CSC 320 Spring 2024
Assignment 1

This assignment has 6 written questions and is out of a total of 30 marks. Submit one PDF file containing your solutions on Brightspace.

Questions

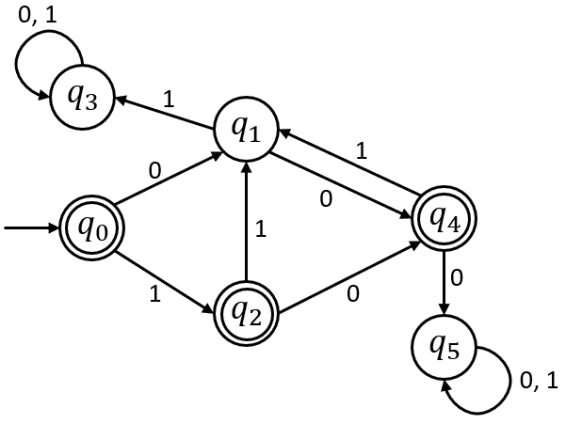
1. **[5 marks]** Let $\Sigma = \{a, b\}$. Consider the following languages L_A and L_B over Σ:
   $L_A = \{w \in \Sigma^* \mid w \text{ contains an even number of occurrences of symbol } a\}$
   $L_B = \{w \in \Sigma^* \mid \text{each pair of consecutive } b\text{'s in } w \text{ is separated by a substring of } a\text{'s of length } 2i, i \geq 0\}$

   Clarification: L_B is saying that between b's there must be $2i$ a's for some $i \geq 0$ (e.g. $baab \in L_B$ and $baaab \notin L_B$). Also, i must be an integer value ≥ 0.

   For each of the following strings, decide whether it is a member of L_A or L_B:

   (a) b
   (b) $aabbbbaa$
   (c) $abaaabaaa$
   (d) $bbaaaabbaab$
   (e) a

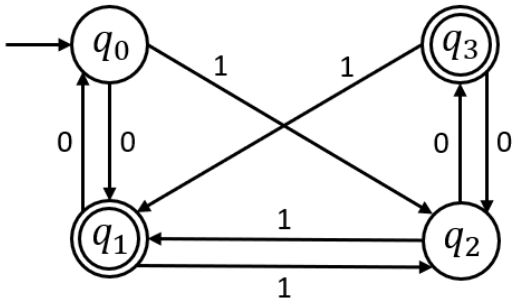
2. **[5 marks]** Consider the following DFA M:



   Describe M as a 5-tuple $M = (Q, \Sigma, \delta, q_0, F)$. In particular, give

   (a) Q
   (b) Σ
   (c) δ (in the form of a transition table)
   (d) q_0
   (e) F

3. **[5 marks]** Consider the following DFA state diagram:



For each of the following strings, give the exact sequence of states that the automaton undergoes when reading the string. Furthermore, indicate whether or not the string is accepted.

(a) $w_1 = \varepsilon$

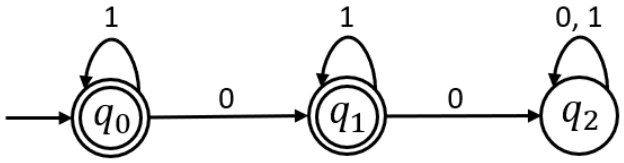
(b) $w_2 = 0111$

(c) $w_3 = 1000000100$

(d) $w_4 = 1010110$

(e) $w_5 = 11111111$

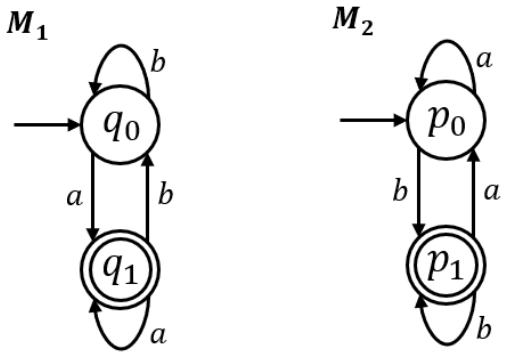
4. **[5 marks]** Consider the state diagram of the following DFA F. Describe the language $L(F)$ that the automaton recognizes using set notation.



5. **[5 marks]** Let $\Sigma = \{a, b\}$. For the following language L_A over Σ, construct a deterministic finite automaton A with $L(A) = L_A$. For the automaton, give the state diagram and the formal 5-tuple definition of the DFA $A = (Q, \Sigma, \delta, q_0, F)$ with a transition table describing δ.

$$L_A = \{w \in \Sigma^* \mid w \text{ starts with an } a \text{ and contains the substring } abb\}$$

6. **[5 marks]** Consider the state diagrams of the following automata M_1 and M_2:



Give a state diagram and transition table for a DFA M that recognizes the language $L(M) = L(M_1) \cap L(M_2)$. For this, you must use the construction from the proof that builds a DFA that recognizes the intersection of two regular languages.