PR 6 TBFO

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5.1.1

Exercise 5.1.1: Design context-free grammars for the following languages:

* a) The set $\{0^n1^n \mid n \geq 1\}$, that is, the set of all strings of one or more 0's followed by an equal number of 1's.

$S \longrightarrow 01$
$S \longrightarrow 0S1$

atau

$S \longrightarrow 01 \mid 0S1$

*! b) The set $\{a^ib^jc^k \mid i \neq j \text{ or } j \neq k\}$, that is, the set of strings of a's followed by b's followed by c's, such that there are either a different number of a's and b's or a different number of b's and c's, or both.

Kasus
- $i = j \rightarrow j \neq k$
- $i \neq j \rightarrow j = k$
- $i \neq j \rightarrow j \neq k$

$S \longrightarrow AB$
$A \longrightarrow aA \quad A \longrightarrow \varepsilon$
$B \longrightarrow bBc \quad B \longrightarrow E \quad B \longrightarrow cD$
$S \longrightarrow CD$
$C \longrightarrow aCb \quad C \longrightarrow E \quad C \longrightarrow aA$
$D \longrightarrow cD \quad D \longrightarrow \varepsilon$
$E \longrightarrow bE \quad E \longrightarrow b$

atau

$S \longrightarrow AB \mid CD$
$A \longrightarrow aA \mid \varepsilon$
$B \longrightarrow bBc \mid E \mid cD$
$C \longrightarrow aCb \mid E \mid aA$
$D \longrightarrow cD \mid \varepsilon$
$E \longrightarrow bE \mid b$

! c) The set of all strings of a's and b's that are *not* of the form ww, that is, not equal to any string repeated.

$S \longrightarrow \varepsilon \quad A \longrightarrow a$
$S \longrightarrow A \quad A \longrightarrow aB$
$S \longrightarrow B \quad B \longrightarrow b$
$B \longrightarrow bA$

atau

$S \longrightarrow \varepsilon \mid A \mid B$
$A \longrightarrow a \mid aB$
$B \longrightarrow b \mid bA$

!! d) The set of all strings with twice as many 0's as 1's.

$S \longrightarrow 001 \quad S \longrightarrow 00S1 \quad S \longrightarrow 0S01 \quad S \rightarrow S001 \quad S \rightarrow 001S$
$S \longrightarrow 010 \quad S \longrightarrow 01S0 \quad S \longrightarrow 0S10 \quad S \rightarrow S010 \quad S \rightarrow 010S$
$S \longrightarrow 100 \quad S \longrightarrow 10S0 \quad S \longrightarrow 1S00 \quad S \rightarrow S100 \quad S \rightarrow 100S$

atau

atau

$S \to 001 \mid 010 \mid 100 \mid S001 \mid S010 \mid S100 \mid 0S01 \mid 0S10 \mid 1S00 \mid 00S1 \mid 01S0 \mid 10S0 \mid 001S \mid 010S \mid 001S \mid$

5.1.2

Exercise 5.1.2: The following grammar generates the language of regular expression $\mathbf{0^*1(0+1)^*}$:

$$\begin{array}{lcl} S & \to & A1B \\ A & \to & 0A \mid \epsilon \\ B & \to & 0B \mid 1B \mid \epsilon \end{array}$$

Give leftmost and rightmost derivations of the following strings:

* a) 00101.

Left Most :

$S \to A1B \to 0A1B \to 00A1B \to 001B \to 0010B \to 00101B \to 00101$

Right Most :

$S \to A1B \to A10B \to A101B \to A101 \to 00A101 \to 00101$

b) 1001.

Left most :

$S \to A1B \to 1B \to 10B \to 100B \to 1001B \to 1001$

Right most :

$S \to A1B \to A10B \to A100B \to A1001B \to A1001 \to 1001$

c) 00011.

Leftmost :

$S \to A1B \to 0A1B \to 00A1B \to 000A1B \to 0001B \to 00011B \to 00011$

Rightmost :

$S \to A1B \to A11B \to A11 \to 0A11 \to 00A11 \to 000A11 \to 00011$

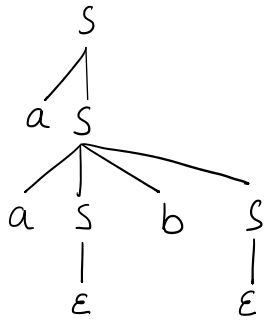
5.4.1

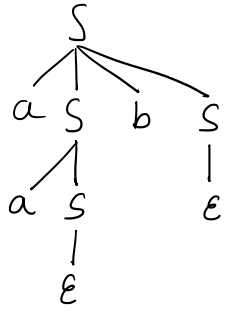
* **Exercise 5.4.1:** Consider the grammar

$$S \to aS \mid aSbS \mid \epsilon$$

This grammar is ambiguous. Show in particular that the string *aab* has two:

a) Parse trees.





b) Leftmost derivations.

$S \longrightarrow aS \longrightarrow aaSbS \longrightarrow aabS \longrightarrow aab$

$S \longrightarrow aSbS \longrightarrow aaSbS \longrightarrow aabS \longrightarrow aab$

c) Rightmost derivations.

$S \longrightarrow aS \longrightarrow aaSbS \longrightarrow aaSb \longrightarrow aab$

$S \longrightarrow aSbS \longrightarrow aSb \longrightarrow aaSb \longrightarrow aab$

5.4.7

Exercise 5.4.7: The following grammar generates *prefix* expressions with operands x and y and binary operators $+$, $-$, and $*$:

$$E \rightarrow +EE \mid *EE \mid -EE \mid x \mid y$$

a) Find leftmost and rightmost derivations, and a derivation tree for the string `+*-xyxy`.

Leftmost :

$E \rightarrow +EE \rightarrow +*EEE \longrightarrow +*-EEEE \longrightarrow +*-xEEE$

$\downarrow$

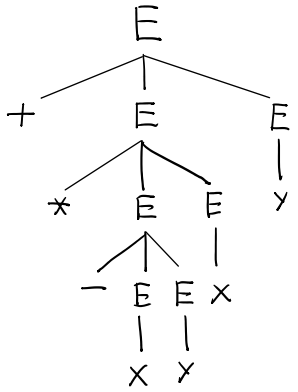
$+*-xyxy \leftarrow +*-xyxE \leftarrow +*-xyEE$

Rightmost :

$E \rightarrow +EE \longrightarrow +Ey \longrightarrow +*EEy \longrightarrow +*Exy$

$\downarrow$

$+*-xyxy \leftarrow +*-Eyxy \leftarrow +*-EExy$



! b) Prove that this grammar is unambiguous.

Metode Induksi

(i) Basis : untuk panjang kata 1, hasil pasti x atau y

$w = x$, $E \rightarrow x$

$w = y$, $E \rightarrow y$

(ii) untuk panjang kata n, asumsikan hanya terdapat 1 leftmost derivation

$\{ E \rightarrow +w ;\ E \rightarrow *w ;\ E \rightarrow -w \}$, $w \in$ String dengan panjang $(n-2)$

(iii) Pembuktian : untuk String dengan panjang $(n+1)$

$E \rightarrow +Ew \mid *Ew \mid -Ew$, $w \in$ String dengan panjang $(n-2)$

untuk String dengan panjang $(n+1)$, dapat dilihat hanya memiliki 1 buah leftmost dan rightmost derivation yang mungkin.

$E \rightarrow +xw \mid +yw \mid *xw \mid *yw \mid -xw \mid -yw$, $w \in$ String dengan panjang $(n-2)$

maka terbukti unambiguous //