Saturday, May 7, 2022

Assignment 8

CSCI 411

1.

$$S \rightarrow SS$$

$$S \rightarrow (S)$$

$$S \rightarrow \varepsilon$$

a. (((()())))

$S \rightarrow (S)$

$\rightarrow$ ((S))

$\rightarrow$ ((SS))

$\rightarrow$ (((S)(S)))

$\rightarrow$ (((ε)(ε)))

$\rightarrow$ ((()())) $\rightarrow$ (((()())))

b. ()(())

$S \rightarrow SS$

$\rightarrow$ (S)(S)

$\rightarrow$ (S)((S))

$\rightarrow$ (ε)((ε))

$\rightarrow$ ()(()) $\rightarrow$ ()(())

2.

$S \rightarrow 0A \mid 1B \mid \varepsilon$

$A \rightarrow 0S \mid 1C$

$B \rightarrow 1S \mid 0C$

$C \rightarrow 0B \mid 1A$

a. 000110

$S \rightarrow 0A$

$\rightarrow 00S$

$\rightarrow 000A$

$\rightarrow 0001C$

$\rightarrow 00011A$

$\rightarrow 000110S$

$\rightarrow 000110\varepsilon \rightarrow 000110$

b. 11001001

$S \rightarrow 1B$

$\rightarrow 11S$

$\rightarrow 110A$

$\rightarrow 1100S$

$\rightarrow 11001B$

$\rightarrow 110010C$

$\rightarrow 1100100B$

$\rightarrow 11001001S$

$\rightarrow 11001001\varepsilon \rightarrow 11001001$

3.

$S \rightarrow S + S \mid S * S \mid (S) \mid N$

$N \rightarrow 0.FD \mid PD.FD \mid PD$

$D \rightarrow 0D \mid 1D \mid 2D \mid 3D \mid 4D \mid 5D \mid 6D \mid 7D \mid 8D \mid 9D \mid \varepsilon$

$F \rightarrow 0 \mid 1 \mid 2 \mid 3 \mid 4 \mid 5 \mid 6 \mid 7 \mid 8 \mid 9$

$P \rightarrow 1 \mid 2 \mid 3 \mid 4 \mid 5 \mid 6 \mid 7 \mid 8 \mid 9$

a. $12.3 + 3 * 0.22$

$S \rightarrow S + S$

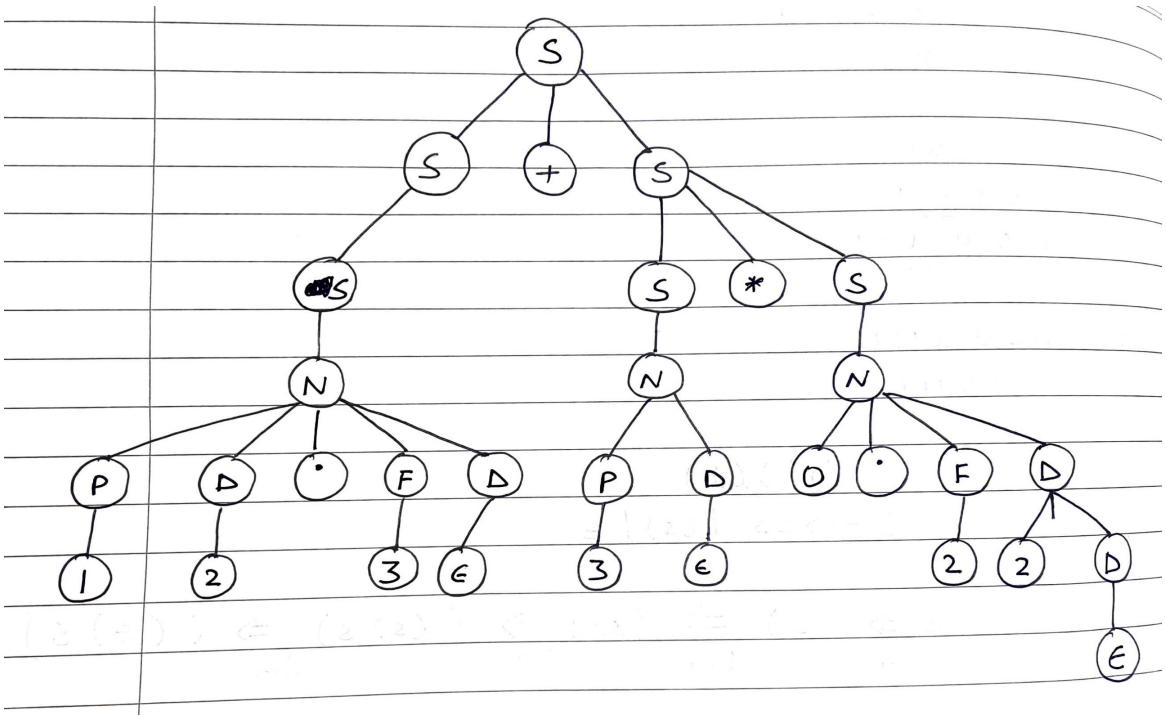
$\rightarrow S + S * S$

$\rightarrow N + N * N$

$\rightarrow PD.FD + PD * 0.FD$

$\rightarrow 12.3\varepsilon + 3\varepsilon * 0.22D$

$\rightarrow 12.3\varepsilon + 3\varepsilon * 0.22\varepsilon \rightarrow 12.3 + 3 * 0.22$



b. $4 * (9 + 13.0) * 75.89$

$S \rightarrow S * S * S$

$\rightarrow N * (S) * N$

$\rightarrow PD * (S + S) * PD.FD$

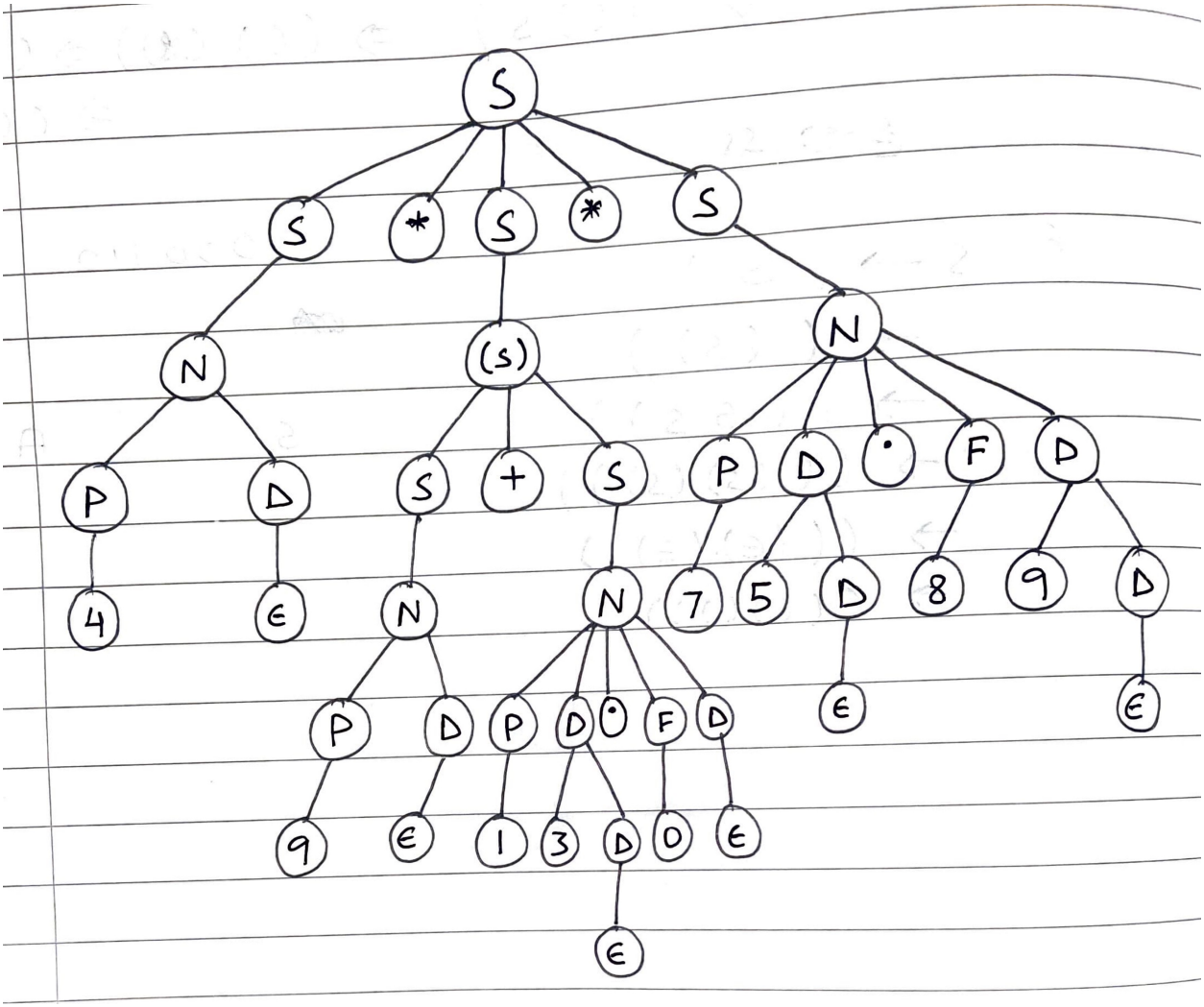
$\rightarrow 4\varepsilon * (N + N) * 75D.89D$

$\rightarrow 4\varepsilon * (PD + PD.FD) * 75\varepsilon.89\varepsilon$

$\rightarrow 4\varepsilon * (9\varepsilon + 13D.0\varepsilon) * 75\varepsilon.89\varepsilon$

$\rightarrow 4\varepsilon * (9\varepsilon + 13\varepsilon.0\varepsilon) * 75\varepsilon.89\varepsilon$

$\rightarrow 4 * (9 + 13.0) * 75.89$



4.

a.

$S \rightarrow 0S \mid 1S \mid 11$

b.

$S \rightarrow A11A$

$A \rightarrow 0A \mid 1A \mid 0 \mid 1 \mid \varepsilon$

c.

$S \rightarrow aSa \mid bSb \mid cSc \mid a \mid b \mid c \mid \varepsilon$

d.

Case 1: i = j,

$S_1 \rightarrow AB$

$A \rightarrow aAb \mid ab \mid \varepsilon$

$B \rightarrow cB \mid c \mid \varepsilon$

Case 2: i = k,

$S_2 \rightarrow aS_2c \mid C$

$C \rightarrow bC \mid b \mid \varepsilon$

Using Case 1 & 2,

$S \rightarrow S_1 \mid S_2$

$S_1 \rightarrow AB$

$A \rightarrow aAb \mid ab \mid \varepsilon$

$B \rightarrow cB \mid c \mid \varepsilon$

$C \rightarrow bC \mid b \mid \varepsilon$

e.

$S \rightarrow AB$

$A \rightarrow aC \mid aCaC$

$B \rightarrow CaCaCaCA \mid \varepsilon$

$C \rightarrow bC \mid cC$

f.

$S \rightarrow aSc \mid A$

$A \rightarrow bAc \mid \varepsilon$

g.

$S \rightarrow A$

$A \rightarrow (A)\ (A) \mid A + A \mid A \mid B$

5.

a.

$S \rightarrow aAc \mid bbB \mid aa$

$A \rightarrow cSc \mid C$

$B \rightarrow A \mid Bbb$

$C \rightarrow C \mid a \mid b \mid \varepsilon$

Step 1: Remove NULL productions

$S \rightarrow aAc \mid bbB \mid aa$ $\quad$ $A \rightarrow cSc \mid C \mid \varepsilon$

$B \rightarrow A \mid Bbb$ $\quad$ $C \rightarrow a \mid b$

$S \rightarrow aAc \mid ac \mid bbB \mid aa$ $\quad$ $A \rightarrow cSc \mid C$

$B \rightarrow \varepsilon \mid Bbb$ $\quad$ $C \rightarrow a \mid b$

$S \rightarrow aAc \mid ac \mid bb \mid bbB \mid aa$ $\quad$ $A \rightarrow cSc \mid C$

$B \rightarrow bb \mid Bbb$ $\quad$ $C \rightarrow a \mid b$

Step 2: Eliminate unit rules

$S \rightarrow aAc \mid ac \mid bb \mid bbB \mid aa$ $\quad$ $A \rightarrow cSc \mid a \mid b$

$B \rightarrow bb \mid Bbb$ $\quad$ $C \rightarrow a \mid b$

Step 3: Simplify grammar, remove C

$S \rightarrow aAc \mid ac \mid bb \mid bbB \mid aa$ $\quad$ $A \rightarrow cSc \mid a \mid b$

$B \rightarrow bb \mid Bbb$

b.

S → 0AB0 | 1C1 | C0A | ε

A → C | AB | 1 | 001

B → SB1 | 0

C → SAC | C1SSC

Step 1: Removal of ε us not possible in initial variable. Hence, we skip removal of null production.

Step 2: Eliminate unit rules

S → 0AB0 | 1C1 | C0A | ε

A → SAC | C1SSC | AB | 1 | 001

B → SB1 | 0

C → SAC | C1SSC

Step 3: Simplify grammar, C is not terminating(removal necessary from all productions)

S → 0AB0 | ε

A → AB | 1 | 001

B → SB1 | 0