Joseph Morgan

Homework 15

CISP440

Section 10.3

In Exercises 1-6, determine whether the givin grammar is context-sensitive, context-free, regular or nonoe of these. Give all characterizations that apply.

2. $T = \{a, b, c\}, N = \{\sigma, A, B\}$**, with productions**

$\sigma \to b\sigma$, $AB \to BA$, $A \to a$,
$\sigma \to aA$, $A \to bA$, $\sigma \to b$,

and σ **as a starting point.**

This grammar is context context-sensitive, as evidenced by the production that has more than one symbol on the left-hand-side.

3. $T = \{a, b\}, N = \{\sigma, A, B\}$**, with productions**

$\sigma \to A$, $A \to aa$, $AB \to ABB$,
$\sigma \to AAB$, $Bb \to ABb$, $B \to b$
$Aa \to ABa$,

and σ **as a starting point.**

This grammar is also context-sensitive, because of the $Bb \to ABb$, $Aa \to ABa$ and $AB \to ABB$ productions.

In Exercises 7-11, show that the given string α ***is in L(G) for the given grammer G by giving a definition of*** α

8. ***abab*****, Exercise 2**

$\sigma \to AB$
$AB \to aAB$
$aAB \to aABb$
$aABb \to aBAb$
$aBAb \to abAb$
$abAb \to abab$

11. ***abaabbabba*****, Exercise 5**

$< S > \to a < A > \to ab < B > \to aba < S > \to abaa < A > \to abaab < B >$
$\to abaabb < A > \to abaabba < S > \to abaabbab < S > \to abaabbabb < S > \to abaabbabba$

12. Write the grammars of Examples 10.3.4 and 10.3.9 and Exercises 1-4 and 6 in BNF

10.3.4:

$< \sigma >::= b < \sigma > |a < S >$

$< S >::= b < S > |b$

10.3.9:

$< \sigma >::= a < A >< B > |a < B >$

$< A >::= a < A >< C > |a < C >$

$< B >::=< D > c$

$< D >::= b$

$< C >< D >::=< C >< E >$

$< C >< E >::=< D >< E >$

$< D >< E >::=< D >< C >$

$< C > c ::=< D > cc$

Exercise 1

$< \sigma >::= b < \sigma > |a < A > |b$

$< A >::= b < A > |a < \sigma > |a$

Exercise 2

$< \sigma >::=< A >< B > |a$

$< A >< B >::=< B >< A >$

$< A >::= a\sigma|b < A > |a$

Exercise 3

$< \sigma >::=< A > | < A >< A >< B >$

$< A > a ::=< A >< B > a$

$< A >::= aa$

$< B > b ::=< A >< B > b$

$< A >< B >::=< A >< B >< B >$

$< B >::= b$

Exercise 4

$< \sigma >::=< B >< A >< B > | < A >< B >< A >$

$< A >::=< A >< B > |a < A > |ab$

$< B >::=< B >< A > |b$

Exercise 6

$< \sigma >::=< A >< A > \sigma$

$< A >< A >::=< B >$

$< B >::= b < B >$

$< A >::= a$

In Exercises 15-24, write a grammar that generates the strings having the givin property.

16. Strings over $\{a, b\}$ starting with a.

$T = \{a, b\}, N = \{\sigma, A, B\}$
$< \sigma >::=< A >< B > | < B >$
$< A >::= a|b$
$< B >::= ab$

17. Strings over $\{a, b\}$ containing a.

$T = \{a, b\}, N = \{\sigma, A, B, C\}$
$< \sigma >::=< \sigma >< C > | < C >< \sigma >$
$< A >::= a|b$
$< B >::= ab$
$< C >::=< A >< B > | < B >< A >$

19. Integers with no leading 0's.

$T = \{0, 1, 2, 3, 4, 5, 6, 7, 8, 9\}, N = \{\sigma, NONZERO, INT\}$
$< \sigma >::=< NONZERO > | < NONZERO >< INT > |0$
$< NONZERO >::= 1, 2, 3, 4, 5, 6, 7, 8, 9$
$< INT >::= 0, 1, 2, 3, 4, 5, 6, 7, 8, 9$

21. Exponential numbers.

$T = \{0 - 9, ., E, -, +\}, N = \{\sigma, I, B, S\}$
$< \sigma >::= 0| < B > | < B > E < I >$
$< I >::=< S > 0 - 9| < S >< I > 0 - 9$
$< B >::=< I > | < I > . < I > |$
$< S >::= +| - |\lambda$

28

Yes, any string generated would have equal numbers of a's and b's. You can tell because the only productions each add one a and one b, just in different places in the string.