



CSC-257

Theory Of Computation

(BSc CSIT, TU)

Ganesh Khatri
kh6ganesh@gmail.com

Conversion of CFG to PDA

- **Step 1** : Convert the given productions of CFG into GNF.
- **Step 2** : The PDA will only have one state $\{q\}$.
- **Step 3** : The initial symbol of CFG will be the initial symbol in the PDA.
- **Step 4**: For non-terminal symbol A , add the following rule :
 $\delta(q, \varepsilon, A) = (q, a)$, where the production rule is $A \rightarrow a$
- **Step 5** : For each terminal symbols, add the following rule :
 $\delta(q, a, a) = (q, \varepsilon)$ for every terminal symbol a

Conversion of CFG to PDA

- Example : Convert the following CFG into PDA

$S \rightarrow 0SX \mid 1SY \mid \epsilon$

$X \rightarrow 1$

$Y \rightarrow 0$

- Here, given grammar is already in GNF
- The PDA can be given :
 $P = \{(q), (0, 1), (S, X, Y, 0, 1), \delta, q, S, q\}$
- The production rule δ can be :

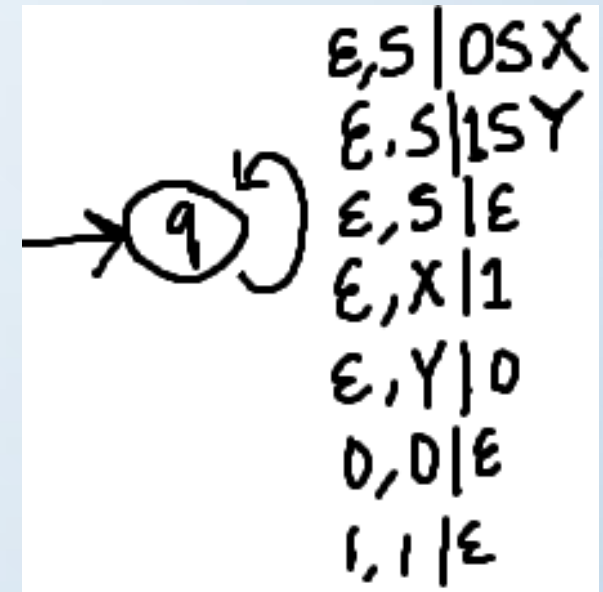
R1 : $\delta(q, \epsilon, S) = \{(q, 0SX) \mid (q, 1SY) \mid (q, \epsilon)\}$

R2 : $\delta(q, \epsilon, X) = \{(q, 1)\}$

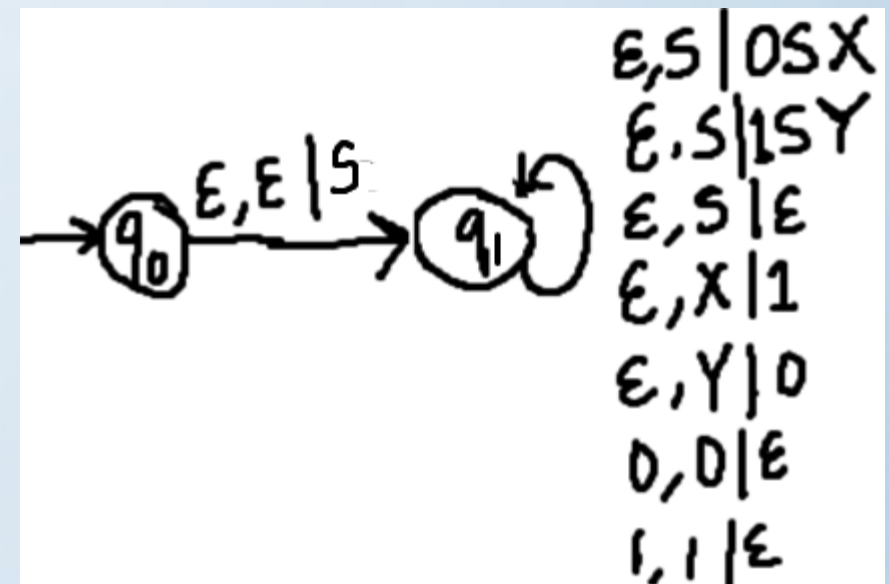
R3 : $\delta(q, \epsilon, Y) = \{(q, 0)\}$

R4 : $\delta(q, 0, 0) = \{(q, \epsilon)\}$

R5 : $\delta(q, 1, 1) = \{(q, \epsilon)\}$



or



Conversion of CFG to PDA

- Testing 1010 against PDA :

- $\delta(q, 1010, S) \vdash \delta(q, 1010, 1SY)$ **R1**
- $\vdash \delta(q, 010, SY)$ **R5**
- $\vdash \delta(q, 010, 0SXY)$ **R1**
- $\vdash \delta(q, 10, SXY)$ **R4**
- $\vdash \delta(q, 10, XY)$ **R1**
- $\vdash \delta(q, 10, 1Y)$ **R2**
- $\vdash \delta(q, 0, Y)$ **R5**
- $\vdash \delta(q, 0, 0)$ **R3**
- $\vdash \delta(q, \epsilon, \epsilon)$ **R4**

- String accepted by empty stack method.

Rules :

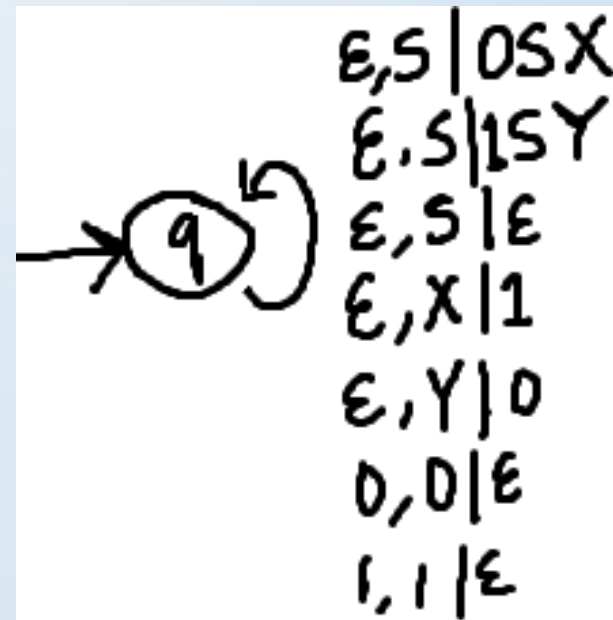
R1 : $\delta(q, \epsilon, S) = \{(q, 0SX) \mid (q, 1SY) \mid (q, \epsilon)\}$

R2 : $\delta(q, \epsilon, X) = \{(q, 1)\}$

R3 : $\delta(q, \epsilon, Y) = \{(q, 0)\}$

R4 : $\delta(q, 0, 0) = \{(q, \epsilon)\}$

R5 : $\delta(q, 1, 1) = \{(q, \epsilon)\}$



Conversion of CFG to PDA

- **Exercise :**

- Construct PDA for the given CFG, and test whether 010000 is acceptable by this PDA.

$$S \rightarrow 0BB$$

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

- Construct PDA for the given CFG, and trace the acceptance of $a + (a^*a)$

$$E \rightarrow T \mid E + T$$

$$T \rightarrow F \mid T * F$$

$$F \rightarrow a \mid (E)$$