

Theory of Computing (CSE 221)

LECTURE 04 - REGULAR EXPRESSION

OPERATIONS OF LANGUAGE

OPERATION	DEFINITION AND NOTATION
<i>Union of L and M</i>	$L \cup M = \{s \mid s \text{ is in } L \text{ or } s \text{ is in } M\}$
<i>Concatenation of L and M</i>	$LM = \{st \mid s \text{ is in } L \text{ and } t \text{ is in } M\}$
<i>Kleene closure of L</i>	$L^* = \bigcup_{i=0}^{\infty} L^i$
<i>Positive closure of L</i>	$L^+ = \bigcup_{i=1}^{\infty} L^i$

OPERATIONS ON LANGUAGE

- Letters or alphabets and digits are the most important elements of language.
- Let L be the set of alphabets $\{A, B, \dots, Z, a, b, \dots, z\}$ and D be the set of digits $\{0, 1, \dots, 9\}$
- L could be in form of upper case and lower case.
- Examples:
 - $L \cup D$ is the set of letters and digits.
 - LD is the set of strings consisting of a letter followed by a digit.
- $LLLL = L^4$ is the set of all four-letter strings.

OPERATIONS ON LANGUAGE

- L^* is the set of all strings of letters, including ϵ , the empty string
- $L(L \cup D)^*$ is the set of all strings of letters and digits beginning with a letter.
- D^* is the set of all strings of one or more digits.

EXAMPLES

- Let $L = \{a, b\}$
- Some regular expressions:
 - $a \mid b$
 - Denotes the set of $\{a, b\}$ having a or b.
 - $(a|b)(a|b)$
 - Denotes $\{aa, ab, ba, bb\}$, the set of all strings of a's and b's of length two.
 - a^*
 - Denotes the set of all strings of zero or more a's , i. e., $\{\epsilon, a, aa, aaa, \dots\}$

EXAMPLES CONTD...

- $(a|b)^*$ or $(a^*|b^*)$
- Denotes the set of all strings containing zero or more instances of an a or b, that is, the set of all strings of a's and b's.

- $a|a^*b$
- Denotes the set containing the string a or all strings consisting of zero or more a's followed by a b

CAN WE DO THE REVERSE?

- Language to Regular Expressions

- Examples:

- “Set of all strings having at least one ab”

- $(ab)^+$

- “Set of all strings having even number of aa”

- $(aa)^*$

- “Set of all strings having odd number of bb”

- $b(bb)^*$

- “Set of all strings having even number of aa and even number of bb”

- $(aa)^*(bb)^*$

EXAMPLE CONTD...

- “Set of all strings having zero or more instances of a or b starting with aa”
- $(aa)(a \mid b)^*$
- “Set of all strings having zero or more instances of a or b ending with bb”
- $(a \mid b)^* (bb)$
- “Set of all strings having zero or more instances of a or b starting with aa and ending with bb”
- $(aa) (a \mid b)^* (bb)$

FINISH

■ Thanks for your Patience.