Regular Language to Regular Expression

❑ Regular Expressions

Regular expressions are symbolic notations used to define search patterns in strings. They describe **regular languages** and are commonly used in tasks such as validation, searching, and parsing.

A **regular expression** represents a **regular language** if it follows these rules:

1. **ϵ (epsilon) is a regular expression** representing the language **{ϵ}** (the empty string).
2. **Any symbol 'a' from the input alphabet Σ is a regular expression**, representing the language **{a}**.
3. **Union (a + b) is a regular expression** if **a** and **b** are regular expressions, representing the language **{a, b}**.
4. **Concatenation (ab) is a regular expression** if **a** and **b** are regular expressions.
5. *Kleene star (a) is a regular expression**, meaning **zero or more occurrences of 'a'**, forming a regular language.

Description	Regular Expression	Regular Languages
Set of vowels	`(a	e
'a' followed by 0 or more 'b'	ab*	{a, ab, abb, abbb, abbbb, ...}
Any number of vowels followed by any number of consonants	[aeiou]*[bcdfghjklmnpqrstvwxyz]*	{ε, a, aou, aiou, b, abcd, ...} (ε represents empty string)

Question - 1:

a. Find the regular expression for the regular language where W = |2| over the Σ = {a, b}

Regular Language, RL = { aa, bb, ab, ba }

Regular Expression, RE = (a+b).(a+b)

b. Find the regular expression for the regular language where W <= |2| over the Σ = {a, b}

Regular Language, RL = { ε, a,b, aa, bb, ab, ba }

Regular Expression, RE = ε + (a+b) + (a+b).(a+b)

c. Find the regular expression for the regular language where W => |2| over the Σ = {a, b}

Regular Language, RL = {aa, bb, ab, ba, }

Regular Expression, RE = (a+b).(a+b). (a+b)* or $(a+b).(a+b)^{+}$

d. Write the regular expression for the language with a string with a single length over ∑ = {a, b}.

Language for the given example is given below

L = { a,b } //string with single length

A regular expression for the above language is given below

L(R) = (a+b)

e. Write the regular expression for the language that accepts all the strings, which has any number of a's and b's over ∑ = {a, b}.

Language for the given example is given below

L = {a, b, ab, ba, aab, aba, aaba ……. }

Regular expression for the above language is given below

L(R) = (a+b)*

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Question - 2:

a. Find the regular expression for the regular language that accepts all string start and end with "a" over the Σ = {a, b}

Regular Language, RL = {a, aa, aaa, aba, abbba, abababa, abbabbba …….}
Regular Expression, RE = a + a.(a+b)*.a

b. Find the regular expression for the regular language that accepts all string start and end with "b" over the Σ = {a, b}

Regular Language, RL = {b, bb, bb, bab, bbbbb, bbababb, bbababbbb …….}
Regular Expression, RE = b + b.(a+b)*.b

c. Find the regular expression for the regular language that accepts all string start and end with same symbol over the Σ = {a, b}

Regular Language, RL = {a, b, aa, bab, baab, aba , bab, bbbbb, bbababb, bbababbbb …….}
Regular Expression, RE = (a + a.(a+b)*.a) + (b + b.(a+b)*.b)

d. Find the regular expression for the regular language that accepts all string start and end with different symbol over the Σ = {a, b}

Regular Language, RL = {ab, ba, abab, bbbbba, abbababb, bbababbbba …….}
Regular Expression, RE = (a.(a+b)*.b) + (b.(a+b)*.a)

e. Write the regular expression for the language that accepts all the strings, having only one "b" and any numbers of "a" over ∑ = {a, b}.

Language for the given example is given below
L = {b, ab, aba, abaa, abaaaa, aaaaabaaaaaaa……. } // all strings having only one "b"
Regular expression for the above language is given below
L(R) = a*ba*

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Question - 3:

a. **Find the regular expression for the regular language that accepts set of all string contains exactly two "a" over the Σ = {a, b}**

Regular Language, RL = {aa, aaa, aba, abbba, abababa, abbabbba …….}
Regular Expression, RE = b*. a . b*. a . b*

b. **Find the regular expression for the regular language that accepts set of all string where 3rd symbol from RHS is "a" over the Σ = {a, b}**

Regular Language, RL = {aaa, baba, abb, ababa, abababa, abbababa …….}
Regular Expression, RE = (a+b)* a (a+b) (a+b)

c. **Find the regular expression for the regular language that accepts set of all string where 3rd symbol from LHS is "a" over the Σ = {a, b}**

Regular Language, RL = {aaa, aba, bba, ababa, abababa, abaabbba …….}
Regular Expression, RE = (a+b) (a+b) a (a+b)*

d. **Write the regular expression for the language that accepts all the strings having even length, over ∑ = {0}.**

Language for the given example is given below
L = { ε, 00, 0000, 000000, 00000000, …….. }
Regular expression for the above language is given below
L(R) = (00)*

e. **Find the regular expression for the regular language where "ab" as a substring over the Σ = {a, b}**

Regular Language, RL = {ab, baba, abb, ababa, abababa, abbababa …….}
Regular Expression, RE = (a+b)* ab (a+b)*

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Question - 4:

a. **Find the regular expression for the regular language that accepts all string start "a" over the Σ = {a, b}**

Regular Language, RL = {a, aa, aaa, aba, abbba, abababa, abbabbba …….}
Regular Expression, RE = a (a+b)*

b. **Find the regular expression for the regular language that accepts all string start "ab" over the Σ = {a, b}**

Regular Language, RL = {ab, abb, aba, abbba, abababa, abbabbba …….}
Regular Expression, RE = ab (a+b)*

c. **Find the regular expression for the regular language that accepts all string start "aab" over the Σ = {a, b}**

Regular Language, RL = {aab, aaba, aabb, aabbba, aabababa, aabbabbba …….}
Regular Expression, RE = aab (a+b)*

d. **Set of strings consisting of even number of "a" followed by odd number of "b"**

Regular Language, RL = { b, aab, aabbb, aabbbbb, aaaab, aaaabbb, .……}
Regular Expression, RE = (aa)*(bb)*b

e. **String of as and bs of even length can be obtained by concatenating any combination of the strings aa, ab, ba and bb including null**

Regular Language, RL = { aa, ab, ba, bb, aaab, aaba, …….}
Regular Expression, RE = (aa + ab + ba + bb)*