Försättsblad till skriftlig tentamen vid Linköpings Universitet

Datum för tentamen	2014-10-29
Sal (4)	G33 G35 G36 G37
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	Olov Andersson
Telefon under skrivtiden	070-5473343
Besöker salen ca klockan	ca. kl. 10
Kursadministratör/kontaktperson (namn + tfnr + mailaddress)	Anna Grabska Eklund, ankn. 2362, anna.grabska.eklund[at]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	
Antal exemplar i påsen	

Försättsblad till skriftlig tentamen vid Linköpings Universitet

Datum för tentamen	2014-10-29
Sal (4)	G33 G35 G36 G37
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	Olov Andersson
Telefon under skrivtiden	070-5473343
Besöker salen ca klockan	ca. kl. 10
Kursadministratör/kontaktperson (namn + tfnr + mailaddress)	Anna Grabska Eklund, ankn. 2362, anna.grabska.eklund[at]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	
Antal exemplar i påsen	

Försättsblad till skriftlig tentamen vid Linköpings Universitet

Datum för tentamen	2014-10-29
Sal (1)	G36
Tid	8-13
Kurskod	TDDC36
Provkod	TEN1
Kursnamn/benämning **Provnamn/benämning**	Logik Skriftlig tentamen
Institution	IDA
Antal uppgifter som ingår i tentamen	4
Jour/Kursansvarig Ange vem som besöker salen	Olov Andersson
Telefon under skrivtiden	070-5473343
Besöker salen ca klockan	ca kl. 10
Kursadministratör/kontaktperson (namn + tfnr + mailaddress)	Anna Grabska Eklund, ankn. 2362, anna.grabska.eklund[at]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	
Antal exemplar i påsen	

Försättsblad till skriftlig tentamen vid Linköpings Universitet

Datum för tentamen	2014-10-29
Sal (4)	G33 G35 G36 G37
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	Olov Andersson
Telefon under skrivtiden	070-5473343
Besöker salen ca klockan	ca. kl. 10
Kursadministratör/kontaktperson (namn + tfnr + mailaddress)	Anna Grabska Eklund, ankn. 2362, anna.grabska.eklund[at]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	
Antal exemplar i påsen	

EXAM: TDDC36, TDDD72 (LOGIC)

29 OCTOBER 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 the following table.

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:

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

   (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, where a is a constant:

$$\Big[\forall x \forall y \big[P(x,a,x) \vee P(a,y,a)\big] \wedge \neg\exists x \exists y \exists z \big[P(x,y,z) \wedge \neg P(z,x,a)\big]\Big] \rightarrow \exists z \big[P(a,z,a)\big]$$

   (a) (*3 points*) using tableaux

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

EXERCISE 2

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

   "triangles are red"
   "circles are green"
   "squares are blue"
   "blue objects are squares"
   "chose an object being red or blue"
   "chose a triangle or not a square"

2. (*2 points*) Hypothesize what object can be chosen, 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).

EXERCISE 3

Consider relations:

relation	intuitive meaning
$S(x)$	object x is small
$M(x)$	object x is medium
$L(x)$	object x is large
$SD(x,y)$	the distance between objects x and y is short
$LD(x,y)$	the distance between objects x and y is long.

Assume that the following properties hold, where a, b are constants:

$$\forall x[S(x) \vee M(x) \vee L(x)] \quad (1)$$
$$\forall x \forall y[SD(x,y) \rightarrow \neg LD(x,y)] \quad (2)$$
$$\forall x \forall y[(S(x) \wedge M(y)) \rightarrow SD(x,y)] \quad (3)$$
$$LD(a,b) \wedge M(b) \wedge \neg M(a) \quad (4)$$

1. *(4 points)* Check informally whether the conjunction of (1)–(4) implies that object a is large, i.e., that $L(a)$ holds.
2. *(6 points)* Verify your informal reasoning using resolution.

EXERCISE 4

1. *(2 points)* Design a Datalog database for storing time-dependent information about cars on a town street. Each car is characterized by its registration number and color. In addition, for each pair of cars c_1, c_2, the database contains information whether in considered time moments c_1 is directly behind c_2.[1]

   We define that car c is *indirectly behind* car d in a given time moment if (in the same time moment) there is $k \geq 1$ and there are cars $c_1, c_2, \ldots, c_k$ such that:

   c is directly behind c_1
   c_1 is directly behind c_2
   ...
   c_{k-1} is directly behind c_k
   c_k is directly behind d.

2. *(1 point)* Provide an exemplary integrity constraint concerning the "directly behind" relation.
3. *(1 point)* Provide an exemplary integrity constraint concerning the "indirectly behind" relation.
4. Formulate in logic queries selecting:
   (a) *(2 points)* all red cars which, at time moment 10, are behind a yellow car
   (b) *(4 points)* all large cars which, at a given time moment, are directly or indirectly behind a given car.

[1] Intuitively, car c_1 is "directly behind" c_2 if c_1 is behind c_2 and there are no cars between c_1 and c_2.