uc3m | Universidad Carlos III de Madrid

Grado en Matemática Aplicada y Computación
Grado en Ingeniería Informática

DEPARTAMENTO DE INFORMÁTICA
UNIVERSIDAD CARLOS III DE MADRID

Formal Languages and Automata Theory
Exercises Finite Automata
Unit 3 – Part 1

1. Given the alphabet {0,1}, construct a DFA which recognizes those elements of the universal language with an odd number of zeros.
2. Given the alphabet {a,b}, construct a DFA which recognizes strings with length "3" of the universal language. (After Unit 4: Obtain the G3 corresponding to this automaton).
3. Given the alphabet {a, b}. Explain how a DFA would be implemented to recognize the language of n-length strings. Firstly, design the automaton for specific values of n, e.g. n = 4, and then design the automaton for any value of n.
4. Given the alphabet {a,b}, design a DFA which recognizes strings with an even number of a's and an odd number of b's.
5. Given the alphabet {0,1}. Design a DFA to recognize the language L which consists of strings with the same number of substrings "01" and substrings "10". Examples: 101 is included in L (**10**1, 1**01**); however, 1010 is not included in L (**10**10, 10**10**, 1**01**0).
6. We want to design a device that, given a string which consists of binary digits, will be able to find if the keyword "1011" is included in the input string and use it as a basis to count the number of times this keyword is included. For instance, for the input string 010**1011**011**1011**, the device would detect two occurrences of the keyword (the "1" in the seventh position is not considered as the beginning of a new apparition). It is required to design the corresponding DFA.
7. In several programming languages, comments are included between the marks "/*"and "*/". Let L be the language of every string of comments limited by these marks. Then, every element in L begins /* and ends with */, but does not include any intermediate */. To simplify the problem, consider that the input alphabet is {a, b, /,*}. Design the DFA which recognizes L.
8. Design a DFA to recognize the language that includes the natural numbers (N = {0, 1, 2, ...}), the integers $\mathbb{Z}$ = {..., -3, -2, - 1, 0, +1, +2, +3, ...}, (e.g. -937, +937), the rational numbers (those which can be expressed as the quotient of an integer and a natural number $n \neq 0$ (e.g. 5/34, -5/34, +5/34), the decimal numbers represented in decimal notation –they have an integer part and fractional part separated by a dot (e.g. 10.40, 7.0)- and in scientific notation, as a product of a decimal number and a power of 10 (exponent different from 0), represented as e ± n (e.g. 1.5e + 13, 237.45e-3).
9. Design a DFA to recognize multiples of 3 given a binary input (starting with the most significant bit). Input number can be of any number of bits and can start with '0'.