Homework review

(0)

4. *(40 points)* Give a regular expression for the following languages.

a. The set of strings over $\{a, b, c\}$ with length three.

$(a|b|c)(a|b|c)(a|b|c)$

— — —

b. The set of strings over $\{a, b\}$ where every aa is followed by b.

$(\cancel{c}|b|aab|ab|\cancel{ac})^*(a|\lambda)$

? send to TA

c. The set of strings over $\{a, b, c\}$ where the total number of b's and c's together is three.

$a^*(b \mid c)a^*(b \mid c)a^*(b \mid c)a^*$

— — —

d. The set of strings over $\{a, b, c\}$ in which all the a's precede the b's, which in turn precede the c's. It is possible that there are no a's, or b's, or c's.

but $a \notin L$.

$a^*b^*c^*$

e. The set of strings over $\{a, b, c\}$ that do not begin with the substring aaa.

$(b \cup c \cup ab \cup ac \cup aab \cup aac)(a \cup b \cup c)^* \cup \lambda \cup a \cup aa$

$a^*b^*c^* \underbrace{- \{a\}}_{\text{not a regular expression.}}$

$(aa^* \; bb^* cc^*)$ | just a | just b

$a^+ \; b^+ \; c^+$

$(a | a^*)(b | b^*)(c | c^*)$ includes a

$(a | b | c)(a^* | b^* | c^*)$ interleaves

$\underline{a}\ \underline{b}\ \underline{c}$

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Wednesday (1)

$(a^* b^* c^*) \cup (a \cup b \cup c)$

$a^+ b^* c^* \cup a^* b^+ c^* \cup a^* b^* c^+$

forces one a — forces one b — forces one c

$L = \{ a^i b^i \mid i \geq 0 \}$

Beware! tricky question

$a^* b^*$

$(a^i b^i)^*$

$\underbrace{a^3}_{aaa}$

not possible ✓ (would prove with pumping lemma)

λ
ab
$aabb$
$aaabbb$

a^* b^*

$\underline{\lambda}$ $\underline{bb}$

$a \cup b$
ab
a^*
are valid regular expressions

$\bar{a}$
$a^* - a$
$a^i b^i$
are not valid regular expressions.

(( ))

)(

(ab))

Chapter 3 Context Free Languages

- recursive definitions
- regular expressions
- context free grammars

$\downarrow$

gives rules to ~~generate~~ generate languages

$\ast$ $\underbrace{A}_{\text{variable}} \longrightarrow aA \mid \lambda$ $\quad a^*$ } zero or more "a"s

produces

may replace A

or may replace A

$\Sigma = \{a, b\}$

$\underbrace{A}_{\text{start variable}} \Rightarrow aA \Rightarrow \underline{aaA} \Rightarrow \underbrace{aa}$

not a terminal string (sentential form)

is a terminal string $\in \Sigma^*$

$A \Rightarrow \lambda$

$\ast$ How write production rules to generate one or more "a"s.

a^+

$A \longrightarrow aA \mid a$

$A \Rightarrow a$

$A \Rightarrow a\underline{A} \Rightarrow aa\overline{\underline{A}} \Rightarrow aa\lambda$

$A \rightarrow aA \mid b \mid a$

at least one "a" followed by a b

$A \Rightarrow b$ } shortest derivations

$A \Rightarrow a$

$A \Rightarrow aA \Rightarrow aaA \Rightarrow aaa$

$\Rightarrow aab$

$a^*(a|b)$

$a\cancel{^*(a|b|\lambda)}$

$a(a|b)^* \mid b$

$\cancel{a^+(a|b|\lambda)}$

$\cancel{a^*}$

could
take multiple "b"s

must

$a^*(a|b|\lambda)$ $\quad \lambda \notin L$

$a^+(a|b|\lambda)$

$(a^+(a|b|\lambda)) \mid b$

$A \rightarrow \lambda$ null production

A produces the null string.

$(a|b)^*$

$A \rightarrow aA \mid bA \mid \lambda$

$A \Rightarrow aA \Rightarrow abA \Rightarrow abbA$