Student Information

Name: Batuhan Akçan
ID: 2580181

Answer 1

a)

G_1 represents the language $L = L_1 \cup L_2$ where
$L_1 = \{0^n 1^n \mid n \geq 0\}$ and $L_2 = \{1^n 0^n \mid n \geq 0\}$.
In other words, L is the language generated by G_1.

b)

Yes, it is ambiguous because the empty string ϵ has 2 distinct (nonsimilar) derivations:
1) $S \rightarrow_{G_1} A \rightarrow_{G_1} \epsilon$
2) $S \rightarrow_{G_1} B \rightarrow_{G_1} \epsilon$

Answer 2

a)

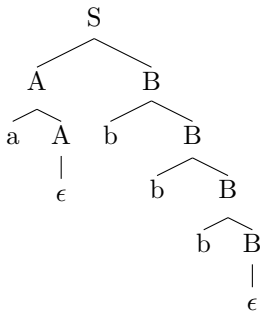
The string a has 2 distinct (nonsimilar) derivations:
1) $S \rightarrow_{G_2} AB \rightarrow_{G_2} A \rightarrow_{G_2} a$
2) $S \rightarrow_{G_2} AB \rightarrow_{G_2} A \rightarrow_{G_2} aA \rightarrow_{G_2} a$.
Therefore, the grammar G_2 is ambiguous.

b)

$G_3 = \{V, \Sigma, R', S\}$ where $V = \{a, b, S, A, B\}, \Sigma = \{a, b\}$ and R' is:
$S \rightarrow AB$
$A \rightarrow aA \mid \epsilon$
$B \rightarrow bB \mid \epsilon$.

c)

$S \rightarrow_{G_3} AB \rightarrow_{G_3} aAB \rightarrow_{G_3} aB \rightarrow_{G_3} abB \rightarrow_{G_3} abbB \rightarrow_{G_3} abbbB \rightarrow_{G_3} abbb$.



Answer 3

a)

i)

Let the grammar that represents L_1 be $G_1 = \{V, \Sigma, R, S\}$ where $V = \{S, c, P, d, R, K, L, a, b\}$, $\Sigma = \{a, b, c, d\}$ and R is:
$S \to cP \mid dR$
$P \to K \mid L$
$K \to aK \mid aKb \mid a$
$L \to Kb \mid aKb \mid b$
$R \to aRbb \mid e$
We can construct a top-down parser M_1 where $L(M_1) = L(G_1)$. Since all top-down parsers are deterministic pushdown automata, M_1 is also a deterministic pushdown automaton. Since only deterministic context-free languages can be recognized by a deterministic pushdown automata, the language recognized by M_1, which is L_1, is a deterministic context-free language.

ii)

Let the grammar that represents L_2 be $G_2 = \{V, \Sigma, R, S\}$ where $V = \{S, P, R, K, L, a, b, c, d\}$, $\Sigma = \{a, b, c, d\}$ and R is:
$S \to P \mid R$
$P \to K \mid L$
$K \to aK \mid aKb \mid ac$
$L \to Kb \mid aKb \mid cb$
$R \to aRbb \mid d$
We can construct a top-down parser M_2 where $L(M_2) = L(G_2)$. Since all top-down parsers are deterministic pushdown automata, M_2 is also a deterministic pushdown automaton. Since only deterministic context-free languages can be recognized by a deterministic pushdown automata, the language recognized by M_2, which is L_2, is a deterministic context-free language.

b)

CF: context-free, $\overline{CF}$: complement of context-free,
DCF: deterministic context-free, R: regular