

Work No. 1

Exercise 01: Describe the languages represented by the following regular expressions:

1. $a(a|b)^*a$
2. $((\varepsilon|a)b^*)^*$
3. $(a|b)^*a(a|b)(a|b)$
4. $a^*ba^*ba^*ba^*$
5. $(aa|bb)^*((ab|ba)(aa|bb)^*(ab|ba)(aa|bb)^*)^*$

Exercise 02: Let the alphabet be $A = \{0,1\}$. Define regular expressions for the languages below:

1. The set of words of length at least n , where n is a fixed natural number
2. The language that contains a number of 1s divisible by 3.
3. All non-empty words that do not contain the substring 11.
4. Binary numbers containing at most three 0s.
5. Words in which there is an even number of 1s between two occurrences of 0.
6. All words that do not contain the factor 101;

Exercise 03: Define regular expressions for the languages below:

1. Non-empty words beginning with a lowercase letter of the alphabet, and each letter is always followed by a digit. These words are of even length:
e1, b2c1d3, ... are accepted words,
e, 1, da1d, abcd, ... are not accepted.
2. Non-empty words composed of lowercase letters of the alphabet, words where the letter 'e' is either completely absent or always present in pairs:
abc, ee, beecce, eeedaf, ... are accepted words,
e, bec, deeca, ... are not accepted.
3. Words composed of lowercase letters of the alphabet,
– where 'a', 'b' and 'c' appear at most once (i.e. 0 or 1 times),
– if 'a' is present, there will be no 'b' or 'c' to its left, near or far,
– if 'b' is present, there will be no 'c' to its left, either near or far.
For example:
a, b, c, abde, btgcf, xaxbefc, ... are accepted words, aeaf, ebdag, acbde, ... are not accepted.

Exercise 4

1. Provide an extended regular expression that recognises natural integers:
 - without any non-significant zeros on the left,
 - composed of an even number of even digits,
 - or composed of an odd number of even digits.

Examples of accepted integers: 224466 246820 135 9975311

Examples of unacceptable integers: 024666 2410 1357 13257

2. Provide an extended regular expression that recognises durations (strictly less than 24 hours) in hours, minutes and seconds, respecting the following constraints:

- A duration is expressed in the format --h--m--s.
- Seconds and minutes are between 0 and 59 and consist of one or two digits.
- Hours are between 0 and 23 and consist of one or two digits.
- Hours can only be present if minutes are present, and minutes can only be present if seconds are present.

Examples of accepted durations: 05s 05m00s 02h3m04s 2h03m4s

Examples of unacceptable durations: 05m: without seconds

3. Provide an extended regular expression in Lex that recognises registration numbers consisting of:
 - 3 to 5 digits not starting with the digit 0,
 - followed by 2 capital letters excluding WW,
 - ending with 2 digits excluding 00

Examples of accepted numbers: 123WA01 64725AA45

4. Provide an extended regular expression that recognises IPv4 addresses (consisting of 4 fields separated by dots. Each field belongs to the interval [0,255]):
 - The first address is 0.0.0.0
 - And the maximum address is 255.255.255.255