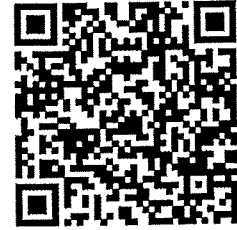


Försättsblad till skriftlig tentamen vid Linköpings universitet



Datum för tentamen	2018-04-05
Sal (2)	TER2(18) TERE(1)
Tid	14-19
Kurskod	TDDD88
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	013-28 20 69
Besöker salen ca klockan	ja
Kursadministratör/kontaktperson (namn + tfnr + mailaddress)	Anna Grabska Eklund, ankn. 2362, anna.grabska.eklund@liu.se
Tillåtna hjälpmedel	1. You can use your own copies of compendium (extract from slides) 2. English-Swedish dictionary.
Övrigt	
Antal exemplar i påsen	

EXAM: TDDD88 (LOGIC)

5 APRIL 2018

Exam rules

1. You can use your own copies of compendium (extract from slides) as well as an English-Swedish dictionary.
2. Exercises are formulated in English, but answers can be given in English or in Swedish.
3. You are not allowed to:
 - use any writing material other than indicated in point 1, in particular you cannot use full slides or ebook with exercises and solutions;
 - 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)	grade
$34 \leq n \leq 40$	5
$27 \leq n < 34$	4
$20 \leq n < 27$	3
$n < 20$	U (not passed)

EXERCISES

EXERCISE 1

1. Prove the following propositional formula:

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

- (a) (2 points) using resolution;
- (b) (2 points) using tableaux.

2. Prove the following formula of first-order logic:

$$\left(\exists x \forall y \forall z [R(x, y) \wedge S(y, z) \wedge T(x)] \right) \rightarrow \left(\forall x \exists y [R(y, x) \wedge S(x, x) \wedge T(y)] \right)$$

- (a) (3 points) using resolution;
- (b) (3 points) using tableaux.

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 home.”
“When John is in a good mood, he visits friends.”
“John cannot be in two different moods.”
“John is in a moderate or good mood.”
“John is in a moderate or bad mood.”

2. (2 points) Hypothesize what is John’s decision where to spend time and explain your reasoning informally.
3. (4 points) Prove your claim formally using proof system of your choice (tableaux or resolution).

EXERCISE 3

Consider a relation R and properties:

- (a) $\forall x \forall y \forall z [(R(x, y) \wedge R(x, z)) \rightarrow R(y, z)]$
 (b) $\forall x \forall y [R(x, y) \rightarrow \exists z [R(z, x) \wedge R(z, y)]]$
 (c) $\forall x \forall y [R(x, y) \rightarrow R(y, x)]$.

- (4 points) Check informally whether the conjunction of (a) and (b) implies (c).
- (6 points) Verify your informal reasoning using tableaux 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:

“every article is directly related to itself.”
3. (1 point) Provide another sample integrity constraint concerning the “directly related” relation.
4. Formulate Datalog queries selecting:
 - (a) (2 points) all short or medium articles related to article entitled “Recursion in DBMS”;
 - (b) (4 points) all long articles directly or indirectly related to article entitled “Recursion in DBMS”, assuming that articles A and B are *directly or indirectly related* when there is $k \geq 0$ and articles A_1, \dots, A_k such that:

$$A \rightsquigarrow A_1 \rightsquigarrow \dots \rightsquigarrow A_k \rightsquigarrow B,$$
 where $C \rightsquigarrow D$ denotes the fact that articles C and D are directly related.