Försättsblad till skriftlig tentamen vid Linköpings universitet

Datum för tentamen	2019-08-31
Sal (1)	TER2(2)
Tid	14-18
Utb. kod	TDDD14
Modul	TEN1
Utb. kodnamn/benämning **Modulnamn/benämning**	Formella språk och automatateori Skriftlig tentamen
Institution	IDA
Antal uppgifter som ingår i tentamen	8
Jour/Kursansvarig Ange vem som besöker salen	Christer Bäckström
Telefon under skrivtiden	0705840889
Besöker salen ca klockan	15
Kursadministratör/kontaktperson (namn + tfnr + mailaddress)	Veronica Kindeland Gunnarsson 28 56 34 veronica.kindeland.gunnarsson@liu.se
Tillåtna hjälpmedel	Se tentamens förstasida
Övrigt	
Antal exemplar i påsen	

Försättsblad till skriftlig tentamen vid Linköpings universitet

Datum för tentamen	2019-08-31
Sal (1)	TER2(19)
Tid	14-18
Utb. kod	TDDD85
Modul	TEN1
Utb. kodnamn/benämning **Modulnamn/benämning**	Formella språk och automatateori En skriftlig tentamen
Institution	IDA
Antal uppgifter som ingår i tentamen	8
Jour/Kursansvarig Ange vem som besöker salen	Christer Bäckström
Telefon under skrivtiden	0705840889
Besöker salen ca klockan	15
Kursadministratör/kontaktperson (namn + tfnr + mailaddress)	Veronica Kindeland Gunnarsson 28 56 34 veronica.kindeland.gunnarsson@liu.se
Tillåtna hjälpmedel	Se tentamens förstasida
Övrigt	
Antal exemplar i påsen	

TDDD14/TDDD85
Formal Languages and Automata Theory
2019-08-31

Materials allowed (Tillåtna hjälpmedel):

- A sheet of notes - 2-sided A5 or 1-sided A4. These notes must be handed in together with the answers and signed in the same way as the exam papers. (Ett blad med anteckningar - 2-sidigt A5 eller 1-sidigt A4. Detta blad ska lämnas in med svaren och signeras på samma sätt som övriga papper.)
- An english dictionary. (Engelsk ordbok).

Instructions:

- You may answer in english or swedish.
- Make sure your text and figures are big and clear enough to read easily.
- All answers must be motivated. A correct answer without reasonable motivation may result in zero points!

Grading: The maximum number of points is 34. The grades are as follows:

grade	TDDD14	TDDD85
3:	18–24 p.	15–21 p.
4:	25–29 p.	22–27 p.
5:	30–34 p.	28–34 p.

Problems

1. Consider the following regular expressions: (4 p)

$0^*(0^*1+1)$	$(0+1)^*$
$(0^*1+01^*)^*$	$(0+1)(0+1)^*$
$(0^*+1)^*$	0^*1
$(0^*1^*)^*$	0^*+1^*

For each of the expressions to the left, tell which expression(s) to the right it is equivalent to, or explain why it is not equivalent to any of them.

2. Assume the alphabet $\Sigma = \{0, 1, 2\}$. Define the sum $sum(s)$ of a string $s \in \Sigma^*$ such that (4 p)

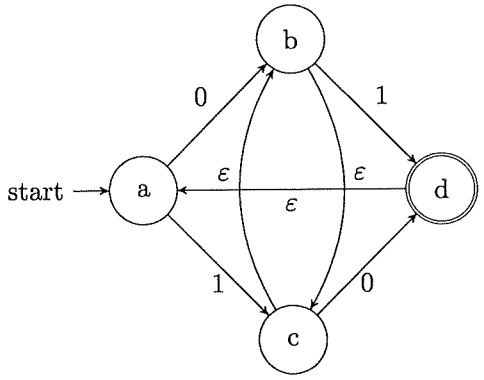
   - $sum(\varepsilon) = 0$ and
   - if $s = x_1, \ldots, x_n$ for some $n > 0$, then $sum(s) = \sum_{i=1}^{n} x_i$,

   i.e. the sum of s is the sum of all its symbols.

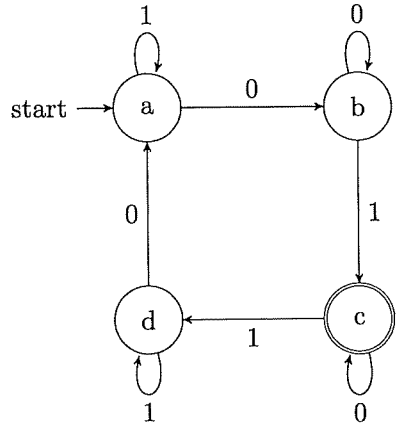
   (a) Give a regular expression that accepts the language $L_1 = \{s \in \Sigma^* \mid sum(s) \text{ is odd }\}$.

   (b) Give a regular expression that accepts the language $L_2 = \{s \in \Sigma^* \mid sum(s) = |s| \text{ and } |s| \leq 3\}$.

3. Convert the following NFA to a DFA using the subset construction method. (4 p) Also draw the state transition diagram for the resulting DFA.



4. Convert the following DFA to a regular expression using the GNFA method (4 p) (or the algebraic method from the course).



5. Give a context-free grammar for the language (4 p)
$L = \{a^k b^m c^n \mid 0 < n \leq k, m > k - n\}$
and explain how the grammar works.

6. Consider the following context-free grammar G where the set of terminals is $\{(,), +, a, b\}$: (6 p)

$$\begin{array}{lrcl} G: & S & \rightarrow & A \\ & A & \rightarrow & (A) \mid A + A \mid B \\ & B & \rightarrow & a \mid b \end{array}$$

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

   (b) Show that $L(G)$ is not regular by using the Myhill-Nerode theorem.

7. Consider the context-free grammar G in the previous problem. (4 p)

   (a) Is G ambiguous?

   (b) Show that G is not LR(0) by using the DK-test (i.e. constructing the DFA of viable prefixes).

   (c) Determine if G is LR(1) or not by using the DK_1-test.

8. Consider all possible choices of languages L_1 and L_2 such that $L_1 \leq_m L_2$. (4 p)

   (a) Does it always hold that $|L_1| \leq |L_2|$ or is this impossible or can it hold or not depending on the choice of L_1 and L_2? Explain why.

   (b) Is it possible that $L_1 = \varnothing$ and $L_2 = \varnothing$? Explain why.