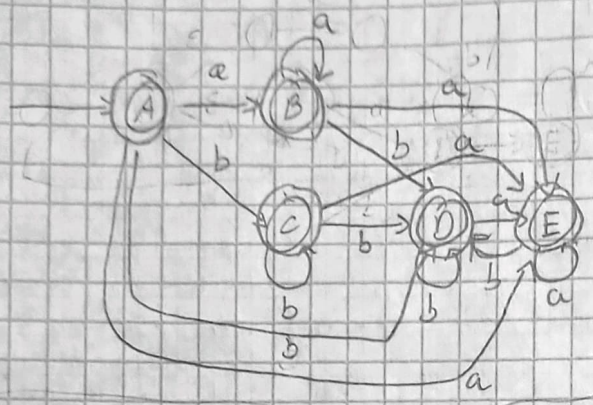
Spencer DeMarco

① a) Lang

$L = (a|b)^* b^* a^*$

FA



CFG

$A \to aB \mid bC \mid bD \mid aE \mid \varepsilon$
$B \to aB \mid bD \mid aE \mid \varepsilon$
$C \to bC \mid bD \mid aE \mid \varepsilon$
$D \to bD \mid aE \mid \varepsilon$
$E \to aE \mid bD \mid \varepsilon$

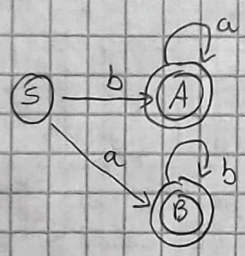
b) Lang

$L = ba^* \mid ab^*$

CFG

$S \to bA \mid aB$
$A \to aA \mid \varepsilon$
$B \to bB \mid \varepsilon$

FA



c) Lang

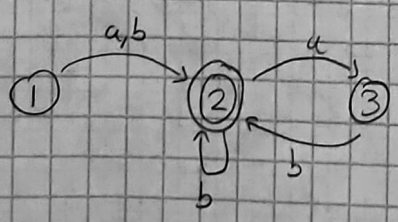
$L = (a+b) + (b+ab)^*$

?

CFG

$1 \to a2 \mid b2$
$2 \to b2 \mid a3 \mid \varepsilon$
$3 \to b2$

FA



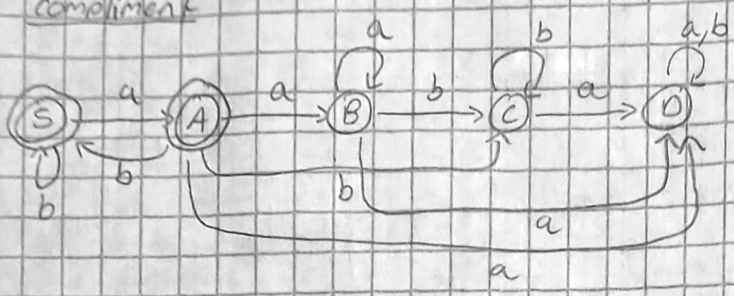
1 = S, 2 = A, 3 = B

$1 = \varepsilon$
$2 = 1a + 1b + 2b + 3b$
$3 = 2a$

$2 = 1a + 1b + 2b + 3b$
$= \varepsilon a + \varepsilon b + 2b + 2ab$
$2 = \varepsilon(a+b) + 2(b+ab)$
$R = Q + RP$
$R = QP^*$
$2 = \varepsilon(a+b) + (b+ab)^*$

② $L = aa^*b^*a$

compliment



③

<num> → <signs> <numList> <decimal> <exp>

<numList> → <digits> <numList> | epsilon // not sure about this line

<decimal> → '.' <digits> <numList> | epsilon

<exp> → 'E' <signs> <digits> <numList> | epsilon

<digits> → 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9

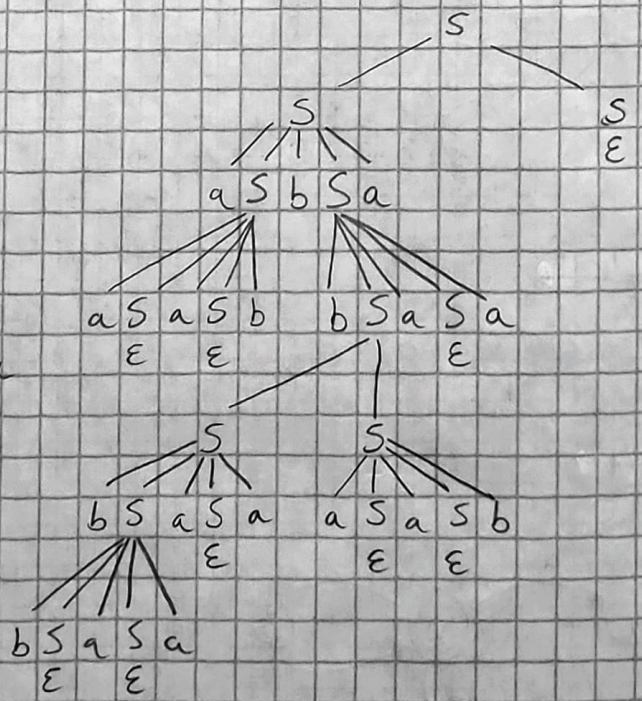
<signs> → + | - | epsilon

④ a)

S → SS → aSaSb → aSbSa → bSaSa → ε

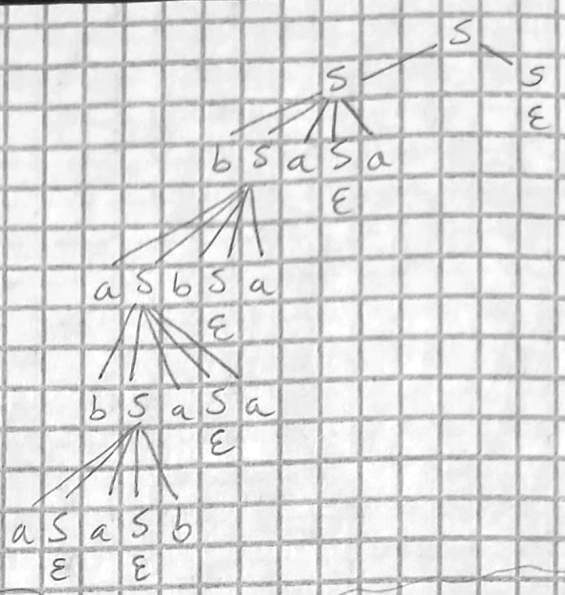
w = aaabbbbbaaaaaabaaa

S → SS
→ aSbSa
→ aaSaSbbSa
→ aaSaSbbbSaSaa
→ aaSaSbbbSSaSaa
→ aaSaSbbbSaSaSbaSaa
→ aaSaSbbbbSaSaaSaSbaSaa
→ aaSaSbbbbbSaSaaSaaSaSbaSaa
→ aaabbbbbaaaaaabaaa



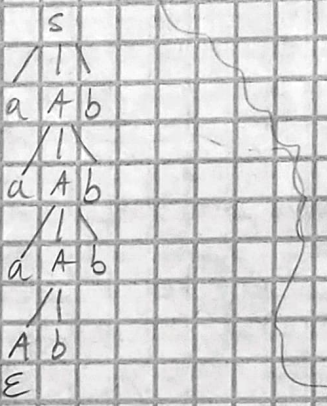
w = babaabaabaaa

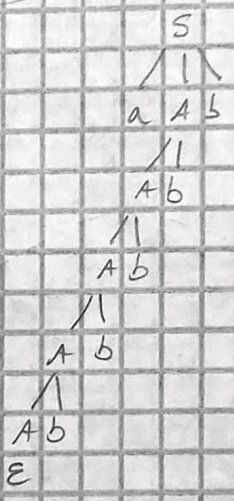
(4) a) S → SS
→ bSaSa
→ baSbSaSa
→ babSaSabSaSa
→ babaSabaSabSaaSa
→ babaabaabaaa



b) S → aAb → Ab → ε
w = abbbbb

S → aAb
→ aAbb
→ aAbbb
→ aAbbbb
→ aAbbbbb
→ abbbbb



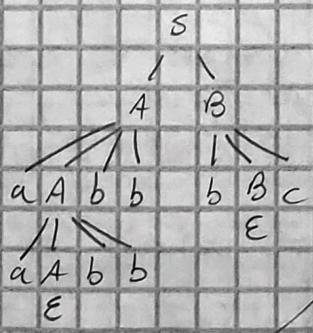


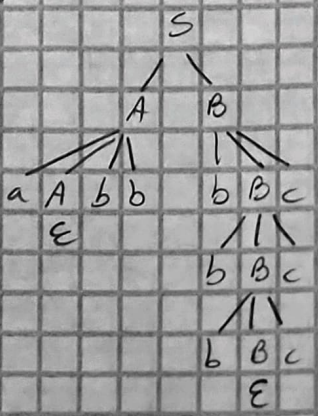
b) w = aaabbbb

S → aAb
→ aaAbb
→ aaaAbbb
→ aaaAbbbb
→ aaabbbb

c) S → AB → aAbb → bBc → ε
w = aabbbbbc

S → AB
→ aAbbB
→ aaAbbbbB
→ aabbbbbBc
→ aabbbbbc





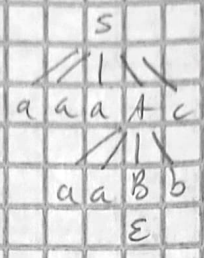
d) w = abbbbbccc

S → AB
→ aAbbB
→ aAbbbBc
→ abbbbBcc
→ abbbbbBccc
→ abbbbbccc

d) $S \to aaaAc \to aaBbc \to \varepsilon$

$w = aaaaabc$

$S \to aaaAc$
$\to aaaaaBbc$
$\to aaaaabc$



d) $w = aaac$

$S \to aaaAc$
$\to aaac$

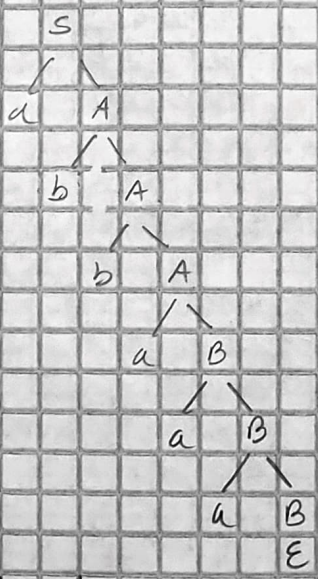
⑤ $S \to aA \mid bB$
$A \to bA \mid aB \mid \varepsilon$
$B \to bB \mid aB \mid \varepsilon$

abbaab S

$S \to aA$
$\to abA$
$\to abbA$
$\to abbaB$
$\to abbaaB$
$\to abbaabB$
$\to abbaab$ ✓

bababaaa

$S \to aA$
$\to abA$
$\to abbA$
$\to abbaB$
$\to abbaaB$
$\to abbaaaB$
$\to abbaaaa$ ✓



⑥ $A \to A+B$
$A \to A-B$
$A \to R$
$R \to R/B$
$R \to R*B$
$R \to r \mid t$
$B \to (A) \mid r \mid t$

a) $A \to RQ$
$R \to sS \mid tS$
$B \to (A) \mid r \mid t$
$Q \to +BQ \mid -BQ \mid \varepsilon$
$S \to /BS \mid *BS \mid \varepsilon$

b)

$First(A) = \{r, t\}$ $First(R) = \{r, t\}$ $First(B) = \{(, r, t\}$

$First(Q) = \{+, -, \varepsilon\}$ $First(S) = \{/, *, \varepsilon\}$

$Follow(A) = \{), \$\}$

$Follow(Q) = Follow(A) = \{), \$\}$

$Follow(R) = First(Q) - \varepsilon \cup Follow(Q) = \{+, -,), \$\}$

$Follow(S) = Follow(R) = \{+, -,), \$\}$

$Follow(B) = First(S) - \varepsilon \cup Follow(S) = \{+, -, *, /,), \$\}$