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Internal Assessment Test II – Oct. 2019

Sub:	ARTIFICIAL INTELLIGENCE					Sub Code:	17CS562	Branch:	OPEN ELECTIVE (ISE V)
Date:	15/10/2019	Duration:	90 min's	Max Marks:	50	Sem / Sec:	V (A&B)		OBE

Answer any five full questions

PART -1

		MARKS	CO	RBT
1 (a)	Define Horn Clause and give syntactic difference between PROLOG and LOGIC with suitable example.	[10]	CO2	L1

Horn clause: A horn clause is a clause that has at most one positive literal.

- Ex: p, ¬p ∨ q, p → q

LOGICAL	PROCEDURAL
Variables are explicitly quantified. ∀x, ∃x	Implicitly quantified. Uppercase: Variables Lowercase: constants.
And ∧	,
OR ∨	Written as list of separate statements.
p→q	Written backward: q :- p

		MARKS	CO	RBT
2 (a)	What is Resolution? Explain Algorithm for Resolution in propositional logic. Apply resolution to prove the predicate 'likes(John, peanuts)' using following set of predicates:	[2+4+4]	CO2	L3

a. ∀x : food(x) → likes (John, x)
b. food (Apples)
c. food (Banana)
d. ∀ a : ∀ b: eats (a, b) ^ ¬killed (a) → food (b)
e. eats (Bill, Peanuts) ^ alive (Bill)
f. ∀c : eats (Bill, c) → eats (Sue, c)
g. ∀ d : alive(d) → ¬ killed (d)
h. ∀ e: ¬ killed(e) → alive(e)

Resolution is a proof procedure with a single operation on variety of processes. Resolution takes two clauses (parent clauses) and produces a new clause (resolvent clause) containing all the literals of the two original clauses except the two complementary literals.

This process continues until one of the two things happen:

- There are no new clauses that can be added.
- An application of the resolution rule derives the empty clause.

An empty clause shows that the negation of the conclusion is a complete contradiction.

ALGORITHM

Producing a proof by resolution of proposition P with respect to a set of axioms F is below:

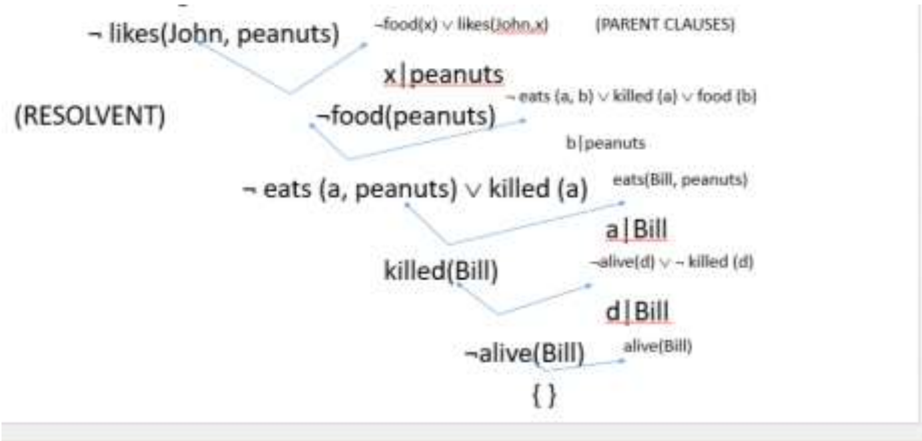
1. Convert all the propositions of F to clause form.
2. Negate P and convert the result to clause form.
3. Repeat until either a contradiction is found or no progress can be made.

   a. Two clauses (one being p) , call these the parent clauses.

b. Resolve them together. The resulting clause called the resolvent. Which will be the disjunction of all of literals of both clauses, if there are any pairs of literals L and ~L , such that one of the parent clause contains L and other contains ~L then eliminate such pair.

c. If the resolvent is the empty clause, then a contradiction has been found. If it is not, then add it to the set of clauses available to the procedure

To prove the predicate likes(John, Peanuts) staring the resolution with negation of the prediate ¬likes(john, peanuts)



This empty clause in the resolution contradicts the initial predicate ¬likes(john, peanuts) the resolution started with and hence likes(john,peanuts) is true

3 (a)	What qualities does a good knowledge representation system should possess? Explain the different approaches used for knowledge representation and list the issues involved in knowledge representation.	[2+6+2]	CO3	L2

The following properties should be possessed by a knowledge representation system.

1. Representational adequacy-

Ability to represent all kinds of knowledge that are needed in the domain.

2. Inferential adequacy-

Ability to manipulate representational structures such that new knowledge can be derived/inferred from the old.

3. Inferential efficiency-

Ability to incorporate additional information into an existing knowledge base that can be used to focus the attention of inference mechanisms in the most promising direction.

4. Acquisitional efficiency-

Ability to easily acquire new information

Approaches to knowledge representation: (Explain with example)

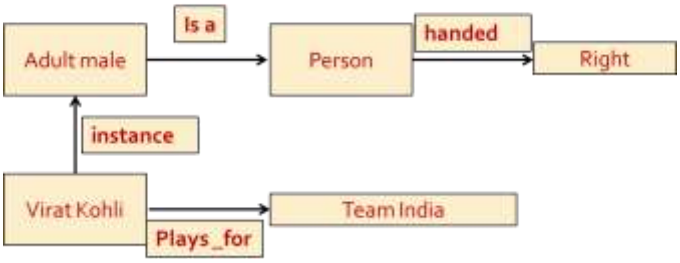
1. Simple relational knowledge: Used in database system.Provides very weak inferential capabilities. May serve as the input to powerful inference engines.

   Ex:

Player	Height	Weight	handed
Peter	6-0	180	right
Ajay	5-10	170	left
John	6-2	215	left
Vickey	6-3	205	right

2. Inheritable Knowledge: Objects are organized into classes and classes are organized in a generalization hierarchy. Inheritance is used as a powerful form of inference, but not adequate. Elements of specific class inherits values and attributes of more general classes in which they are included.

   Ex: Slot and filler structure, semantic network, frames.



3. Inferential knowledge: The aim of logic is to develop a system of methods and principles that we may use as criteria for evaluating and constructing arguments. Traditional logic is necessary to describe the inferences. This also requires an additional inference procedure that can exploit the inference knowledge else it is useless.

   Ex:

   If a car has a good battery (B)
   good sparkplugs (S)
   gas (G)
   good tyres (T) THEN the car can move **B^S^G^T->C**

4. Procedural knowledge: It specifies what to do and when, in terms of programs generally using LISP programming language. Makes use of the knowledge when it executes the code to perform a task.Can also be in the form of production rules.

   Ex:

```
( defunassessment ( average-mark )
(cond( ( > average-mark 90 ) 'excellent )
( ( > average-mark 80 ) 'very_good)
( ( > average-mark 70 ) 'good )
( ( > average-mark 60 ) 'fair )
( t 'poor ) ) )
> ( assessment 72 )
GOOD
> ( assessment 38 )
POOR
```

Important issues in knowledge respresentation:

- Identifying Important attributes: Two imp attributes: Instance and Isa
- Important relationships among attributes: Inverse, existence in an 'isa' relationship, reasoning about values (constraints and derivation) and single valued attributes(unique value)
- Choosing the granularity of representation: Level of detailing , breaking data in to primitives.
- Representing sets of objectives: Extensional and Intentional definition
- Finding the right structure for large amount of knowledge.

4 (a)	Write a note on spelling error checking and correction techniques, explain minimum edit distance algorithm with suitable example.	[4+6]	CO3	L2

Spelling checking techniques:

- Broadly categorized in to three categories:
  1. **Non-word error detection:** Involves detection of misspelled words or non-words. Ex: ‘Soper’ is a non-word correct form may be super or sober. The most commonly used techniques are **N-gram analysis** and **Dictionary look-up.**
     a. **N-gram analysis:** Probabilities of occurrences of N-grams in a large corpus of text to decide on the error in the word. Those strings that contains highly infrequent sequence are treated as case of spelling errors. In spell checker it is the letters which are considered instead of words. This technique is also used in OCR(optical character recognition)
     b. **Dictionary look-up:** involves use of an efficient dictionary look-up couples with pattern matching algorithms , dictionary partitioning mechanism(searching) and morphological processing methods.
  2. **Isolated-word correction:** Focuses on the correction of an isolated non-word by finding its nearest and meaningful word and makes an context independent attempt to rectify the error. Techniques used are:
     a. **Minimum edit distance technique**
     b. **Similarity key techniques**
     c. **Rule based methods**
     d. **N-gram, probabilistic and neural network based technique.**
  3. **Context dependent error detection and correction:** This finds the error and will try to correct the word which fits into the context. More complex to implement and requires more resources.

It involves correction of both real-word error as well as non-word error.

Ex: Peace comes from within

Piece comes from within

Both the first words are correct but first one fits with respect to the context.

5 (a) Illustrate the representation of the following in predicate logic with an example: [10] CO2 L1

1. 'instance' and 'isa' relationship
2. 2. Adding exception
3. Computable functions

Ans **isa and instance relationship:**

1.Instance(Marcus,man)
2.Instance(Marcus ,Pompeian)
3.isa(Pompeian,Roman)
4.instance (Caesar, ruler)
5. $\forall$x: instance(x,Roman) $\rightarrow$loyalto(x,Caesar) $\vee$hate(x, Caesar)

Exception:

$\forall$x: romans(x)$\wedge\neg$ eq(x, Paulus) $\rightarrow$loyalto(x,Caesar) $\vee$hate(x, Caesar)

Computable functions:

gt(2+3,1)

6 (a) Explain various steps involved in Natural Language Processing. Briefly explain four way of handling sentence [6+4] CO3 L1

- : A natural language is meant for communicating about world. NLP aims is to build a computational model of language, which can be used for communicating about the world. Natural language processing includes both **understanding and generation.** Natural language processing is divided in to two tasks:

1. Processing written texts: Using lexical, syntactic and semantic knowledge of the language.
2. Processing spoken language: In addition to knowledge required for processing texts it requires knowledge about phonology (organization of sounds) along with ambiguities that arise in speech.

Steps in NLP includes :

1. **Morphological analysis:** Breaking sentence in to words and punctuation symbols.(Individual tokens). (Ex: Parts of speech)
2. **Syntactic analysis:** Structures that shows how words relate to each other using rules of language (Grammar).
3. **Semantic analysis:** Structures from the syntactic analysis are assigned meanings.
4. **Discourse integration:** Meaning of a sentence may depend on the sentences that precede and may influence the meanings of the sentences that follow it.
5. **Pragmatic analysis:** What was said to what was actually meant.

7 (a) What is a CORPUS? Explain how corpora helps in statistical natural language processing. [10] CO3 L2

Processing of long sentences give rise to ambiguities as processing of such sentences yields to large number of analyses. Statistical information of large corpus of the concerned language aids in disambiguation.

Corpora: It is a large collection of segments of a language. Corpora may be available in form of a collection of raw text or in a more sophisticated annotated or marked up form along with the information about the word.

Example of corpora: Written or spoken language, content of an entire book or books, newspaper, magazine, speeches etc.

Sublanguage corpora: Corpora related to particular domain.

Treebank: Corpora that contains parse tree and syntactic information along with text.

Parallel corpora: Corpora collection of texts in multiple languages.

Concordance: Is an index or list of the important words in a text or group of texts along with how often a word exists.

Collocation: Collection of words that often occur together.

8 (a) Define CNF? Give an algorithm for converting proposition logic into CNF and apply the same to convert the following propositions to CNF: (Imp)	[6+4]	CO2	L2

a. Marcus was a man.
b. Marcus was a Pompeian
c. All Pompeians were Romans
d. Caesar was a ruler
e. All romans were either loyal to Caesar or hated him
f. Everyone is loyal to someone
g. People only try to assassinate rulers they are not loyal to.
h. Marcus tried to assassinate Caesar.

CNF: Every sentence in Propositional Logic is logically equivalent to a conjunction of disjunctions of literals. A sentence expressed as a conjunction of disjunctions of literals is said to be in Conjunctive normal Form or CNF. (AND of ORs).

Algorithm:

1. Eliminate $\rightarrow$: $a \rightarrow b$ is equivalent to $\neg a \vee b$
2. Reduce the scope of each $\neg$ to a single term using:
    1. $\neg(\neg p)=p$;
    2. $\neg(a \wedge b)=\neg a \vee \neg b$
    3. $\neg(a \vee b)=\neg a \wedge \neg b$
    4. $\neg \forall x: p(x) = \exists x: \neg p(x)$
    5. $\neg \exists x: p(x) = \forall x: \neg p(x)$
3. Standardize variables so that each quantifier binds a unique variable.

$\forall x: p(x) \vee \forall x: q(x) = \forall x: p(x) \vee \forall y: q(y)$

4. Move all quantifiers to the left of the formula:

$\forall x: p(x) \vee \forall y: q(y)$ can be written as $\forall x: \forall y: p(x) \vee q(y)$ (prenex normal form)

5. Eliminate existential qualifiers: Eliminate the existential qualifier by substituting for the variable a reference to a function that produces the desired value.

$\exists y: principal(y) = principal(s1(y))$

S1 is known as **skolem function**.

6. Drop all the prefix: all remaining variables are universal quantifiers hence need not be specified.

$\forall x: \forall y: \; p(x) \vee q(y) \;=\; p(x) \vee q(y)$

7. Convert the matrix into a conjunction of disjuncts by using associative and distributive property:

$(a \vee b) \vee c = a \vee (b \vee c)$

$(a \wedge b) \vee c = (a \vee c) \wedge (b \vee c)$

8. Create a separate clause for each disjunct.

Axioms in clause form:

1. $man(Marcus)$
2. $Pompeian(Marcus)$
3. $\neg Pompeian(x_1) \vee Roman(x_1)$
4. $ruler(Caesar)$
5. $\neg Roman(x_2) \vee loyalto(x_2, Caesar) \vee hate(x_2, Caesar)$
6. $loyalto(x_3, f1(x_3))$
7. $\neg man(x_4) \vee \neg ruler(y_1) \vee \neg tryassassinate(x_4, y_1) \vee loyalto(x_4, y_1)$
8. $tryassassinate(Marcus, Caesar)$