

CENG 280

Formal Languages and Abstract Machines

Spring '2015-2016

Take Home Exam 1

26 March 2016, Saturday, 23:55

Question 1

For the following, give a regular expression that represents the sets provided.

- a) The set of strings over $\{a, b, c\}$ that begin with a , contain exactly two b 's, and end with cc .
- b) The set of strings of even length over $\{a, b, c\}$ that contain exactly one a .
- c) The set of strings over $\{a, b\}$ that contains an even number of substrings ba .

Question 2

Construct the specified finite automaton accepting each of the following languages.

- a) DFA : The set of strings over $\{a, b\}$ that have odd length or end with aaa .
- b) NFA : The set of strings over $\{a, b\}$ in which every a is followed by b or ab .

Question 3

Is the family of regular languages closed under countable infinite unions ? That is, if L_0, L_1, \dots are regular, is $\bigcup_{i=0}^{\infty} L_i$ necessarily regular ? If so prove it, If not give a counterexample.

Question 4

Show that the set given below is not regular:

$$\{ a^i b^j c^{2j} \mid i \geq 0, j \geq 0 \}$$

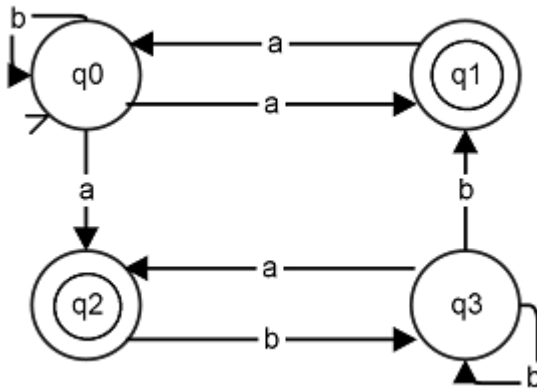
Question 5

Prove that the family of regular languages is closed under the operation of set difference.

Question 6

For the NFA given below, construct the state diagram of equivalent DFA. For this question, you also should express the correspondence between the states of the DFA and the NFA. Is the DFA constructed minimal ?

Note that, q_0 is the start state whereas q_1, q_2 are accepting states.



1 Regulations

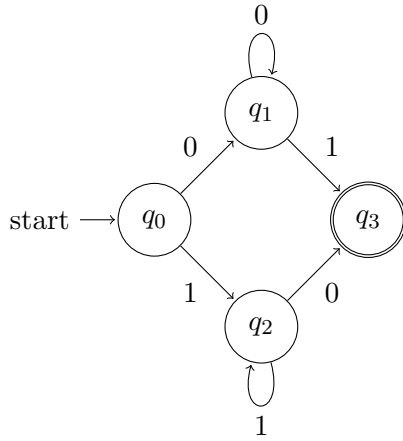
1. A simple code for inserting an automaton is :

```

\begin{tikzpicture}[shorten >=1pt,node distance=2cm,on grid,auto]
  \node[state,initial] (q_0) {$q_0$};
  \node[state] (q_1) [above right=of q_0] {$q_1$};
  \node[state] (q_2) [below right=of q_0] {$q_2$};
  \node[state,accepting] (q_3) [below right=of q_1] {$q_3$};
  \path[->]
    (q_0) edge node {0} (q_1)
           edge node [swap] {1} (q_2)
    (q_1) edge node {1} (q_3)
           edge [loop above] node {0} ()
    (q_2) edge node [swap] {0} (q_3)
           edge [loop below] node {1} ();
\end{tikzpicture}

```

which will give ;



2. You have to write your answers to the provided sections of the template answer file given. Other than that, you cannot change the provided template answer file. If a latex structure you want to use cannot be compiled with the included packages in the template file, that means you should not use it.
3. Do not write any other stuff, e.g. question definitions, to answers' sections. Only write your answers. Otherwise, you will get 0 from that question.
4. **Late Submission: 3 days in total**
5. **Cheating: We have zero tolerance policy for cheating.** People involved in cheating will be punished according to the university regulations.
6. **Newsgroup:** You must follow the newsgroup (news.ceng.metu.edu.tr) for discussions and possible updates on a daily basis.
7. **Evaluation:** Your latex file will be converted to pdf and evaluated by course assistants. The .tex file will be checked for plagiarism automatically using “black-box” technique and manually by assistants, so make sure to obey the specifications.

2 Submission

Submission will be done via COW. Download the given template file, "the1.tex", when you finish your exam upload your "the1.tex" file to COW.

Note: You cannot submit any other files. Don't forget to make sure your .tex file is successfully compiled in Inek machines using the command below.

```
$ pdflatex the1.tex
```