

Informatics 1 - Computation & Logic: Tutorial 7

Computation: Regular Expressions

Week 9: 11-15 November 2013

Please attempt the entire worksheet in advance of the tutorial, and bring with you all work, including (if a computer is involved) print-outs of code and test results. Tutorials cannot function properly unless you do the work in advance.

You may work with others, but you must understand the work; you can't phone a friend during the exam.

Assessment is formative, meaning that marks from coursework do not contribute to the final mark. But coursework is not optional. If you do not do the coursework you are unlikely to pass the exams.

Attendance at tutorials is **obligatory**; please let your tutor know if you cannot attend.

Regular expressions

1. Which language is defined by the following regular expression?

$$(a|ab)(c|bc)$$

2. Write FOUR other regular expressions which define the same language.

3. Which languages are defined by the following regular expressions?

(a) $(a|b)^*$

(b) $a|b^*$

(c) $(ab)^*$

(d) ab^*

(e) $((ba^*b)|a^*)^*$

4. Write regular expressions for the following languages:

- (a) the set of strings over $\{a, b\}$ which contain no more than two a 's

- (b) the set of strings over $\{a, b\}$ which both start and end with a

- (c) the set of binary numbers which are multiples of four

5. Verify if the following regular expressions are equivalent, using the following algebraic laws:

$$L(\emptyset|R) = L(R) = L(R|\emptyset) \quad (1)$$

$$L(R|R) = L(R) \quad (2)$$

$$L(R|S) = L(R) \cup L(S) = L(S|R) \quad (3)$$

$$L((R|S)|T) = L(R|(S|T)) \quad (4)$$

$$L(\epsilon R) = L(R) = L(R\epsilon) \quad (5)$$

$$L(\emptyset R) = L(\emptyset)L(R) = L(\emptyset) = L(R\emptyset) \quad (6)$$

$$L((RS)T) = L(R(ST)) \quad (7)$$

$$L(R(S|T)) = L(R)L(S|T) = L(RS|RT) \quad (8)$$

$$L((R|S)T) = L(R|S)L(T) = (L(R) \cup L(S))L(T) = L(RT|ST) \quad (9)$$

$$L(\emptyset^*) = L(\emptyset)^* = \{\epsilon\} = L(\epsilon) \quad (10)$$

$$L(RR^*) = L(R)L(R^*) = L(R^*R) \quad (11)$$

$$L(RR^*|\epsilon) = L(R^*) \quad (12)$$

$$L((R|S)^*) = L((R^*S^*)^*) \quad (13)$$

$$L((RS)^*R) = L(R(SR)^*) \quad (14)$$

(a) $((aa^* | \epsilon)c | ((b | b)c)$ equivalent to $(a^* | b)c$

(b) $(a(ba)^*b | (ab)^*)$ equivalent to (ab)

(c) $((\epsilon(a | \emptyset))^*b^*)^*$ equivalent to $(a | b)^*$

This tutorial exercise sheet was written by Paolo Besana, and revised by Thomas French and Areti Manataki. Send comments to A.Manataki@ed.ac.uk