Opinion

by

Assoc. Prof. Dr. Hristo Alexandrov Ganchev

Member of the Scientific Jury, appointed by Order No. 346 / 30.12.2019 of the Director of IICT-BAS, in connection with the procedure for obtaining the Doctor of Science Degree in Professional Degree 4.6 " Computer Science" by Assoc. Dr. Stoyan Milkov Mihov

The dissertation presented is entitled "Finite-State Automata, Transducers and Bimachines: Algorithmic Constructions and Implementations". It is in English and has a volume of 219 pages, including an introduction, 8 chapters, a conclusion (containing the author's contributions, a list of publications in which they have been published) the results of the dissertation as well as a declaration of originality) and a bibliography.

The theory of Finite State Automata starts from the mid 20 th century. In the classic version, finite-state automata are a class of algorithms for recognizing word membership problems. This class is very broad since, roughly speaking, every algorithm (or algorithmic device), which requires a fixed amount of memory can be simulated by a finite-state automaton. One of the main advantages of the finite-state automata is their speed. Indeed, the complexity of the deterministic finite-state automata algorithms is linear with respect to the length of the input word. Towards the end of the 20th century, interest in this class of algorithms increased, and in addition to membership problems, they are also being investigated as transducers. This necessitates the consideration of finite-state automata not only over ordinary finite alphabets (free monoids) but also over arbitrary finitely generated monoids. The possibility of having some commutativity in the monoid necessitates the development of new algorithms for dealing with the automata, so as to preserve the linear complexity of the execution of the automaton. This gives rise to two important varieties of finite-state automata, namely sub-sequential transducers and bimachines. The advances in these studies, as well as the increase in computing power of computers, have led to a boom in the last 20 years in applications of finite-state automata and their derivates. They are widely used in computational linguistics for tasks such as automatic text correction, speech recognition and synthesis, as well as automatic translations.

This dissertation is a complete systematic work on finite-state automata over finitely generated monoids. The first three chapters are introductory, in which the reader is introduced to the concepts of monoid, classical finite-state automaton, monoid finite-state automaton, and the relationship between the two concepts. Chapter 4 deals with the general properties of multi-tape finite-state automata and transducers. The fifth chapter deals with deterministic transducers and sub-sequential transducers, and chapter six deals with bimachines. The seventh chapter presents a new programming language that was developed to easily integrate mathematical definitions of structures and algorithms. Chapter eight presents the implementation in this programming language of all the algorithms presented in the previous chapters.

The dissertation is written extremely well. All concepts are carefully introduced and explained, and reading the work does not imply specific prior knowledge. The correctness of all algorithms has been proven, and they are illustrated with appropriate examples that make it easier to understand the ideas behind formal constructions. In addition, the presented algorithms are accompanied by commentaries on their strengths and weaknesses . The new programming language is clearly described and accompanied by appropriate specific examples that facilitate its acquisition. The implementation of the algorithms is accompanied by clear documentation indicating exactly what the program is expected to accomplish at each step.

There is a significant amount of scientific accomplishments in the dissertation. The most important ones are the algorithms for canonization of subsequetional transducers, the one for building a bimachine from a finite-state transducer, and the one for the composition of bimachines. In my view, they represent significant steps in the development of the theory of the finite-state transducers and bimachines, which have strong application side. With these results, Prof. Mihov establishes himself as one of the leading world specialists in the field.

The abstract and the author's reference reflect correctly the content and the contributions in the dissertation.

The dissertation is based on one monograph , one book chapter, 3 articles in impact factor journals and 7 articles in impact rank journals. More than 50 citations can be found in SCOPUS . The co-author of ht e monograph has presented a letter stating the leading role of professor Mihov. This fulfills the minimum requirements of the RBMP, as well as the internal rules of the IICT for obtaining the degree of Doctor of Science.

I give my **positive** assessment of the thesis.

Given the foregoing, I strongly recommend the honorable jury to award to Assoc. Prof. Stoyan Milkov Mihov the "Doctor of Science" degree in the field of higher education 4. " Natural Sciences , Mathematics and Computer Science" professional degree 4.6 "Computer Science" .

Sofia ,
03/26/2020

Hristo Ganchev