

Prolog Exam
15 August 2008

The grade is "the number of points + 10" divided by 10.

Question:	1	2	3	4	5
points:	15	20	20	15	20

Good luck!

Question 1: Unification & operators (15 points)

- (a) Give for each of the following goals whether they are successful or fail. In case of success give the variable-bindings and in case of failure give a brief explanation.

?- $p(f(X,Y),Z) = p(f(b,Z),Y)$.
?- $p(X,Y,Z) = q(A,2,C)$.
?- $p(f(X,X),Y) = p(f(Y,b),a)$.
?- $[1, [2,3] \mid [4,5]] = [A \mid B]$.
?- $[f(X),X,f(Y)] = [f(1) \mid Z]$.
?- $[1,3,5] = [X,Y]$.
?- $X + Y * Z = *(A,B)$.
?- $X + Y * Z = +(A,B)$.
?- $f(A,B) == f(3,Z)$.
?- $f(g(X,Y), h(X)) =.. L$.

- (b) Represent the list $[1, [2, 3], 4]$ in a tree representation.

Question 2: Programming Techniques (20 points)

The behaviour of the predicate `listing(P,N)` is as follows: `listing(P,N)` prints all present clauses of the predicate `P` in the database with `N` arguments. If such predicate is not in the database then `listing(P,N)` fails. Thus for example the query `?:- listing(member,2)` prints the clauses of predicate `member`, but `listing(member,1)` fails.

Write two versions of this predicate:

- (a) with the use of the build-in predicate `bagof`
- (b) without use of the build-in predicate `bagof`.

Question 3: recursion (20 points)

- (a) Write a recursive procedure `last` that computes the last element of a list.
- (b) The SWI-Prolog system has the predicate `append(L1,L2,L3)` as build-in predicate: putting `L2` after `L1` results in the list `L3`. Given this predicate, give a non-recursive definition of `last`.

Question 4: A database (15 points)

In a database of a bank are for each client the following information: name, address, account number, balance, and a list of services which the client uses. A name consists of a first name and a family name, and an address consists of a street, a number and a place. Possible services which clients can use are: creditcard (CC), chipcard (CH), pincode (PC), and personal loan (PL).

Name	Account	Balance	Address	Services
Theo Jansen	3980371	3572	Bachstraat 15, Zoetermeer	CH, PC
Dirk DeJong	2767712	-750	Uilenstede 325, Amsterdam	CH, PC, CC, PL
Thea Jansen	1730893	2753	Bachstraat 15, Zoetermeer	CC, CH, PL
...	...	...	...	...

- (a) Give an appropriate Prolog representation for the database (think about a good data abstraction), and show the use of your representation by giving the following questions as a Prolog query using your representation.
- Does the database contain a client with a balance of more than 1000, and if so what is the first name of this client?
 - Does the database contain a client with two accounts, and if so what is the total balance?
 - What are the names of clients from Amsterdam who use at least 3 services?
- (b) Write a Prolog program `total` that given a list `L` of client-names computes the total balance of the clients in `L`.
- (c) Write a Prolog program `red` that computes from a given list `L` of client-names the sublist of all clients `L` which have a negative balance.

Question 5: Derivation tree (20 points)

(a) Give the complete derivation tree for the computation of all answers (thus inclusive backtracking) of the query
?- p(Y),w(Y)..

- write the rule-nr on each link of the tree
- write fail if a branch fails
- make explicit which path(s) is(are) cut by the !-operator.

(1) $p(X) :- q(X), r(X), !.$

(2) $p(\text{foo}).$

(3) $q(a).$

(4) $q(b).$

(5) $q(c).$

(6) $r(b).$

(7) $r(c).$

(8) $s(b).$

(9) $s(c).$

(10) $w(U) :- s(U).$

(b) Explain in words the difference between a "red cut" and a "green cut". Is the cut in the program above a "red cut" or a "green cut"? Motivate your answer.

End exam