TOC-3

Q1 a) Define V, Σ, P & S

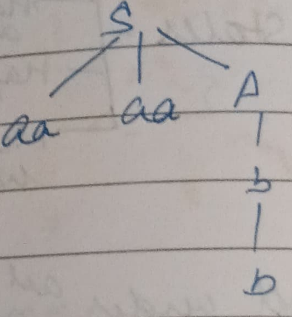
- Σ = {a, b}
  V = {S, A}
  Start symbol : S
- Production (P):
  S → aaS / aaA
  A → bA / ε

S generates an even no. of a's (at least 2) & ge
any no. of b's

b) String: aaaabb
leftmost Derivation

S → aaS
→ aa aaA
→ aa aabA
→ aa aabbA
→ aa aabb

(c)



Leaves
aa aa bb → "aaa

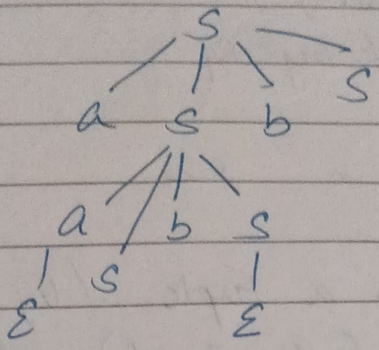
(d) Regular expression for L:
$(aa) + b^*$

Since this RE exists, L is a Regular langu
and every regular language is also contex
free.

Q2 Derive aabb

S → aSbS
→ a(aSbS)bS
→ aaεbεbε = aabb

7) Parse Tree



Leaves (Left to right): aabb → aabb

(b) A grammer is ambigous if there exists at least one string in the language that has two distinc pass trees (equivalently two different leftmost or rightmost derivations)

Claim: The grammer $S \to aSbS / \varepsilon$ is unambiguous

Proof:-

- Any nonempty string generated by this grammer must begin with a (because the only production introducing terminal with a) & therefore must be produced by one application of

$$S \to aS_1 bS_2$$

- In any derivation of a non-empty string w. the first a in w must match some b later in w, Let that matching b at posⁿ k. The grammer forces that matching to be the ~~f~~ produced in the same production

aS_1bS_2 that produces the first a. That uniquely splits w into three parts

- a (the first terminal)
- Substring generated by S_1
- b
- substring " " $S2$

Q3. Define the PDA as a tuple $(Q, \Sigma, T, \delta, q_0, z_0, f)$

Let $M = (Q, \Sigma, \Gamma, \delta, q_0, z_0, f)$ where

$Q = \{q_0, q_1, q_f)$

$\Sigma = \{a, b]$

$\Gamma = \{z_0, x\} - z_0$

q_0 is start state

z_0 " initial state

$F = \{q_f\}$

b) 1 $\delta(q_0, a, z_0) = \{(q_0, xz_0]\}$

2 $\delta(q_0, a, x\} = \{(q_0, x, x]\}$

3 $\delta(q_0, b, x) = \{(q_1, \varepsilon)\}$

4 $\delta(q_1, b, x) = \{(q_f, z_0)\}$

5 $\delta(q_1, \varepsilon, z_0) = \{(q_f, z_0)$

6 $\delta(q_0, \varepsilon, z_0) = \{(q_f, z_0)]$

c) start: $(q_0, aaabbb, z_0)$

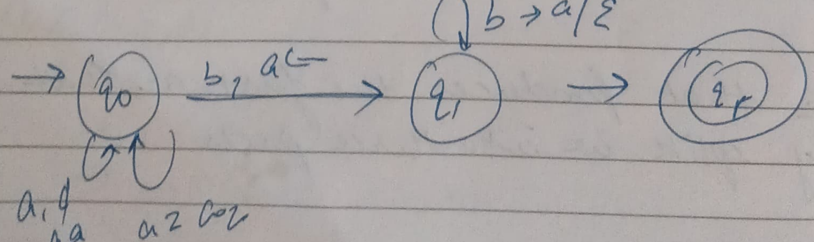
1 $(q_0, aaabbb, z_0)$

2 $(q_0, aabbb, xz_0)$

3 $(q_0, abbb, xxz_0)$

4 $(q_0, bbb, xxxz_0)$

(d)



Page No.
Date / /

Q4 a) There is a pumping length $p \geq 1$ such that for every string set with $|s| \geq p$

$s = uvwxy$

Satisfying

1) $|vwx| \leq p$
2) $|vx| > 0$
3) $i \geq 0$

b) Choose string $s \in L$ where $|s| \geq p$
Let p be the pumping length

$s = a^p b^p c^p \in L$
$|s| = 3p > p$

c) Show some pumped string leaves L

~~Let $s = a^p b^p c^p \in L$~~
~~$|s| = 3p > p$~~

Let $s = a^p b^p c^p$ since $|vwx| \leq p$, The Substring vwx lies fully inside one block

If vwx is within one block, pumping adds/removes symbols

If vwx spans two block pumping disturb their balance while the third block stays unchanged

d) Because the pumping lemma for CFL is necessary property of all context-free language

Q5 L C(G) = S (a^m b^n (m>0, n≥0)

To find : Context free grammer G that generates this (angu)

Grammer :

Let G = (V, Σ, P, S) where

V = {S, T}

Σ = {a, b}

S is the start symbol

Production P

S → aS / aT

T → bT / ε

→ Explaination

S ensures at least one 'a' is produced since every derivation starts with a

T generates zero or more bs

→ Eg derivations

S → aS → aaT → aabT → aabT → aabbb

Generated string : aabbb ∈ L(G)

L(G) = { a^m, b^n | m>>n ≥ 0 }

Q6 S → aS / aSbS / c

Two different parse trees for aacbc

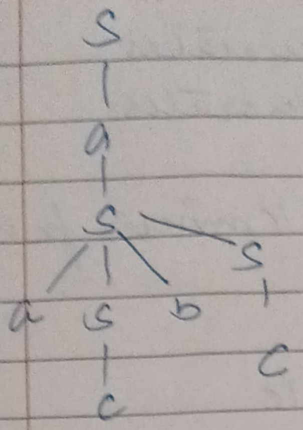
Derivation A

1 S → aS

2 aS → a(aSbS)

3 c (aSbc) → a (cacbS)

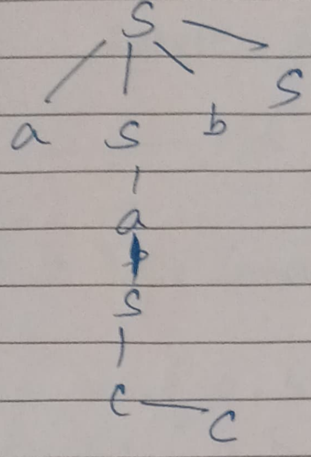
4 a (acbc) r a (acbc) = aacbc



Derivation

1. $S \to aSbS$
2. $aSbS \to a(aS)bS$
3. $a(aS)(bS) \Rightarrow a(ac)bS$
4. $a(ac)bS + a(ac)bc = aacbc$

Parse trees B (Diff shape)



(right most $S \to C$)

The two trees are structurally different
∴ the grammer is ambiguous

→ A grammer is ambigous some doing string has two diff parse trees

Q Given:

$G \to (TS, A, B)\ \{a, b, c\}\ PS)$ with
$PS \to B \to C$
$A \to aB$

1) Find non terminals that generates terminal
$B \to C \to$ B generate

A → aB & B generate → A generātes
S → A & A generātes → S generātes

step-2 : find reachable non terminal from start S:

'S' is start

from S → A → A reachable

from A → aB ⇒ B reachable