Försättsblad till skriftlig tentamen vid Linköpings Universitet

Datum för tentamen	2014-01-17
Sal (1) Om tentan går i flera salar ska du bifoga ett försättsblad till varje sal och <u>ringa in</u> vilken sal som avses	KÅRA
Tid	8-13
Kurskod	TDDD72
Provkod	TEN1
Kursnamn/benämning **Provnamn/benämning**	Logik En skriftlig tentamen
Institution	IDA
Antal uppgifter som ingår i tentamen	4
Jour/Kursansvarig Ange vem som besöker salen	Andrzej Szalas
Telefon under skrivtiden	013-28 19 95 eller 0709 46 1995
Besöker salen ca kl.	ca kl. 09:30 och en gång mot slutet av tentan
Kursadministratör/kontaktperson (namn + tfnr + mailaddress)	Anna Grabska Eklund, ankn. 2362, anna.grabska.eklund@liu.se
Tillåtna hjälpmedel	You can use your own copies of slides as well as an English-Swedish dictionary *** Kopia på egna föreläsningslides Engelsk-Svensk ordbok
Övrigt	
Vilken typ av papper ska användas, rutigt eller linjerat	Valfritt
Antal exemplar i påsen	

Samma testa som TDDC 36 ?

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Övrigt	
Vilken typ av papper ska användas, rutigt eller linjerat	Valfritt
Antal exemplar i påsen	15

EXAM: TDDC36, TDDD72 (LOGIC)

17 JANUARY 2014

RULES

1. You can use your own copies of slides as well as an English-Swedish dictionary.

2. Exercises are formulated in English, but answers can be given in English or Swedish.

3. You are not allowed to:

   - use any writing material other than indicated in point 1;
   - use calculators, mobile phones or any other electronic devices;
   - lend/borrow/exchange anything during the exam.

4. If an exercise has not been specified completely as you see it, state which (reasonable) assumptions you have made.

5. Begin each exercise on a new sheet of paper. Write only on one side of the paper. Write clearly and make sure to give adequate explanations for all your answers.

6. There are 4 exercises, each exercise gives maximum 10 points (40 points together). Grading is provided in tables below.

number of points (n)	Swedish grade	ETCS grade
$34 \leq n \leq 40$	5	A
$27 \leq n < 34$	4	B
$20 \leq n < 27$	3	C
$n < 20$	not passed	F (not passed)

EXERCISES

EXERCISE 1

1. Prove the following propositional formula:[1]

   $$[\neg P \wedge (\neg Q \vee \neg R)] \rightarrow [(\neg P \wedge \neg Q) \vee \neg R]$$

   (a) (*2 points*) using tableaux;

   (b) (*2 points*) using Gentzen system (as provided in the book or during lectures - up to your choice).

2. Prove the following formula of predicate logic:

   $$\left(\exists x \forall y [P(x, y, y)] \wedge \neg \exists x \exists y \exists z [P(x, y, z) \wedge P(a, y, b)] \right) \rightarrow \exists z [\neg P(z, b, b)]$$

   (a) (*3 points*) using tableaux;

   (b) (*3 points*) using resolution.

EXERCISE 2

1. (*4 points*) Translate the following sentences into a set of propositional formulas:

   "When John is in a bad mood, he goes to a cinema."
   "When John is in a moderate mood, he stays at his home."
   "When John is in good mood, he visits his friends."
   "John cannot be in two different moods."
   "Eve says that John is in a moderate or good mood."
   "Jack says that John is in a moderate or bad mood."

2. (*2 points*) Assuming that that Eve and Jack tell the truth, hypothesize what is John's decision where to spend time and explain your reasoning informally.

3. (*4 points*) Prove your claim formally using a proof system of your choice (tableaux, Gentzen system or resolution. Please do not use truth table method, as this will give no points).

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[1]Recall that there is precedence among the connectives. The order of precedence from high to low is: negation, conjunction, disjunction, implication, equivalence. For example, $\neg Q \vee S \wedge R$ stands for $(\neg Q) \vee (S \wedge R)$.

EXERCISE 3

Consider roads connecting various places and satisfying the following conditions:

(a) "Every place is connected via a road to some other place."

(b) "Every two places x, y have the property that whenever there is a road from x to y then there is also a road from y to x."

(c) "For every places x, y, z, if there is a road from x to y and from y to z then there is also a road from x to z."

1. *(3 points)* Express in predicate logic properties (a), (b) and (c).

2. *(2 points)* Check informally whether the conjunction of (a), (b) and (c) implies that "From every place there is a road to itself.".

3. *(5 points)* Verify your informal reasoning using a proof system of your choice (Gentzen system or resolution).

EXERCISE 4

1. *(2 points)* Design a Datalog database for storing information about articles in newspapers. Each article is characterized by:

   - its title;

   - its length (*short, medium, long*);

   - directly related articles.

2. *(1 point)* Express in predicate calculus the constraint:

   "direct relationship among articles is reflexive and symmetric".

3. *(1 point)* Provide another exemplary integrity constraint.

4. Formulate in logic queries selecting:

   (a) *(2 points)* all short or medium articles related to article entitled "Conjunctive Queries".

   (b) *(4 points)* all long articles directly or indirectly related to article entitled "Conjunctive Queries", assuming that articles A and B are *directly or indirectly related* when there is $k \geq 0$ and articles $A_1, \ldots, A_k$ such that

   $$A \leftrightharpoons A_1 \leftrightharpoons \ldots \leftrightharpoons A_k \leftrightharpoons B,$$

   where $A \leftrightharpoons B$ denotes the fact that articles A and B are directly related. For example, if $A \leftrightharpoons C$ and $C \leftrightharpoons B$ then A is directly or indirectly related to C and B. If $A \leftrightharpoons C \leftrightharpoons D \leftrightharpoons B$ then A is directly or indirectly related to C, D and B, the same for C and B, etc.