

CS312

Homework #6 Answer Key

1 CNF Step 1

Perform step one of converting the following CFG into CNF by adding a new start state S . $V = \{A, B\}$, $\Sigma = \{0, 1, \epsilon\}$, $S = A$, $R =$

$$\begin{aligned}A &\rightarrow BAB \mid B \mid 1 \mid \epsilon \\ B &\rightarrow 00 \mid \epsilon\end{aligned}$$

Answer

$V = \{S, A, B\}$, $\Sigma = \{0, 1\}$, $S = S$, $R =$

$$\begin{aligned}S &\rightarrow A \\ A &\rightarrow BAB \mid B \mid 1 \mid \epsilon \\ B &\rightarrow 00 \mid \epsilon\end{aligned}$$

2 CNF Step 2

Perform step two of converting the following CFG's into CNF by removing ϵ rules. **No points off if $C \rightarrow C$ rule left in for part (a).**

2.a

$V = \{S, A, B, C\}$, $\Sigma = \{a, b, c\}$, $S = S$, $R =$

$$\begin{aligned}S &\rightarrow A \\ A &\rightarrow AaB \\ B &\rightarrow b \mid C \mid \epsilon \\ C &\rightarrow CC \mid c \mid \epsilon\end{aligned}$$

Answer

$V = \{S, A, B, C\}, \Sigma = \{a, b, c\}, S = S, R =$

$$\begin{aligned} S &\rightarrow A \\ A &\rightarrow AaB \mid Aa \\ B &\rightarrow b \mid C \\ C &\rightarrow CC \mid c \end{aligned}$$

2.b

$V = \{S, A, B\}, \Sigma = \{a, b, \epsilon\}, S = S, R =$

$$\begin{aligned} S &\rightarrow A \\ A &\rightarrow AA \mid AB \mid B \mid a \\ B &\rightarrow BB \mid b \mid \epsilon \end{aligned}$$

Answer

$V = \{S, A, B\}, \Sigma = \{a, b\}, S = S, R =$

$$\begin{aligned} S &\rightarrow A \mid \epsilon \\ A &\rightarrow AA \mid AB \mid B \mid a \\ B &\rightarrow BB \mid b \end{aligned}$$

3 CNF Step 3

Perform step three of converting the following CFG's into CNF by removing unit rules. **No points off if $A \rightarrow BC$ rule left in for part (b).**

3.a

$V = \{S, A, B\}$, $\Sigma = \{a, b\}$, $S = S$, $R =$

$$\begin{aligned} S &\rightarrow A \\ A &\rightarrow AA \mid AB \mid A \mid B \mid aB \\ B &\rightarrow BB \mid Bb \mid b \end{aligned}$$

Answer

$V = \{S, A, B\}$, $\Sigma = \{a, b\}$, $S = S$, $R =$

$$\begin{aligned} S &\rightarrow AA \mid AB \mid BB \mid Bb \mid b \mid aB \\ A &\rightarrow AA \mid AB \mid BB \mid Bb \mid b \mid aB \\ B &\rightarrow BB \mid Bb \mid b \end{aligned}$$

3.b

$V = \{S, A, B, C, D\}$, $\Sigma = \{a, b, c\}$, $S = S$, $R =$

$$\begin{aligned} S &\rightarrow A \mid \epsilon \\ A &\rightarrow BC \\ B &\rightarrow BD \mid bb \\ C &\rightarrow CD \mid cc \\ D &\rightarrow B \mid C \end{aligned}$$

Answer

$V = \{S, B, C, D\}$, $\Sigma = \{a, b, c\}$, $S = S$, $R =$

$$\begin{aligned} S &\rightarrow BC \mid \epsilon \\ B &\rightarrow BD \mid bb \\ C &\rightarrow CD \mid cc \\ D &\rightarrow BD \mid bb \mid CD \mid cc \end{aligned}$$

4 CNF Step 4

Perform step four of converting the following CFG into CNF by removing remaining rules.

$V = \{S, A, B\}$, $\Sigma = \{a, b\}$, $S = S$, $R =$

$$\begin{aligned} S &\rightarrow AAB \mid aBb \mid ABB \mid Ab \\ A &\rightarrow AAB \mid aBb \mid ABB \mid Ab \\ B &\rightarrow BB \mid Bb \mid b \end{aligned}$$

Sample Answer

$V = \{S, A, B\}$, $\Sigma = \{a, b\}$, $S = S$, $R =$

$$\begin{aligned} S &\rightarrow AE \mid FC \mid EB \mid AC \\ A &\rightarrow AE \mid FC \mid EB \mid AC \\ B &\rightarrow BB \mid BC \mid b \\ C &\rightarrow b \\ D &\rightarrow a \\ E &\rightarrow AB \\ F &\rightarrow DB \end{aligned}$$

5 CFG to PDA Conversion

Using the technique that was covered in class, convert the following CFG to a PDA:

$$V = \{A, B, C, D\}, \Sigma_\epsilon = \{x, \sqrt{}, +, (,)\} \cup \{\epsilon\}, S = A, R =$$

$$A \rightarrow B \mid C \mid x$$

$$B \rightarrow \sqrt{C} \mid \sqrt{A}$$

$$C \rightarrow (D) \mid (A)$$

$$D \rightarrow A + A$$

