PRIFYSGOL CYMRU; UNIVERSITY OF WALES

DEGREE EXAMINATIONS MAY/JUNE 2003

SWANSEA

Computer Science

CS 125 Logic Programming

Attempt 2 questions out of 3

Time allowed: 2 hours

Students are permitted to use the dictionaries provided by the University

Students are NOT permitted to use calculators

LOGIC PROGRAMMING
(Attempt 2 questions out of 3)

Question 1.

(a) Suppose a Prolog program defines a predicate `solved` such that `solved(S, N)` means that student `S` solved problem number `N`. Formulate queries that correspond to the following questions:

 (i) Which problems did Ann solve?

 (ii) Which problems where solved by both Ann and Tom?

 (iii) Who solved at least two problems?

 (iv) Is it true that Tom didn't solve any of the problems except problems 1 and 2?

[7 marks]

(b) Which of the following queries fail, and which succeed? In the case of success, give the answers that Prolog will return.

 (i) `?- [X|T] = [a,b].`

 (ii) `?- [X,a|T] = [X,X].`

 (iii) `?- [X,Y] = [Z].`

 (iv) `?- [X|X] = [X].`

 (v) `?- N = 2, M = N*2, N = M-N.`

 (vi) `?- N is 2, M is N*2, N =:= M-N.`

[9 marks]

(c) Define predicate `mult_list/3` that computes for a given list of numbers $L = [X_1, \ldots, X_k]$ and a given number N the list $[X_1 * N, \ldots, X_k * N]$.

For example the query `?- mult_list([1,0,2], 3, L)` should yield the answer `L = [3,0,6]`.

[9 marks]

Question 2.

(a) For each of the following pairs of terms state whether or not they are unifiable. In each case give a most general unifier, or state why the terms are not unifiable.

   (i)   `2*2`   `2+X`

  (ii)   `f(U,U)`   `f(g(V,V),V)`

 (iii)   `f(V,f(V,V))` `f(h(a,b,c),U)`

[**7 marks**]

(b) Use a failure driven loop to define a predicate `write_squares/1` that writes for a given list of numbers L all squares of members of L to the standard output. The squares should be written with a blank in between.

[**10 marks**]

(c) Suppose you are given a Prolog program defining a database of students and their average marks (in %) of the following form:

```
average(harry,62).
average(hermione,97).
average(malfoy,70).
average(ron,58).
   .
   .
   .
```

Write a query that will return as answer the list of all students that achieved an average mark of at least 70%. You may use the built-in predicate `findall/3`.

[**8 marks**]

Question 3.

(a) (i) Explain the effect of the cut predicate on Prolog's search tree.

   (ii) How is the predicate `not` (negation as failure) defined? Give a definition that does *not* contain the symbol ";".

   [9 marks]

(b) Consider the following program

```
min(X, Y, M) :- X =< Y, !, M = X.
min(_, Y, M) :- M = Y.
```

What would be the response of Prolog to the following queries?

   (i) ?- min(1, 2, 2).
   (ii) ?- min(2, 1, M).

Which of the queries above would receive different answers if the cut in the program defining `min` were removed? Explain the reason for the difference.

Is the cut in the program above a "green cut" or a "red cut"? Justify your answer.

   [8 marks]

(c) Draw the resolution trees for the following queries and determine the answers that Prolog will return.

   (i) ?- not(a=b).
   (ii) ?- not(b=X), X=a.

   [8 marks]