CSC/CPE 481 Final Exam

Winter 2001

Prof.: Franz J. Kurfess

This is the final exam for the CSC/CPE 481 Final Exam, Winter 2001. It is a take-home exam, and you may use textbooks, course notes, or other material, but you must formulate the text for your answers yourself. You are not allowed to discuss the questions and answers with other students or anybody else. If you need clarifications about questions, you can contact me via email, or see me during my office hours on Tuesday, March 20, from 4-6 p.m. The deadline for the exam is Friday, March 23, 2001, 5:00 pm. You must submit a printed and signed copy of the exam, which you can either leave in the drop box in front of the CSC department office (room 14-154), or give to me on Friday, March 23, between 4 and 5 p.m.

Student Name:	**Student ID:**
Signature:	**Date:**

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Task 1: Multiple Choice Questions

Mark the correct answers (only one per question).

a) Why are rules an important method to represent knowledge? 3

- ☐ They are reasonably close to the way humans deal with knowledge, and they can be processed reasonably well by computers.
- ☐ Rules are essentially the same as the `if ...then ...else` construct in procedural programming languages.
- ☐ Rules use mathematical logic notation, and thus have the full power of logic-based systems.
- ☐ Rules use a graphical notation, which is often easier for humans to understand.

b) Which of the following statements is the best characterization of *forward reasoning*? 3

- ☐ Available evidence is combined step by step until an acceptable solution is found.
- ☐ A possible solution is formulated as a hypothesis, and evidence for the hypothesis is systematically assembled.
- ☐ All types of reasoning where backtracking is not allowed.
- ☐ It is essentially the equivalent of breadth-first search.

c) In which situations is *backward reasoning* typically appropriate? 3

- ☐ There are relatively few facts, and many acceptable conclusions.
- ☐ There are many facts, and only a few acceptable conclusions.
- ☐ There are no facts for some acceptable conclusions.
- ☐ There are many facts, but no hypothesis can be formulated in advance.

d) What is the purpose of *pattern matching* in rule-based systems? 3

- ☐ It computes variable substitutions that are compatible for current facts, and the premises and the consequents of a rule.
- ☐ It is a different name for the unification process in logic systems.
- ☐ It propagates partial results through a network of facts and rules
- ☐ It is the same as variable assignment in a procedural language.

e) What is the main effect of the Rete algorithm for rule-based systems? 3

- ☐ it makes the pattern matching process more efficient
- ☐ it is an alternative to pattern matching
- ☐ it determines the ordering of rules for conflict resolution
- ☐ it is used for implementing fuzzy logic within a rule-based system

f) Is it possible to use CLIPS for backward reasoning problems? 3

- ☐ Yes, it is no different than systems with built-in backward reasoning mechanisms
- ☐ Yes, but it requires additional overhead and is less efficient than systems with built-in backward reasoning mechanisms.
- ☐ Yes, but it requires a recompilation of the whole CLIPS system.
- ☐ No, it is definitely not possible.

g) What is *conflict resolution* in rule-based systems? 3

- ☐ If there are several rules that possibly match the currently active facts, one of them must be selected.
- ☐ If there is no rule that possibly matches the currently active facts, conflicting variable bindings may be eliminated through conflict resolution.
- ☐ Inconsistent rules in the knowledge base are modified or eliminated through conflict resolution.
- ☐ Conflict resolution is a more efficient variant of the resolution proof method for logic.

h) What is a major obstacle for the use of *probability theory* to deal with uncertainty in knowledge-based systems? 3

- ☐ it relies critically on the availability of suitable data sets
- ☐ its formal foundations are not strong enough
- ☐ it severely restricts the expressiveness of knowledge-based systems
- ☐ the methods and mechanisms it uses are incompatible with the common knowledge representation schemes

i) What is the basic idea of *Dempster-Shafer theory* with respect to uncertainty in knowledge-based systems? 3

- ☐ it expresses a measure of belief in a hypothesis, as supported by available evidence
- ☐ under certain conditions, it allows the calculation of the probability of a cause given some symptoms for the cause
- ☐ it is a mathematical theory of evidence based on intervals indicating the range of belief in a statement
- ☐ it uses linguistic variables to describe concepts with vague values

j) In which situations are blackboard systems more suitable than systems such as CLIPS? 3

- ☐ If subsystems using different knowledge representation or processing mechanisms must cooperate in order to solve a problem.
- ☐ In cases where forward reasoning is not appropriate.
- ☐ In cases where uncertainty is a major factor in the knowledge base.
- ☐ In real-time systems where the system needs to respond immediately to inputs.

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Task 2: Short Questions

1. What are the main differences between *forward* and *backward* reasoning systems? 10

2. Briefly discuss the suitability of CLIPS for the two following example problems:

   (a) A help desk system, where a customer calls with a question, and CLIPS would be used to identify possible answers to the question. 5

   (b) An engine monitoring system in a car, where sensor values provide information about the current status of the engine, and the driver needs to be alerted if something is not in order. 5

3. Two approaches to dealing with uncertainty in knowledge-based systems are *Bayesian reasoning* and *certainty factors*. What are the main differences between these two approaches? 10

Task 3: Academic Course Selection System

In this task, you need to describe the design of a knowledge-based system that provides assistance to students for the selection of courses: the Academic Course Selection System (ACSS). The system is intended for two user groups: Academic advisors, who would use it to help students with questions about course selections, and who might also use it to verify if a student has satisfied the formal criteria for a program. Students would use the system to determine which courses to take, and to verify that a course would fit into their selected major/minor/specialization area.

The system must provide at least the following functions:

- check the eligibility of a course towards a certain major, minor, or specialization
- verify if a student has the prerequisites for a course
- present a student with a choice of possible courses for which the student is qualified, and that fit into the student's degree program and specialization area
- check if the courses taken by a student comply with the regulation of the student's program and area of specialization

You can assume that an electronic version of the current catalog as well as the academic information for a given student is available to the system, although maybe not in the most suitable format.

a) Give an overall description of your system, and how it would be used by the two user groups. 10

b) Briefly describe the knowledge base(s) and reasoning methods used by your system, and how they realize the functions listed above. 10

c) List some additional functions that your system can provide to the above or some additional user groups. 10

d) Given that funding would be a problem for the realization of such a system, would you recommend the use of CLIPS to implement the ACSS? Justify your recommendation! 10

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Total Points: 100