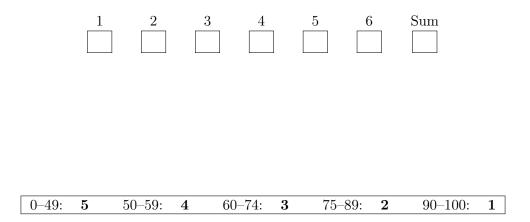
## Third Exam Logic Programming, LVA 703113

October 2, 2015

Name:

Studentnumber:

The exam consists of 6 exercises with a total of 100 points. Please fill out your name and credentials *before* you start the exam.



1. Consider the directed graph  $G = (\{a, b, c, d, e, f, g\}, E)$  with the following set of edges:

 $E = \{(a, b), (a, c), (b, d), (c, d), (d, e), (f, g)\}.$ 

- Represent G in Prolog and implement a relation connected/2 that expresses that two nodes are connected in G. (4 pts)
- Show that for any graph G the *size* of the search tree for a ground query is bounded quadratic in the number of vertices of G. (6 pts)
- Is the above estimate on the size of the search tree also true for non-ground queries? (4 pts)
- Implement a predicate duplicate/3 that duplicates the elements of a list a given number of times. For example the query duplicate ([a,b,c],2, Xs) should deliver the answer Xs = [a, a, b, b, c, c]. Use difference-lists in your implementation, where you can assume that \ seperates difference lists. (15 pts)
- 3. Implement a predicate  $isotree(Tree_1, Tree_2)$  which holds if  $Tree_1$ ,  $Tree_2$  are isomorphic binary trees. (6 pts)

Hint: You can use any suitable representation of binary trees.

4. Consider the following grammar for propositional formulas over the atoms  $\mathsf{p},\,\mathsf{q},$  and  $\mathsf{r}:$ 

$$\begin{array}{ll} P \to \mathsf{true} \mid \mathsf{false} & P \to \neg P \\ P \to (P \land P) & P \to (P \lor P) \end{array}$$

 Write a DCG that generates the languages by *directly* encoding the grammar and builds an expression tree for the formula parsed. (10 pts)

(15 pts)

(20 pts)

- Improve your implementation by taking into account the following precedence of connectives  $\neg > \land > \lor$ , so that brackets can be dropped. Furthermore prevent the left-recursion in the grammar.
- 5. Implement (part of) the *Knight's tour problem*: how can a knight jump on an  $N \times N$  chessboard in such a way that it visits every square exactly once?

*Hint*: Represent the squares by pairs of their coordinates of the form X/Y, where X and Y are integers between 1 and N. It suffices to implement the relation jump(N,X/Y,U/V) to express the fact that a knight can jump from X/Y to U/V on a  $N \times N$  chessboard.

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6.	. Determine whether the following statements are true or false. Every correct answer		
	is worth 2 points, every wrong answer -1 points. (The worst that can happen is		
	that you get zero points for this exercise.)	(	

## statement

A rule is a universally quantified logical formula of the form  $A \leftarrow B_1, B_2, \ldots, B_n$ , where A is a goal and for all  $i = 1, \ldots, n$ :  $B_i$  is a goal.

An SLD-refutation is a finite SLD-derivation ending in the goal to be proven.

Logic programming is a declarative programming paradigm, that is, the computation of a function is made a first-class citizen.

The declarative semantics of a program P is the minimal model of P.

The order of goals is irrelevant in the computation model of logic programming, but not the order of rules.

A search tree is the same as an SLD tree.

Prolog is a language without types and the main technique to manipulate data is unification.

Difference lists are ineffective if the generation of different sections of a list depend on each other.

A meta-interpreter in Prolog interprets Prolog terms on the Warren abstract machine.

The predicate bagof(Template,Goal,Bag) unifies Bag with the alternatives of Goal that meet Template.

(20 pts)

no

yes