Regular Languages

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Spoken by the common folk...
Definition

A language is a **Regular Language** iff some Finite State Machine recognizes it.
Intuition:

What would make a language NOT Regular?

Answer: It requires memory.

(other than tracking state, that is)
A Few Examples (not limited to):

Non-Regular languages

- $0^n1^n$
- $0^m1^n, m > n$
- $w = (0|1)^*$
  where $\#_0(w) = \#_1(w)$
- $ww$ or $ww^R$

Regular Languages

- Contains a substring
- $0^*1^*0^+$
- Any finite language
- Binary numbers divisible by 3
Regular Operations

Let \( A \) and \( B \) be languages. We define the regular operations union, concatenation, and star as follows:

- **Union**: \( A \cup B = \{x | x \in A \text{ or } x \in B\} \).
- **Concatenation**: \( A \circ B = \{xy | x \in A \text{ and } y \in B\} \).
- **Star**: \( A^* = \{x_1x_2...x_k | k \geq 0 \text{ and each } x_i \in A\} \).
Question: Are Regular Languages closed under Union, Concatenation, and Star?