

CSCI 550 Theory of Computing

CSCI 659 Topics in Computing Theory

Chapter 6 Supplementary Lecture Notes

Dr. J

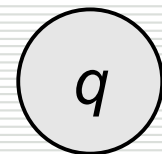
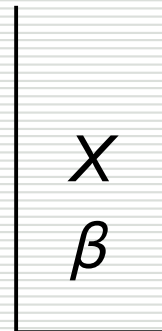
Juliano@csuChico.edu



This work is licensed under the Creative Commons Attribution-ShareAlike License. To view a copy of this license, visit <http://creativecommons.org/licenses/by-sa/2.0/> or send a letter to Creative Commons, 559 Nathan Abbott Way, Stanford, California 94305, USA.

PDA to CFG Conversion Algorithm

- Given: PDA, $A = (Q, \Sigma, \Gamma, \delta, q_0, Z_0, F)$
- Find: CFG, $G = (V, T, P, S)$ where $L(G) = N(A)$
- Suppose $X \in \Gamma$ is on the stack and $a \in \Sigma$ is read, what can happen to X ?
 - X is popped off the stack; or
 - X is replaced by at least one other stack symbol
 - and so on recursively (stack grows and shrinks and grows and shrinks and ...)

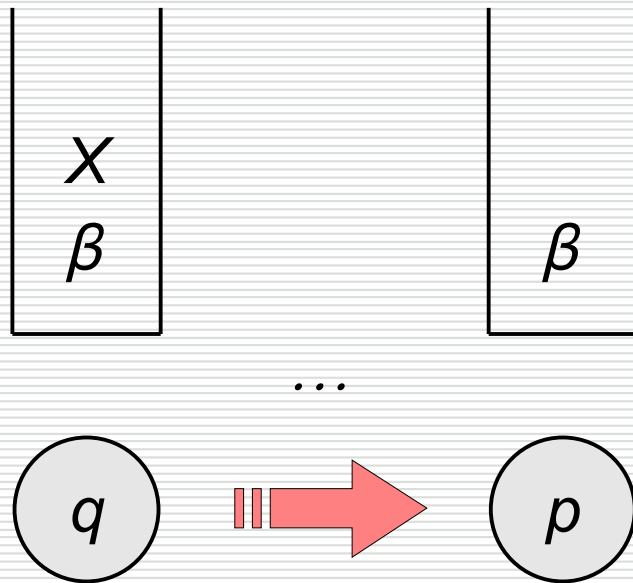


PDA to CFG Conversion Algorithm

- Given: PDA, $A = (Q, \Sigma, \Gamma, \delta, q_0, Z_0, F)$
- Find: CFG, $G = (V, T, P, S)$ where $L(G) = N(A)$

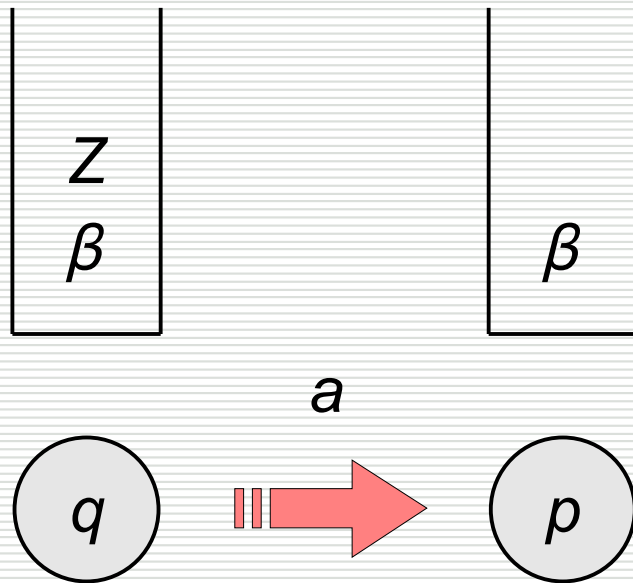
- Eventually, as more input is consumed, X must be popped off so we can move to an empty stack ...
- *composite symbols* $[qXp]$ where $q, p \in Q$ and $X \in \Gamma$:
 - variable $[qXp]$ can be replaced by all words generated by starting at state q , with X at the top of the stack, and ending at state p .

Visual interpretation of $[qXp]$...



- Variable $[qXp]$ generates all strings in $(V \cup T)^*$ by starting at state q , with X at the top of the stack, and ending at state p .
- So, now we can consider how to generate production rules ...

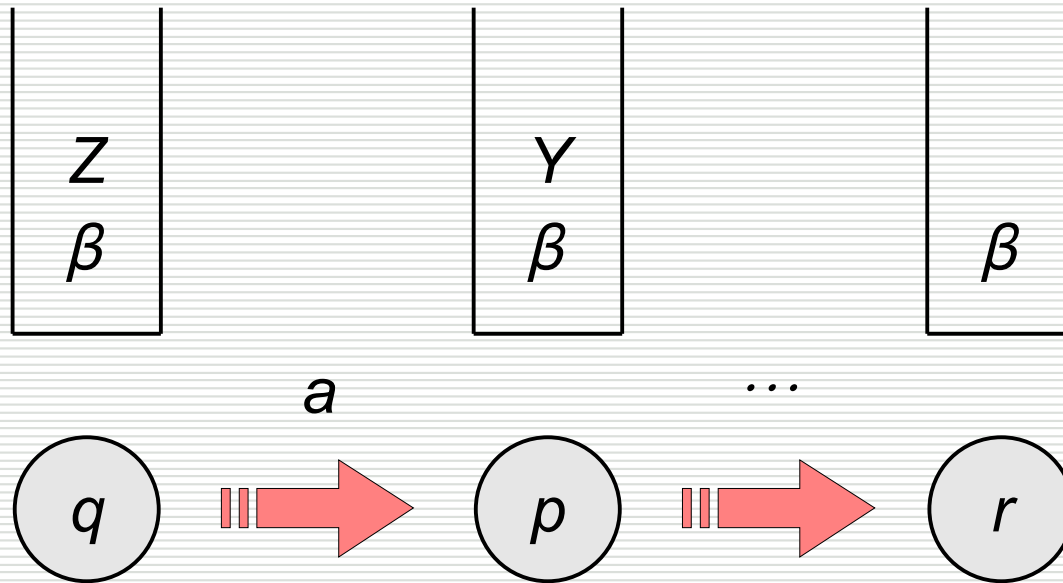
1) *Popping* rule ...



Add production **$[qZp] \rightarrow a$**

□ whenever $(p, \varepsilon) \in \delta(q, a, Z)$

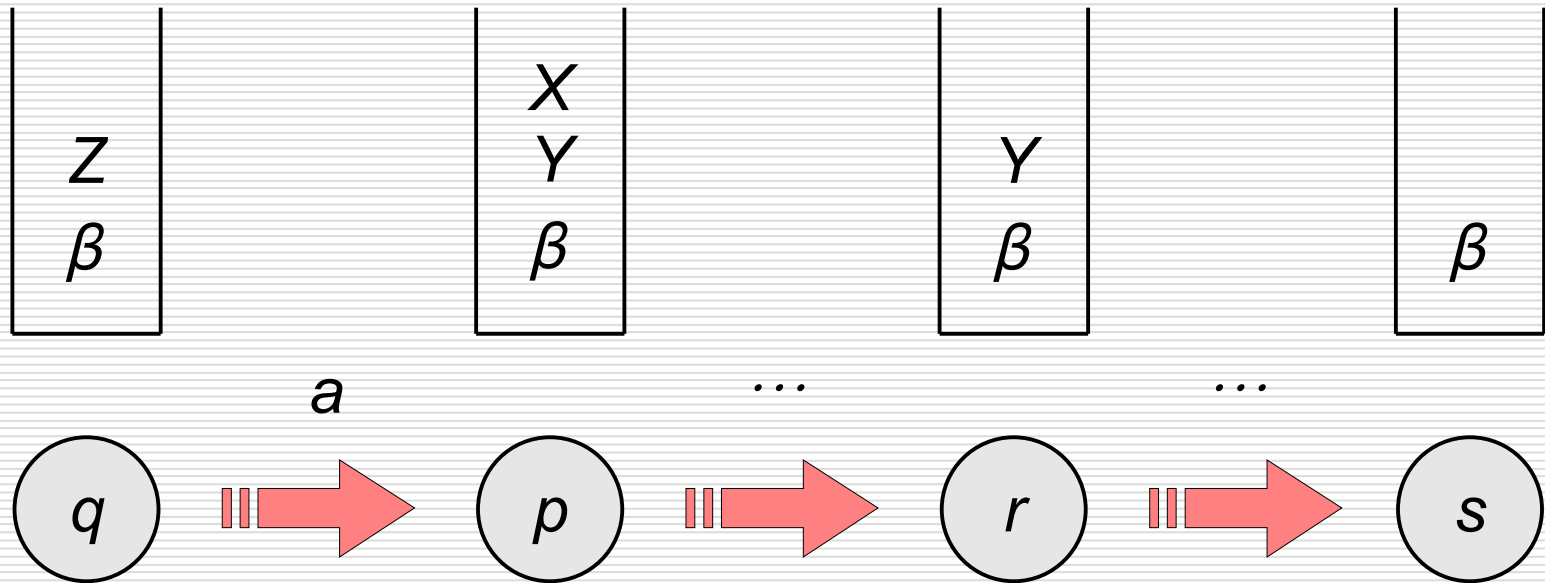
2) *One stack symbol replaced by one rule ...*



Add production **$[qZr] \rightarrow a[pYr]$** , for all $r \in Q$

□ whenever $(p, Y) \in \delta(q, a, Z)$

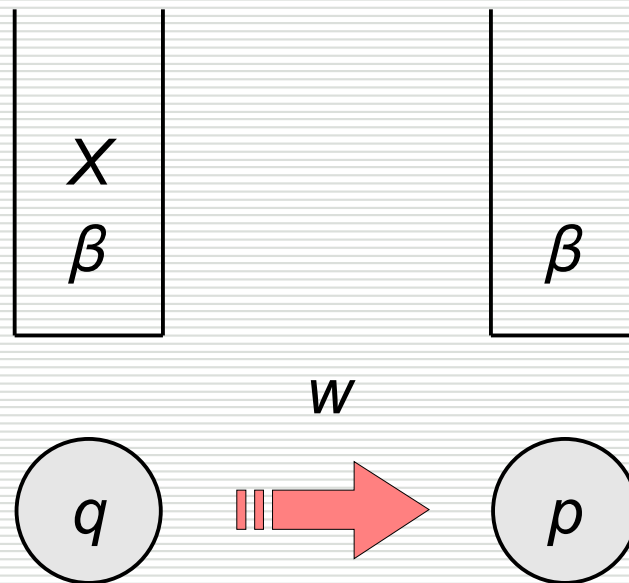
3) *One stack symbol replaced by two rule ...*



Add production **$[qZs] \rightarrow a[pXr][rYs]$** , for all $r, s \in Q$

□ whenever $(p, XY) \in \delta(q, a, Z)$

Essence of the algorithm ...



$[qXp] \xRightarrow{*} w$ if and only if $(q, w, X\beta) \vdash^* (p, \varepsilon, \beta)$

where $q, p \in Q$, $X \in \Gamma$, $\beta \in \Gamma^*$, $w \in \Sigma^*$