

Formal Languages and Automata Theory

Exercises Finite Automata

Unit 3 – Part 1

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* Several exercises are based on the ones proposed in the following books:

- Enrique Alfonseca Cubero, Manuel Alfonseca Cubero, Roberto Moriyón Salomón. *Teoría de autómatas y lenguajes formales*. McGraw-Hill (2007).
- Manuel Alfonseca, Justo Sancho, Miguel Martínez Orga. *Teoría de lenguajes, gramáticas y autómatas*. Publicaciones R.A.E.C. (1997).
- Pedro Isasi, Paloma Martínez y Daniel Borrajo. *Lenguajes, Gramáticas y Autómatas. Un enfoque práctico*. Addison-Wesley (1997).



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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 string 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 string with the same number of substrings “01” and substrings “10”. Examples: 101 is included in L (**101, 101**); however 1010 is not included in L (**1010, 1010, 1010**).
6. We want to design a device that, given a string which consists of binary numbers, will be able to find if the keyword “1011” is included in the input string and it also would be used as a basis to count the number of times this keyword is included. For instance, for the input string 010**1011**011**011**, 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 it does not include any intermediate */. To simplify the problem, consider that the input alphabet is $\{a, b, /, *\}$. Indicate the DFA which recognizes L.
8. Design a DFA to recognize binary numbers which multiple of 3. (After Unit 4: Obtain the G3 corresponding to this automaton).

