CSE303 Q4 Practice Solutions

DEFINITION A context-free grammar $G = (V, \Sigma, R, S)$ is called **regular**, or **right-linear** iff

$$R \subseteq (V - \Sigma) \times \Sigma^*(V - \Sigma \cup \{e\}).$$

QUESTION 1 (3pts)

Given a **Regular grammar** $G = (V, \Sigma, R, S)$, where

$$V = \{a, b, S, B\}, \quad \Sigma = \{a, b\},$$

$$R = \{S \to bS \mid B \mid e, \quad B \to baB \mid a \mid b\}.$$

1. Construct a finite automaton M, such that $L(G) = L(M)$- must use general construction from the proof of the theorem:

"For any Regular Grammar G, L(G) is regular".

You can just draw a diagram.

Solution We construct a non-deterministic finite automata

$$M = (K, \Sigma, \Delta, s, F)$$

as follows:

$$K = (V - \Sigma) \cup \{f\}, \ \Sigma = \Sigma, s = S, \quad F = \{f\},$$

$$\Delta = \{(S, b, S), (S, e, B), (S, e, f), (B, ba, B), (B, a, f), (B, b, f)\}$$

2. Trace a transitions of M that lead to the acceptance of the string $bbbbabab$, and compare with a derivation of the same string in G.

Solution

The accepting computation is:

$$(S, bbbbabab) \vdash_M (S, bbbabab) \vdash_M (S, bbabab) \vdash_M (S, babab) \vdash_M (B, babab)$$
$$\vdash_M (B, bab) \vdash_M (B, b) \vdash_M (f, e)$$

G derivation is:

$$S \Rightarrow bS \Rightarrow bbS \Rightarrow bbbS \Rightarrow bbbB \Rightarrow bbbbaB \Rightarrow bbbbabaB \Rightarrow bbbbabab$$

QUESTION 2

1. Construct a Push Down Automaton M such that $L(M)$ contains all $w \in \{a,b\}^*$, such that w has the same number of a's and b's, i.e. such that

$$L(M) = \{w \in \{a,b\}^* : \#a = \#b\}.$$

Justify your answer. You can DRAW A DIAGRAM!

Solution in the Lecture Notes.