CPE/CSC 481 - W05

Knowledge-Based Systems

Midterm Exam

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This is the midterm exam for CPE/CSC 481-W05 *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) One of the fundamental principles used in development environments for knowledge-based systems is   3

   □ the availability of common-sense knowledge in the shell

   □ they automatically recognize the limits of their knowledge

   □ the tight integration of knowledge and its usage

   □ the separation of knowledge and its usage

b) Which of the following is the best description of *knowledge representation*?   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) Why is the RETE algorithm so important for many expert systems?   3

   □ it greatly improves the efficiency of rule-based expert systems

   □ it is mainly for historical reasons because it was used in one of the very first expert systems

   □ it ”lifts” the expressiveness of rules from propositional logic to first order logic

   □ It is an inference procedure especially suitable for computers.

d) The main reasoning method used by Clips is based on   3

   □ forward-chaining and pattern matching

   □ resolution and unification

   □ higher-order logic and metaknowledge

   □ Boolean Algebra for rules

e) What is the role of the *consequent* in a Clips rule?   3

   □ it contains the `defrule` keyword, the name of the rule, and an optional comment string

   □ it specifies the patterns that are to be matched against the facts

   □ it separates the antecedent and the consequent of the rule

   □ it contains the actions to be performed when the rule fires

f) Which statement is the best characterization of *scripts* in the context of knowledge-based systems?

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☐ 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

g) Which is the *least expressive* logic language that utilizes facts and true/false?

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☐ propositional logic

☐ first order predicate logic

☐ temporal logic

☐ logic with probability theory

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

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☐ All types of reasoning where backtracking is not allowed.

☐ It is similar to breadth-first search.

☐ 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.

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

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☐ It is the same as variable assignment in a procedural language.

☐ It propagates partial results through a network of facts and rules.

☐ 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.

j) Which of the following statements is the best characterization of *union probability* for two events A and B in probability theory?

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☐ the probability that both of two independent events occur

☐ the probability that one of two independent events occurs

☐ for two *dependent* events A and B, the probability that event A occurs given that B has already occurred

☐ for two *independent* events A and B, the probability that event A occurs given that B has already occurred

Subtotal Task 1: 30

Task II – Short Questions

1. What are the main aspects of and the main differences between *forward* and *backward* reasoning systems? You can use examples to illustrate important points.   15

2. *Bayesian Reasoning* and *Certainty Factors* are two approaches that can be used to deal with uncertainty in knowledge-based systems. What are the most important aspects of these two approaches? Describe the underlying principles and concepts, their advantages and drawbacks, and the main differences.

15

Comment: The number of bullet points indicated below does not necessarily correspond to the exact number of aspects you are expected to list.

Aspect	Bayesian Reasoning	Certainty Factors
Principles and Concepts	• • • • •	• • • • •
Differences	• • • • •	• • • • •
Advantages	• • • • •	• • • • •
Problems	• • • • • •	• • • • •

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. Project Team Assembler. The task is to investigate a system that helps a manager select the most appropriate structure for a project team, and select the most suitable members from the available employees. You can assume that the company has some kind of framework for projects, and also keeps profiles that capture the capabilities and skills of their employees.

    (a) *General Aspects*:   4

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    (b) Case *for* Clips/Jess, or rule-based systems in general: 4

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    (c) Case *against* Clips/Jess, or rule-based systems in general: 4

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(d) System design: 4

(e) Overall recommendation: 4

2. Driving Advisor: A system that provides guidance to the driver of a vehicle. Practically all recent automobiles have sensors that measure many different parameters relevant for the operation of a vehicle. Some vehicles not only provide information about the status of the vehicle itself, but also of its environment (e.g. outside temperature, road condition, distance to the vehicle ahead) and even the driver (e.g. duration and frequency of eye closures to detect sleepiness). Such a system can collect relevant information, and either offer advice to the driver (e.g. "Slow down, icy road surface"), or directly influence the vehicle (e.g. by slowing down to maintain a minimum distance to the vehicle ahead). Your task is to do an informal feasibility study of such a system from a knowledge engineering perspective. You may take into account other issues such as user interaction, privacy, security, etc., but the main emphasis should be on the suitability of knowledge-based system technology (particularly rule-based systems) for this domain.

(a) *General Aspects* :   4

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(b) Case *for* CLIPS/JESS, or rule-based systems in general: 4

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(c) Case *against* CLIPS/JESS, or rule-based systems in general: 4

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(d) System design: 4

(e) Overall recommendation: 4

Subtotal Task 3: 40

Total Points: 100