CSC 320 - Tutorial

1. Deterministic Finite Automaton
2. Non-deterministic Finite Automaton

Deterministic Finite Automaton (DFA)

- Is expressed as a **5-tuple** $(Q, \Sigma, \delta, q_0, F)$
  - Q: finite set of states
  - Σ: alphabet finite set
  - δ: transition function $(Q \times \Sigma) \rightarrow Q$
  - q_0: start state $q_0 \in Q$
  - F: sets of accept/final states $F \subseteq Q$
- The language L of a deterministic finite automata M, L(M) is <u>exactly</u> the set of all strings that M accepts ∴ M recognizes L(M)
- A given language L is **regular** iff it is recognized by some deterministic finite automaton

Non-deterministic Finite Automata (NFA)

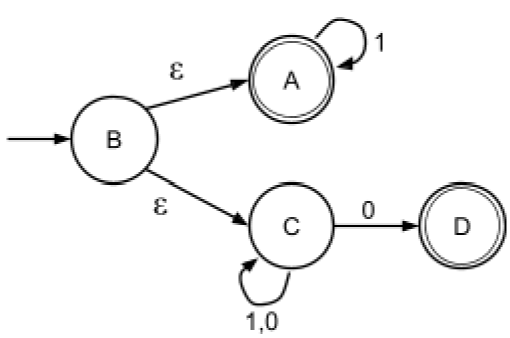
- Is expressed as a **5-tuple** $(Q, \Sigma, \delta, q_0, F)$
  a. Q: finite set of states
  b. Σ: alphabet
  c. δ: transition function $Q \times (\Sigma \cup \{\varepsilon\}) \rightarrow P(Q)$
  d. q_0: start state $q_0 \in Q$
  e. F: sets of accept/final states $F \subseteq Q$
- The language L of a non-deterministic finite automata N, L(N) is <u>exactly</u> the set of all strings that N accepts
- For every DFA M there exists an equivalent NFA N (ie. L(M) = L(N))
- For every NFA N there exists an equivalent DFA M

Questions

1. Give the formal specification of a DFA for the following languages:
    a. $L_1 = \{0\}^*$ over $\Sigma = \{0\}$

    b. $L_2 = \{w \in \{a, b\}^* \mid w$ is a string NOT in $L((ab^+)^*)\}$

2. Consider the state diagram below:



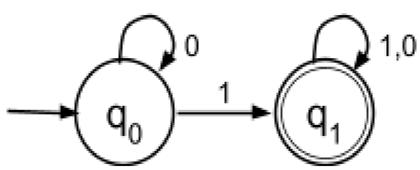
    a. Is this state machine a DFA or an NFA? How can you tell?

b. Is the string 0011 accepted by this state machine? What about 1100?

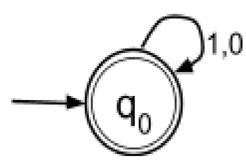
c. What is the language of this machine?

3. Given an example of how regular languages L_1 and L_2 are closed under intersection using the DFAs M_1 and M_2 below (proof by construction) where $L_1 = L(M_1)$ and $L_2 = L(M_2)$

M_1



M_2



a. How would the state machine change for the union? Ie. if the new DFA is to recognize $L_1 \cup L_2$ instead.

4. Design an NFA state diagram for the following language:
   a. $L = \{ w \in \{0, 1\}^* \mid w$ contains 00 or 11 as a substring $\}$

   b. Express the NFA as a 5-tuple $(Q, \Sigma, \delta, q_0, F)$ and describe δ as a transition table