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FORMAL LANGUAGES & AUTOMATA

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1.8.1. What language is represented by the regular expression $(((a^\star a)b) \cup b)$?

ANSWER:

(((a* a) b) ∪ b) = { (a* a) b, b} = {ab, aab, aaab, ..., b}

1.8.2. Rewrite each of these regular expressions as a simpler expression representing the same set.

(a) $\varnothing^\star \cup a^\star \cup b^\star \cup (a \cup b)^\star$

(b) $((a^\star b^\star)^\star (b^\star a^\star)^\star)^\star$

(c) $(a^\star b)^\star \cup (b^\star a)^\star$

(d) $(a \cup b)^\star a (a \cup b)^\star$

ANSWER:

(a) Ø* ∪ a* ∪ b* ∪ (a ∪ b)* = (a ∪ b)*

(b) ((a* b*)* (b* a*)*)* = (a ∪ b)*

(c) (a* b)* ∪ (b* a)* = (a ∪ b)*

(d) (a ∪ b)* a(a ∪ b)* = (a ∪ b)* a(a ∪ b)*

1.8.3. Let $\Sigma = \{a, b\}$. Write regular expressions for the following sets:

(a) All strings in Σ^* with no more than three a's.

(b) All strings in Σ^* with a number of a's divisible by three.

(c) All strings in Σ^* with exactly one occurrence of the substring aaa.

ANSWER:

(a) aaa ∪ b* = {a} o {a} o {a} ∪ {b}*

(b) (aaa)* = ({a} o {a} o {a})*

(c) (ab ∪ aab ∪ b)* aaa(ba ∪ baa ∪ b)*

1.8.5. Which of the following are true? Explain.

(a) $baa \in a^*b^*a^*b^*$

(b) $b^*a^* \cap a^*b^* = a^* \cup b^*$

(c) $a^*b^* \cap b^*c^* = \emptyset$

(d) $abcd \in (a(cd)^*b)^*$

ANSWER:

(a) True

(b) True

(c) False

(d) False