Student Information

Name : Kaan Karaçanta

ID : 2448546

Answer 1

a) Let G_1 the grammar of the language L_1.

$$G_1 = (V_1, \Sigma, R_1, s)$$

$$V_1 = \{S_0\} \cup \Sigma$$

$$\Sigma = \{a, b\}$$

$$s = S_0$$

$$R_1 = \{S_0 \longrightarrow S_0bS_0bS_0aS_0|S_0bS_0aS_0bS_0|S_0aS_0bS_0bS_0|\epsilon\}$$

b) Let G_2 the grammar of the language L_2.

$$G_2 = (V_2, \Sigma, R_2, s)$$

$$V_2 = \{S_1\} \cup \Sigma$$

$$\Sigma = \{a, b\}$$

$$s = S_1$$

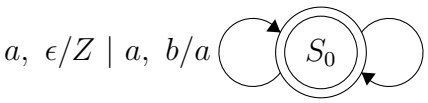
$$R_2 = \{S_1 \longrightarrow aS_1b|aaS_1b|\epsilon\}$$

c) The corresponding pushdown automaton according to the G_1, which generates L_1, is the following:

$$M_1 = (\{S_0\}, \{a, b\}, \{Z, a, b\}, \Delta, S_0, \{S_0\})$$

$$\Delta = \{((S_0, a, \epsilon), (S_0, Z)), ((S_0, b, \epsilon), (S_0, b)), ((S_0, a, b), (S_0, a)), ((S_0, b, Z), (S_0, a)), ((S_0, b, a), (S_0, \epsilon))\}$$

This pushdown automaton can be drawn in this form:



d) We have defined G_1 and G_2 for the languages L_1 and L_2 in the parts a and b. As context free languages are closed under union, we can write a new grammar for $G_3 = G_1 \cup G_2$, and let $G_3 = (V_3, \{a, b\}, R_3, s)$, where:

$$V_3 = V_1 \cup V_2 \cup \{S\} = \{S_0, S_1, S, a, b\}$$

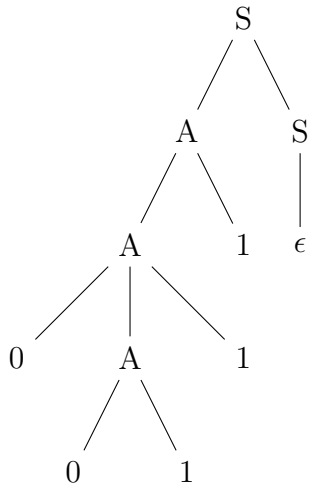
$$s = S$$

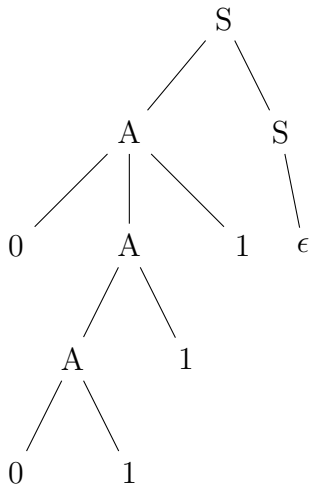
$$R_3 = R_1 \cup R_2 \cup \{S \longrightarrow S_0, S \longrightarrow S_1\}$$

$$= \{S_0 \longrightarrow S_0bS_0bS_0aS_0|S_0bS_0aS_0bS_0|S_0aS_0bS_0bS_0|\epsilon, S_1 \longrightarrow aS_1b|aaS_1b|\epsilon, S \longrightarrow S_0|S_1\}$$

Answer 2

a) We know that if there are 2 different parse trees for a string in the language, this language is ambiguous. The string 00111 is in the language and has 2 different parse trees these trees can be shown as:





b) $L(G_1)$ is the language with the strings whose number of ones is equal to or bigger than the number of zeros, and if it is not the empty string, the strings will start with a zero. A disambiguous grammar G_2, which is different than the given one, can be written as $G_2 = (V_2, \Sigma, R_2, S)$ where:

$$V_2 = \{0, 1, S, V, T\}$$

$$\Sigma = 0, 1$$

$$R_2 = \{S \longrightarrow 0V|\epsilon,$$
$$V \longrightarrow T1V|T1T,$$
$$T \longrightarrow 1T0T|0T1T|\epsilon\}$$

c) The leftmost derivation of 00111 is:

$S \longrightarrow 0V \longrightarrow 0T1V \longrightarrow 00T1T1V \longrightarrow 001T1V \longrightarrow 0011V \longrightarrow 0011T1T \longrightarrow 00111T \longrightarrow 00111$

This string's corresponding parse tree is: