National University of Computer & Emerging Sciences, Karachi

Fall-2024 CS-Department

Assignment 1

Course Code: CS301	Course Name: Theory of Automata

Instructions:

You must submit the scanned copy of your own handwritten assignment on google classroom within the due date, strong action would be taken on plagiarism cases with straight **zero** in assignment.

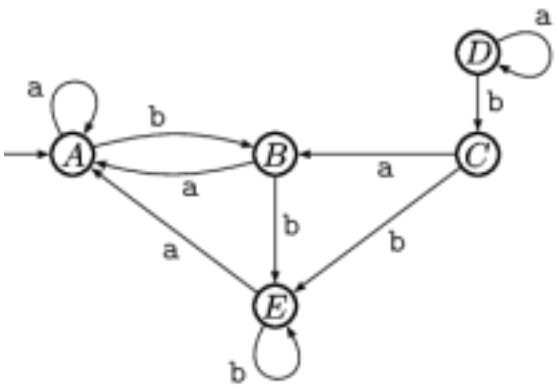
Question 1: Properties of Regular Languages.

A.

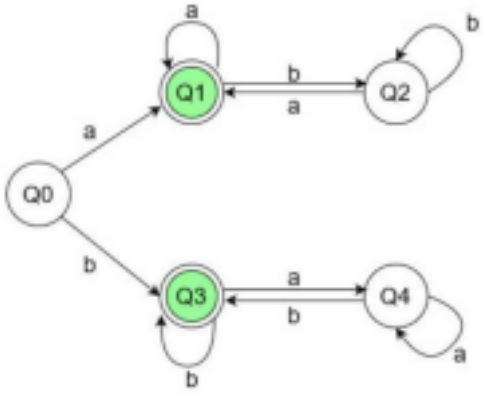
a. Perform union of **DFA1** and **DFA2** using Kleen's Theorem.

b. Find the Concatenation of **DFA1** and **DFA2 to make DFA2.DFA1** using Kleen's Theorem.

c. Perform Kleen's Star Closure on **DFA2**.

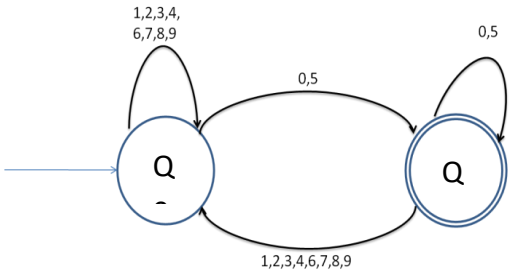


DFA1

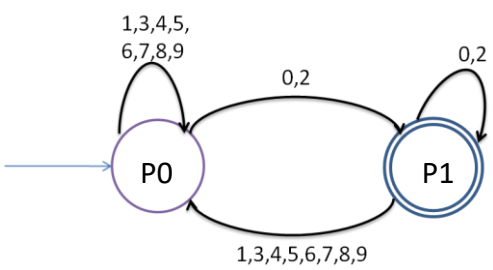


DFA2

B.



DFA10: Divisible by 5



DFA20: Divisible by 2

a. Given two DFA's DFA1 and DFA2 find the intersection DFA1∩ DFA2 to find DFA10. What language does DFA 10 accepts?
b. Minimize DFA10.

Question 2: DFA/ regular Languages

A. Find the DFA for the given languages.

a) Language L of string which does not contain the substring bb and

ends with 'a' defined over alphabet {a, b}.

b) Find the DFA corresponding to set of strings with either no 1 preceding a 0 or no 0 preceding a 1.

c) Draw a DFA for the language accepting strings such that each '1' is immediately preceded and followed by '0'. Defined over input alphabets Σ = {0, 1}.

B. Express each of these languages over Σ= {0,1} using a regular expression.

a) L1 the set consisting of the strings 0, 11, and 010.

b) L2 the set of strings of three 0s followed by two or more 0s, containing no 1s.

c) L3 the set of strings of odd length.

d) L4 the set of strings that contain exactly one 1.

e) The set of strings containing a string of 1s such that the number of 1s equals 2 modulo 3 followed by an even number of 0s.

D. Write regular expression for the following language

a. $L = \{a^n b^m, n>=4, m <=3\}$

b. All words that contain exactly two b's or exactly three a's, not more.

c. All strings that do not have the substring 'bab'.

Question 3: CFG

A. Write CFG of the following languages:

a. L2 = $\{a^n b^{n-3} : n \geq 3\}$

b. L3= {w∈ {0,1} * | the length of w is odd and the middle symbol is 0}

c. L4 = {w ∈Σ* | w is a string of balanced parentheses}, Σ = {(,)}

d. L5= $\{a^{2n} b^{3n} \mid n \geq 0\}$

e. L6 = $\{a^n b\, a^m \mid n \geq 0 \mid n \text{ is even} \mid m < n\}$. Defined over alphabet Σ = {a, b}.

f. L7= $\{a^n b^n c^m \mid n, m >= 1\}$

g. L8= $\{0^n 1^m 2^k 3^q 4^p 5^r 6^s \mid n=s, m=r, k=p, \{m, n, s, p, q, r, k\}>=0\}$

B. Write CFG of the following languages:

a) L1 = $\{0^i 1^j 2^k \mid k <= i\}$

b) L2 = $\{0^i 1^j 2^k \mid k <= j\}$

c) Find L3 = L1∪L2

Question 4: Ambiguous Grammer
Let G=V, ∑, R, <STMT> be the following grammar.

<STMT> → <ASSIGN>|<IF-THEN>|<IF-THEN-ELSE>
<IF-THEN > → if condition then <STMT>
<IF-THEN - ELSE> →if condition then<STMT>else <STMT>
<ASSIGN> →a: = 1

∑ = {if, condition, then, else, a:=1}
V = {<STMT>, <IF-THEN>, <IF-THEN-ELSE>, <ASSIGN>}

G is a natural-looking grammar for a fragment of a programming language, but G is ambiguous. Show that G is ambiguous.