CS 4201 Expert System– 2020/2021	Handout: model answer exam

Question #1 Complete:

1. ____ is the study of making valid inferences.

Answer: Logic

2. _____ refers to giving meaning to symbols.

Answer: Semantics

3. The structure of a semantic set is shown graphically in terms of _____ and _____ connecting them.

Answer: nodes, arcs

4.The___ can be used to characterize knowledge in a semantic net.

Answer: interconnected nodes(IS-A, A-KIND-OF)

5. deftemplate

6. The components of es include_,_____,_

Answer: Knowledge base, Inference engine, user interface

7._____ is method used to organize and formalize knowledge

Answer: Knowledge representation

8. CLIPS stores all its facts in ----

Answer: factlist

9. The header of rules in CLIPS consists of ___,____,_____

Answer: Keyword defrule, Name of the rule – fire-emergency,Optional comment string – "An example rule".

10. ---------a method for choosing rule to fire when more than one rule can be fired in a given cycle.

Answer:Conflict resolution

11. A(n) _____ is a group of slots and fillers that defines a stereotypical object.

Answer: frame

12. FMS stands for_____

Answer: Finite Machine State

13. _____ is useful for debugging purposes.

Answer: Watch command

14. _____allows more important rules to stay at the top of the agenda.

Answer: Salience

15. When CLIPS reads character from keyboards , it groups them into ----------

Answer: command

Questions#2:

1. Compare between knowledge acquisition, knowledge representation and knowledge engineering?

   Answer:

- **Knowledge acquisition facility – automatic way for the user to enter knowledge in the system bypassing the explicit coding by knowledge engineer.**
- **Knowledge representation: Knowledge representation is key to the success of expert systems.**
  Expert systems are designed for knowledge representation based on rules of logic called inferences.
  Knowledge affects the development, efficiency, speed, and maintenance of the system
  A number of knowledge-representation techniques have been devised:
  1. **Rules**
  2. **Semantic nets**
  3. **Frames**
  4. **Scripts**
  5. **Logic**
  6. **Conceptual graphs**
- **knowledge engineering: develops rules that are applied to data in order to imitate the thought process of a human that is an expert on a specific topic. This field of artificial intelligence attempts to emulate the judgment and behavior of a human expert in a particular field.**
  In its initial form, knowledge engineering focused on the transfer process; transferring the expertise of a problem-solving human into a program that could take the same data and make the same conclusions.
  It was determined that transfer processing had its limitations, as it did not accurately reflect how humans make decisions. It did not consider intuition and gut feeling, known as analogous reasoning and nonlinear thinking, that often may not be logical. Another reason why the transfer approach was not successful was that the systems did not have the collateral information (information that is not central to a specific issue or field but is still useful in making judgements and decisions) which human specialists and experts had.
  In conclusion: is the process of understanding and then representing human knowledge in data structures; semantic models, a conceptual diagram of the data as it relates to the real world; and heuristics, rules that lead to solutions to every problem taken in AI. Expert systems and algorithms are examples that form the basis of the representation and application of this knowledge. The knowledge engineering process includes knowledge acquisition, representation, and validation; inferencing; and explanation and justification

2. Explain the different situations on conflict resolution process?

   Answer:

   Conflicts arise in the chaining when 2 rules lead to the same conclusion (consequent) and to resolve conflict a strategy is needed.

   What does it mean?

   Conflict resolution strategies are used in rule-based expert systems, to help in choosing which production rule to fire. The need for such a strategy arises when the conditions of two or more rules are satisfied by the currently known facts

   Different strategies?

   There are seven conflict resolution strategies in CLIPS: depth, breadth, simplicity, complexity, lex, mea, and random. The default strategy is depth in CLIPS.

   This is more details if you need

   1- Depth Strategy

   Newly activated rules are placed above all rules of the same salience. For example, given that fact activates rule1 and rule2 and factb activates rule3 and rule4, then if fact is asserted before fact b, rule3 and rule4 will be above rule1 and rule2 on the agenda. However, the position of rule1 relative to rule2 and rule3 relative to rule4 will be arbitrary.

   2 Breadth Strategy

   Newly activated rules are placed below all rules of the same salience. For example, given that facta activates rule1 and rule2 and factb activates rule3 and rule4, then if facta is asserted before factb, rule1 and rule2 will be above rule3 and rule4 on the agenda. However, the position of rule1 relative to rule2 and rule3 relative to rule4 will be arbitrary.

   3 Simplicity Strategy

   Among rules of the same salience, newly activated rules are placed above all activations of rules with equal or higher specificity. The **specificity** of a rule is determined by the number of comparisons that must be performed on the LHS of the rule. Each comparison to a constant or previously bound variable adds one to the specificity. Each function call made on the LHS of a rule as part of the :, =, or test conditional element adds one to the specificity. The boolean functions **and**, **or**, and **not** do not add to the specificity of a rule, but their arguments do. Function calls made within a function call do not add to the specificity of a rule. For example, the following rule

```
(defrule example
  (item ?x ?y ?x)
  (test (and (numberp ?x) (> ?x (+ 10 ?y)) (< ?x 100)))
  =>)
```

has a specificity of 5. The comparison to the constant item, the comparison of ?x to its previous binding, and the calls to the **numberp**, **<**, and **>** functions each add one to the specificity for a total of 5. The calls to the **and** and **+** functions do not add to the specificity of the rule.

4 Complexity Strategy

Among rules of the same salience, newly activated rules are placed above all activations of rules with equal or lower specificity.

5 LEX Strategy

6 MEA Strategy

3. How will the expert system be maintained and evolve?

   Answer:

   Expert System development and maintenance include:

   a) problem Identification
   b) System design and ES technology identification
   c) development of prototype
   d) testing and refinement of prototype
   e) complete and field the expert system
   f) maintain the system

Question #3:

2. Given the following **deftemplates** describing a family tree,Write the suitable rules to build the relations (Uncle, Sister, grandparent):

```
(deftemplate father-of (slot father) (slot child))
(deftemplate mother-of (slot mother) (slot child))
(deftemplate male  (slot person) )
(deftemplate female  (slot person) )
(deftemplate wife-of   (slot wife) (slot husband))
(deftemplate husband-of   (slot husband) (slot wife))
```

   Answer:

```
(defrule parent-rule
(or (father-of (father ?x)(child ?y))
    (mother-of(mother ?x)(child ?y))
=>(assert (parent ?x ?y)
)
(defrule grandparent
(and(parent ?x?y)(parent ?y ?z))
=>(assert (grandparent ?x ?z))
)
```

3. A rule-based expert system has five components: **the knowledge base, the database, the inference engine, the explanation facilities, and the user interface**.

4. Production Rules?

Answer:

Advantages and Disadvantages of Production Rules:

Advantages:

- **simple and easy to understand**
- **straightforward implementation**
- **formal foundations for some variants**

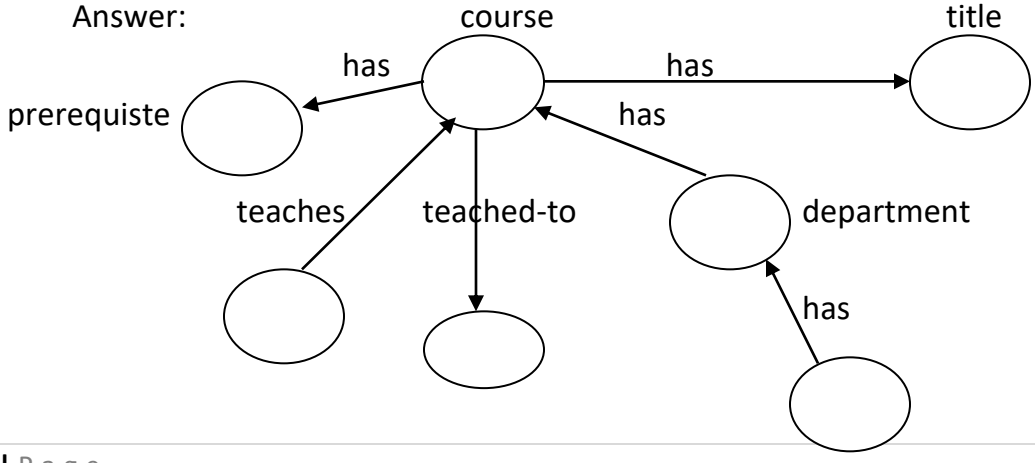
Disadvantages:

- **simple implementations are very inefficient**
- **some types of knowledge are not easily expressed in such rules**
- **large sets of rules become difficult to understand and maintain**

Question#4:

A. Create a semantic network to describe a University course. Your network should include the concepts: course, title, department, faculty, student, lecturer and pre-requisite.

Answer:



lecturer student faculty

B. Using CLIPS define facts for a patient with symptoms of “Measles”.A "Patient" may have values for fever, spots, rash and sore-throat.

Answer:

```
(deftemplate Patient
(slot fever)
(slot spots)
(slot rash)
(slot sore_throat))
(deftemplate Diagnosis
(slot diagnosis))
(deftemplate Treatment
(slot treatment))
(defrule Measles
(declare (salience 100))
(Patient (fever high) (spots yes))
=>
(assert (Diagnosis (diagnosis measles)))
(printout t "Measles diagnosed" crlf))
(defrule Allergy1
(and (Patient (spots yes))
(not (Diagnosis (diagnosis measles))))
=>
(assert (Diagnosis (diagnosis allergy)))
(printout t "Allergy diagnosed from spots and lack of measles" crlf))
(defrule Allergy2
(Patient (rash yes))
=>
(assert (Diagnosis (diagnosis allergy)))
(printout t "Allergy diagnosed from rash" crlf))
(defrule Flu
(Patient (sore_throat yes) (fever mild | high))
=>
(assert (Diagnosis (diagnosis flu)))
(printout t "Flu diagnosed" crlf))
(defrule Penicillin
(Diagnosis (diagnosis measles))
```

=>
(assert (Treatment (treatment pennicillin)))
(printout t "Penicillin prescribed" crlf))
(defrule Allergy_pills
(Diagnosis (diagnosis allergy))
=>
(assert (Treatment (treatment allergy_shot)))
(printout t "Allergy shot prescribed" crlf))
(defrule Bed_rest
(Diagnosis (diagnosis flu))
=>
(assert (Treatment (treatment bed_rest)))
(printout t "Bed rest prescribed" crlf))
(deffacts Symptoms
(Patient (fever high)
(spots yes)
(rash no)
(sore_throat no)))

C. Draw a semantic net for different kinds of computers