REER REVIEW

for the competition for the academic position "Associate Professor"

in the Professional Field 4.5 Mathematics (Mathematical Logic),

for the needs of the Sofia University "St. Kliment Ohridski"

Faculty of Mathematics and Informatics (FMI of SU),

announced in Newspaper of State, No. 105 of 11.12.202020

and at the Internet pages of FMI and SU

The peer review is written by **Prof. D.Sci. Vesselin Stoyanov Drensky, Full Member of the Bulgarian Academy of Sciences**, working in the Institute of Mathematics and Informatics of the Bulgarian Academy of Sciences, Professional Field 4.5 Mathematics, as a member of the Scientific Jury for the competition by Order No. РД 38-84/10.02.2021 of the Rector of the Sofia University.

The only applicant who has applied for the position is

Chief Assistant Professor Ph.D. Stefan Vladimirov Gerdjikov from the Department of Mathematical Logic and Applications at the Faculty of Mathematics and Informatics of the Sofia University "St. Kliment Ohridski".

I.   Description of the presented documents

1. Information about the documentation

The documentation presented by the applicant is in accordance with the requirements of the law and the accompanying rules of the Sofia University.

The applicant for the position Chief Assist. Prof. Ph.D. Stefan Vladimirov Gerdjikov participates in the competition with 9 publications in foreign scientific issues. He has also added 16 other documents which concern: the statement that he wants to apply for the position; CV, diplomas for M.Sci. and Ph.D.; documents confirming his position as a Chief Assist. Professor at the University; proofs that he covers the minimal scientific requirements of the law for the position; the announcement for the competition as well as data for the scientific activity of the applicant which we shall comment below.

2. Information for the applicant

The applicant Stefan Gerdjikov graduated the FMI of SU first as a Bachelor in Informatics and then received a Master of Science diploma in Informatics, specialization "Logic and Algorithms". Later, he completed the Ph.D. program at the FMI of SU and defended his Ph.D.

Thesis on "An Effective Algorithm for Asymptotical Search in Regular Sets" with scientific advisor Assoc. Prof. Ph.D. (now D.Sci.) Stoyan Mihov. During his studentship Chief Assist. Prof. Stefan Gerdjikov spent a year as an Erasmus student in Mathematics in Karlsruhe and after the defense of his Ph.D. Thesis two years as a Marie Curie fellow at the Ludwig Maximilian University of Munich where he worked on "Index Based Statistical Analysis of Large Text Corpora" under the supervision of Prof. Klaus Schulz. He worked as an instructor and Assist. Professor the FMI of SU, a programmer at the Institute of Information and Communication Technologies (IICT) at the Bulgarian Academy of Sciences and since 2014 is a Chief Assist. Professor at the FMI of SU. Since 2016 he is a Chief Assist. Professor at IICT–BAS in a part time position.

3. General characteristic of the scientific work and achievements of the applicant

The main scientific results of Chief Assist. Prof. Gerdjikov are published in the period 2008–2020 and are in the applications of Mathematical Logic to Theoretical Computer Science. According to Mathematics Subject Classification MSC accepted by Mathematical Reviews and Zentralblatt his publications are in the fields:

68-XX Computer science and more precisely in 68Q45 Formal languages and automata. They have also relations with 20M35 Semigroups in automata theory, linguistics, etc.; 52B55 Computational aspects related to convexity; 52C45 Combinatorial complexity of geometric structures; 68Q25 Analysis of algorithms and problem complexity; 68Rxx Discrete mathematics in relation to computer science (68R15 Combinatorics on words) and 68U05 Computer graphics; computational geometry (digital and algorithmic aspects).

Most of the main results of the applicant are in the problematics successfully developed both abroad and by the members of the Bulgarian school in Mathematical Logic working in the applications to Computer Science which is internationally recognized for many years. Additionally, most of the results are in the meeting points with Discrete Geometry, Semigroup Theory and other parts of Mathematics, Computer Science and Mathematical Linguistics. Chief Assist. Prof. Gerdjikov has obtained interesting results in the above listed branches of Science and has shown that he is one of the perspective young members of the Bulgarian school. The list of his publications consists of 9 papers presented for the competition, and from the other 7 publications one is in C.R. Acad. Bulg. Sci., one in Annuaire de l'Univ. de Sofia and 5 are in proceedings of conferences. It makes a pleasant impression that the applicant works successfully in a team. From his 16 publications 4 are without coauthors and the others are written in collaboration with colleagues from FMI and IICT as well as with foreign mathema-

ticians from Australia, China, Germany, Great Britain, India, Ireland, the Netherlands, Spain, and the U.S.A. One can see from the data presented in the system "The Authors" which collects information for the scientific activity of the scientists at the Sofia University that the obtained results have been reported at a series of respected international and national forums. Another confirmation follows from the fact that an essential part of the publications of the applicant are in proceedings of conferences which means that the results have been presented at these meetings. I want also to mention that Chief Assist. Prof. Gerdjikov has participated in several projects with European or national funding.

It can be concluded from the applied documentation that:

a) The scientific publications satisfy the minimal requirements of the law and the accompanying rules of the Sofia University for the academic position "Associate Professor" in the scientific field of the competition and even satisfy them with some excess. With minimum requirements for groups of indicators B, D and E respectively 100, 200 and 50 points, the applicant has submitted information for 126, 270 and 136 points;

b) The scientific publications submitted for the position have not been used in previous applications. I can confirm this personally since I was a referee of the Ph.D. Thesis of the applicant;

c) No plagiarism has been established in the presented for the competition works.

4. **Characteristics and evaluation of the teaching activity of the applicant**

Chief Assist. Prof. Gerdjikov starts his successful teaching career already as a Bachelor student. He has read and continues to read most of the courses included in the Masters and Bachelor programs at the Department of Mathematical Logic and Applications. He was an advisor or a consultant of three Master students who successfully defended their Master Theses. In the moment he is responsible for the Masters program of Computer Linguistics of the FMI. Chief Assist. Prof. Gerdjikov works actively also with gifted secondary school students and the preparation of the Bulgarian mathematical teams for competitions. In 2020 he was the head of the Bulgarian team at the Balkan Olympiad and the deputy head of the team at the International Mathematical Olympiad .

5. **Analysis of the scientific and scientific-applied achievements of the applicant contained in the documents and publications presented for the competition**

The applicant has presented for the competition 9 papers: 4 papers are in journals (Theoretical Computer Science, Computational Geometry Theory and Applications, Fuzzy Sets and Systems и ACM SIGMOD Record) and 5 papers are in proceedings of conferences in Israel, France and Spain. Two of the papers are in quartile Q1, one in quartile Q2 and one in quartile

Q4. The total impact factor is 6,313. The interdisciplinarity of the research of the applicant is confirmed by the fact that these journals are indexed in 6 groups of journals with impact factor: Computer Science, SCIE Information Systems, SCIE Software Engineering, Statistics and Probability, Mathematics, Mathematics Applied. The other 5 papers have SJR. Two of the papers are with the applicant as a single author, 2 are with one coauthor, 3 with two coauthors, one is with 6 coauthors and 1 with 9 coauthors. Among the coauthors are the advisor of the Master and Ph.D. Theses of the applicant Stoyan Mihov (in 4 of the papers), Petar Mitankin (in 3 of the papers), Klaus Schulz (in 2 of the papers) and 15 coauthors in one paper. All papers are published in the period 2008 – 2020.

Besides the abstracts of the papers presented for the competition in Bulgarian and English Chief Assist. Prof. Gerdjikov has included in his documentation detailed exposition for his achievements which gives a good possibility for orientation in the problems and exactly reflects his achievements and their place in the general picture. The applicant very precisely has de-scribed the contribution of each of the coauthors in the joint papers.

The applicant has grouped his publications in five groups which cover a large circle of questions in several branches of Theoretical Computer Science, Mathematics and Mathemati-cal Linguistics.

1.   *Effective constructions for building bimachines.* Bimachines form a class of deterministic finite-state machines which present the class of regular functions on words. There is a standard construction of bimachines starting with functional transducers. The applicant has included in this group two papers published in 2017 and 2019. The papers contain new con-structions which improve the classical ones.

2.   *Axiomatization of monoids.* The group consists of two papers published in 2018. They describe a large class of monoids (semigroups with unity) which directly generalizes classical constructions and can solve the problems for determinization, canonization and minimization. This is achieved by adding new axioms. Both papers are published in conference proceedings with limit of the number of pages and in the beginning of November 2020 the applicant wrote a text with the impressive number of 148 pages which contains a very detailed description of the results and the methods for their establishing. I think that the applicant has to popularize and eventually to publish this text.

3.   *From monoids to maximal factorizations and back to monoids.* This group consists of one paper which is the most recently published among the papers presented for the competition. The leading idea is how algorithms for ordinary automata can be transferred to automata with additional algebraic structure. It has turned out that the existence of maximal

factorization is a sufficient condition for the solving of many practical problems as minimization and canonization.

4. *An algorithm for minimal decomposition into pseudo-triangles of simple polygons.* The applicant has included in this group a paper from 2008. It contains a generalization of the algorithm for minimal decomposition of simple polygons into convex polygons. The new moment is the usage of the so called pseudo-triangles.

5. *Effective algorithms for approximate similarity search.* The group contains three papers from 2014. The first one is with 9 coauthors of an international team and the other two are with Bulgarian colleagues. The results are in the spirit of the Ph.D. Thesis of the applicant. The created algorithms are both of purely theoretical interest and have a direct practical application in Linguistics and the analysis of historical texts.

I want to mention that in order to establish the results in the papers presented for the competition the applicant uses a large arsenal of techniques of Theoretical Computer Science, Mathematical Logic and other branches of Mathematics.

The character of the scientific contributions of the applicant are in developing of new methods and enriching of the existing knowledge. Since the results have some relations with Theoretical Computer Science they have direct applications in practice.

Chief Assist. Prof. Stefan Gerdjikov has presented a list of 17 citations of 4 of the papers submitted for the competition and two more citations of one of the other papers. Most of citations are in publications of foreign scientists.

6. Critical remarks and recommendations

I do not have essential critical remarks and recommendations to the documentation presented for the competition.

7. Personal impressions for the applicant

I know Chief Assist. Prof. Stefan Gerdjikov since his studentship and I have excellent personal impressions for him. Later I have had the possibility to obtain an impression for his scientific results, also as a referee for his Ph.D. Thesis. I have a very good opinion about his results and about his broad mathematical interests.

8. Conclusion for the application

After my careful and critical reading of the documentation and the publications presented for the competition and my analysis of their significance and the scientific and scientific-applications contributions **I confirm** that the scientific contributions are sufficient as

required by the law and the additional requirements of the Sofia University for the position "Associate Professor" in the scientific field of the competition. In particular, the applicant satisfies the minimal national requirements for the scientific field and there is not a plagiarism in the presented publications for the competition.

I give my **positive** evaluation for the application.

II. CONCLUSION

I r**ecommend** the Scientific Jury to suggest that the Council responsible for the election of the Faculty of Mathematics and Informatics of the Sofia University "St. Kliment Ohridski" to elect Chief Assist. Prof. Ph.D. Stefan Vladimirov Gerdjikov for the academic position "Associate Professor" in the professional field 4.5 Mathematics (Mathematical Logic).

April 7, 2020   Referee:

(Prof. D.Sci. Vesselin Drensky, Full member of the BAS)