CS-302 HW6

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Question-1

a) $G_1 = (V, \Sigma, R, S)$, $V = \{S, A, B, C, D, E\}$, $\Sigma = \{a, b, c\}$

~~only~~ E is nullable in G After removing the null transitions.

$S \to AE \mid EB \mid A \mid B \mid C$; $A \to aA \mid a$; $B \to Bb \mid b$; $C \to Cc$

$D \to aCb \mid a \mid b \mid c$; $E \to aEb \mid ab$

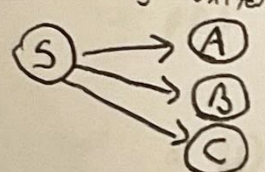
b) $G_2 = (V, \Sigma, R, S)$, $V = \{S, A, B, C, D, E\}$, $\Sigma = \{a, b, c\}$

There is only unitary transition in S.

$S \to AE \mid EB \mid aA \mid a \mid Bb \mid b \mid Cc$; $A \to aA \mid a$; $B \to Bb \mid b$; $C \to Cc$

$D \to aCb \mid a \mid b \mid c$; $E \to aEb \mid ab$

The graph representing unitary transition



c) I will firstly eliminate nongenerating then I will eliminate nonreachable. In G_2, C is not generating since it can never terminate. We need to eliminate the transitions that include C.

$G_{2,1} = (V, \Sigma, R, S)$, $V = \{S, A, B, D, E\}$, $\Sigma = \{a, b, c\}$

$S \to AE \mid EB \mid aA \mid a \mid Bb \mid b$; $A \to aA \mid a$; $B \to Bb \mid b$

$D \to a \mid b \mid c$; $E \to aEb \mid ab$

Now, we need to Eliminate non reachable the only non-reachable variable is D.

$G_3 = (V, \Sigma, R, S)$, $V = \{S, A, B, E\}$, $\Sigma = \{a, b\}$

$S \to AE \mid EB \mid aA \mid a \mid Bb \mid b$; $A \to aA \mid a$; $B \to Bb \mid b$

$E \to aEb \mid ab$

d) CNF for G_3, we need to introduce new transitions to replace terminal symbols. $T_a \to a$; $T_b \to b$

$S \to AE \mid EB \mid T_aA \mid a \mid BT_b \mid b$; $A \to T_aA \mid a$; $B \to BT_b \mid b$; $E \to T_aET_b \mid T_aT_b$

* S, A, and B already in the Chomsky Normal form for the E we need to introduce a new transition P to make it CNF. $P \to ET_b$

Overall all transitions:

$S \to AE \mid EB \mid T_aA \mid BT_b \mid a \mid b$; $A \to T_aA \mid a$; $B \to BT_b \mid b$; $E \to T_aP \mid T_aT_b$; $P \to ET_b$

e) The language where all of the a's comes before all of the b's.

$L(CNF) = (s \in a^i b^j \mid i \geq 0,\ j \geq 0 \text{ and not}(i = 0 \text{ and } j = 0)\}$

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Question-2

a) G is a CFG. $G = (V, T, P, S)$

$V = \{S, A, B\}$, $T = \{ (,), \{,\}, [,] \}$

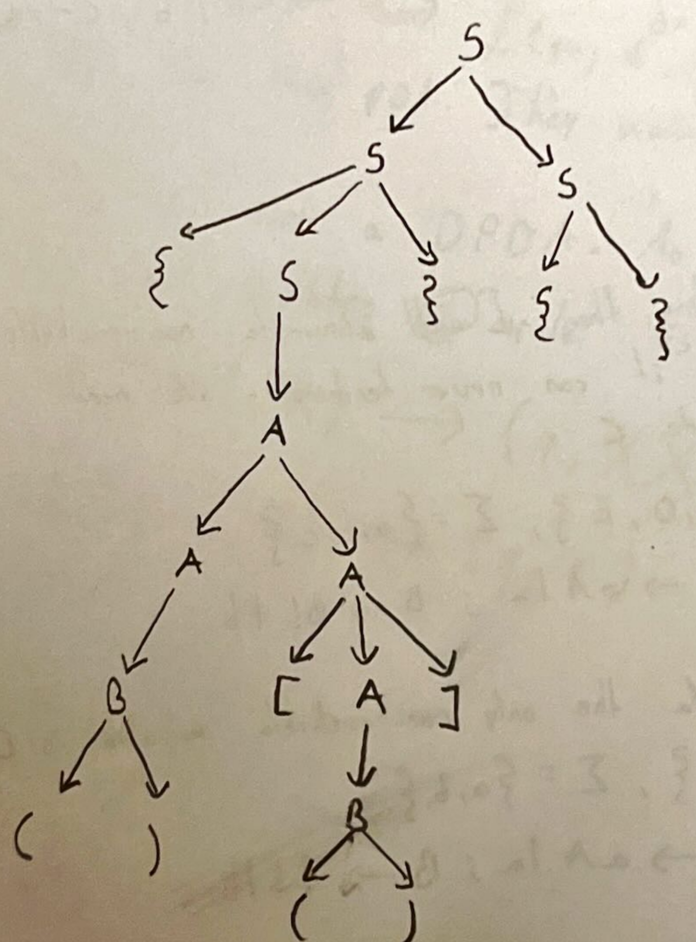
P:

$S \rightarrow \{S\} \mid SS \mid A \mid \{\}$

$A \rightarrow [A] \mid AA \mid B \mid []$

$B \rightarrow (B) \mid BB \mid ()$

b) Parse tree of $\{()[()]\}\{\}$



CS-302- HW6

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Exercise
6.4.1

a) This is not a DPDA, In DPDA, the following propeties should hold:

① $|\delta(q, a, X)| \leq 1$ where $q \in Q$, $a \in \Sigma$, $X \in \Gamma$

② if $|\delta(q, a, X)| = 1$ then $|\delta(q, e, X)| = 0$.

There are productions that violates ② rule.

$\delta(q_0, 0, 0)$ and $\delta(q_0, \epsilon, 0)$ are both productions to rule for this PDA. They violate the ② rule.

b) This is not a DPDA. As I stated the rules in part a) This PDA violates ② rule as well.

$\delta(q, 1, X) \rightarrow (q, XX)$

$\delta(q, e, X) \rightarrow (q, \epsilon)$

Violation of the ② rule.

CS-302 HW-6

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Exercise 6.4.2

a) P is a DPDA

$P = (Q, \Sigma, \Gamma, \delta, q_0, Z_0, F)$

$Q = \{q_0, q_1, q_2, f_1, f_2\}$; $\Sigma = \{0, 1\}$

$\Gamma = \{0, Z_0\}$

$F = \{f\}$

$\delta(q_0, e, Z_0) = (f_1, Z_0)$

$\delta(f_1, 0, Z_0) = (q_1, 0Z_0)$

$\delta(f_1, 1, Z_0) = (f_2, Z_0)$

$\delta(q_1, 0, 0) = (q_1, 00)$

$\delta(q_1, 1, 0) = (q_2, e)$

$\delta(q_2, 1, 0) = (q_2, e)$

$\delta(q_2, e, Z_0) = (f_2, Z_0)$

$\delta(f_2, 1, Z_0) = (f_2, Z_0)$

b) P is a DPDA

$P = (Q, \Sigma, \Gamma, \delta, q_0, Z_0, F)$

$Q = \{q_0, q_1, N\}$, $\Sigma = \{0, 1\}$, $\Gamma = \{0, Z_0\}$, $F = \{q_0, q_1\}$

$\delta(q_0, 0, Z_0) = (q_0, 0Z_0)$

$\delta(q_0, 0, 0) = (q_0, 00)$

$\delta(q_0, 1, Z_0) = (N, Z_0)$

$\delta(q_0, 1, 0) = (q_1, e)$

$\delta(q_1, 1, 0) = (q_1, e)$

$\delta(q_1, 1, Z_0) = (N, Z_0)$

$\delta(N, 1, Z_0) = (N, Z_0)$

CS-302 HW-6

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Exercise 6.4.2

c) P is a DPDA

$P = (Q, \Sigma, \Gamma, \delta, q_0, Z_0, F)$

$Q = \{q_0, q_1, q_2, q_3, f_1, f_2, f_3\}$

$\Sigma = \{0, 1\}$

$\Gamma = \{Z_0, 0, 1\}$, $F = \{f_1, f_2, f_3\}$

$\delta(q_0, e, Z_0) \rightarrow (f_1, Z_0)$

$\delta(f_1, 1, Z_0) \rightarrow (f_2, 1Z_0)$ ⟶ only one $\delta(f_2, 1, 1) \rightarrow (f_2, 11)$

$\delta(f_1, 0, Z_0) \rightarrow (q_1, 0Z_0)$

$\delta(q_1, 0, 0) \rightarrow (f_1, 00)$

$\delta(f_1, 0, 0) \rightarrow (q_1, 00)$ ⟶ Accept or reject strings without 1.

$\delta(f_1, 1, 0) \rightarrow (q_2, 0)$

$\delta(q_1, 1, 0) \rightarrow (q_2, 0)$

$\delta(q_2, 1, 0) \rightarrow (q_2, 0)$

$\delta(q_2, 0, 0) \rightarrow (q_3, e)$

$\delta(q_3, 0, 0) \rightarrow (q_3, e)$

$\delta(q_3, e, Z_0) \rightarrow (f_3, Z_0)$ ⟶ final state acceptance