Department of Computer Science and Software Engineering
Concordia University
COMP 335: Introduction to Theoretical Computer Science
Fall 2015

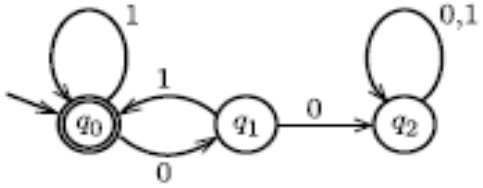
Assignment 1
Evaluation: 50 pts
(3% of your final grade)

Due date and time: Monday, October 5th 2015 by midnight

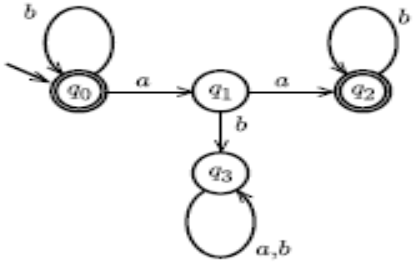
When answering questions on this assignment (or any other assignment or exam in this course), you are free to make use of facts that were stated in the lecture or that are found in the course text without having to argue or reprove those facts.

Question 1 (10 pts)

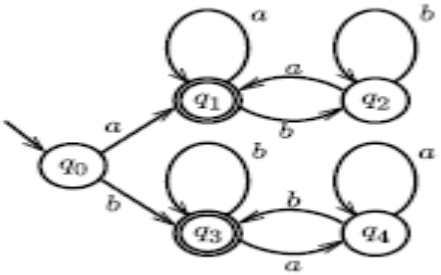
Describe concisely the strings accepted by the automata defined by the following state diagrams.



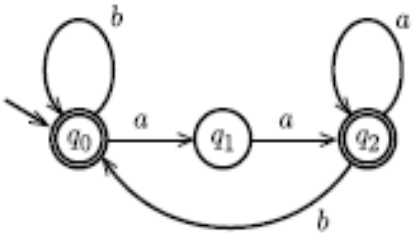
(a)



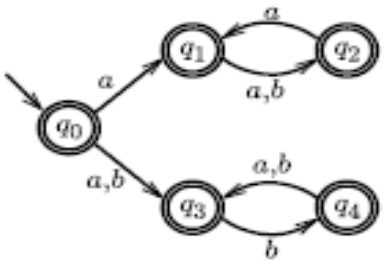
(b)



(c)



(d)



(e)

Question 2 (5 pts)

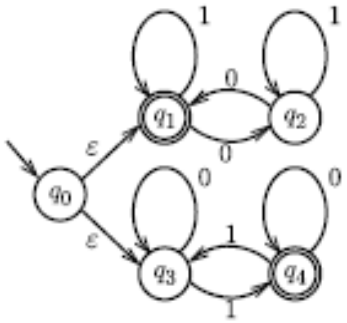
a) Show deterministic finite automata that accept the following languages. Let the alphabet be {0, 1}.

1) {*w* | *w* contains 101 as a substring}
2) {*w* | every 1 in *w* is preceded and is followed by at least one 0}

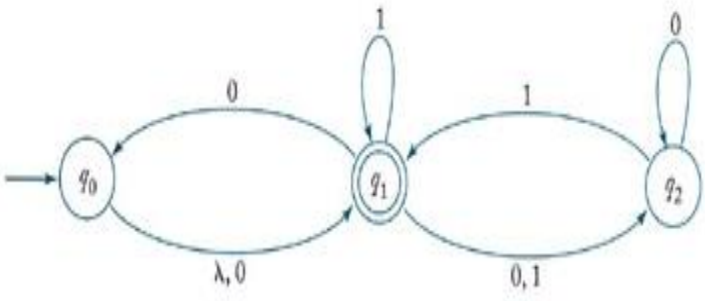
b) Show the state diagram of simple nondeterministic finite automata that accept the language of machine (1) in part (a) of this question.

Question 3 (8 pts)

a) Informally describe the language accepted by the NFA shown below.
b) Transform the NFA to an equivalent DFA.

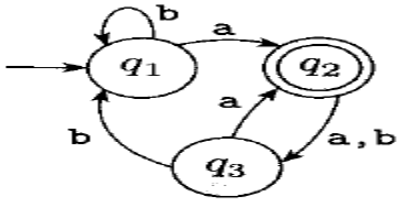


c) Convert the following NFA into an equivalent DFA

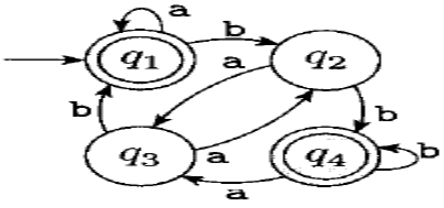


Question 4 (5pts)

Give the formal description of the machines M1 and M2 below.



M_1



M_2

Question 5 (5pts)

Each of the following languages is the complement of a simpler language. In each part, construct a DFA for the simpler language, and then use it to give the state diagram of a DFA for the language given. In both part (a) and (b), $\sum = \{a, b\}$

a) {w | w does not contain the string ab}
b) {w | w does not contain the substring baba}

Question 6: (5pts)

Give state diagrams of NFAs with the specified number of states recognizing each of the following languages. In both parts (a) and (b), the alphabet is {0, 1}.

a) The language {w | w ends with 00} with three states
b) The language 1*(001*)* with three states

Question 7 (4 pts)

Are there languages for which $\overline{L^*} = (\overline{L})^*$

Question 8 (5 pts)

Answer the following:

a) Is it true that for any NFA $M = (Q, \Sigma, \delta, q_0, F)$ the complement of $L(M)$ is equal to the set$\{w \in \Sigma^*: \delta^*(q_0, w) \cap F = \emptyset\}$? If so, prove it; if not, give a counterexample.

b) Is it true that for any nfa $M = (Q, \Sigma, \delta, q_0, F)$ the complement of $L(M)$ is equal to the set$\{w \in \Sigma^*: \delta^*(q_0, w) \cap (Q - F) \neq \emptyset\}$? If so, prove it; if not, give a counterexample.

Question 9 (3 pts)

Prove that every NFA can be converted to an equivalent one that has a single accepted state.

Submission:

- **Assignment must be done individually (no groups are permitted).**
    - Your file should be called *a#_studentID*, where # is the number of the assignment and *studentID* is your student ID number. For example, for the first assignment, student 123456 would submit a pdf file named a1_123456.pdf
- Your assignment must be handed either <u>electronically</u> **or** <u>in the assignments box.</u>
    a) **Assignments handled electronically** must be **via EAS. Make sure that you upload the assignment to the correct directory of Assignment 1 using EAS. Assignments uploaded to the wrong directory will be discarded and no resubmission will be allowed.** Electronic submission can be in PDF or scans of clear handwriting.
    b) **Printed handled assignment must be in the assignment Box** (in EV building 3rd floor, next to the computer science department main office) under the proper course section E or G).
- Make sure you write the following statement on your assignment:
  "I certify that this submission is my original work and meets the Faculty's Expectations of Originality"**,** with your signature, I.D. #, and the date.

<u>Note</u>: Assignment not submitted by the due date and in the correct format and/or to the correct location will not be graded – NO EXCEPTIONS!!!!