UNIVERSITY OF EDINBURGH

FACULTY OF SCIENCE

ARTIFICIAL INTELLIGENCE 4

Date: 30 May 1989 Time: 2.00 - 3.30

Examiners: Chairman - J.A.M. Howe
External - A.G. Cohn

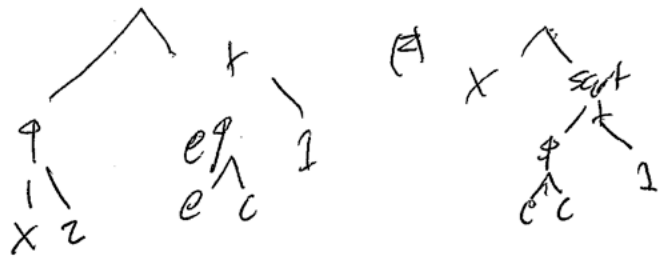
MATHEMATICAL REASONING

INSTRUCTIONS TO CANDIDATES

1. Candidates *must* answer question 1, and *either* question 2 *or* question 3.

2. Each question is marked out of 100%. The marks at the side of the questions show how these are apportioned.

3. If more than two questions are attempted, candidates should cross out the answer which is **NOT** to be marked. Otherwise, the examiners will mark only the first two answers which appear in the script.



Attraction Collection Isolation.

Question 1

(a) In the PRESS system many algebraic identities are available as rewrite rules. Explain briefly why and how PRESS uses meta-level inference to guide their use.

[25%]

(b) For each of the following identities, describe two different ways it could be used, giving examples. Explain what measures could be used to direct their usage, and show how they ensure termination of rewriting.

$$U.(V+W) = (U.V) + (U.W) \qquad (1)$$

$$X^{Y.Z} = (X^{Y})^{Z} \qquad (2)$$

[25%]

(c) What does the term confluent mean when used to describe a set of rewrite rules? Explain why the technique of critical pairs can be used as part of a test for confluence, and what the other requirements are.

[30%]

(d) Give an example of a critical pair arising from two of your rewrite rules from (b).

[20%]

Question 2

(a) Define the full resolution rule of inference for clauses in Kowalski format.

[10%]

(b) Describe the LUSH resolution and SL resolution restrictions on full resolution.

[30%]

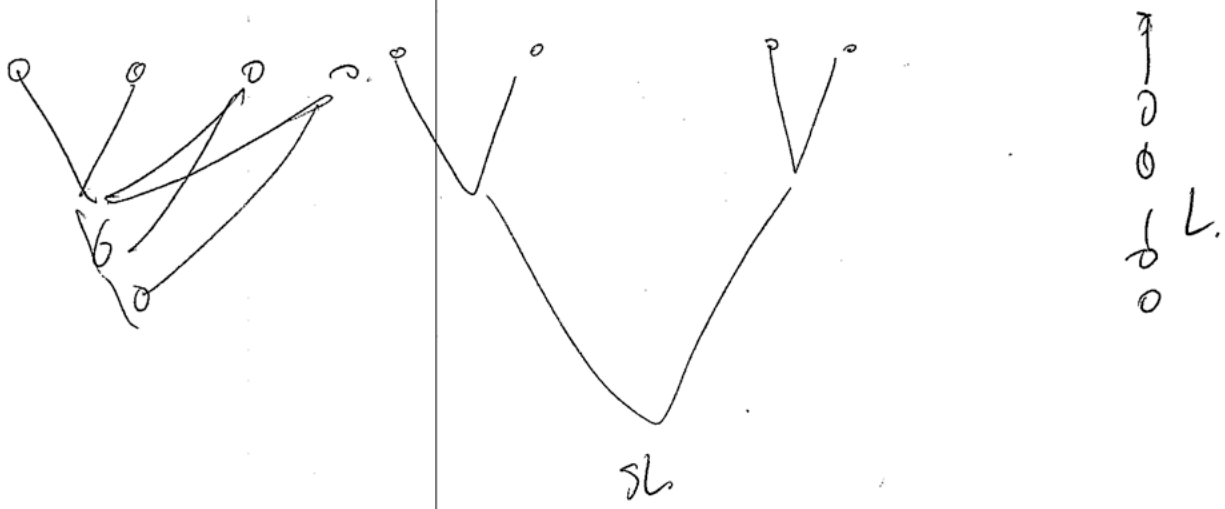
(c) Draw the first 3 levels of the resolution refutation search tree for the following clauses, taking 1 as the top clause.

pensioner(X)	→	(1)
male(Y)∧age(Y,A)∧greater-eq(A,65)	→ pensioner (Y)	(2)
female(Z)∧age(Z,B)∧greater-eq(B,60)	→ pensioner(Z)	(3)
	→ female (anne)	(4)
	→ female (jessie)	(5)
	→ male (bob)	(6)
	→ age (anne, 40)	(7)
	→ age (jessie, 63)	(8)
	→ age (bob, 63)	(9)
	→ greater-eq (63,60)	(10)
	→ greater-eq (67,65)	(11)

[30%]

(d) Why is LUSH resolution an appropriate restriction for these clauses? Indicate clearly which branches of your tree in (c) would be pruned, and why.

[30%]



Question 3

(a) What is an <u>interpretation</u> of a set of predicate calculus sentences?

[10%]

(b) How can interpretations be used to control the search for a proof of a conjecture?

[40%]

(c) Draw the LUSH resolution search space for the following clauses with (1) as top clause.

<u>Clause 3</u>

odd(s(s(s(a))))	→	(1)
even (X)	→ odd(s(X))	(2)
odd (X)	→ even(s(X))	(3)
	→ even (a)	(4)
strange (X)	→ odd (X)	(5)
peculiar (X)	→ strange (X)	(6)

[15%]

(d) Give an interpretation which could be used to control this search and explain what its effect would be on the search space.

[35%]