

STATEMENT REPORT

In connection with a procedure for the acquisition of the educational and scientific degree “Doctor” by candidate Dimiter Dimitrov Dobrev, Title of the PhD Thesis: “Artificial Intelligence – Definition, Realization, and Consequences (What is it, how can we do it and what shall we do once we do it?)

Area of university education: **4. Natural Sciences, Mathematics and Informatics**

Professional field: **4.5 Mathematics**

Doctoral program: **"Mathematical Logic" (Self-study doctoral student)**

Section **„ Algebra and Logic”,**

Institute of Mathematics and Informatics, Bulgarian Academy of Sciences (IMI-BAS)

This statement report has been prepared by: Prof. Doctor of Mathematical Sciences Petar Stoyanov Kenderov (pensioner) as a member of the scientific jury for the defense of this PhD thesis according to Order № 108/29.04.2024 r. of Prof. Petar Boyvalenkov, Director of IMI-BAS.

1. General characteristics of the dissertation thesis and the presented materials.

Dimiter Dimitrov Dobrev was enrolled as a self-study doctoral student in the above-mentioned Doctoral program on January 28, 2019 (by order No. 218/30.01.2019 of the director of IMI-BAS). Prof. Dr. Ljubomir Lalov Ivanov has been appointed as the scientific supervisor. As can be seen from the documents attached to the procedure, Dimiter Dimitrov Dobrev took, within the time limit set for the purpose, all the specialty exams (Logical Programming, Mathematical Logic and Introduction to Temporal Logic), as well as an English language exam and a Presentation Skills test (the latter two items taken in the Education Center of BAS). He was dismissed from the doctoral study “with the right to defend a dissertation” by order No. 159/31.01.2023 of Prof. Petar Boyvalenkov, Director of IMI-BAS. According to order No. 62/18.03.2024 of the director of IMI-BAS, 22.03.2024 a pre-defense of Dimiter Dobrev’s dissertation was held. I took part in that meeting. The discussion was a real pre-defense of a dissertation. There were positive as well as critical opinions. At the end of the discussions, the proposal to direct the thesis for defense was supported by 8 “YES”, 1 “AGAINST”, and 3 “ABSTAINED” votes.

All the documents envisaged by Appendix 4 to the Regulations on the terms and conditions for acquiring scientific degrees and for holding academic positions at the Institute of Mathematics and Informatics of the BAS have been provided. The minimum requirements for obtaining the educational and scientific degree "Doctor", envisaged in Appendix 1 of the Regulations for the conditions and procedures for acquiring scientific degrees and for holding academic positions in the Bulgarian Academy of Sciences, are also satisfied. Besides the dissertation itself, Dimiter Dobrev has published 4 papers in the Serdica Journal of Computing (altogether 158 pages) and one article in Mathematica Balkanica. Both Journals are indexed in Mathreviews and Zetralblatt fuer Mathematik and all the papers are related to Artificial Intelligence (AI), the major topic of the dissertation.

The dissertation consists of 115 pages. The literature at the end of the dissertation comprises about 90 items of which 26 are authored by Dimiter Dobrev. The earliest publication is from 1896 (of the famous scientist Becquerel who discovered radioactivity). There is a publication from the beginning of the 20th century (1902, of the equally famous physiologist Ivan Pavlov). These two references have been used to illustrate some analogies with the topics considered by the author of the dissertation. The distribution of cited references directly related to the dissertation exhibits some pattern: one cluster around the turn of the century and

another cluster in the last 10 -15 years. This has its own explanation. The clusters correspond to the intensity of research about the basic notions and nature of AI, including the attempts to give adequate definition of General AI.

The dissertation has three major sections which are in one-to-one correspondence with the structure of the dissertation and the discussion in the Introduction:

What is Artificial Intelligence? (pp.11 – 35);

How can we create AI? (pp. 36 – 87);

What shall we do once we are done with creating AI? (pp. 88 – 94).

There is, as usual, an Introduction (pp. 7-10) and a Conclusion (p. 97).

2. Short CV and personal impressions of the candidate

From the documents provided in connection with this procedure, one can retrieve that Dimiter Dobrev was born in 1966 and got his master's degree from the Faculty of Mathematics and Informatics of Sofia University in 1995 (with specialization in Mathematical logic and its Applications). Ever since works for the section "Algebra and/or Logic" in the Institute of Mathematics and Informatics at BAS. Over the years he lectured in Sofia University and New Bulgarian University. The portfolio of courses includes „Strawberry Prolog and Artificial Intelligence", "Artificial Intelligence", "Mathematical Logic", "Logical Programming", "Discrete Mathematics", and "Discrete Structures".

Much to my regret, my direct personal impressions from the candidate are from the last 3-4 years only. He seems to be a very non-standard member of our mathematical community. His research interests in the field "Artificial Intelligence" are at the highest possible level of abstraction, dealing with questions of existential importance for the future of the field: "What is General AI?" and "How to make General AI?". On the other hand, he is the creator of [Strawberry Prolog](#), a Prolog compiler, and other practice-related software for transliteration of the Cyrillic alphabet, Cyrillic keyboard arrangements, as well as software for protection from SPAM. Besides, he has participated in several Research projects from completely different science areas: "Metallization of dielectric materials from innovative environmentally friendly electrolytes", and "Development of innovative methods for forming functional coatings based on anodic aluminum oxide and subsequent chemical metallization". Finally, there is a list of several Patents for inventions. One of them is on the unmanned control of Metro-train motions (patent № 67273 B1 issued by the Bulgarian Patent Office (15.03.2021)). I was not able to check the existence of the other Patents, perhaps because of absence of knowledge where to look for them.

In any case, such a diversity of interests and engagements is impressive and outlines a kind of personality which is not often to meet among Bulgarian mathematicians.

3. Content analysis of the scientific and applied achievements of the candidate, contained in the presented Ph.D. dissertation and the publications to it, included in the procedure.

In recent years, we have witnessed unprecedented achievements based on the use of Artificial Intelligence. However, these achievements are due to the so-called "Narrow Artificial Intelligence", the effectiveness of which is limited only in some separate and specific field of science and/or practice. The idea of creating a General Artificial Intelligence, effective in all fields of knowledge and human activities, is still in the state of "A Horizon to which we aspire". Under construction, even initial clarification, are some basic notions and concepts such as "What is AI?", "What tools are needed for its creation and effectiveness?", "What

would be the consequences of its existence?" These are questions that accompany the development of this interdisciplinary field since its inception. They are also the subject of treatment in the presented dissertation. The presence of the dissertation author in this area is noticed. His informal definition of AI has gained considerable circulation and appears at the top of Google's answers to queries with the keywords "Definition of AI". In the first part of the thesis, a formal definition of AI is also given, which builds on previous definitions starting from the work of Hernández-Orallo, J., & Minaya-Collado, N. from 1998 and the work of Marcus Hutter from 2000 year. Dobrev's definition is more general in several respects. For example, it refers to an AI that would be effective in arbitrary "worlds". To achieve this goal, Dofrev proposes in the second part of the dissertation a detailed and elaborated framework for creating a language for describing such "worlds", motivating his research with natural arguments such as "to study and know a given world, one must first describe it."

Regarding the conclusions in the third part of the thesis (What will we do after we make strong AI?) I am skeptical. From the assumption of the existence of an object with ideal and unlimited possibilities (General AI) all sorts of consequences can be drawn that do not contradict logic. But is the very premise for the existence of such an object consistent? Precisely in the form that the author suggests to us?

On the other hand, for some of the dangers accompanying AI it is better to be aware in advance. Dobrev's thesis that the need for labor will disappear causes a feeling of reversal of the action of the well-known concept "Labor made a man out of the animal." Will the absence of the need for labor lead to "reverse evolution?" The expected "atomization" of society (lack of communication between humans, replaced by "communication" only with and through AI) will undermine the very idea of community, and over time may lead to the disappearance of the main advantage of man over animals (the latter cannot communicate and make societies on a global scale).

In this sense, it is not an exaggeration to consider that there is some contribution in the third part of the dissertation as well.

4. Approbation of the results

The mentioned 26 author's publications at the end of the dissertation can be accepted as a kind of "approbation" of the results. Among these publications, there are many which were presented at different conferences and scientific forums. This also can serve as a kind of approbation. Besides the publications listed in the thesis, the author has other publications, part of which are in journals popularizing science.

None of the publications of Dobrev is in journals with Impact Factor or with the SJR index. Nevertheless, the candidate presents an impressive list of citations of his publications. A significant part of these citations are in journals, books and other published materials which are indexed by SCOPUS. For instance, one of his articles published in 2000 in PC Magazine Bulgaria (a journal popularizing computers in Bulgaria) enjoys 8 citations, among which 3 in SCOPUS indexed sources (authored by the above-mentioned Hernández Orallo, J.!))

Three other papers related to the thesis:

Dobrev, D. "A Definition of Artificial Intelligence". Mathematica Balkanica, New Series, Vol. 19, 2005, Fasc. 1-2, pp.67-73.

Dobrev, D. (2005). Formal definition of artificial intelligence. International Journal of Information Theories and Applications, Vol. 12, Number 3, 2005, pp.277-285.

Dobrev, D. "Comparison between the two definitions of AI". (arXiv:1302.0216)

have 119 citations. Among these citations there are 33 in sources indexed by SCOPUS. Significant part of the citations are in monographs and in other person's theses. This shows that the efforts of D. Dobrev have produced an indirect Impact Factor which also has to be taken into account when assessing his achievements.

5. Qualities of the abstract

The abstract correctly and fully reflects the facts and conclusions in the dissertation work.

6. Critical notes and recommendations

The publication activities of D. Dobrev deviate seriously from the traditional routines established in the Bulgarian mathematical community. He does not seem to care to publish in well-established specialized journals where the articles are subjected to serious check by people well-versed in the corresponding area. Some of his publications are in his internet domain (with open access to them) or in journals without significant coverage by indexing instruments. My recommendation is to change this. The dissertation as well as the articles of him are written in a good style with rich language and care for the reader.

7. Conclusion

Not being a specialist in the field of AI, I decided to ask the opinion of a Narrow AI about the author of the thesis. To the question

Are you aware of Dobrev's definition of General AI?

ChatGPT 4o answered:

Yes, I can provide information on Dimiter Dobrev's definition of General AI. Dimiter Dobrev is a researcher who has contributed to the theoretical foundations of AGI. His work focuses on formalizing the concept of AGI and proposing definitions that capture its essence.

Dimiter Dobrev's approach to defining General AI is rooted in formal logic and theoretical computer science. He proposes a definition that emphasizes the following aspects:

- 1. **Universal Intelligence:** Dobrev defines General AI as a system capable of achieving goals across a wide variety of environments. This concept is closely related to the idea of universal intelligence, which measures an agent's ability to perform well in a broad range of tasks and settings.*
- 2. **Problem-Solving Ability:** According to Dobrev, General AI should be able to solve any problem that a human can, given sufficient time and resources. This involves understanding the problem, devising a plan, and executing it effectively.*
- 3. **Adaptability and Learning:** General AI must be capable of learning from its experiences and adapting its strategies to new and unfamiliar situations. This ability to generalize knowledge and apply it to different contexts is a key characteristic of AGI.*
- 4. **Formal Framework:** Dobrev often uses formal mathematical frameworks to describe and analyze General AI. He seeks to create a rigorous definition that can be used to guide the development and evaluation of AGI systems.*

While Dobrev's work is more theoretical and formal compared to some other perspectives on AGI, it contributes to the broader understanding of what it means to create a truly intelligent

machine. His efforts align with the goal of developing a precise, unambiguous definition of General AI that can be used in both academic research and practical applications.

Having become acquainted with the PhD thesis and the other materials presented in this procedure and basing on what was said above **I confirm** that the presented PhD thesis and the scientific publications to it, as well as the quality and originality of the results and achievements presented in them, meet the requirements of the Act on Development of the Academic Staff in the Republic of Bulgaria, the Rules for its Implementation and the corresponding Rules at IMI-BAS for acquisition by the candidate of the educational and scientific degree “Doctor” in the Area of university education **4. Natural Sciences, Mathematics and Informatics**, Professional field **4.5 Mathematics**.

In particular, the candidate meets the minimal national requirements in the professional field.

Based on the above, **I recommend** the scientific jury to award Dimiter Dimitrov Dobrev the educational and scientific degree “Doctor” in the Scientific field (Area of university education) **4. Natural Sciences, Mathematics and Informatics**, Professional field **4.5 Mathematics**.

Date: 07.06.2024

Signature:
/Professor Petar Kenderov/