CSC/CPE 481 Final Exam

Winter 2002

Prof.: Franz J. Kurfess

This is the final exam for the CSC/CPE 481 Final Exam, Winter 2002. 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 Monday and Tuesday from 4-6 p.m. The deadline for the exam is Wednesday, March 20, 2002, at noon. 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 Wednesday, March 20; between 9:00 am and noon I will be either in room 14-232, where I will be supervising a CSC 101 final exam, or in my office.

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

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Task I – Multiple Choice Questions
Mark the correct answers (only one per question).

a) One of the fundamental principles in knowledge-based systems is 3

- ☐ the availability of common-sense knowledge in the shell
- ☐ the fact that they atuomatically recognize the limits of their knowledge
- ☐ the tight integration of knowledge and its usage
- ☐ the separation of knowledge and its usage

b) What is the contribution of *Markov algorithms* to expert systems as we know them now? 3

- ☐ they allow for a more efficient treatment of production rules through the use of priorities
- ☐ the discovery that in principle any formal system in mathematics or logic can be formulated as a set of production rules
- ☐ they are the basis for the PROLOG programming language which is frequently used for the development of expert systems
- ☐ they are the only practical way to capture the semantics of rule-based expert systems

c) Which statement is the best characterization of *semantic networks* in the context of knowledge-based systems? 3

- ☐ a frequently used method to formulate the knowledge in expert systems based on rules that describe the conversion of symbol strings into other symbol strings
- ☐ a knowledge representation method based on graphs
- ☐ a knowledge representation method that represents related knowledge about a subject through groups of slots and fillers
- ☐ a knowledge representation method particularly suited for time-ordered sequences, e.g. of events

d) What is the purpose of the *agenda* in CLIPS? 3

- ☐ contains all currently available facts
- ☐ restricts the facts that can be utilized at a certain point
- ☐ contains all activated rules
- ☐ contains a trace of fired rules

e) What is the main evaluation method for CLIPS? 3

- ☐ forward reasoning
- ☐ backward reasoning
- ☐ inference network
- ☐ backtracking

f) What is the basic idea of *fuzzy logic* 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

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Task II – Short Questions

1. Why are variables and functions so important for the representation of knowledge, both for predicate logic and for rule-based systems? 10

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

3. Briefly discuss the suitability of CLIPS for the two example problems below.

   (a) A spam and virus email filter system. This systems checks incoming email messages in order to identify messages that are of no interest to the user, or may contain viruses. 8

   (b) An monitoring system for a petroleum refinery. This system collects data from various sensors distributed throughout the plant, and controls the activities of the plant through actuators. 8

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

Task III – Interactive Learning Support System

In this task, you need to describe the design of a knowledge-based system that provides assistance for computer-supported, interactive learning: Interactive Learning Support System (ILSS). This system contains modules with material about topics in the course in various formats (e.g. text, video, sound, demonstrations, interactive assignments, etc.). The system is intended for two user groups: *Students*, who would use it to match the available course modules and presentation methods to their background knowledge and preferred learning method. *Instructors* would use the system to select modules for courses, arrange them in a suggested sequence, determine evaluation methods and check points (e.g. quizzes, tests, homework assignments), and to collect information about the performance of the students in the class.
The system must provide at least the following functions:

Module Selection : Verify that the collection of modules selected by the instructor is valid (i.e. it doesn't violate any dependencies between modules), feasible (the amount of material is compatible with the number of units the course is worth), and matches the course description (i.e. the concepts mentioned in the catalog description are present in the selected modules).

Generic Schedule : Determine the generic schedule for all students taking a specific course to be offered during a quarter.

Student Schedule : Construct an individual schedule for a particular student taking the course, derived from the generic schedule while taking into account additional information about the student's specific constraints (e.g. other courses, job) and preferences.

Prerequisite Checker : Verify if a student has the prerequisites to work on a particular module within the course.

Task List : Present the student with a choice tasks to be performed on a given day, ranked according to their urgency (how much time until the deadline) and priority (how many points does it contribute to the overall grade), and possibly other factors of your choice.

You can assume that an electronic version of the material for the course as well as the administrative information for students is available to the system through data bases.

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

Module Selection :

Generic Schedule :

Student Schedule :

Prerequisite Checker :

Task List :

c) List some additional functions that your system can provide to the above or some additional user groups. 8

d) Given that funding would be a problem for the realization of such a system, do you think that expert systems are an appropriate technology for such a system? Would you recommend the use of CLIPS or JESS to implement the ACSS? Justify your recommendation! 8

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Total Points: 100