usable bike" is a vague concept that could be represented using *fuzzy sets*.

a) Sketch in a diagram the *membership function* for the vague concept "usable bike" and explain what the X-axis and the Y-axis represents..
b) A "bike wreck" is the opposite of a usable bike. Explain in words how you can calculate the *membership function* (also called *characteristic function*) for "bike wreck" from the *membership function* for "usable bike".

A next task for the system is to classify the bikes into different types, such as "racing bike", "ladies bicycle", "mountain bike" etc. Suppose that we have the following schematic representation of this classification task. In this scheme, raw data (R's) is combined via logical operators (∧ and, ∨ or, ¬ not) into abstract data (D's) and then classified into solution classes (S's). Solution classes with a common parent are *mutual exclusive*.
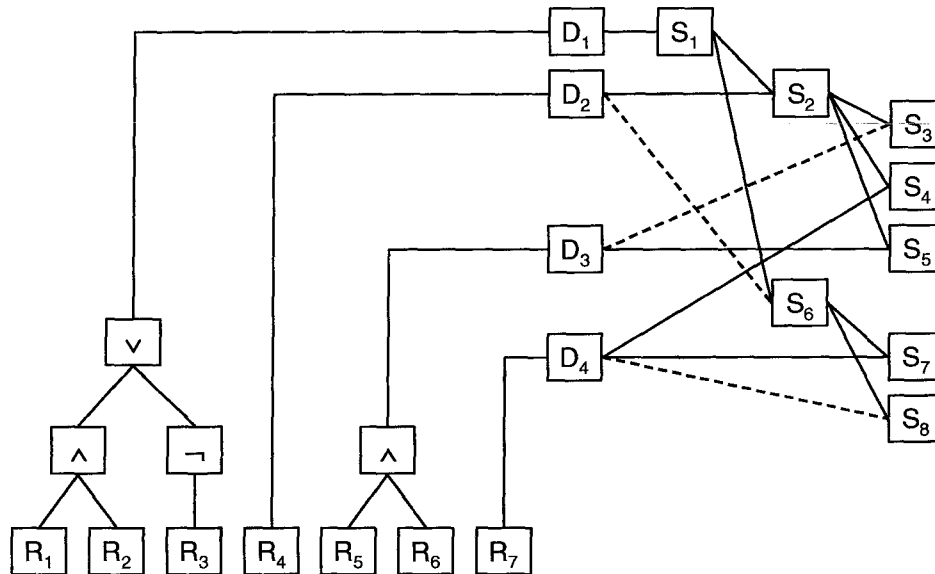
c) Give an example of R_5, R_6 and D_3 for the classification of bicycles.
d) For each of the following vectors, describe which solutions are *consistent*, which solutions *match* and which solutions are *inconsistent*.
   1. R = (? ? 0 1 1 ? ?)
   2. R = (1 1 0 0 1 1 0)
e) Explain which standard classification method is the most obvious choice when using this model. Describe this method.

A next task for the system is searching for registered bicycle thefts in the neighborhood of the location where a bike is found.
f) Describe the *nearest first* algorithm for efficiently finding points that are close to another point.

A problem with the use of this algorithm is that the number of bicycle thefts in the center is much larger than the number of thefts in neighborhoods further away from the center.
g) Explain why this is a problem for efficient searching.
h) Give the name of the representation of space that solves this problem and explain this representation.

End of exam.