TCS II
Formal Languages and Computability 2020/21
1st Midterm

6. April 2021

Solve the assignments on your own.

Time limit is 90 minutes.

Good 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:

$$
\begin{aligned}
L_1 &= \left\{ a^n b a^n \mid n \geq 1 \right\}, \Sigma = \{a, b\} \\
L_2 &= \left\{ w \mid (01)^* 1 (1 + 00)^* \right\}, \Sigma = \{0, 1\}
\end{aligned}
$$

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-touple. 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.

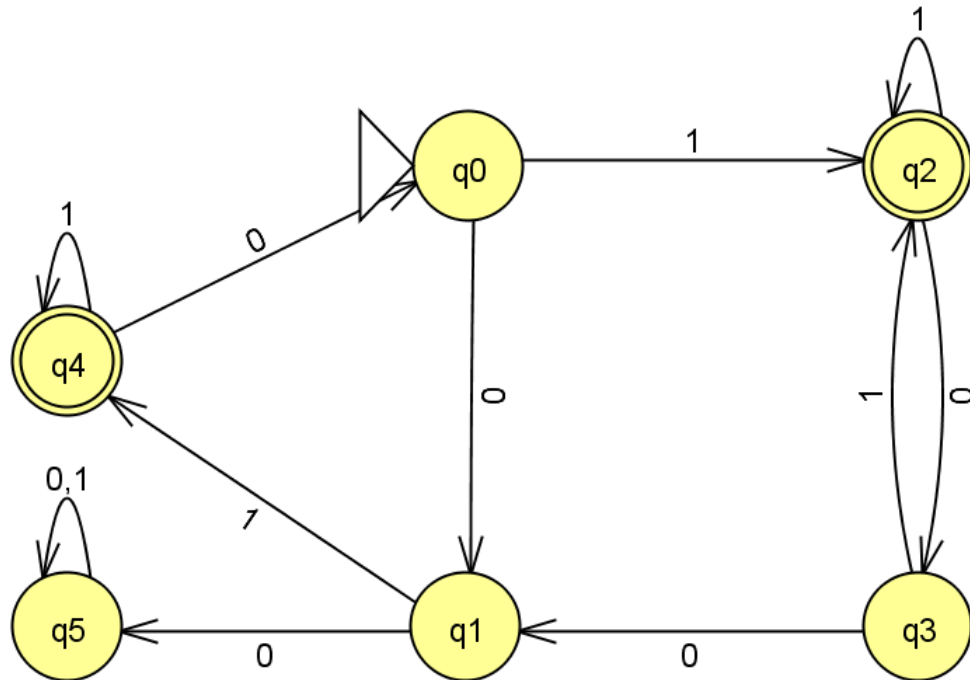**2. Assignment:** (20 points)

You are given the following ε-NFA:
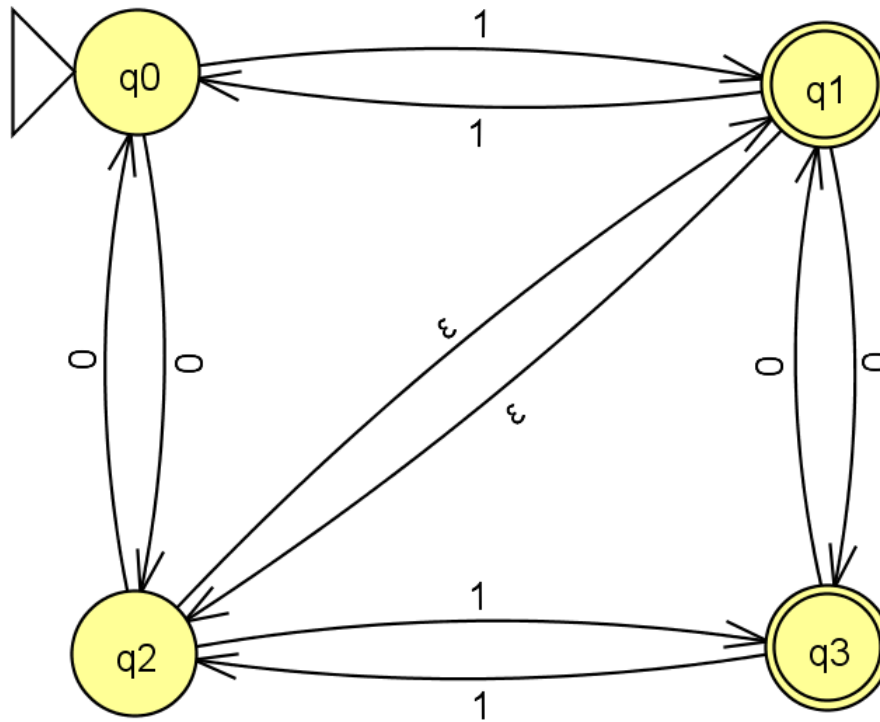
QUESTIONS:
Convert the ε-NFA into a DFA.

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), $\Sigma = \{0, 1, 2\}$:

$S \rightarrow X \mid Y \mid XY \mid YX$
$X \rightarrow 01 \mid 0Y1 \mid \varepsilon$
$Y \rightarrow 2 \mid X2$
$Z \rightarrow 12 \mid 1XX2$

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