# Theory of Automata & Formal Languages (Theory of Computation)

Compiled By

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### Languages

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• L=  $\{\lambda , a ,aa ,aaa, aaaa,...., \} = \{a^n | n >= 0\}$ 

L={x belongs to{a, b}\*| length of x is even}

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• L=  $\{a, aaa, aaaaaa, \dots, \} = \{a^n \mid n \text{ is odd }\}$ 

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- L1 =  $\{a, aaa, aaaaa, ..., \} = \{a^n \mid n \text{ is odd }\}$
- L2=  $\{\lambda , aa, aaaa, ...., \} = \{a^n \mid n \text{ is even } \}$
- L1L2= a.aa = aaa = aa.a = L2L1
- L1L2= a.  $\lambda$ = a =  $\lambda$ .a=L2L1

• Find languages L1 and L2 satisfying L1L2= L2L1 and L1 is a proper non-empty subset of L2 and L1  $\neq$ { $\lambda$ }

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- L1 =  $\{a, aaa, aaaaa, ...., \} = \{a^n \mid n \text{ is odd }\}$
- L2=  $\{\lambda, a, aa, aaa, aaaa, ..., \} = \{a^n \mid n > = 0 \}$
- L1L2= a.aa = aaa = aa.a = L2L1
- L1L2= a,  $\lambda$ = a =  $\lambda$ .a=L2L1

 Let languages L1 and L2 be subset of {a,b}\* and consider two languages L1\*U L2\* and (L1 U L2)\*.
 Which of the two is always a subset of the other?

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- L1={a}, L1\*= { $\lambda$ , a, aa, aaa, aaaa,.....}
- L2={b}, L2\*={ $\lambda$  ,b, bb, bbb, bbb,.....}
- L1\* U L2\* =  $\{\lambda, a, b, aa, bb, aaa, bbb, \dots \}$
- (L1 U L2) = {a, b}, (L1 U L2)\* = {λ, a, b, ab, ba, aba, .....}

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- $A = \{ a \}, |A| = 2$
- $B = \{ba, \}, |B| = 2$
- $\bullet$  AB = {abba, aba, aba, aa} = {abba, aba, aa}
- |AB|= 3
- |A|\*|B|=2\*2=4
- Statement is not always true

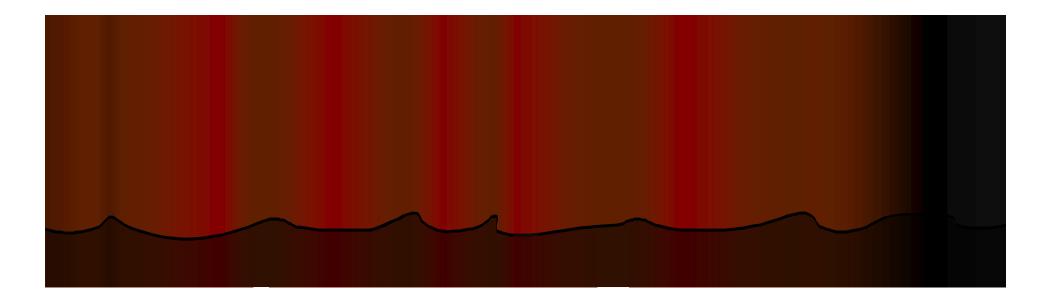
• Let L1, L2 and L3 be languages over some alphabet  $\Sigma$ . Is L1(L2  $\cap$  L3) = L1.L2  $\cap$  L1.L3 always true?

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- L1={ab, a}
- L2={a}
- L3={ba}
- L1(L2  $\cap$  L3) = {ab, a} .  $\Phi$  =  $\Phi$
- $L1.L2 \cap L1.L3 = \{aba, aa \} \cap \{abba, aba \} = \{aba\}$



Let  $L_1, L_2$  be languages, then the concatenation  $L_1 \circ L_2 = \{w \mid w = xy, x \in L_1, y \in L_2\}$ . If  $L_2 = \emptyset$ , then there is no string  $y \in L_2$  and so there is no possible w such that w = xy. Thus for any  $L_1$ , we'll have  $L_1 \circ \emptyset = \emptyset$ .



## Are (L1 $\cap$ L2) \* and L1\* $\cap$ L2\* always Equal?

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L1 = \{a, ba\}
L2 = \{ab, a\}
L1* = { ^, a, ba, aa, aba, baa, baba, ....}
L2* = \{ , ab, a, abab, aba, aab, aa, ..... \}
L1* \cap L2* = \{^{\land}, a, aba, aa, \ldots \}
L1 \cap L2 = \{a\}
(L1 \cap L2)^* = \{^{\land}, a, aa, aaa, \dots \}
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They are not always equal