CS 3186 --- Assignment #10

(I) Define/Describe a context free grammar G and the language L(G)

Context free grammar G = G(V,T,S,P)
V = Variables, S = Starting variable, T = Terminals, P = Production rules
$L(G) = \{w: S =>^* w, w \in T^*\}$

(II) Define/Describe a sentential form in a derivation.

The sentential form of a sentence follows:
$S => w_1 => w_2 => \ldots => w_n => w$
Where w_x are sentential forms of the derivation of w. Apply each derivation by replacing a variable with another variable or terminal based on the production rules.

(III) Differentiate between a leftmost and a rightmost derivation sequence.

In a leftmost derivation sequence, the variables are replaced one at a time from left to right.
In a rightmost derivation sequence, the variables are replaced one at a time from right to left.

(IV) Define an ambiguous grammar.

An ambiguous grammar is when two or more derivatives can end up with the same string.

(V) Sometimes only the production rules of a grammar are defined with the starting nonterminal given by the first rule.
R-> XRX | S
S-> aTb | bTa
T-> XTX | X | λ
X->a | b

a. What are the variables of G?
R, S, T, X

b. What are the terminals of G?
a, b, λ

c. Which is the start variable of G?
R

d. Give 3 strings of varying lengths in L(G).
ab, aaba, bbabaa, babaabb

e. Give 3 strings *not* in L(G).
aa, bbb, λ, aaaaa…...

f. True or False: T => aba
False, T => XTX | X | λ, none directly give aba

g. True or False: T =>* aba.
True, T => XTX => XXX => aba

h. True or False: T => T
False, T => XTX | X | λ, T can't lead back to T

i. True or False: T =>* T.

False, T => XTX | X | λ ,T can't lead back to a single T

j. True or False: XXX =>* aba.

True, X => a | b so XXX => aba

k. True or False: X =>* aba.

False, X => a | b there are only terminals X can lead to

l. True or False: T =>* XX.

True, T => XTX | X | λ, so T => XTX => X λX = XX

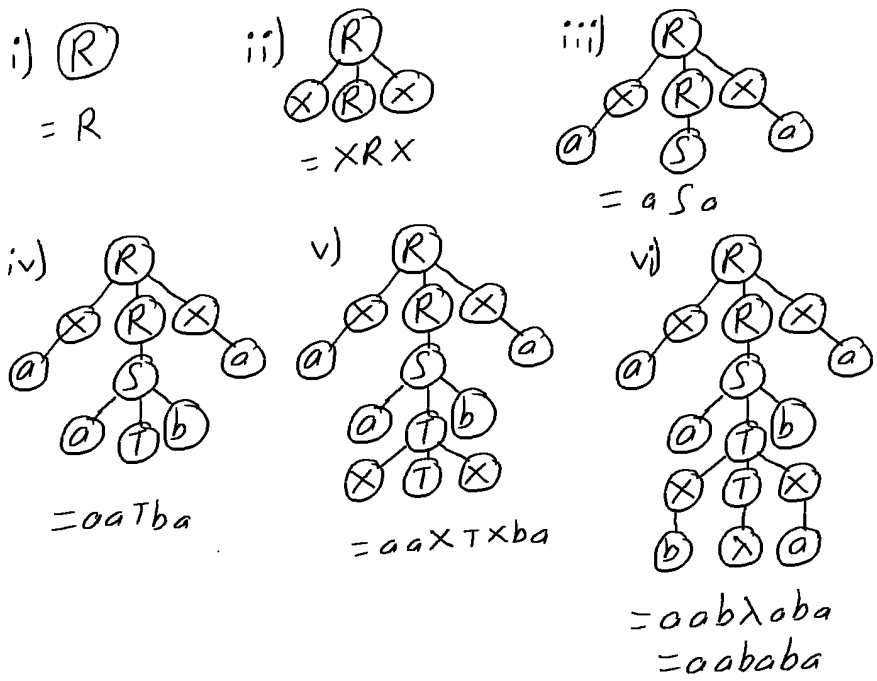
m. True or False: T =>* XXX

True, T => XTX | X | λ, so T => XTX => XXX

n. True or False: S =>* λ

False, S => aTb | bTa which have terminals, so S can't end up with only λ

(v) Using the rule of the above grammar, using leftmost derivation (or using a rightmost derivation) show step by step the partial derivation trees, yield for each of the sentential forms in deriving aababa (as described in the notes)



(VI) Show G is ambiguous, give two leftmost, two rightmost & two derivation trees

G = ({S,A,B,,D}, {a,b,c},S,P}

Where P, the production rules are:

$$S \rightarrow BC \mid AD$$
$$B \rightarrow aBb \mid \lambda$$
$$C \rightarrow cC \mid \lambda$$
$$A \rightarrow aA \mid \lambda$$
$$D \rightarrow bDc \mid \lambda$$

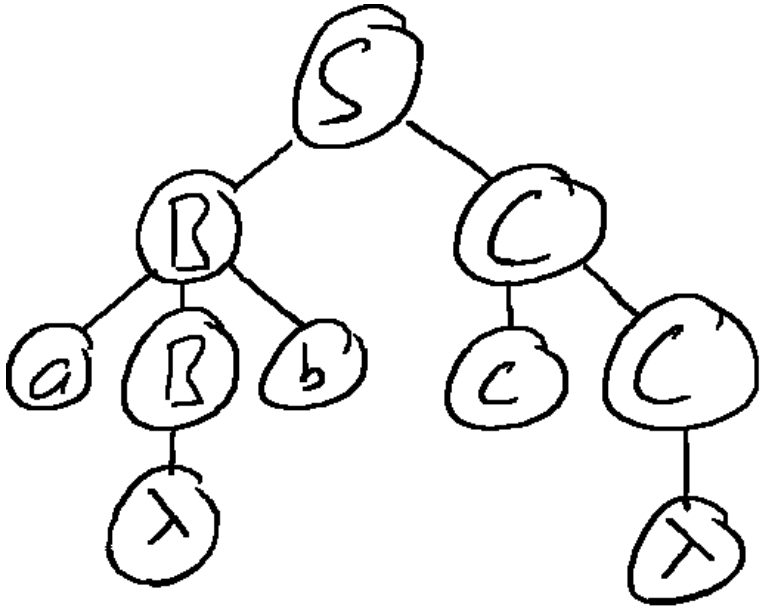
Leftmost:

S => BC => aBbC => aλbC => aλbcC => aλbcλ = abc
S => AD => aAD => aλD => aλbDc => aλbλc = abc

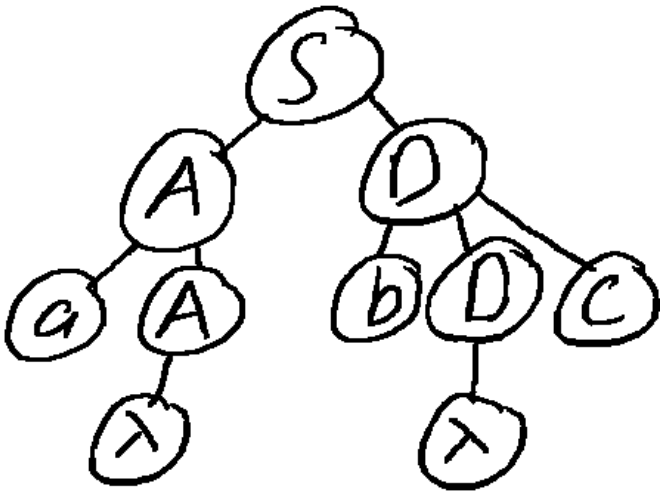
Rightmost:

S => BC => BcC => Bcλ => aBbcλ => aλbcλ = abc
S => AD => AbDc => Abλc => aAbλc => aλbλc = abc

Derivation Trees



$= abc$



$= abc$