CENG 280

Formal Languages and Abstract Machines

Homework 5 - Sample Solutions

Question 1 (20 points)

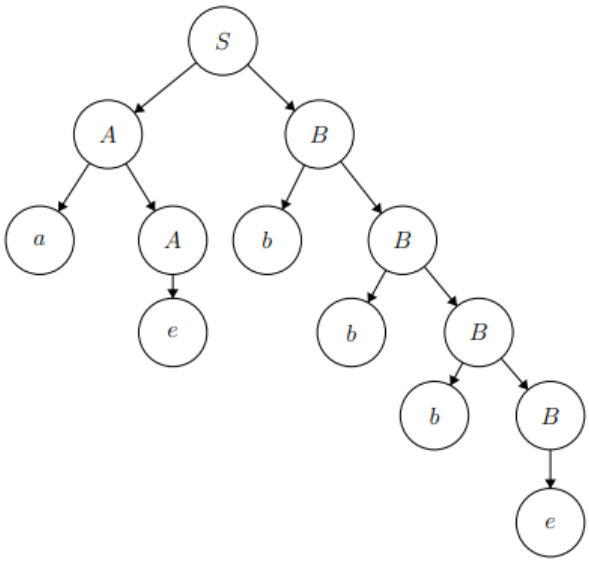
G_1 represents 0^n1^n or 1^n0^n.
G_1 is ambiguous because $\epsilon \in G_1$ and there are two derivations for ϵ; $S \to A \to \epsilon$ and $S \to B \to \epsilon$.

Question 2 (30 points)

a) There are two derivations for string 'aa';
$S \to AB \to A \to aA \to aaA \to aa$ and
$S \to AB \to A \to aA \to aa$

b) $G_2' = \{V, \Sigma, R, S\}$ where $V = \{a, b, S, A, B\}, \Sigma = \{a, b\}$ and R is;
$S \to AB$
$A \to aA|\epsilon$
$B \to bB|\epsilon$

c) $S \to AB \to aAB \to aB \to abB \to abbB \to abbbB \to abbb$



Question 3

The solutions below are taken from the textbook's solution manual.

a) (i) $L = \{ca^m b^n : m \neq n\}\{da^m b^{2m} : m \geq 0\}$ is deterministic context-free because $L\$$ is accepted by the following deterministic pushdown automaton:

$$
\begin{aligned}
K &= \{p, q, r, s, t, u, v, w\} \\
\Sigma &= \{a, b, c, d, \$\} \\
\Gamma &= \{a, \perp\} \\
s &= p \\
F &= \{x, u, w\} \\
\Delta &= \{((p, c, e), (q, \perp)), ((p, d, e), (r, \perp)), \\
&\quad ((q, a, e), (q, a)), ((q, b, a), (s, e)), \\
&\quad ((q, b, \perp), (t, e)), ((q, \$, a), (u, e)), \\
&\quad ((s, b, a), (s, e)), ((s, b, \perp), (t, e)), \\
&\quad ((t, b, e), (t, e)), ((t, \$, e), (x, e), \\
&\quad ((s, \$, a), (u, e)), \\
&\quad ((u, e, a), (u, e)), ((r, a, e), (r, aa)), \\
&\quad ((r, \$, \perp), (w, e)), ((r, b, a), (v, e)), \\
&\quad ((v, b, a), (v, e)), ((v, \$, \perp), (w, e))\}
\end{aligned}
$$

a) (ii) $L = \{a^m c b^n : m \neq n\} \cup \{a^m d b^{2m} : m \geq 0\}$ is deterministic context-free because $L\$$ is accepted by the following deterministic pushdown automaton:

$$
\begin{aligned}
K &= \{p, q, r, s, t, u, v, w\} \\
\Sigma &= \{a, b, c, d, \$\} \\
\Gamma &= \{a, \perp\} \\
s &= p \\
F &= \{t, v, w\} \\
\Delta &= \{((p, e, e), (q, \perp)), ((q, a, e), (q, aa)), \\
&\quad ((q, c, e), (r, e)), ((q, d, e), (s, e)), \\
&\quad ((r, b, aa), (r, e)), ((r, \$, aa), (t, e), \\
&\quad ((t, e, aa), (t, e)), ((r, b, \perp), (u, e)), \\
&\quad ((u, b, e), (u, e)), ((u, \$, e), (v, e)), \\
&\quad ((s, b, a), (s, e)), ((s, \$, \perp), (w, e))\}
\end{aligned}
$$

b)