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Assignment 2

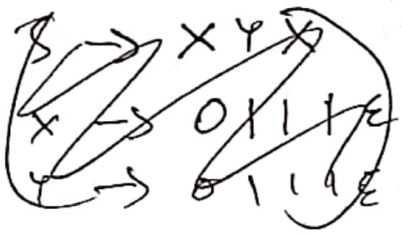
pg 128 ; 2.4

a) $\{w \mid w$ has atleast 3 1s$\}$ $\Sigma = \{0, 1\}$

$S \rightarrow X1X1X1X$

$X \rightarrow 0X \mid 1X \mid \varepsilon$

b) $\{w \mid w$ starts & ends with same symbol$\}$



$S \rightarrow 0X0 \mid 1X1 \mid \varepsilon$

$X \rightarrow 0 \mid 1 \mid \varepsilon \mid S$

c) $\{w \mid w$ length is odd$\}$

$S \rightarrow 0S0 \mid 0S1 \mid 1S0 \mid 1S1 \mid 0 \mid 1$

d) $\{w \mid w$ length is odd and 0 in middle$\}$

$S \rightarrow 0 \mid 0S0 \mid 0S1 \mid 1S0 \mid 1S1$

e) $\{w \mid w = w^R$; where w^* is palindrome$\}$

$S \rightarrow 0S_1 0 \mid 1S_1 1 \mid \varepsilon$

$S_1 \rightarrow 0 / 1 / S$

f) $\{w \mid w$ is empty set$\}$ $S \rightarrow \varepsilon$

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2.9

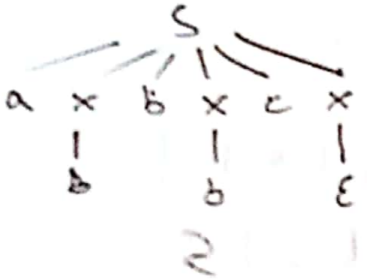
$A = \{a^i b^j c^k \mid i = j \text{ or } j = k \text{ where } i, j, k \geq 0\}$

$S \rightarrow aXbXcX$

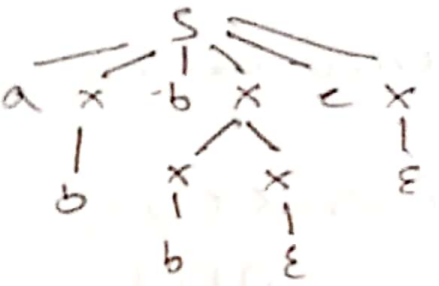
$X \rightarrow a \mid b \mid c \mid XX \mid \varepsilon$

For the string, abbbc

(i)



(ii)



∴ Ambiguous because more than 1 way to produce the string

2.14

A → BAB | B | ε

B → 00 | ε

(i) A′ → A

A → BAB | B | ε

B → 00 | ε

(ii) A′ → A

B → $X_0X_0 \mid \varepsilon$

$X_0 \rightarrow 0$

A → BAB | B | ε

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iii) $A' \to A$

$A \to BB' \mid B \mid \varepsilon$

$B' \to AB$

$B \to X_0 X_0 \mid \varepsilon$

$X_0 \to 0$

iv) $A' \to A \mid \varepsilon$

$A \to BB' \mid B \mid B' \mid$

$B' \to AB \mid B$

$B \to X_0 X_0$

$X_0 \to 0$

v) $A' \to BB' \mid X_0 X_0 \mid AB \mid \varepsilon$

$A \to BB' \mid X_0 X_0 \mid AB$

$B' \to AB \mid X_0 X_0$

$B \to X_0 X_0$

$X_0 \to 0$

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2.28

b) {w | number of a & b is equal}

$S \rightarrow aSb / bSa / \varepsilon$

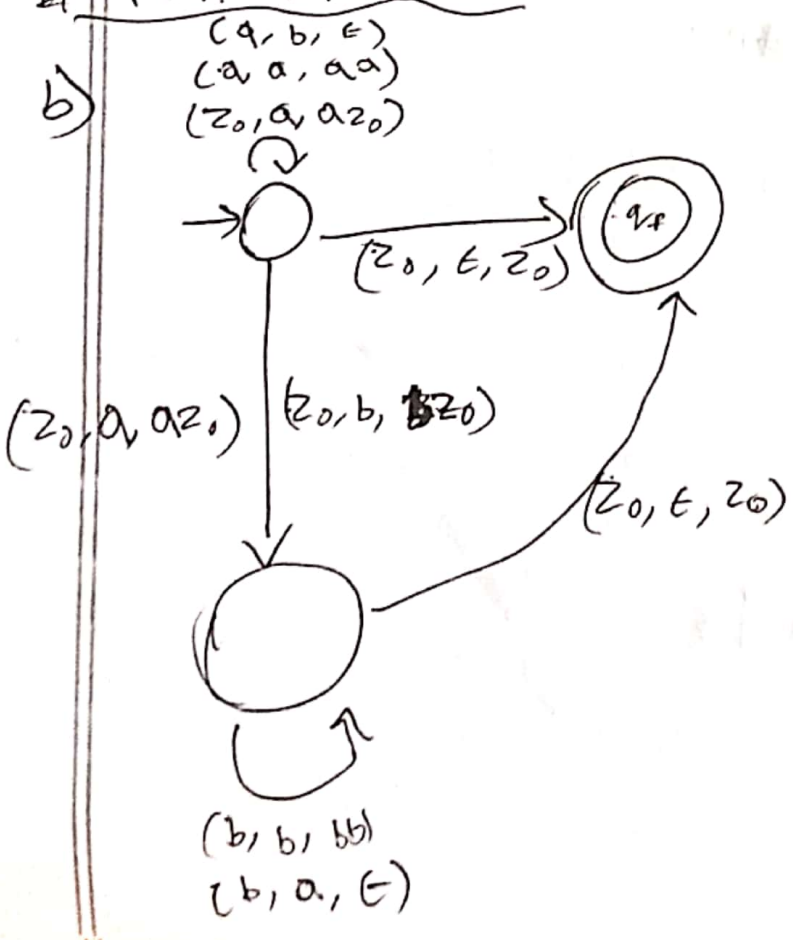
c) {w | number of a atleast 2 number of b's}

$S \rightarrow AaSbA / AbSaA / A$

$A \rightarrow aA / \varepsilon$

PDA for 2.28

b)



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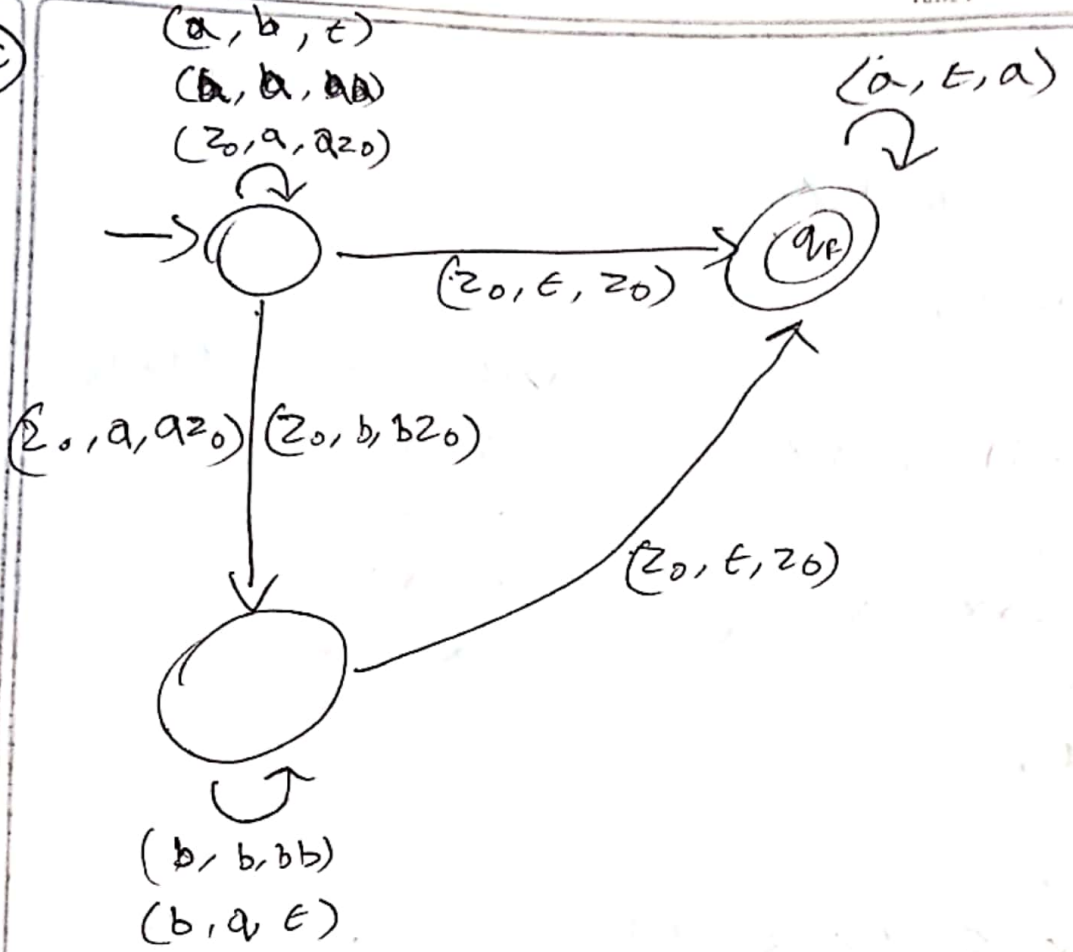
c)



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CYK

b) $S \to aSb / bSA / \epsilon$

Convert to CNF

i) $S' \to S$

$S \to aSb / bSA / \epsilon$

ii) $S' \to S$

$S \to X_a S X_b / X_b S X_a / \epsilon$

$X_a \to a$

$X_b \to b$

iii) $S' \to S$

$S \to X_a S_1 / X_b S_2 / \epsilon$

$S_1 \to S X_b /$

$S_2 \to S X_a$

$X_a \to a$

$X_b \to b$

iv) $S' \to S / \epsilon$

$S \to X_a S_1 / X_b S_2$

$S_1 \to S X_b / X_b$

$S_2 \to S X_a / X_a$

$X_a \to a$

$X_b \to b$

v) $S' \to X_a S_1 / X_b S_2 / \epsilon$

$S \to X_a S_1 / X_b S_2$

$S_1 \to S X_b / b$

$S_2 \to S X_a / a$

$X_a \to a$

$X_b \to b$

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Now, for string "aaa bbb"

6	$\{S'\}$					
5	$\emptyset$	$\emptyset$				
4	$\emptyset$	$\{S\}$	$\emptyset$			
3	$\emptyset$	$\emptyset$	$\emptyset$	$\emptyset$		
2	$\emptyset$	$\emptyset$	$\{S\}$	$\emptyset$	$\emptyset$	
1	$\{X_a, S_2\}$	$\{X_a, S_2\}$	$\{X_a, S_2\}$	$\{X_b, S_1\}$	$\{X_b, S_1\}$	$\{X_3, S_1\}$
	a	a	a	b	b	b

4 : aabb => $X_a S_1 + X_b$

X_a S_1 X_b

$+ S_1 +$

$S + X_b \Rightarrow S_1$

4 : aabb => $X_a + S X_b$

X_a S X_b

S_1

$\Rightarrow S$

Sub :

i) $S \to A_a S bA / A b S_a A / A$

$A \to aA / \in$

Convert to CNF

1) $S' \to S$

$S \to A_a S_b A / A b S_a A / A$

$A \to aA / \varepsilon$

ii) $S' \to S$

$S \to A X_a S X_b A / A X_b S X_a A / A$

$A \to X_a A / \varepsilon$

$X_a \to a$

$X_b \to b$

iii) ~~$S' \to S$~~

$S \to AA_1 / AA_2 / A$

$A_1 \to SB_1$

$B_1 \to X_b A$

$A_2 \to X$

iii) $S' \to S$

$S \to AA_1 / AB_1 / A$

$A_1 \to X_a A_2$

$A_2 \to S A_3$

$A_3 \to X_b A$

$B_1 \to X_b B_2$

$B_2 \to S B_3$

$B_3 \to X_a A$

$A \to X_a A / \varepsilon$

$X_a \to a$

$X_b \to b$

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iv) $S' \to S / \varepsilon$

$S \to AA_1 / A_1 / AB_1 / B_1 / A$

$A_1 \to X_a A_2$

$A_2 \to S A_3$

$A_3 \to X_b A / X_b$

$B_1 \to X_b B_2$

$B_2 \to S B_3$

$B_3 \to X_a A / X_a$

$A \to X_a A$

$X_a \to a$

$X_b \to b$

v) $S' \to \varepsilon / AA_1 / A_1 / AB_1 / B_1 / X_a A$

$S \to AA_1 / X_a A_2 / AB_1 / X_b B_2 / X_a A$

$A_1 \to X_a A_2$

$A_2 \to S A_3$

$A_3 \to X_b A / b$

$B_1 \to X_b B_2$

$B_2 \to S B_3$

$B_3 \to X_a A / a$

$A \to X_a A$

$X_a \to a$

$X_b \to b$

Sub :

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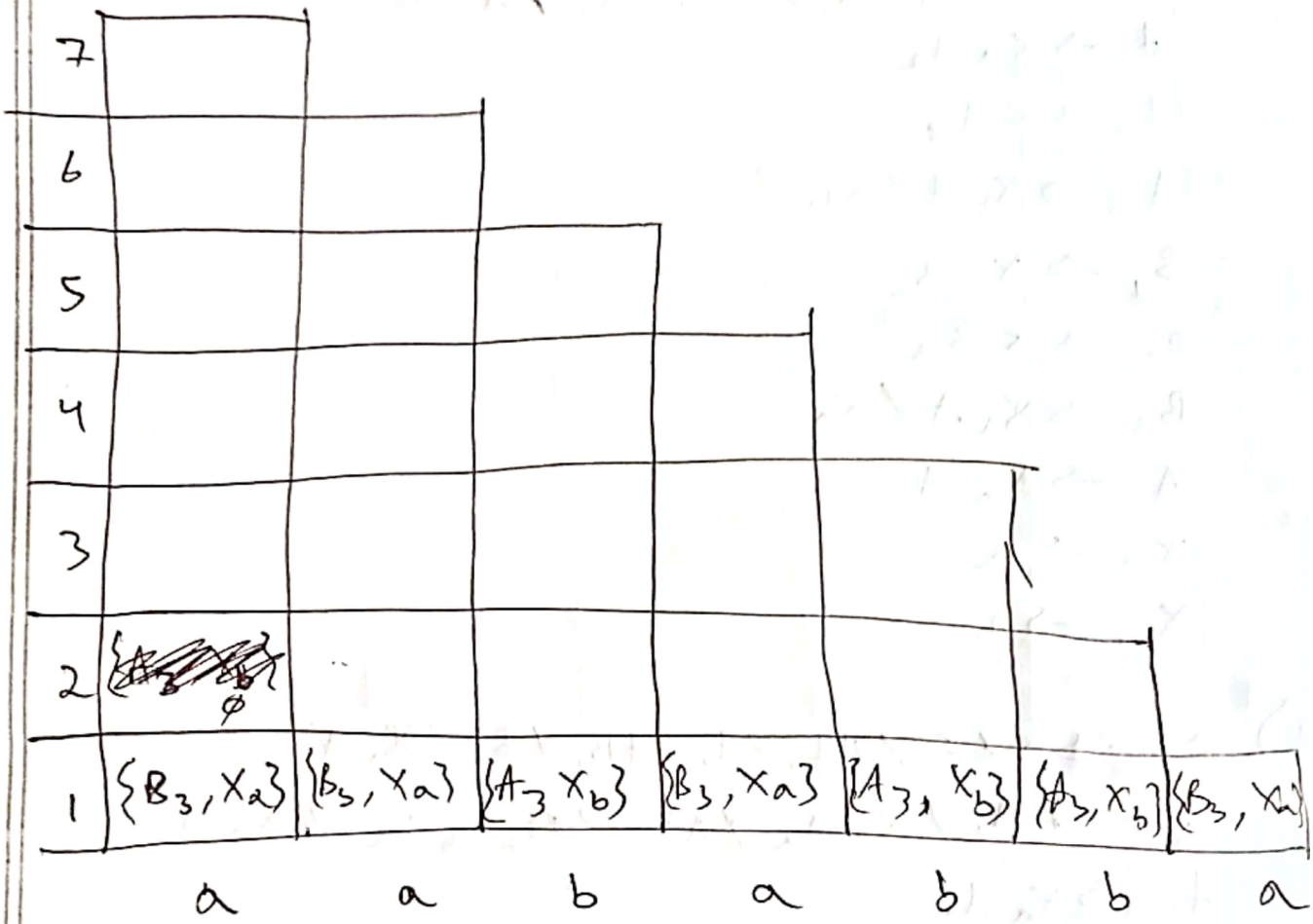
Now, for string "aababba"



2) aa = $X_a + X_a$ / $B_3 + X_a$ / $X_a + B_3$

ab = $X_a + X_b$ / $X_a + A_3$ / $B_3 + X_b$ / $B_3 + A_3$