Theoretical Computer Science II
Formal Languages and Computability 2018/19
Written Exam

7. June 2019

Solve the assignments on your own.

Time limit is 90 minutes.

Best of luck!

ASSIGNMENT	POINTS	OUT OF	ASSIGNMENT	POINTS	OUT OF
1			2		
3			4		

FIRST AND LAST NAME: _____

STUDENT ID: _____

SIGNITURE: _____

1. Assignment: (30 points)
Let's define languages:

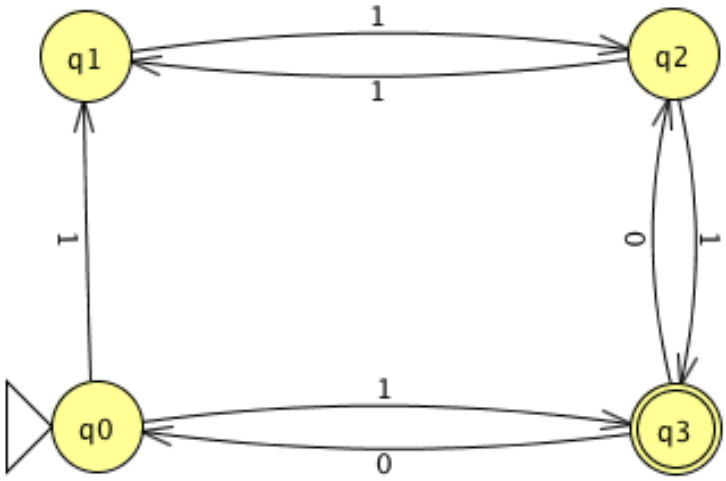
$$L_1 = \{wx^n \mid w \text{ is an arbitrary string containing } x\text{'s and } y\text{'s, of length } n\}, \Sigma = \{x, y\}$$
$$L_2 = \{w \mid (0 + 11)^*10\}, \Sigma = \{0, 1\}$$

QUESTIONS: For every language:

1. Find out if the language is regular or not, justify your claim!
2. For every language, define a grammar for it.

   INSTRUCTIONS:
   If a language is regular, construct a deterministic finite automaton (you get some points for a non-deterministic one). If the language is not regular you must show that such an automaton cannot be constructed (pumping lemma for RL).

2. Assignment: (15 points)
You are given the following NFA:



QUESTIONS:
Transform the NFA to a DFA using the procedure shown in class.

3. Assignment: (25 points)
You are given the following context-free grammar:

$$\begin{aligned} S &\rightarrow EGFH \\ E &\rightarrow eE \mid e \\ F &\rightarrow f \mid E \\ G &\rightarrow g \\ H &\rightarrow hH \mid hh \mid e \end{aligned}$$

QUESTIONS:

1. Convert the grammar into the Chomsky normal form (show all steps of the conversion).
2. Use the CYK algorithm to check if the word $egehh$ is in the language of the grammar.

4. Assignment: (30 points)
Let's define the following language:

$$L_3 \;=\; \left\{ w0w^R \mid w \in (a+b)^* \right\}$$

QUESTIONS:

1. Construct a Turing machine for the language L_3.
   Write down the complete 7-touple defining the TM.
2. Use instantaneous descriptions of the TM
   to show the derivation of the word $ab0ba$.