CS320: Problems for Day 8, Winter 2023

Problem 1 Let M be the finite automaton represented by the state diagram on Figure 1, and let L be the language accepted by M.

Write a complete formal definition or a state-transition graph of a deterministic finite automaton M' that accepts L and show your work. If such automaton does not exist, prove it.

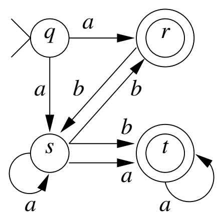

Figure 1:

Problem 2 Let M be the finite automaton represented by the state diagram on Figure 2, and let L be the language accepted by M.

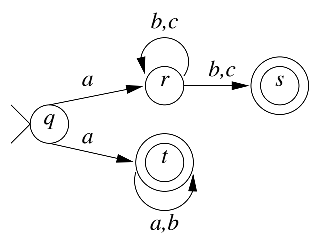

Figure 2:

(a) Is the finite automaton M deterministic? Justify briefly your answer.

(b) If M is not deterministic, construct a deterministic finite automaton M' that accepts L and show your work. If such an automaton M' does not exist, explain why.

Problem 3 Let L be the language defined by the regular expression

$$\boldsymbol{b(a \cup b^*((c^* \cup (cb)^*)ac)^*)b}$$

(a) Construct a finite automaton M that accepts L. If such an automaton M does not exist, explain why.

(b) If you constructed an automaton M in your answer to part (a), is M deterministic? Justify briefly your answer.

Problem 4 Let M be the finite automaton represented by the state diagram on Figure 3, and let L be the language accepted by M.

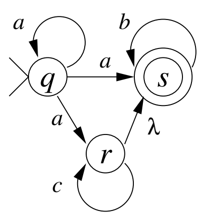

Figure 3:

Construct a state-transition graph of a deterministic finite automaton M_1 that accepts L, and show your work. If such automaton does not exist, prove it.

Problem 5 Let L be the language accepted by the finite automaton $M = (Q, \Sigma, \delta, q, \{f\})$, where $\Sigma = \{a\}$, $Q = \{p, q, r, s, t, v, w, x, y, z, f\}$,
and δ is given by the following table:

	a	λ
p	$\{z\}$	$\emptyset$
q	$\{t, r\}$	$\{s\}$
r	$\emptyset$	$\{q, t\}$
s	$\emptyset$	$\{w\}$
t	$\{z, y\}$	$\{p, w\}$
v	$\{x\}$	$\{r\}$
w	$\{y\}$	$\emptyset$
x	$\{p\}$	$\{v\}$
y	$\{p\}$	$\{f\}$
z	$\emptyset$	$\{v\}$
f	$\emptyset$	$\emptyset$

Compute the λ-closure of state v.

Problem 6 Let M be the finite automaton represented by the state diagram on Figure 4, and let L be the language accepted by M.

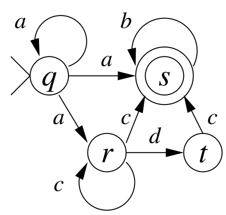

Figure 4:

Write a complete formal definition of a context-free grammar G that generates L. If such grammar does not exist, prove it.