CPE/CSC 481 - W04

Knowledge-Based Systems

Midterm Exam

Instructor: Franz J. Kurfess

This is the midterm exam for CPE/CSC 481-W04 *Knowledge-Based Systems*. It is an open-book 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. The use of calculators and computers is permitted for numerical calculations and looking up material, but not for the execution of programs to solve exam questions.
The exam time is 1 hour and 20 minutes.

Student Name:	**Date:**
Signature:	

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

a) What is the contribution of *Post Production Systems* to expert systems as we know them now? 3

- ☐ they characterize a subset of rules that can be executed very efficiently
- ☐ 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

b) Which of the following is the best description of an *explanation facility*? 3

- ☐ the transfer of knowledge from humans to computers
- ☐ the storage of knowledge in a format suitable for processing by computers
- ☐ a computer-based mechanism for the generation of new conclusions from existing knowledge
- ☐ a description of the reasons why a particular solution was generated

c) Which of the following is the best description of an expert system *shell*? 3

- ☐ a high-level language specifically designed for knowledge representation and reasoning
- ☐ a collection of rules and facts that contains the domain knowledge
- ☐ a development environment where the domain specialist has to provide only the knowledge content, but not the reasoning methods
- ☐ the formal background (often based on mathematical logic) for the inference engine

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 refraction? 3

- ☐ rules fire only once for a specific set of facts
- ☐ recently used facts are not used for a certain time ("refractory period")
- ☐ used for recursive rules by allowing certain types of rules to fire repeatedly
- ☐ a reasoning method based on fractitioning, i.e. splitting the rule base repeatedly into smaller groups of rules

f) Which of the following CLIPS commands defines the *structure* of facts? 3

- ☐ `facts`
- ☐ `deftemplate`
- ☐ `assert`
- ☐ `retract`

g) Which of the following statements is the best description of *a priori knowledge*? 3

- ☐ knowledge that is available prior to perception through senses
- ☐ knowledge that is verifiable through sensory perception
- ☐ knowledge that indicates how to do something
- ☐ knowledge that is difficult to express through language

h) Which of the following statements is the best description of *a tacit knowledge*? 3

- ☐ knowledge that is available prior to perception through senses
- ☐ knowledge that is verifiable through sensory perception
- ☐ knowledge that indicates how to to something
- ☐ knowledge that is difficult to express through language

i) Which statement is the best characterization of *frames* 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

j) What does it mean that a logical sentence is *satisfiable*? 3

- ☐ the sentence is true under all possible interpretations in all possible worlds
- ☐ the sentence is true under all possible interpretations in some possible worlds
- ☐ the sentence is true if there exists a true interpretation in some possible world
- ☐ the sentence is syntactically correct

Subtotal Task 1: 30

Task II – Short Questions

1. The CLIPS and JESS environments use `assert` and `retract` for the modification of knowledge at runtime. From a logical point of view, these operations are somewhat questionable, but nevertheless they are very frequently used. 10

   - What are the main problems they may cause?

   - Why are they very useful in practice?

2. Describe the main differences between *rules* and *mathematical logic* (in particular predicate logic) with respect to the representation and processing of knowledge. What are the respective advantages and problems?

10

Aspect	*Rules*	*Logic*
Features	•	•
	•	•
	•	•
	•	•
	•	•
	•	•
	•	•
	•	•
	•	
	•	
	•	
	•	
	•	
	•	
Differences	•	•
	•	•
	•	•
	•	•
	•	•
	•	
	•	
	•	
Advantages	•	•
	•	•
	•	•
	•	•
	•	•
	•	
Problems	•	•
	•	•
	•	•
	•	•
	•	•
	•	•
	•	•

Subtotal Task 2: 20

Task III – Suitability of Rule-Based Systems

Discuss the suitability of CLIPS or JESS for the two following example problems. Describe the general aspects, strengths and weaknesses for each example, and determine if you would use CLIPS or JESS for such a problem, or not. Develop a rough sketch of the possible design for such a system (even if you have reservations about the suitability of CLIPS or JESS), and make a final recommendation. The design outline can consist of a block diagram, templates for critical entities in the system, informal descriptions of sample rules, or other means that you think are appropriate.

1. Selection of cell phone plans. Choosing the "best" provider and plan for cell phone service can be quite cumbersome, mostly due to the large number of plans available and the difficulty of comparing individual plans that frequently are described in different ways by the providers. The task is to investigate a system that helps a user select the most appropriate plan for their needs.

   (a) *General Aspects*: 5

   (b) Case *for* CLIPS/JESS, or rule-based systems in general: 5

   (c) Case *against* CLIPS/JESS, or rule-based systems in general: 5

-
-
-
-
-
-
-
-

(d) System design: 5

(e) Overall recommendation: 5

2. Exercise advice: A system that provides guidance to the user of a gym. Assuming that all exercise equipment in a gym is equipped with the appropriate sensors, and that relevant information from the the user is also available, the system collects this information on an ongoing basis during the workout. It compares it against information collected previously, and makes suggestions for exercises to the user. It may also configure equipment specifically for the user and the exercises to be performed.

   (a) *General Aspects* : 5

   (b) Case *for* CLIPS, or rule-based systems in general: 5

   (c) Case *against* CLIPS, or rule-based systems in general: 5

(d) System design: 5

(e) Overall recommendation: 5

Subtotal Task 3: 50

Total Points: 100