Friday 11:50 - Next lecture.
Quiz 2 Thursday 14/09/2017.

Context Free Grammars.

stmt ::= ifstmt | assgnmnts | — | —
ifstmt ::= if <cond> stmt else stmt

cond ::= true | false | term > term

$$e ::= \phi \mid \varepsilon \mid a \mid e + e \mid e \cdot e \mid e^*$$

$e ::= \phi$
$e ::= \varepsilon$
$e ::= a$
$e ::= e + e$

$(a+b)^* b \cdot (a+b^*)$

Rules
Productions.

$e = e \cdot e$

$(a+b)^* b \rightsquigarrow e$

$a+b^* \rightsquigarrow e$

e - Non-terminals.

$a, b, +, {}^*$ → terminals

Σ = Terminals.

$(a+b)^* b \cdot (a+b^*)$

$e \Rightarrow e \cdot e \rightarrow e \cdot e \cdot e \rightarrow e^* \cdot e \cdot e$

$\rightarrow (e+e)^* \cdot e \cdot e \rightarrow (a+e)^* e \cdot e$

$\rightarrow (a+b)^* e \cdot e \rightarrow (a+b)^* b \cdot e \rightarrow$

$(a+b)^* b \cdot (e+e) \rightarrow (a+b)^* b \cdot (a+e)$

$\rightarrow (a+b)^* b \cdot (a+e^*) \rightarrow (a+b)^* b \cdot (a+b^*)$

sentence

$\Sigma = \{a, b, *, +, \cdot, \}$

$e \xrightarrow{*} (a+b)^* b \cdot e \xrightarrow{*}$

$\rightarrow$ one step derivation.

$\xrightarrow{*}$ 0 or more steps derivation

Context Free Grammars.

$G = (N, T, S, P)$

N - non-terminals

T - terminals

S - $S \in N$ start symbol

P - set of productions / rules

$$P \subseteq N \times \{N \cup T\}^*$$

$T = \Sigma$ is our alphabet

G generates a language over terminals

$L(G) \subseteq \Sigma^*$ = all the sentences that can be derived from S in G.

- Derive / derivation
- sentence / sentential forms.

$$L(G) = \{ w \mid S \xRightarrow{*} w \wedge w \in \underbrace{\Sigma^*}_{T^*} \}$$

$a^* b^*$ - Give a grammar ~~for~~ this.

$S \to \varepsilon \mid aS \mid Sb$

$N = \{S\}$ $T = \{a, b\} = \Sigma$

Derivation : aaabb

$S \to aS \to aaS \to aaaS \to aaaSb$

$\to aaaSbb \to aaabb$

$S \to aS \to aSb \to aaSb \to$

$aaSbb$

$S \to \varepsilon$: derivation of ε

$a^* b^* \setminus \{\varepsilon\}$

$G_1 = S \to aS \mid Sb$

$L(G_1) = \emptyset$

G_2: $S \to aS \mid Sb \mid a \mid b$

$L(G_2) = a^* b^* \setminus \{\varepsilon\}$

Σ^*

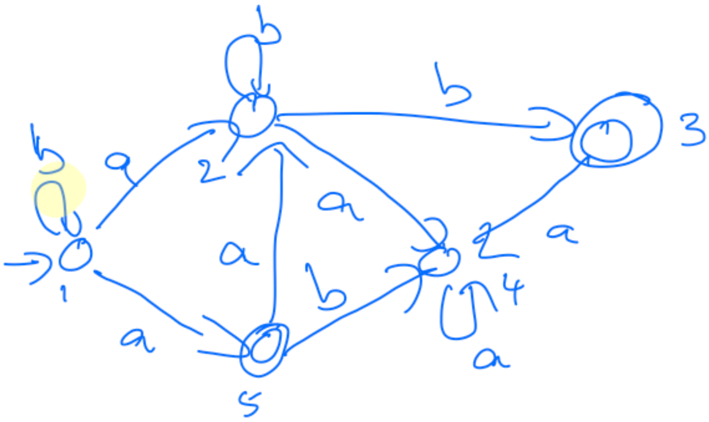
$G_3 ::= S \to aS \mid Sb \mid \varepsilon \mid bS \mid Sa$

$G_4 ::= S \to aS \mid bS \mid \varepsilon$

abaab

$S \Rightarrow aS \to abS \to abaS \xrightarrow{*} \cdots$

$\xrightarrow{*}$ abaab



$N = \{S_1, S_2, S_3, S_4, S_5\}$

$S_1 \to bS_1 \mid aS_2 \mid aS_5$ $\quad S_4 \to aS_4$

$S_2 \to bS_2 \mid bS_3 \mid aS_4$

$S_3 \to \varepsilon \mid aS_4$ $\quad S_5 \to aS_2 \mid bS_4 \mid \varepsilon$

eg: of a Right Linear grammar.

b a a b b

$S_1 \rightarrow b S_1 \rightarrow ba S_2 \rightarrow baa S_4$

$S_1 \rightarrow b S_1 \rightarrow ba S_3 \rightarrow baa S_2$

$\rightarrow baab S_2 \rightarrow baabb$

$N \rightarrow aaab \ldots N' a - ba \ldots$

$\underline{T^* N \cancel{T^*}} \quad | \quad T^*$

$T^* N$

linear

L Regular iff it is generated by a Right-linear grammar.

$G = S \to \varepsilon \mid aSb$

$L(G) = \{a^n b^n \mid n \geq 0\}$

$S \to aSb \to aaSbb$

Palindroms .

$S \to aSa \mid bSb \mid a \mid b \mid \varepsilon$

aba

Palindroms $\setminus \{\varepsilon\}$

$S \to aSa \mid bSb \mid a \mid b \mid aa \mid bb$

$\{a^n b^n c^n \mid n > 0\}$