Exercise 9.1

1. L can contain a word of arbitrary length, and it cannot be recognized by a computer with only finite memory

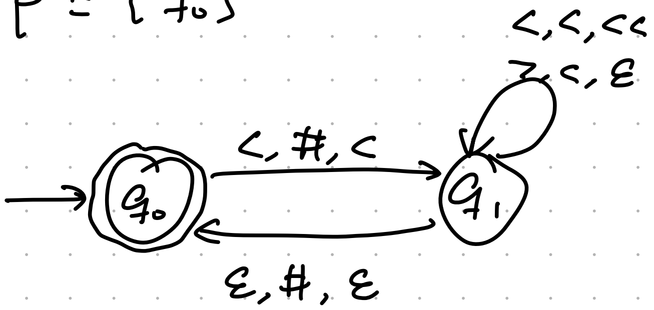
2. $G = (\{S\}, \{<, >\}, P, S)$

where $P = \{ S \to \varepsilon \mid SS \mid <S> \}$

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

where $Q = \{q_0, q_1\}$ $\Sigma = \{<, >\}$ $\Gamma = \{<, >, \#\}$.

$q_0 = q_0$, $Z_0 = \#$, $F = \{q_0\}$



$\delta(q_0, <, \#) = \{(q_1, <)\}$

$\delta(q_1, <, <) = \{(q_1, <<)\}$.

$\delta(q_1, >, <) = \{(q_1, \varepsilon)\}$.

$\delta(q_1, \varepsilon, \#) = \{(q_0, \varepsilon)\}$

$\delta(q, x, z) = \emptyset$ everywhere else

4. $(q_0, <<><>>, \#) \vdash (q_1, <><>>, <) \vdash (q_1, ><>>, <<)$

$\vdash (q_1, <>>, <) \vdash (q_1, >>, <<) \vdash (q_1, >, <) \vdash (q_1, \varepsilon, \#)$

$\vdash (q_0, \varepsilon, \#)$

$\therefore <<><>> \in L(P)$

- Exercise 10.3

1. $N_\varepsilon = \phi$

$$\text{first}(F) = \text{first}(F*) \cup \text{first}((R)) \cup \text{first}(a) \cup \text{first}(b) \cup \text{first}(0) \cup \text{first}(1)$$

since $\text{first}(a\alpha) = \{a\}$, $\therefore$ $\text{first}(0) = \{0\}$ $\text{first}(1) = \{1\}$

$\text{first}(a) = \{a\}$ $\text{first}(b) = \{b\}$

$\text{first}((R)) = \{(\}$

since $\text{first}(A\alpha) = \text{first}(A) \cup \phi$, if $A \notin N_\varepsilon$

$\therefore$ $\text{first}(F*) = \text{first}(F) \cup \phi = \text{first}(F)$, $F \notin N_\varepsilon$

$\therefore$ $\text{first}(F) = \text{first}(F) \cup \{(, 1, 0, a, b\}$.

since first(F) is the smallest set satisfying the above equation

$\therefore$ $\text{first}(F) = \{(, 1, 0, a, b\}$

2. first(T) = first$(T \cdot F)$ $\cup$ first(F).

since $T \notin N_\varepsilon$,

first$(T \cdot F)$ = first$(T) \cup \phi$ = first(T)

since first$(F) = \{0, 1, a, b, (\}$

$\therefore$ first(T) = first$(T) \cup \{0, 1, a, b, (\}$.

first(T) is the smallest set satisfying the equation.

$\therefore$ first$(T) = \{0, 1, a, b, (\}$.

$\therefore$ first$(T \cdot F)$ = first$(T) = \{0, 1, a, b, (\}$

$\because$ $T \to T \cdot F \mid F$ and first$(T \cdot F) \cap$ first$(F) = \{0, 1, a, b, (\}$.

$\therefore$ This breaks the rule of LL(1)

$\therefore$ G is not LL(1)

3. $F \to (R)F' \mid aF' \mid bF' \mid 0F' \mid 1F'$

$F' \to \varepsilon \mid *F'$

$T \to FT'$

$T' \to \varepsilon \mid \cdot FT'$

$R \to FR'$

$R' \to \varepsilon \mid +TR'$

· Exercise 11.4

$M = (Q, \Sigma, T, \delta, q_0, B, F)$

$Q = \{q_0, q_1, q_2, q_3, q_4, q_5, q_6, q_7, q_8\}$

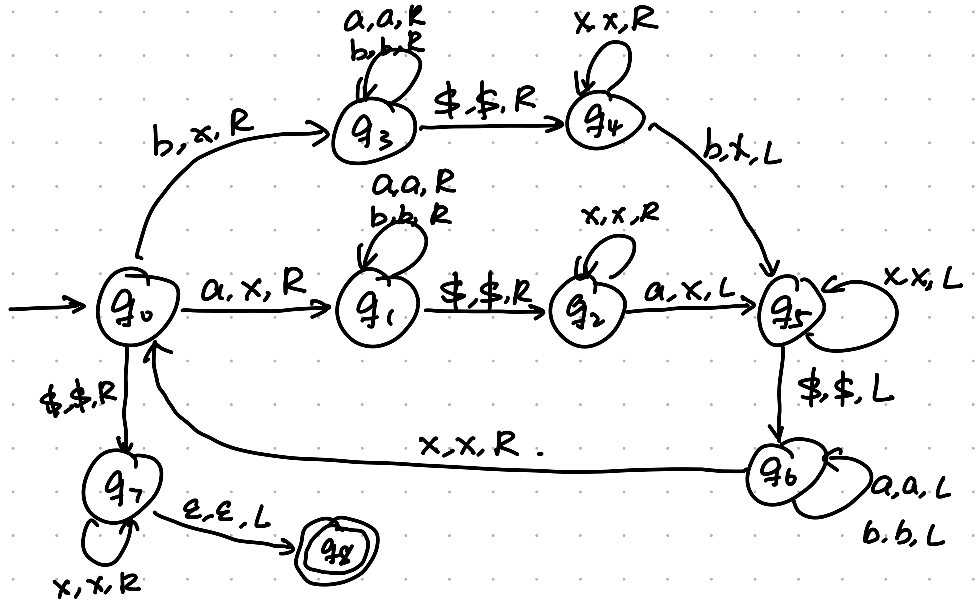
$\Sigma = \{a, b, \$\}$

$T = \Sigma \cup \{x\}$

$q_0 = q_0$

$B =$

$F = \{q_8\}$



$\delta(q_0, a) = (q_1, x, R)$

$\delta(q_0, b) = (q_3, x, R)$

$\delta(q_0, \$) = (q_7, \$, R)$

$\delta(q_1, a) = (q_1, a, R)$

$\delta(q_1, b) = (q_1, b, R)$

$\delta(q_1, \$) = (q_2, \$, R)$

$\delta(q_2, x) = (q_2, x, R)$

$\delta(q_2, a) = (q_5, x, L)$

$\delta(q_3, a) = (q_3, a, R)$

$\delta(q_3, b) = (q_3, b, R)$

$\delta(q_3, \$) = (q_4, \$, R)$

$\delta(q_4, x) = (q_4, x, R)$

$\delta(q_4, b) = (q_5, x, L)$

$\delta(q_5, x) = (q_5, x, L)$

$\delta(q_5, \$) = (q_6, \$, L)$

$\delta(q_6, a) = (q_6, a, L)$

$\delta(q_6, b) = (q_6, b, L)$

$\delta(q_6, x) = (q_0, x, R)$

$\delta(q_7, x) = (q_7, x, R)$

$\delta(q_7, \varepsilon) = (q_8, \varepsilon, L)$

$\delta(q, x) =$ stop everywhere else

$(\varepsilon, q_0, ab\$ab) \vdash (x, q_1, b\$ab) \vdash (xb, q_1, \$ab)$

$\vdash (xb\$, q_2, ab) \vdash (xb, q_5, \$xb) \vdash (x, q_6, b\$xb)$

$\vdash (\varepsilon, q_6, xb\$xb) \vdash (x, q_0, b\$xb) \vdash (xx, q_3, \$xb)$

$\vdash (xx\$, q_4, xb) \vdash (xx\$x, q_4, b) \vdash (xx\$, q_5, xx)$

$\vdash (xx, q_5, \$xx) \vdash (x, q_6, x\$xx) \vdash (xx, q_0, \$xx)$.

$\vdash (xx\$, q_7, xx) \vdash (xx\$x, q_7, x) \vdash (xx\$xx, q_7, \varepsilon)$.

$\vdash (xx\$x, q_8, x)$

$\therefore ab\$ab \in L(M)$