

Ad-posted by section (Lila, Glin, ...). T2 spoile : CSC236 fall 2012 B overage, bock Fridey - automata and languages FSA

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Using Introduction to the Theory of Computation, Chapter 7

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formal languages

FSAs

notes



some definitions

Many problems can be reduced to languages: logical formulas, identifiers for compilation, natural language recognition. Key question is recognition: $P^{Voccessing}$

Given language L and string s, is $s \in L$?

Languages may be described either by descriptive generators (for example, regular expressions) or procedurally (e.g. finite state automata)

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more notation

string length: denoted |s|, is the number of symbols in s, e.g. |bba| = 3.

s = t: if and only if |s| = |t|, and $s_i = t_i$ for $1 \le i \le |s|$.

 s^{R} : reversal of s is obtained by reversing symbols of s, e.g. $1011^{R} = 1101$. $\xi^{R} = \xi$ $\xi^{R} = \xi$

st or $s \circ t$: contcatenation of s and t — all characters of s followed by all those of t, e.g. $bba \circ bb = bb abb$.

> s^k : denotes s concatenated with itself k times. E.g., $ab^3 = ababab$, $101^0 = \varepsilon$.

 $\Sigma^{n}: \text{ all strings of length } n \text{ over } \Sigma, \Sigma^{*} \text{ denotes all}$ $\mathfrak{T}^{o} = \{ \mathfrak{E} \}$

language operations

$$5^{*}$$
 \sum_{L}^{∞} \sum_{L}^{L} $\sim L$ \sum_{I}^{∞} \sum_{L}^{I} $\sim L$

 \overline{L} : Complement of L, i.e. $\Sigma^* - L$. If L is language of strings over $\{0, 1\}$ that start with 0, then \overline{L} is the language of strings that begin with 1 plus the empty string.

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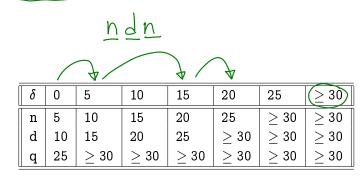
$$L \cup L'$$
: union $\{2a, b, ba\} = L'$

 $L \cap L'$: intersection

L - L': difference $L \setminus L'$

states needed to classify a string

what state is a stingy vending machine in based on coins? accepts only nickles (a), dimes (b), and quarters (c), no change given, and everything costs 30 cents useful toy (you'll need JRE)



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build an automaton with formalities... quintuple: $(Q, \Sigma, q_0, F, \delta)$ Q is set of states, Σ is finite, non-empty alphabet, q_0 is start state F is set of accepting states, and $\delta: Q \times \Sigma \mapsto Q$ is transition function e_q . $\{04, 54, 104, 154, 204, 254, 2304\}$

We can extend $\delta: Q \times \Sigma \mapsto Q$ to a transition function that tells us what state a string takes the automaton to:

$$\delta^* : Q \times \Sigma^* \mapsto Q \qquad \delta^*(q, s) = \begin{cases} \delta(\delta^*(5, n \downarrow), n) \\ = \delta(\delta(\delta^*(5, n), \downarrow), n) \\ = \delta(\delta(\delta^*(5, \epsilon), n), \downarrow), n) \\ q & \text{if } s = \epsilon \\ \delta(\delta^*(q, s'), a) & \text{if } s' \in \Sigma^*, a \in \Sigma \\ \leq -\delta^*q \end{cases}$$

String s is accepted if and only iff $\delta^*(q_0, s) \in F$, it is rejected otherwise.

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example — an odd machine

devise a machine that accepts strings over $\{a, b\}$ with an odd number of as

Formal proof requires inductive proof of invariant:

$$\delta^*(E,s) = egin{cases} E & ext{if s has even number of as} \ O & ext{if s has odd number of as} \end{cases}$$



notes

