

**TCS II**  
**Formal Languages and Computability 2018/19**  
**1st Midterm (A)**

8. April 2019

Solve the assignments on your own.

Time limit is 80 minutes.

Good luck!

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

FIRST AND LAST NAME: \_\_\_\_\_

STUDENT ID: \_\_\_\_\_

SIGNATURE: \_\_\_\_\_

**1. Assignment:** (30 points)

Let's define languages:

$$L_1 = \{wa^n \mid w \text{ is an arbitrary string containing } a\text{'s and } b\text{'s, of length } n\}, \Sigma = \{a, b\}$$

$$L_2 = \{w \mid 01^*0(11+00)^*\}, \Sigma = \{0, 1\}$$

QUESTIONS:

For every language:

1. Find out if the language is regular or not, justify your claim!

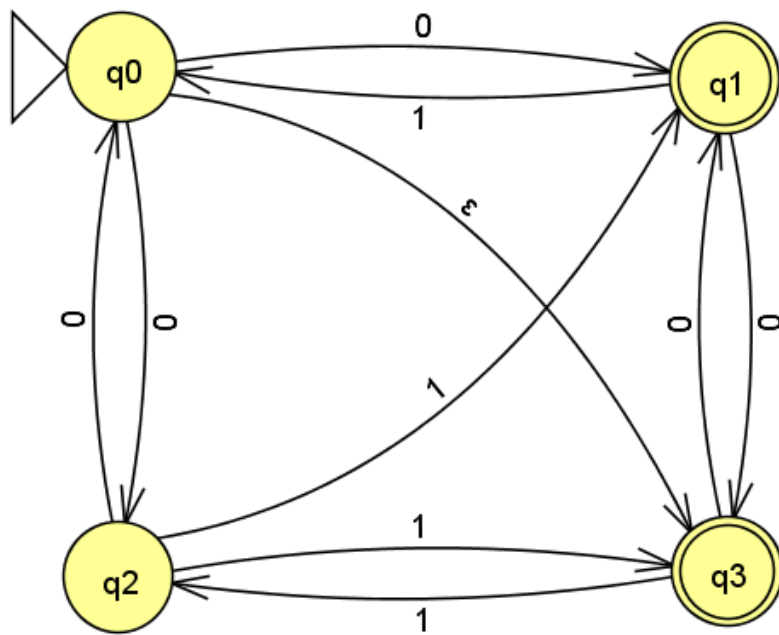
INSTRUCTIONS:

If a language is regular, construct a deterministic finite automaton (DFA) – write down the complete 5-tuple. If the language is not regular, you must prove that such an automaton cannot be constructed (pumping lemma for regular languages).

2. For every language, define a context free grammar (CFG) for it.

**2. Assignment:** (20 points)

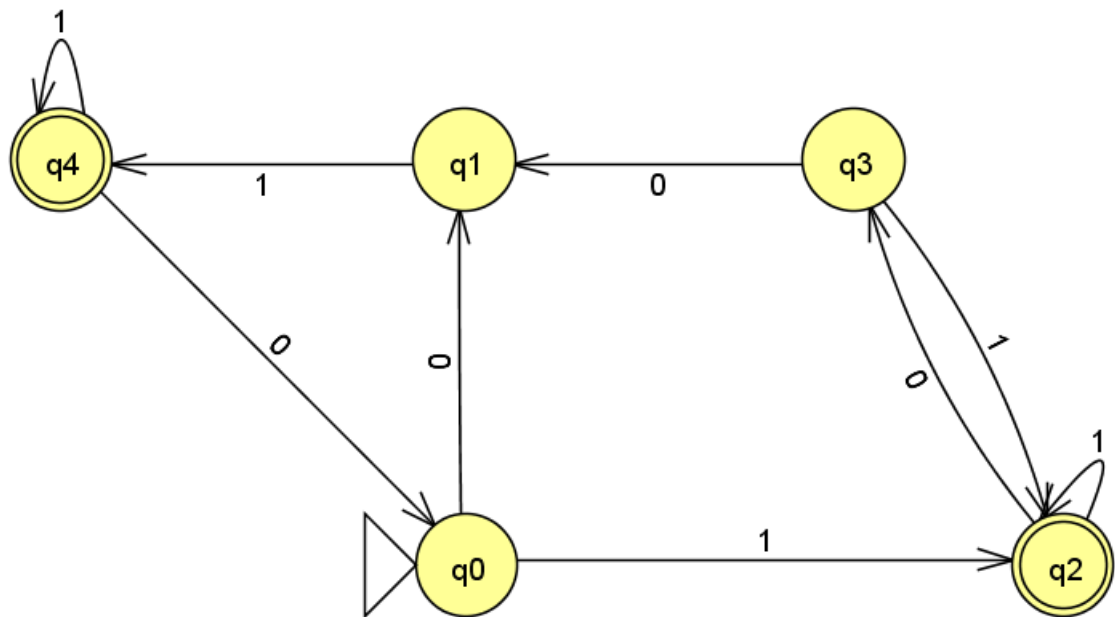
You are given the following  $\varepsilon$ -NFA:

**QUESTIONS:**

Transform the  $\varepsilon$ -NFA to a DFA using the procedure(s) shown in class.

**3. Assignment:** (25 points)

You are given the following automaton:

**QUESTIONS:**

Minimize the automaton using the table filling method.

**4. Assignment:** (25 points)

You are given the following context free grammar (CFG),  $\Sigma = \{0, 1, 2\}$ :

$$\begin{aligned} S &\rightarrow X \mid Y \mid XY \\ X &\rightarrow 011 \mid 0X1 \mid \varepsilon \\ Y &\rightarrow 2 \mid 2Y \\ Z &\rightarrow 012 \mid 0ZY \end{aligned}$$

QUESTIONS:

Turn this grammar into Chomsky Normal Form (CNF) – write down the complete procedure.