



Försättsblad till skriftlig tentamen vid Linköpings Universitet

Datum för tentamen	2010-08-21
Sal Om tentan går i flera salar ska du bifoga ett försättsblad till varje sal och <u>ringa in</u> vilken sal som avses	TER3
Tid	8-12
Kurskod	TDDD08
Provkod	TEN1
Kursnamn/benämning Provnamn/benämning	Logikprogrammering
Institution	IDA
Antal uppgifter som ingår i tentamen	9
Jour/Kursansvarig Ange vem som besöker salen	Ulf Nilsson, IDA
Telefon under skrivtiden	076 8601935
Besöker salen ca kl.	10
Kursadministratör/kontaktperson (namn + tfnr + mailaddress)	Gunilla Mellheden 2297 gunme@ida.liu.se
Tillåtna hjälpmedel	Inga
Övrigt	Inget
Vilken typ av papper ska användas, rutigt eller linjerat	Valfritt
Antal exemplar i påsen	

Exam in TDDD08 LOGIC PROGRAMMING

Saturday 21 August, 2010, 8:00–12:00

No means of assistance (inga hjälpmedel)!

Grading will rely on the following limits (out of max 36):

Grade	3	4	5
Points	≥ 18	≥ 24	≥ 30

Ulf Nilsson can be reached on phone 076–8601935 during the exam.

You may answer in English or in Swedish as you prefer.

REMEMBER TO GIVE MOTIVATIONS TO ALL ANSWERS!!!

1. Determine which of the following pairs of formulas that are unifiable, and give the mgu in case there is one:

| ?- $p(f(X,g(Y)),Z) = p(f(Z,Z),g(a))$.

| ?- $p(f(g(X,Y),Z),X) = p(f(Z,X),Y)$.

| ?- $p([], [X|Y], Y) = p(Z, [Y], W)$.

| ?- $p(a, f(X,Y), b) = p(Y, f(Z,Z), Y)$.

(4 points)

2. Give short but precise descriptions of the following notions to demonstrate that you understand them:

- Stratified logic program,
- Closed world assumption,
- Least Herbrand model,
- Occur check.

(4 points)

3. Mergesort is a sorting method where a list of integers is sorted into ascending order by first dividing the list into two lists of equal (± 1) length which are sorted recursively and where the two sorted lists are finally “merged” together. The following is a not completely correct attempt to implement mergesort:

```
sort([], []).
sort([X|Xs], Ys) :-
    split(Xs, L1, L2),
    sort(L1, S1),
    sort([X|L2], S2),
    merge(S1, S2, Ys).
```

```

split([], [], []).
split([X|Xs], [X|Ys], Zs) :-
    split(Xs, Zs, Ys).

merge([], [], []).
merge([], [X|Xs], [X|Xs]).
merge([X|Xs], [], [X|Xs]).
merge([X|Xs], [Y|Ys], [X|Zs]) :-
    X <= Y,
    merge(Xs, [Y|Ys], Zs).
merge([X|Xs], [Y|Ys], [Y|Zs]) :-
    X > Y,
    merge([X|Xs], Ys, Zs).

```

What is wrong with the program? Modify it so that it works.

(4 points)

4. Consider the following definite program:

```

p(a).
p(X) :- q(X,Y), r(Y).
q(f(X),X).
r(a).
r(f(X)) :- r(X).

```

Provide the (1) Herbrand universe, (2) Herbrand base and (3) Least Herbrand model of the program.

(4 points)

5. Translate the following DCG into a Prolog program (using the translation used in most Prolog systems):

```

fib(0) --> [1].
fib(s(0)) --> [1].
fib(s(s(X))) --> fib(s(X)),fib(X).

```

Use the resulting Prolog program to prove that the string [1,1,1,1,1] belongs to the language of fib(s(s(s(s(0))))). That is, draw the refutation.

(4 points)

6. Consider the following general program:

```

p(X) :- q(X), \+ q(f(X)).
q(X) :- r(X).
q(X) :- s(X), \+ r(X).
r(a).
s(a).

```

Draw the SLDNF-forest of the goal $:- p(X)$. assuming that Prolog's computation rule is used. What are the answers?

(4 points)

7. To place a cut in a (correct) definite program may affect the completeness but it never affects the soundness. However, the latter is not true for general logic programs. Give an example of a general logic program containing a cut, such that $\leftarrow A$ has a refutation (using SLDNF-resolution extended with the cut rule) but A is not a logical consequence of the completion of the program.

(4 points)

8. Write a Prolog program that takes a binary tree of integers with the representation

```
btree([]).  
btree(node(N,Left,Right)) :-  
    integer(N),  
    btree(Left),  
    btree(Right).
```

och replaces the value in each node by the largest value in the tree.

(4 points for a solution that solves the problem in a single traversal)

9. Let P be a definite program, I a Herbrand interpretation of P and M_P the least Herbrand model of P . Decide if the following is valid

$$M_P \subseteq I \text{ iff } I \text{ is a Herbrand model of } P.$$

Prove the statement or give a counter example.

(4 points)