Regular Languages and Regular Sets

CS712

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A language is a set of strings.

Individual elements that make up a string are chosen from a finite set called the alphabet.

e.g. alphabet $A = \{a, b\}$

$L_1 = \{a, b\}$

$L_2 = \{a^n b^n, n \geq \phi\}$

If A is an alphabet, then A^* is the set of all strings over A.

↳ any language over A is a subset of A^*

notes

the empty string is a string, denoted as λ

$\{\lambda\}$ is a language

the empty set is a language, denoted as ϕ

concatenation of strings:

$$(aab)(ba) \text{ is } (aabba)$$

product of languages L & M

$$(L)(M) = \{(s)(t) \mid s \in L \text{ and } t \in M\}$$

$$L^0 = \{\lambda\}$$

$$L^n = \{(s_1)(s_2)\cdots(s_n) \mid s_K \in L \text{ for } 1 \leq K \leq n\}$$

$$L^* = L^0 \cup L^1 \cup L^2 \cup \ldots L^n \cup \ldots$$

$\hookrightarrow$ the closure of L

note: $\{\lambda\}^* = \{\lambda\}$

$$\phi^* = \phi^0 \cup \phi^1 \cup \phi^2 \dots$$
$$= \{\lambda\} \cup \phi \cup \phi \dots$$
$$= \{\lambda\}$$

$(\{\lambda\})(L) = L$ $\quad$ $(L)(\{\lambda\}) = L$

$(\phi)(L) = \phi$ $\quad$ $(L)(\phi) = \phi$

$\phi \cup L = L$

The <u>recognition</u> <u>problem</u>: is string s in language L?

example

$A = \{a, b\}$

$((ab) | (ba))^* = \{\lambda, ab, ba, abab, abba,$
$baab, baba, \ldots\}$

A is the alphabet.

	Regular Language	Regular Set
base	Φ, $\{\lambda\}$, $\{a\}$ $\forall a \in A$	Φ, λ, a $\forall a \in A$
recurse	if L & M are regular languages then the following are regular languages: i) $L \cup M$ ii) $(L)(M)$ iii) L^*	if R & S are regular sets then the following are regular sets: i) (R) ii) $R \mid S$ iii) RS iv) R^*

i.e: a regular set is notation for describing a regular language