

CS310

Context Free Languages
and Grammars

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Quick Review

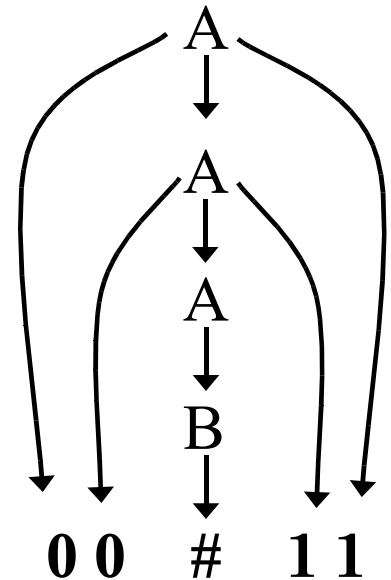
- (CFG) 4-tuple (V, Σ, R, S)
 - V finite set of variables
 - Σ finite set of terminals
 - R set of rules of form:
 - variable \rightarrow (string of variables and terminals)
 - $S \in V$, start variable
 - $L(G) = \{ w \in \Sigma^* \mid S \xrightarrow{*} w \}$
 - w is in Σ^* and can be derived from S

Example

$A \rightarrow 0A1$

$A \rightarrow B$

$B \rightarrow \#$



Constructing a CFG from a Language, L

- Requires some thought and creativity, just like building a Finite Automata
- Hints:
 - If possible, break L into pieces $L = L_1 \cup L_2$
 - Create grammar for L1 and L2, $S \rightarrow S_{L_1} \mid S_{L_2}$
 - If L is regular, use regular expression as guide
 - If L is regular, construct DFA then construct CFG:
 - Make variable R_i for each state q_i in DFA
 - Add rule $R_i \rightarrow \epsilon$ for all $q_i \in F$, $R_i \rightarrow aR_z$ if $\delta(q_i, a) = q_z$
 - R_0 is start where q_0 is start of DFA

Example

$L = \{ w \mid w \text{ contains at least three 1s} \}$

CFG?

Example

$\{ w \mid \text{the length of } w \text{ is odd} \}$

Example

$\{ w \mid w \text{ contains more 1s than 0s} \}$

(not regular!)

Example

- $\{a^i b^j c^k \mid i=j \text{ or } i=k\}$