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15.(i)length is at most 2:L={∑,a,b,aa,ab,ba,bb}

∑+a+b+aa+ab+ba+bb=(∑+a+b)(∑+a+b)

(ii)language of even length:((a+b)(a+b))*

L={∑,aa, ab,ba,bb,aaaa,...}

(iii)language starting and ending with the same letter:a(a+b)*+b(a+b)*bb

(iv)language starting and ending with a different letter:a(a+b)*b+b(a+b)*a

16. Regular expression: Regular expressions can be thought of as the algebraic description of a regular language. Regular expression can be defined by the following rules: Every letter of the alphabet ∑ is a regular expression. Null string є and empty set Φ are regular expressions.

Identies of regular expression

1. L + M = M + L

2. (L + M) + N = L + (M + N)

3. (LM)N = L(MN)

4. ∅ + L = L + ∅ = L

5. L = L = L

6. ∅L = L∅ = ∅

7. L(M + N) = LM + LN

8. (M + N)L = ML + NL

9. L + L = L

10. (L∗)∗ = L∗

11. ∅∗ =

12. ∗ =

13. (xy)∗x = x(yx)∗

14. The following are all equivalent:

(a) $(x + y)^*$

(b) $(x^* + y)^*$

(c) $x^*(x + y)^*$

(d) $(x + yx^*)^*$

(e) $(x^*y^*)^*$

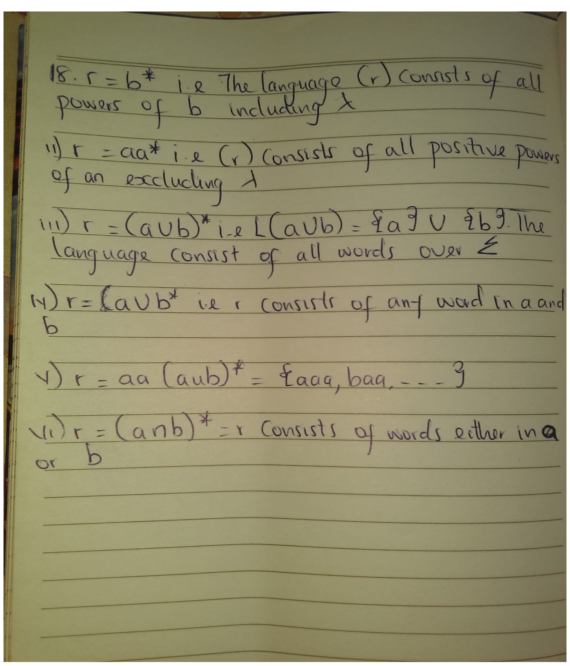
(f) $x^*(yx^*)^*$

(g) $(x^*y)^*x^*$

17. Symbols used in regular expression

- question mark (?),
- backslash (\),
- period (.),
- caret (^),
- square brackets ([and])

18.



18. $r = b^*$ i.e The language (r) Consists of all powers of b including λ

ii) $r = aa^*$ i.e (r) Consists of all positive powers of an excluding λ

iii) $r = (a \cup b)^*$ i.e $L(a \cup b) = \{a\} \cup \{b\}$. The language consist of all words over Σ

iv) $r = (a \cup b^*$ i.e r consists of any word in a and b

v) $r = aa(a \cup b)^* = \{aaa, baa, ---\}$

vi) $r = (a \cap b)^* = r$ Consists of words either in a or b

19.

This language consists of words begining with aa followed by a or and word in b

let $r = (a\, n\, (b)^*)$

This language consists of words beginning with a followed by all powers of b.

49 $L_1 = b^m a^n \mid m > 0,\ n > 1$

$L(r) = bb^*\ aaa^*$

$L(L(r)) = \{baa,\ bbaa,\ bbaaa, \dots\}$

$L_2 = a^n b^m a \mid m > 1,\ n > 0.$

$L(r) = aa^*\ bbb^*\ a^*$

$L = (L(r)) = \{abba,\ aabbba,\ aabbba\}$

$L_3 = ab^n \mid n > 0$

$L(r)\ (ab)(ab)^*$

$L(L(r)) = \{ab,\ abab,\ ababab, \dots\}$

20. Any set that denotes the value of the Regular Expression is called a "Regular Set". Regular sets have various properties: Property 1).The union of two regular sets is also a regular set.

ii. A string in L(R1 + R2) is a string from R1 or a string from R2.

A string in L(R1R2) is a string from R1 followed by a string from R2.

A string in L(R*) is a string obtained by concatenating n elements for some n≥0

21i. 110= {1} {0} is represented by 1 and 0 respectively therefore 110 is obtained by concatenating 1,1,0

ii. baab ={b} {a}

iii. {01,10} = it is a union of {01} and {10} so we have 01+10

iv. {λ,10} it is represented λ+10

v. {abb,a,b,bba} it is represented by abb+a+b+bba

vi. {∑,a,aa,aaa,...} it represents sets {a}*

vii. {∑,II,III,IIII...} it represents sets {I}*

22i. {aaa, aaa, baa, bbaa,...}

ii. {10,110,1110}

iii. {1}*

23. Grammar:In formal language theory, a grammar (when the context is not given, often called a formal grammar for clarity) describes how to form strings from a language's alphabet that are valid according to the language's syntax.. A formal grammar is defined as a set of production rules for strings in a formal language.

Difference between language and grammar

Language in terms of the theory of computation can be referred to as the set of strings which is a subset of ∑*, which is the set of all possible combinations of the elements contained in the set of symbols ∑. Grammar can be treated as a language generator.

24. A sentential form is any string derivable from the start symbol. Thus, in the derivation of a + a * a , E + T * F and E + F * a and F + a * a are all sentential forms as are E and a + a * a themselves. A sentence is a sentential form consisting only of terminals such as a + a * a.