

Prolog Exam

29 May 2008

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

Question:	1a	1b	2	3a	3b	3c	4a	4b	5
points:	10	10	15	5	10	5	10	10	15

Good luck!

Question 1: Unification & Operators (20 points)

Question 1a: (10 points)

Given the two facts:

`p([1,2,3]).`

`p([the, cat, sat, [on, the, mat]]).`

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([X|Y]).`

?- `p([_,_,_,[_|X]]).`

?- `p([X,Y|Z]).`

?- `p([A, B | C, D]).`

Question 1b: (10 points)

Given are the following operator definitions:

```
op(500,yfx,plus).  
op(400,xfy,times).
```

Write the following expressions as a tree structure, such that their term structure is clear.

1. one plus two plus three
2. one times two times three
3. one times two plus three
4. one plus two times three
5. (one plus two) times three

Question 2. recursion (15 points)

Write a predicate `echo` (without any argument) that repeatedly reads a term, then prints the term. The predicate has to repeat this until the term `stop` has been read, then the execution has to be terminated. The word that has been printed at the end, is thus always `stop`.

Question 3: Cuts (20 points)

Consider the following Prolog program:

```
select(X, [X|Xs], Xs) .  
select(X, [Y|Ys], [Y|Zs]) :- select(X, Ys, Zs) .
```

- a. Explain the working of this program . Given an element A, and a list B, what is then the result of the call `select(A,B,C)`? What is the result of backtracking?
- b. We can add a cut ! at three places in this program: (i) in the body of the first clause, (ii) at the beginning of the body of the second clause, (iii) at the end of the body of the second clause. Explain for each of the three possibilities what the effect is on the working of the program. What is the result for each of these cases for the call `select(A,B,C)`? And what happens with backtracking?
- c. Explain in words the difference between a "red cut" and a "green cut". Which of the three cuts in the previous question are "red cuts", and which are "green cuts"?

Question 4: sets (20 points)

- a. Given the predicate `subset(SubSet,Set)` that is true precisely when $\text{SubSet} \subset \text{Set}$, write a definition for the predicate `powerset(Set,PowerSet)` that is true if `PowerSet` is the powerset of `Set`, that means that: `PowerSet` is the set of all subsets of `Set`.
- b. Given a database with clauses of the form:
`country(Name,MillionInhabitants, NeighbourCountries)`. Examples are:

```
country(netherlands,15,[germany,belgium]).
country(uk,56,[ireland]).
...
```

We define “big countries” as all countries with more than 50 million inhabitants.

Write a procedure `big_countries(SetofBigCountries)` which determines the set of all big countries.

Question 5: term manipulation (15 points)

Prolog has the system-predicates

`functor(Term, Functor, Arity)`, `arg(Number, Term, Arg)` and `Term =.. List`.

From those three predicates `=..` is the most fundamental one, because the other two can be expressed in terms of `=..`.

Give the definitions of `functor(Term, Functor, Arity)` and `arg(Number, Term, Arg)` in terms of `=..`.

End exam