5.1 (b)

**1.** Find context-free grammars for the following languages:

(a) $L = a^n b^n$, $n$ is even.

(b) $L = a^n b^n$, $n$ is odd.

(c) $L = a^n b^n$, $n$ is a multiple of three.

$S \to aaSbb \mid ab$

5.9(a)

**9.** Find context-free grammars for the following languages (with $n \geq 0$, $m \geq 0$).

(a) $L = \{a^n b^m : n \leq m + 3\}$. $n - 3 \leq m$

$S \to aS_1 \mid aaS_1 \mid aaaS_1 \mid S_1$

$S_1 \to aS_1b \mid S_1b \mid \lambda$

5.9(e)

(e) $L = \{w \in \{a, b\}^* : n_a(w) \neq n_b(w)\}$.

(f) $L = \{w \in \{a, b\}^* : n_a(w) > n_b(w)$, where $w$ i

$S \to S_1 \mid S_2$

$S_1 \to S_1S_1 \mid aS_1b \mid bS_1a \mid A$

$A \to aA \mid a$

$S_2 \to S_2S_2 \mid aS_2b \mid bS_2a \mid B$

$B \to bB \mid b$

5.12(e)

(e) $L = \{a^n b^m c^k, k = n + 2m\}$.

(f) $L = \{a^n b^m c^k, k \neq n + m\}$

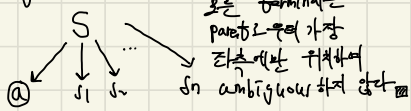
$S \to aSc \mid B$, $B \to bBcc \mid \lambda$

5.2(2)

is an s-grammar.

**2.** Show that every s-grammar is unambiguous.

def) S grammar $A \to ax$, $x \in V^*$, $(A, a)$ 쌍이 모든 $S \to aS_1 | S_2 \cdots S_n$ 의 형태로 갖고 있는 parsing tree 형태로 나타내면 다음과 같고, 모든 terminal은 parsing tree의 가장 좌측에만 위치하며 $S_n$ ambiguous 하지 않다.



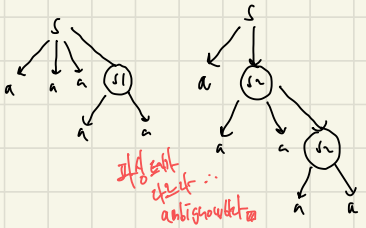

5.2.15

expressions on $\Sigma = \{a, b\}$.

**15.** Is it possible for a regular grammar to be ambiguous?

답) $S \to aaaS_1 | aS_2$
$S_1 \to aa | aaS_1$
$S_2 \to aa | aaS_2$

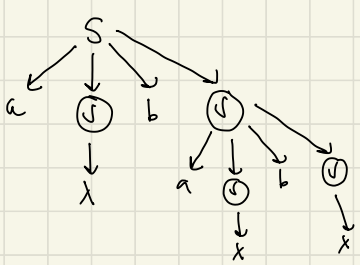
left linear 혹은 regular

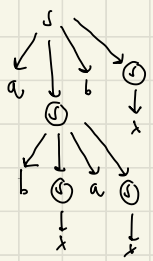



파생트리 다르다 ∴ ambiguous하다

**17.** Show that the following grammar is ambiguous:

$$S \to aSbS \,|\, bSaS \,|\, \lambda.$$




abab의 파생트리 다르다 ∴ ambiguous하다