

OLLSCOIL NA hÉIREANN
THE NATIONAL UNIVERSITY OF IRELAND, GALWAY

SEMESTER II EXAMINATIONS 2000

**THIRD B.A. IN INFORMATION TECHNOLOGY & HIGHER
DIPLOMA IN APPLIED SCIENCE (SOFTWARE DESIGN &
DEVELOPMENT)**

CT319 – ARTIFICIAL INTELLIGENCE

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Time allowed: 2 hours
Answer 4 questions. All questions carry equal marks

1. (a) Given the following set of facts and rules:

parent(bob, sue)
parent(mary, sue)
parent(bob, dave)
parent(mary, dave)
parent(sam, bob)
parent(jill, bob)
parent(ken, jill)
parent(pam, jill)
parent(des, pam)
parent(sam, bill)
parent(jill, bill)
parent(bill, dot)
parent(bill, molly)
parent(bill, phil)

if parent(X , Y) and parent(X , Z) then sibling(Y , Z)
if parent(X , Y) and parent(W , Z) and sibling(X , W)
then cousin (Y , Z)

where:

parent(X , Y) – X is the parent of Y
sibling(X , Y) – X is the sibling of Y
cousin(X , Y) – X is the cousin of Y

what additional facts can be deduced using only the rules given? Show which facts can be deduced in more than one way.

- (b) Write a rule that deduces the relation grandparent(X , Y) - X is the grandparent of Y. What further facts can now be deduced?
- (c) Write rules that deduce the relation ancestor(X , Y) – X is an ancestor of Y. What further facts can now be deduced.
- (d) Write a rule that deduces the relation commonancestor(X , Y) – X and Y share a common ancestor. What additional facts can now be deduced.

2. Explain the difference between each of the following:

Breadth first search
Depth first search
Depth bound depth first search
Depth first search with iterative deepening
Heuristic search

Discuss the advantages and disadvantages of each of these search techniques, giving an example of a situation where you think each technique would be appropriate.

3. (a) What is the difference between forward chaining and backward chaining? When would each of these techniques be appropriate? Give an example for each.
- (b) What is the purpose of certainty factors (CFs) in expert systems like MYCIN?
- (c) How are CFs introduced into MYCIN type expert systems?
- (d) How is conflicting information handled in MYCIN type expert systems?
- (e) Does the order that the rules fire in MYCIN ever have any effect on the CFs? What does this imply for such expert systems?

4. (a) Suppose that an ATMS network contains the following nodes among others:

$\langle X, \{ \{ a1, a3, a5 \}, \{ a2, a4 \} \} \rangle$
 $\langle Y, \{ \{ a1 \}, \{ a2, a3 \}, \{ a4 \} \} \rangle$
 $\langle \text{FALSE}, \{ \} \rangle$

with FALSE denoting the node whose label is the collection of all the nogoods encountered so far. Given a derived nogood of $\{ a1, a3 \}$, according to the label-update algorithm of ATMS, what will be the updated labels for X, Y and FALSE?

- (b) Suppose the justification 'if X and Y then Z' is now added. State the label of the newly created node Z, show each step in it's calculation.
- (c) What would the label for Z be if the justification 'if X and Y then Z' was applied to the original network and then the derived nogood of $\{ a1, a3 \}$ was added to the ATMS?

5. (a) Explain what is meant by Qualitative Reasoning. What are its advantages and disadvantages?
- (b) Given the following constraints (which represent the motion of a ball being thrown in the air):

$$\begin{aligned} \text{DERIV} (x, v) \\ \text{DERIV} (v, a) \\ a = g < 0 \end{aligned}$$

and the quantity spaces:

$$\begin{aligned} \{ -\infty, 0, \infty \} \text{ for } v \\ \{ 0, \text{top} \} \text{ for } x \end{aligned}$$

If the initial state is (the ball has just stopped rising):

$$\begin{aligned} \text{QS}(x, t_1) &= \langle \text{top}, \text{std} \rangle \\ \text{QS}(v, t_1) &= \langle 0, \text{dec} \rangle \\ \text{QS}(a, t_1) &= \langle g, \text{std} \rangle \end{aligned}$$

what are the possible next states?

P-transition rules

Rule-id	QS(v, t _i)	QS(v, t _i , t _{i+1})
P1	$\langle l_j, \text{std} \rangle$	$\langle l_j, \text{std} \rangle$
P2	$\langle l_j, \text{std} \rangle$	$\langle (l_j, l_{j+1}), \text{inc} \rangle$
P3	$\langle l_j, \text{std} \rangle$	$\langle (l_{j-1}, l_j), \text{dec} \rangle$
P4	$\langle l_j, \text{inc} \rangle$	$\langle (l_j, l_{j+1}), \text{inc} \rangle$
P5	$\langle (l_j, l_{j+1}), \text{inc} \rangle$	$\langle (l_j, l_{j+1}), \text{inc} \rangle$
P6	$\langle l_j, \text{dec} \rangle$	$\langle (l_{j-1}, l_j), \text{dec} \rangle$
P7	$\langle (l_j, l_{j+1}), \text{dec} \rangle$	$\langle (l_j, l_{j+1}), \text{dec} \rangle$

- 6 (a) What is meant by the Turing Test? Is it a reasonable method for determining if a machine is displaying "intelligence"?
- (b) Searle proposed the "Chinese Room" scenario. Describe the principles of this scenario and explain what Searle thought it could prove.
- (c) What are the differences between symbolic and non-symbolic AI? Classify each of the following as either symbolic or non-symbolic:

ATMS
Neural Networks
Rule-based Expert Systems
Fuzzy Logic
Qualitative Reasoning

Justify your answers.