

Homework 1

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Exercise 1

1. Describes the languages denoted by the following regular expressions:

- (a) $a(a|b)^*a$
: All strings of 'a' and 'b' that starts and ends with 'a'.
- (b) $((\varepsilon|a)b^*)^*$
: All strings of 'a' and 'b'.
- (c) $(a|b)^*a(a|b)(a|b)$
: All strings of 'a' and 'b' where the 3rd element from the right is 'a'.
- (d) $a^*ba^*ba^*ba^*$
: All strings of 'a' and 'b' that only contains three 'b'.
- (e) $(aa|bb)^*((ab|ba)(aa|bb)^*(ab|ba)(aa|bb)^*)^*$
: All strings of 'a' and 'b' that has a even number of 'a' and 'b'.

2. Write regular definitions for the following languages:

- (a) All strings of lowercase letters that contain the five vowels in order.
: other \rightarrow [bcdfghjklmnpqrstvwxyz]
want \rightarrow other^{*}a(other|a)^{*}e(other|e)^{*}i(other|i)^{*}o(other|o)^{*}u(other|u)^{*}
- (b) All strings of lowercase letters in which the letters are in ascending lexicographic order.
: a^{*} b^{*} ... z^{*}
- (c) Comments, consisting of a string surrounded by /* and */, without an intervening */, unless it is inside double-quotes (").
:
- (d) All strings of digits with no repeated digits. Hint: Try this problem first with a few digits, such as {0, 1, 2}.
: A \rightarrow 0?2(02)^{*}
want \rightarrow 0|A?0?1(A0?1|01)^{*}A?0?|A0?
- (e) All strings of a's and b's that do not contain the substring abb.
: b^{*}(a+b?)^{*}
- (f) All strings of a's and b's that do not contain the subsequence abb.
: b^{*} | b^{*}a+ | b^{*}a+ba^{*}

3. Write character classes for the following sets of characters:
 - (a) The first ten letters (up to "j") in either upper or lower case.
: [A-Ja-j]
 - (b) The lowercase consonants.
: [bcdfghjklmnpqrstvwxyz]
 - (c) The "digits" in a hexadecimal number (choose either upper or lower case for the "digits" above 9).
: [0-9a-f]
 - (d) The characters that can appear at the end of a legitimate English sentence (e.g., comma, exclamation point).
: [.,!]
4. Design finite automata (deterministic or nondeterministic) for this language
 - (a) All strings of digits with no repeated digits. Hint: Try this problem first with a few digits, such as $\{0, 1, 2\}$.

5. Convert the following regular expressions to deterministic finite automata:

- (a) $(a|b)^*$
- (b) $(a^*|b^*)^*$
- (c) $((\varepsilon|a)|b^*)^*$
- (d) $(a|b)^*abb(a|b)^*$