Tribhuwan University
Institute of Science and Technology
2076 (new)

Bachelor Level / fourth-semester / Science
Computer Science and Information Technology(CSC261)
(Artificial Intelligence)
Candidates are required to give their answers in their own words as far as practicable.
The figures in the margin indicate full marks.

Full marks: 60
Pass marks: 24
Time: 3 hours

Attempt all the questions.

Section-A

Long Answer Questions.

Attempt any Two questions **(2x10=20)**

1. Construct a state space with appropriate heuristics and local costs. Show that Greedy Best First search is not complete for the state space. Also illustrate A* is complete and guarantees solution for the same state space.

2. How resolution algorithm is used in FOPL to infer conclusion?

Consider the facts;

Anyone whom pugu loves is a star. Any hero who does not reherse does not act. Anmol is a hero. Any hero who does not work does not reherse. Anyone who does not act is not a star. Convert above into FOPL and use resolution to infer that "If Anmol does not work, then pugu does not love Anmol".

3. Define mathematical model of artificial neural network. Discuss how Hebbian learning algorithm can be used to train a neural network. Support your answer with an example.

Section-B

Short Answer Questions.

Attempt any Eight questions. **(8x5=40)**

4. What is AI? How can you define AI from the perspective of thought process?

5. Discuss the types of environment where an agent can work on.

6. Illustrate with an example, how uniform cost search algorithm can be used for finding goal in a state space.

7. Define frame. How knowledge is encoded in a frame? Justify with an example.

8. What do you mean by membership of an element in a fuzzy set? Given a domain of discourse X={10, 20, 30, 40, 50, 60, 70}, construct a fuzzy set from X. Use your own assumptions for defining membership.

9. Write an algorithm for learning by Genetic Approach.

10. How uncertain knowledge is represented? Given following full joint probability distribution representing probabilities of having different sizes of CD, find the probability that a CD cover has a length of 130mm given the width is 15mm.

y=width ↓	x=Length →		
	129	130	131
15	0.12	0.42	0.06
16	0.08	0.28	0.04

11. How the concept of machine vision are used in Robotics to configure sensors of Robots?

12. How syntactic and semantic analysis is done during natural language processing? Explain with example.

Artificial Intelligence - 2076
Ankit Panger

Q.2. How resolution algorithm is used in FOPL to infer conclusion?
Consider the fact.

Anyone whome pugo loves is a star. Any hero who does not rehearse does not act. Anmol is a hero. Any hero who does not work does not rehearse. Anyone who does not act is not a star.

Convert above into FOPL & use resolution to infer that, "If Anmol does not work, then pugo does not love Anmol.".

=) Resolution algorithm can be used in FOPL to infer conclusion in following steps

1. Convert the given facts into First order logic.
2. Convert the FOL to Conjunctive normal form a
   i) Eliminate implication
   ii) Standardize variable (not necessary) } It can be of any order
   iii) Move negation inwards
   iv) Skolemization (Removing existential quantifier)
   v) Drop universal quantifier)
3. Negate the statement needed to prove.
4. Draw resolution graph/tree (unification)

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Now, Considering the given facts

Step-1: 1st let's convert the given facts into FOL

① Anyone whom pugo loves is a star.

$$\forall x [loves(pugo, x) \rightarrow star(x)]$$

② Any hero who doesn't rehearse does not act.

$$\forall x [hero(x) \wedge \neg rehearse(x) \rightarrow \neg act(x)]$$

③ Anmol is a hero

$$hero(Anmol)$$

④ Any hero who doesn't work doesn't rehearse

$$\forall x [hero(x) \wedge \neg work(x) \rightarrow \neg rehearse(x)]$$

⑤ Anyone who doesnot act is not a star.

$$\forall x (\neg act(x) \rightarrow \neg star(x))$$

~~Negated Conclusion Goal: $\neg work$~~

Step-2: Let's Convert the FOL to CNF

Step-i: Remove implication

① $\forall x (\neg loves(pugo, x) \vee star(x))$

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(2) $\forall x \left[\neg (hero(x) \wedge \neg rehearse(x)) \vee \neg act(x) \right]$

(3) $hero(Anmol)$

(4) $\forall x \left[\neg (hero(x) \wedge \neg work(x)) \vee \neg rehorse(x) \right]$

(5) $\forall x (\neg(\neg act(x)) \vee \neg star(x))$

Step-ii: Move negation inwards

(1) $\forall x [\neg loves(pugu, x) \vee star(x)]$
(2) $\forall x [\neg hero(x) \vee rehearse(x) \vee \neg act(x)]$
(3) $hero(Anmol)$
(4) $\forall x [\neg hero(x) \vee work(x) \vee \neg rehearse(x)]$
(5) $\forall x (act(x) \vee \neg star(x))$

Step-iii: Drop universal quantifiers

(1) $\neg loves(pugu, x) \vee star(x)$
(2) $\neg hero(x) \vee rehearse(x) \vee \neg act(x)$
(3) $hero(Anmol)$
(4) $\neg hero(x) \vee work(x) \vee \neg rehearse(x)$
(5) $act(x) \vee \neg star(x)$

-3: Negate goal by changing it to CNF

Goal: $\neg work(Anmol) \rightarrow \neg love(pugu, Anmol)$

$\neg[\neg work(Anmol) \vee \neg love(pugu, Anmol)$

$work(Anmol) \vee \neg love(pugu, Anmol)$

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Negate goal

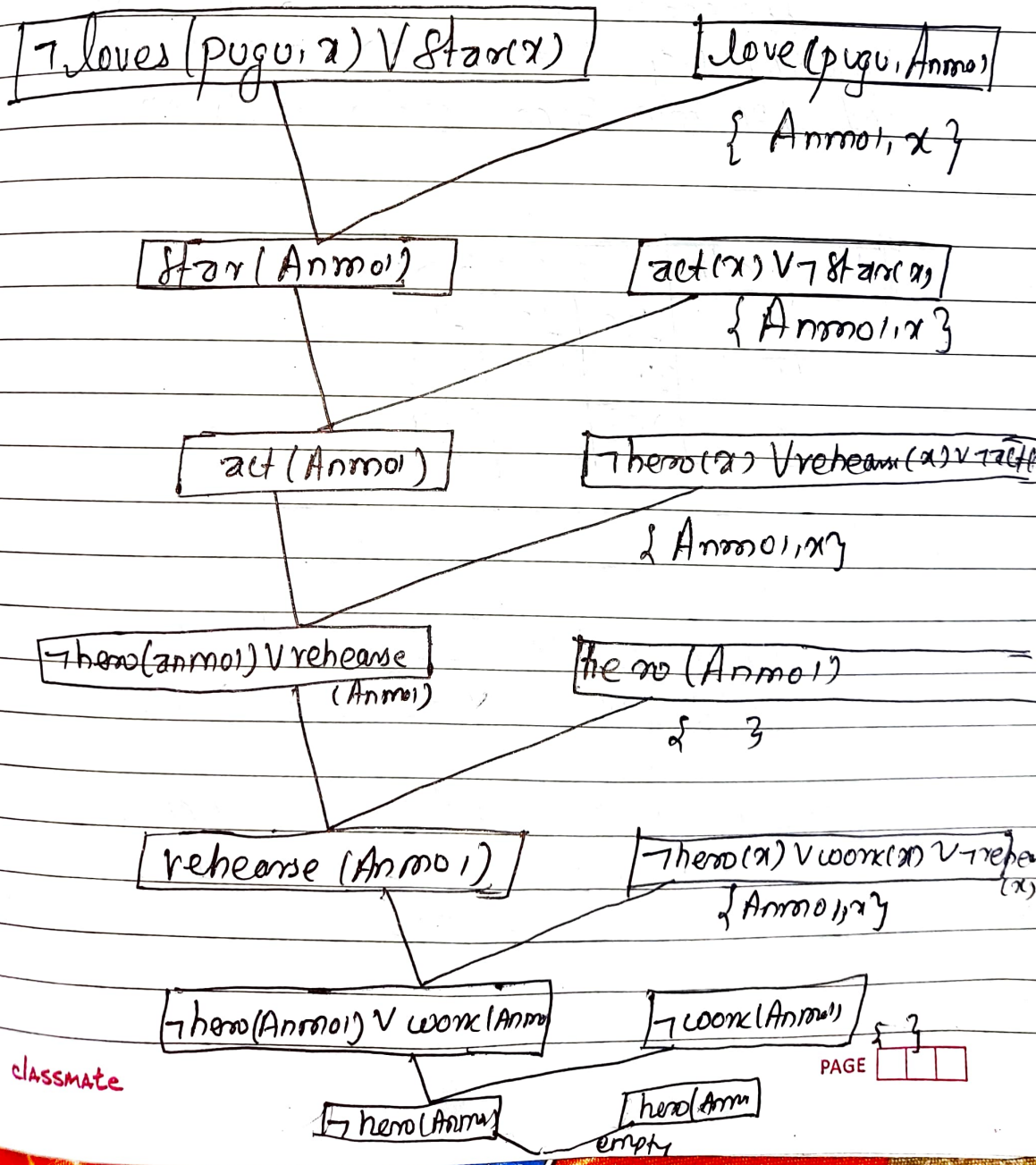
. $\neg work(Anmol) \wedge love(pugu, Anmol)$

It can be split as

(6) $\neg work(Anmol)$

(7) $love(pugu, Anmol)$

Step-4: Draw resolution graph.



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Hence, the conclusion "If Ammo doesn't work, then pugu doesn't love Ammo" can be inferred from the given facts.

Section

Q.10. Given following joint probability distribution, representing probabilities of having different sizes of CD, find the probability that a CD has a length of 130 mm given width is 15 mm

Y=width ↓	X=Length →		
	129	130	131
15	0.12	0.42	0.06
16	0.08	0.28	0.04

⇒ Here,

Probability of length = 130 and width is 15 mm

$$P(X=130 \cap Y=15) = 0.42$$

Probability of width is 15 mm

$$P(Y=15) = 0.12+0.42+0.06$$
$$= 0.6$$

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Hence, probability that a CD has a length of 130 mm given that width is 15 mm is

$$P\left(\frac{X=130}{Y=15}\right) = \frac{P(X=130 \cap Y=15)}{P(Y=15)}$$

$$= \frac{0.42}{0.6}$$

$$= 0.7$$

Hence, probability is 0.7

Q.8. Given a domain of discourse $X = \{10, 20, 30, 40, 50, 60, 70\}$ construct a fuzzy set from X. Use your own assumption for defining membership

⇒ We know, fuzzy set is defined as

$$A \to \{(x, \mu_A(x)\} / x \in X$$

Where, $\mu_A(x) : x \to [0,1]$ is called membership function.

Given, $X = \{10, 20, 30, 40, 50, 60, 70\}$

Let, fuzzy set A → numbers close to 30

$x = 10, \mu_A(10) = 0.5$

$x = 20, \mu_A(20) = 0.8$

$x = 30, \mu_A(30) = 1$

$x = 40, \mu_A(40) = 0.8$

$x = 50, \mu_A(50) = 0.5$

$x = 60, \mu_A(60) = 0.1$

$x = 70, \mu_A(70) = 0$

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Note: We choose 0, 0.1, 0.5, 0.8, ----1 at random

∴ Fuzzy set A = { (10, 0.5), (20, 0.8), (30, 1),
(40, 0.8), (50, 0.5),
(60, 0.1), (70, 0) }