# Homework 1

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## Homework Description

Introduction assignment to languages, grammar, and finite state machines.

## Course Details

- **Course** - CS435
- **Instructor** - Dr. Chi-Cheng Lin

## Homework Results

**Question 1**

Let $L_1 = \{a^n b^n : n \geq 0\}$. Let $L_2 = \{c^n : n > 0\}$. For each of the following strings state whether or not it is an element of $L_1 L_2$.

**Answer**

By definition of concatenation, $L_1 L_2 = \{a^n b^n c^m : n \geq 0, m > 0\}$

a. $\varepsilon$: No, if $\varepsilon \in L_1 L_2$ then $a^0 b^0 c^0 \in L_1 L_2$ but by definition of $L_1 L_2$, m must be greater than 0.

b. aabbcc: Yes, aabbcc $\in L_1 L_2$ when n and m are 2.

c. aabbcccc: Yes, aabbcccc $\in L_1 L_2$ when n is 2 and m is 4.

d. aabcc: No, aabcc $\notin L_1 L_2$ since by definition of $L_1 L_2$ both a and b must have the same number of instances n, but in this a has 2 and b has 1.

**Question 2**

Let $L_1 = \{a^n b^n : n \geq 0\}$. Let $L_2 = \{c^n : n > 0\}$. For each of the following strings state whether or not it is an element of $L_1 \cup L_2$.

**Answer**

By definition of union, for each element $w$ if $w \in L_1$ or $w \in L_2$ then $w \in L_1 \cup L_2$

a. $\varepsilon$: Yes, $\varepsilon \in L_1$ when n is 0, therefore $\varepsilon \in L_1 \cup L_2$

b. aabbcc: No, aabbcc $\notin L_1$ since $L_1$ does not have a definition for c, and aabbcc $\notin L_2$ since $L_2$ does not have a definition for a or b.

c. cccc: Yes, cccc $\in L_2$ when n is 4, therefore cccc $\in L_1 \cup L_2$

d. aabb: Yes, aabb $\in L_1$ when n is 2, therefore aabb $\in L_1 \cup L_2$

**Question 3**

Let $L = \{w \in \{a, b\}^\star : |w| \equiv_3 0\}$. List the first six elements in the lexicographic enumeration of L.

**Answer**

By definition of $|w| \equiv_3 0$ we know that any element $x \in L$ will need to have a length of a multiple of 3. To start we need to consider $\varepsilon \in \{a, b\}^\star$ which has a length of 0 which, and $0 \bmod 3 = 0$. Then, lets consider strings of length 3, listing them in lexicographic enumeration order we have: {aaa, aab, aba, abb, baa, bab, bbb}. Therefore, the first six will be: {$\varepsilon$, aaa, aab, aba, abb, baa}.

**Question 4**

$L = \{w \in \{a, b\}^\star : x \in \{a, b\} * (w = ax)\}$.

**Answer**

a. Give a simple, precise English description for the language $L$.

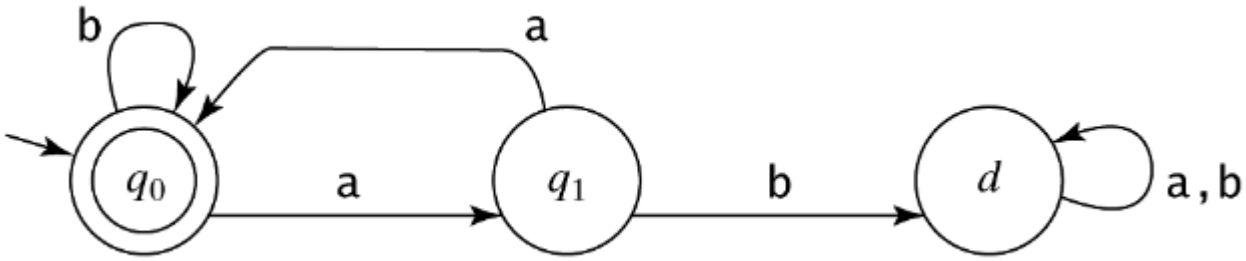
- "A string composed of characters a and b, where the string starts with a."

b. List the first six element in the lexicographic enumeration of $L$.

- {a, aa, ab, aaa, aab, aba}

**Question 5**

Construct the following finite state machine (FSM) in JFLAP:



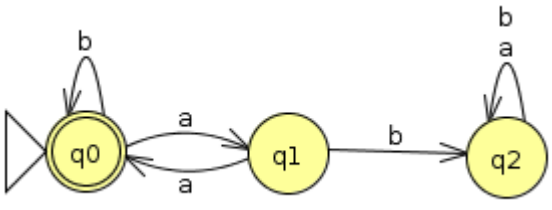

And test it using strings {bbaabaa, aaaabbabaa}

**Answer**

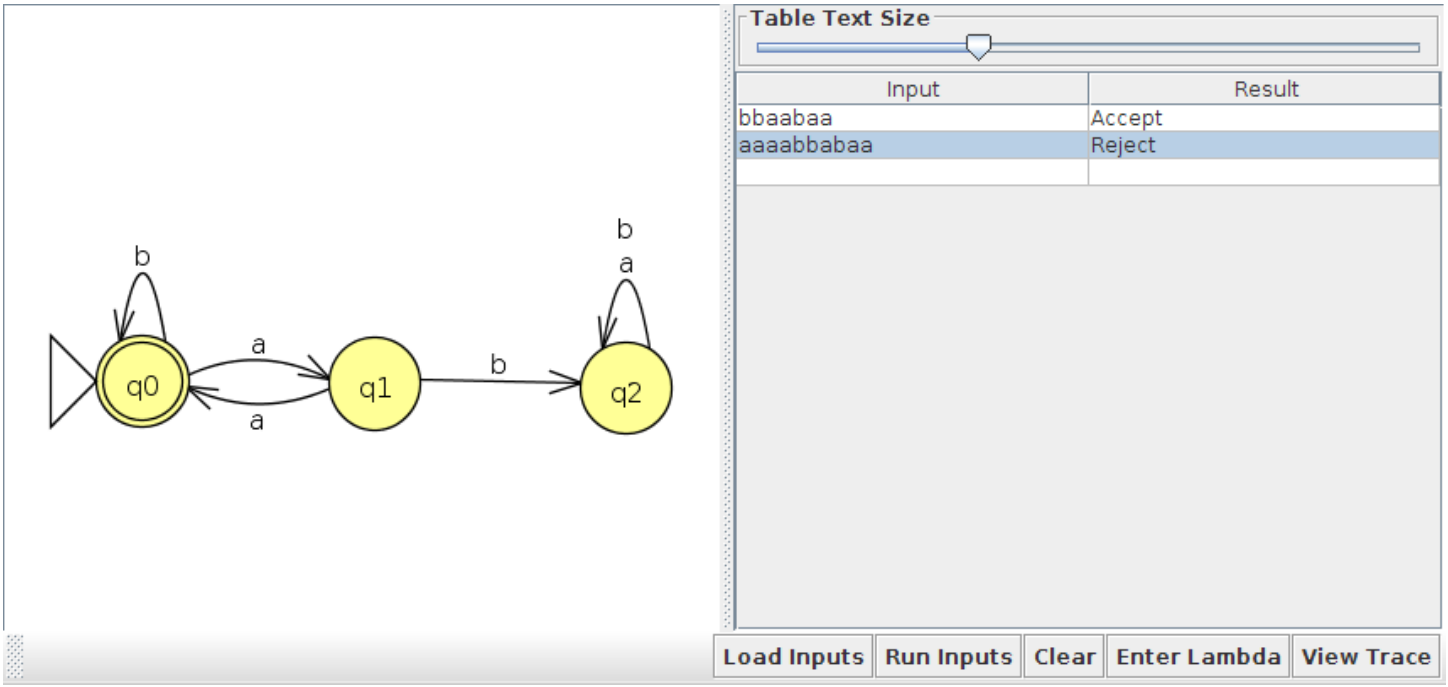
Link to JFLAP file:

assets/problem5.jff

Image:

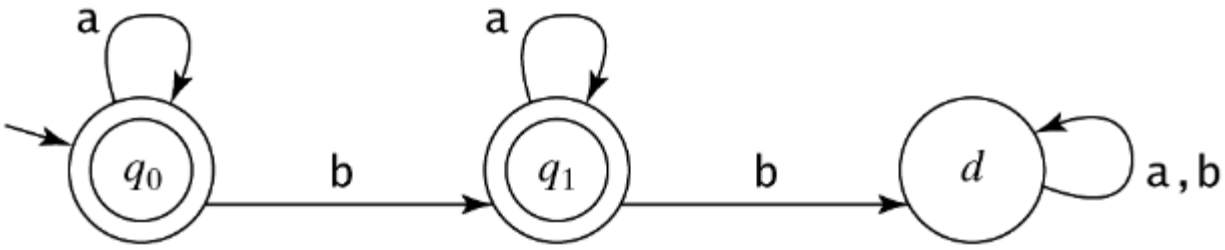



Test Results




**Question 6**

Describe the following DFSN M formally as $M = (K, \Sigma, \delta, s, A)$




- $K$ - finite set of states
- $\Sigma$ - is an alphabet
- $\delta$ - is the transition function from $(Kx\Sigma \rightarrow K)$
- $s \in K$ - is the initial state
- $A \subseteq K$ - is the set of accepting states

**Answer**

$M = (K, \Sigma, \delta, s, A) = (\{q_0, q_1, d\}, \{a, b\}, \delta, \{q_0\}, \{q_0, q_1\})$

where $\delta = \{((q_0, a), q_0), ((q_0, b), q_1), ((q_1, a), q_1), ((q_1, b), d), ((d, a), d), ((d, b), d)\}$

Version 1.0
Last updated 2019-09-08 13:45:17 -0500