Försättsblad till skriftlig tentamen vid Linköpings universitet

Datum för tentamen	2019-01-07
Sal (1)	TER2(4)
Tid	14-18
Utb. kod	TDDD65
Modul	TEN1
Utb. kodnamn/benämning **Modulnamn/benämning**	Introduction to the Theory of Computation Skriftlig tentamen
Institution	IDA
Antal uppgifter som ingår i tentamen	6
Jour/Kursansvarig Ange vem som besöker salen	Christer Bäckström
Telefon under skrivtiden	0705-840889
Besöker salen ca klockan	15
Kursadministratör/kontaktperson (namn + tfnr + mailaddress)	Annelie Almquist 2934 annelie.almquist@liu.se
Tillåtna hjälpmedel	Ordbok från/mellan engelska och annat språk. Inga övriga hjälpmedel.
Övrigt	
Antal exemplar i påsen	

TDDD65
Introduction to the Theory of Computation
2019-01-07

Materials allowed: A dictionary from English to any other language is allowed. No other books, notes etc. are allowed and no electronic equipment (calculators, computer, mobile phones etc.) are allowed.

Grading: The maximum number of points is 30 and 15 points are required to pass the examination. At least 15 p is required for grade 3, at least 20 p is required for grade 4 and at least 25 p is required for grade 5.

Please observe the following:

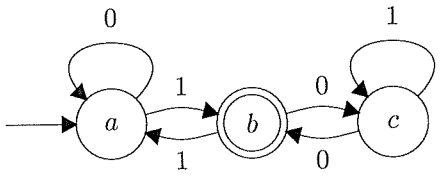
- Use only one side of each paper.
- Each problem must be solved on a separate paper (or several papers, if necessary. Subproblems of a problem (a, b, c etc.) may be solved on the same page.
- Properly justify all your answers. If you give only an answer without justification, you may get zero points even if the answer is correct.
- Make sure your answers are readable.
- Try to leave space for comments on every page.

Good luck!

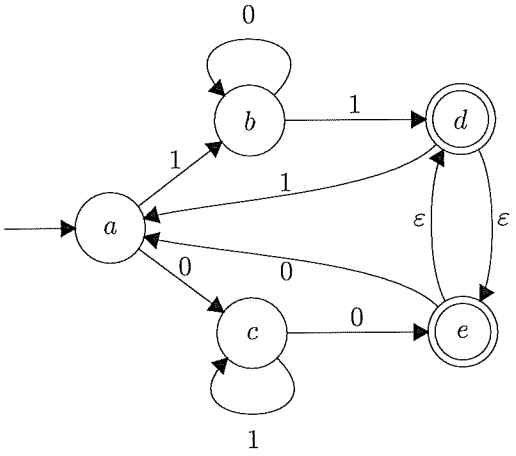
Problems

1. Assume the alphabet $\Sigma = \{0, 1, 2\}$. Draw the state transition diagram for a DFA that accepts exactly those strings $x_1 x_2 \dots x_n$ such that $n > 0$ and $x_1 + x_2 + \cdots + x_n = 4$. For example, the strings 001201 and 2101 should be accepted but 12 and 020220 should be rejected (4 p)

2. Convert the following DFA to a regular expression using the GNFA method. (4 p)



3. Convert the following NFA to an equivalent DFA, using the standard method (i.e. the subset construction method). (4 p)



4. Let the language L contain all strings of the form $(01)^*(02)^*$ where the number of 1's is less than or equal to the number of 2's. (6 p)

   (a) Prove that L is not regular by using the pumping lemma for regular languages.

   (b) Prove that L is a CFL by providing a CFG for it.

5. Let A, B and C be languages. (6 p)

   (a) Suppose A is decidable, B is undecidable and that $A \leq_m C$ and $B \leq_m C$. Can C be decidable?

   (b) Suppose A is decidable, B is undecidable and that $A \leq_m B$ and $A \leq_m C$. Can C be decidable?

   (c) Suppose A and C are undecidable, and that $A \leq_m B$ and $B \leq_m C$. Can B be decidable?

6. The MAXSAT problem is defined as follows. (6 p)

   Input: A CNF formula φ and a positive integer k.
   Question: Can at least k clauses in φ be simultaneously satisfied?

   That is, in contrast to the usual SAT problem, we do not require that all clauses in φ are satisfied, it is sufficient that k clauses can be satisfied.

   Prove that MAXSAT is NP-complete.