Curriculum Vitae

Dr. Temur Kutsia

Contact

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Education

June 1985	High school graduation (with gold medal) in Abasha, Georgia.
June 1992	University degree (Dipl.-Math.) in mathematics, Tbilisi State University.
Dec. 1997	Candidate of sciences degree, Tbilisi State University.
June 2002	Doctoral degree (Dr. techn.) in computational logic, University of Linz.
Apr. 2011	Habilitation in mathematics, University of Linz.

Career History

1993–1995	Junior researcher, Institute of Applied Mathematics, Tbilisi State University
1995–1998	Researcher at the Institute of Applied Mathematics, Tbilisi State University
1998–2002	PhD student at RISC Linz
2002–2006	Postdoc at RISC Linz
2006–2011	Coordinator and scientific advisor of an EU project at RISC Linz
2011–	Associate professor at RISC Linz.

Research Area

- Keywords: computational logic, equational constraint solving, unification, generalization
- Main contributions: development of unification, matching, and anti-unification algorithms for various logical theories and implementation of the corresponding software packages; development of a calculus and a tool for conditional rule-based hedge transformations.

Publications

118 publications since 2002, among them: 11 edited volumes and special issues, 19 journal articles, 40 refereed papers in conference proceedings, 1 book chapter, 22 other refereed publications, 25 technical reports. Selected ones:

- T. Kutsia. Solving equations with sequence variables and sequence functions. *Journal of Symbolic Computation,* 42(3):352–388, 2007.
  DOI: http://dx.doi.org/10.1016/j.jsc.2006.12.002.
- T. Kutsia, J. Levy, M. Villaret. Anti-unification for unranked terms and hedges. *Journal of Automated Reasoning.* 52(2):155–190, 2014.
  DOI: http://dx.doi.org/10.1007/s10817-013-9285-6.

- T. Kutsia, M. Marin. Matching with regular constraints. In: G. Sutcliffe and A. Voronkov, editors, *Logic in Programming, Artificial Intelligence and Reasoning. Proceedings of the 12th International Conference LPAR 2005.* Volume 3835 of Lecture Notes in Artificial Intelligence, Springer, 2005, 215–229.
  DOI: `http://dx.doi.org/10.1007/11591191_16`.

- T. Kutsia, B. Buchberger. Predicate logic with sequence variables and sequence function symbols. In: A. Asperti, G. Bancerek, A. Trybulec, editors. *Proceedings of the 3rd International Conference on Mathematical Knowledge Management, MKM 2004.* Volume 3119 of Lecture Notes in Computer Science, Springer, 2004, 205–219.
  DOI: `http://dx.doi.org/10.1007/978-3-540-27818-4_15`.

- D. Cerna, T. Kutsia. Idempotent anti-unification. *ACM Transactions on Computational Logic.* 21(2), 10:1–10:32, 2020.
  DOI: `https://doi.org/10.1145/3359060.`

Selected Other Scientific Activities

- Guest editor of four special issues of the Journal of Symbolic Computation and one special issue of the Journal of Symbolic Logic. Editorial board member of Tbilisi Mathematical Journal. Proceedings editor of six conferences.

- PC chair of 12 international conferences, including

  – Mathematical Aspects of Computer and Information Sciences, MACIS'17
  – Symbolic Computation in Software Science, SCSS'14
  – Algebraic Biology, AB'07
  – Logic, Language and Computation, TbiLLC'09 and TbiLLC'11 (area chair);

  PC member of 50 conferences, including RTA'15, RTA'13, RTA'08, LPAR'15, LPAR'13, PPDP'14, PPDP'10, CICM'20, CICM'17, CICM'13, LOPSTR'20, LOPSTR'10, several editions of SYNASC, UNIF, SCSS; steering committee member of 6 international conferences: SCSS, MACIS, TbiLLC, PPDP (2010–2015), UNIF (2013–2018), WWV (2009–2012).

- Conference chair and organizer of 26 international scientific events, among them SCSS'13, PPDP'10, LOPSTR'10, RTA'08, AB'07, series of training schools in symbolic computation 2006–2011.

- More than 50 research visits and more than 20 invited talks at colloquiums and conferences; invited guest lectures at the University of Brasilia, University of Tsukuba, West University of Timişoara; visiting fellowship at the CS Department, University of Liverpool (2015, 2018).

- Advised 2 PhD and 15 master theses (completed); member of PhD defense committees in the universities of Brasilia, Franche-Comté, Porto, Siena, Technical University of Catalonia, Vienna University of Technology. Invited lecturer at 8 international summer schools, including ESSLLI and two editions of ISR (International School on Rewriting).

- Project evaluation: Austrian Academic Exchange Service (OeAD), Trond Mohn Foundation (Norway), Georgian National Science Foundation. Expert team member: Linz Institute of technology (LIT). Evaluation of research institutes: Ministry of Education of Georgia. Reviewing for Mathematical Reviews, Zentralblatt MATH, Computing Reviews. Elsevier Outstanding Reviewer Recognition from the Journal of Computer and System Sciences (2016).

- Acquired altogether about 800.000 EUR of research grants since 2012, from which so far 2 PhD students and 4 postdocs have been supported. Besides, managed EU project activities at RISC with the budget of 900.000 EUR.

Vision Statement

Temur Kutsia

Research Institute for Symbolic Computation (RISC)
Johannes Kepler University Linz, Austria

The field of symbolic computation

I see symbolic computation as a field concerned about finding the algorithmic solution of problems dealing with symbolic objects. This view is based on the definition outlined by Bruno Buchberger in the editorial of the very first issue of the Journal of Symbolic Computation. I have had the privilege of working with him during the past twenty years first as a student and then as a colleague, and deeply share his views about the field and the scope of the journal.

In this view, two main subareas of symbolic computation are computer algebra and computational logic. They are understood broadly and include computational geometry (related to computer algebra) and automated synthesis, transformation, and verification of programs (also called automatic programming, connected to computational logic). Symbolic objects are formal algebraic or logic entities, such as e.g., integers, rationals, polynomials, matrices, residue classes, terms, formulas, proofs, programs, etc. The aspects of algorithmic solutions of problems include mathematical and logical foundations; design, development, and analysis of new algorithms; their implementation and integration with software systems; applications for solving problems in various areas of science and engineering. All these put symbolic computation in "the core of the intersection" of mathematics, logic, and computer science. I think it is a fascinating area to study and do research.

This position of symbolic computation influences the way how we educate students in this field. The corresponding curriculum should include courses from mathematics, logic, and computer science. (I could bring the RISC PhD program as an example of such a curriculum at the doctoral level.) On the other hand, symbolic computation itself can assist education. I think future generation symbolic computation systems will play an increasingly important role there with their rich libraries for manipulating symbolic objects (both for computation and reasoning, providing students with a possibility to experiment and learn by doing) and advanced visualization utilities (meeting visual learning style preferences of many people).

They will become more powerful, more user-friendly, more comfortable to work with, and the younger generation will start using them already from the student years.

This development eventually will also affect the way how mathematics is done. People familiar with advanced symbolic computation techniques and systems will more often use computers to address difficult reasoning problems. Already now, there are some spectacular examples of large-scale computer-aided proofs: Hales' proof of the Kepler conjecture, the proof of the qTSPP-conjecture by Koutschan, Kauers, and Zeilberger, or Heule's proof of the Schur Number Five Problem, just to name a few. With the advancement of symbolic computation techniques and software and people being keener to use them, we will see more automation of routine tasks, more theorems being proved, and more algorithms being developed automatically or semi-automatically. It will eventually take symbolic computation to the meta-level, applied it to itself as a way of doing mathematics by computers.

Interactions with the other disciplines will increase and become more diverse. For instance, symbolic computation may benefit from machine learning methods e.g., in generating conjectures from examples. Knowledge representation, a subfield of artificial intelligence, is an example of symbolic AI and benefits from logic-based methods. Combined neuro-symbolic techniques will be more actively investigated. Database techniques will play an important role in storing and maintaining mathematical knowledge bases. Controlled natural/mathematical languages can provide a useful user interface to symbolic computation systems. Computational logic and computational linguistics have a long history of interactions, but symbolic techniques can have interesting applications in other subareas of digital humanities, e.g., in archeology. In addition to the existing applications, we will see many more exciting uses of symbolic techniques in combinatorics, number theory, numerics, particle physics, kinematics, coding theory, cryptanalysis, software science, etc.

The relation between subareas within symbolic computation is an important issue. Computer algebra and especially computational logic are becoming more and more diversified, which can be seen by the increasing number of specialized conferences and journals in those areas. This tendency leads to the danger that the communities get isolated from each other. Even now, people working in one subarea might not understand colleagues from a different subfield. There have been some attempts to bring researchers from different sides together, most recent one in the frame of a European project SC^2, involving teams working on computer algebra or SAT solving. I think that within the symbolic computation community, collaboration efforts should be actively encouraged to bridge the gap. The Journal of Symbolic Computation can play an important role here, as its goal is "to establish one common avenue of communication for researchers working in the different subareas."

Journal of Symbolic Computation

The Journal of Symbolic Computation has the reputation of a high-quality journal, firmly established as the main publication venue for the field of symbolic computation. It is the utmost task of the editor to keep its high standards.

Scope

The Web page of the JSC lists the following research areas:

- Computational algebra
- Computational geometry (non-linear)
- Automated theorem proving
- Automatic programming
- Design and implementation of symbolic computation languages and systems
- Applications in education, science, engineering and industry

I think this is a good fine-grained representation of the scope that encompasses both subareas of symbolic computation. Perhaps the keyword "automated theorem proving" can be replaced by "computational logic", which would widen the description and include rewriting, model checking, and constraint solving among others.

The journal should cover all the aspects of the field, as it does now: logical and mathematical foundations, algorithms, software implementation and software systems, and applications. I don't think any of them should be particularly singled out and emphasized since they all are very important. The papers can be either in the form of a regular research submission, a tutorial survey, an application note, or a system description. The only decisive factor should be the quality of the submission, independent of what aspect of symbolic computation it concerns and what kind of paper it is.

Organization

Refereeing procedure. According to the current procedure, when an author submits a paper to the journal (by email to the editor), he/she also names three members of the editorial board who are experts in the subject of the paper, do not have the conflict of interests with the authors, and can handle the submission. The editor selects one of them, who is then responsible for refereeing. He or she finds referees, organizes reviewing, and is the contact person of the author during the refereeing process. Based on the reviews, the board member decides to accept or reject the paper, or it may have to be revised. It is a single-blind review procedure.

In my opinion, the procedure works well and I see no reason why it should be changed. From the technical side, Elsevier plans to offer the same editorial submission system to all its journals by the end of 2020. It will have new tools to help editorial teams in their daily tasks such as, e.g., reviewer recommender. I think the JSC can benefit from it.

Role of the editor, of the editorial board, of the publishing company. The duties and rights of the editors, editorial boards, and the publishing company are described on the Elsevier Editor Hub Web page. It contains many tools and resources to support editors in their roles.

The editor is responsible for the journal content, reputation, and development. He/she forms the editorial board and works with them, ensures the supply of high-quality submissions, promotes the journal, follows the rules of ethical editing, and works closely with the publishing staff. It is the editor's responsibility to adequately reflect changes in the field in the scope of the journal. Editorial board members are responsible for organizing fair, unbiased, timely review of the submitted manuscripts assigned to them. They assist the editor in decision-making, provide advice, promote the journal, attract submissions, suggest topics for special issues. The publisher's responsibilities include the guardianship of the scholarly record, providing support to the editors and authors, guaranteeing editorial independence, promoting publishing and editing ethics.

When talking about these roles and the journal organization in general, it is also important to learn from experienced people. I hope and will be very grateful if Bruno and Hoon will share with me their knowledge of successfully managing a top journal of the field.

Special issues. Special issues increase the visibility of the journal in a target audience, attract top contributors, and promote the chosen subject among the readers of the journal. The issues are intended to be collections of original research articles reflecting the interactions of symbolic computation and a focused discipline (e.g., SC in Software Science, or SC and SAT Solving), or are dedicated to a conference in the area (e.g., ISSAC, MEGA). They are handled by one or more guest editors, who are experts in the subject and work on the special issue in close contact with the editor of the journal. Although some papers in special issues can be commissioned, they all should go through the usual peer-review procedure according to the standards of the journal. The time period between a call and publication should be reasonable, approx. 1-1.5 year.

Hard copies, e-version, archiving, promotion. Currently, JSC is distributed both in hard copies and electronically from the Web. I think this should stay. The current option of the Elsevier open archive works well,

where all articles published after 48 months have unrestricted access and will remain permanently free to read and download.

To promote the journal, various measures can be taken. The editorial board members can be asked to recommend it to their colleagues and students. The PC chairs of interesting events can be contacted, proposing them to organize a special issue. The journal should be visible at the major computer algebra and computational logic events (e.g., presenting the latest issue, distributing flyers or other promo material) and in social media. Elsevier also offers its marketing and promotion channels, explained in the Editor Marketing Toolkit.

The outlook for the field of symbolic computation and the journal

As already mentioned, I can envisage that with the advancement of symbolic computation tools and with the growing number of their casual users, symbolic computation eventually will be lifted to the meta-level of "doing mathematics by computer". Such tools will be the next generation mathematical assistant systems, supporting the user not only in everyday mathematical activities such as proving, solving, simplifying, and computing but also in exploring theories, presenting and publishing results, storying and retrieving mathematical data, etc. In other words, they will be able to manage mathematical knowledge.

It is a highly nontrivial task. Over the centuries, a vast amount of mathematical knowledge has been generated: definitions, theorems, proofs, algorithms, conjectures, problems, etc. One can distinguish two approaches towards storing/keeping it: digitization and formalization. Examples of "digitized" repositories are electronic collections such as sciencedirect, ACM DL, SpringerLink, arXiv, DBLP, Safari Books Online, NIST Digital Library of Mathematical Functions, Gröbner Bases Bibliography, etc. Here information is kept is some textual or hypertextual format. Examples of formalized mathematical knowledge are the Mizar library, The Coq library, AFP, TPTP, Wolfram functions, HELM, etc., where information has a structured mathematical form.

Currently, the digitization approach is dominant. Knowledge stored in the digitized repositories can be accessed by searching or browsing. Current technologies help to perform such a search fast. However, from the point of view of mathematical knowledge retrieval, it is pretty restricted. One can not put mathematical queries to such databases.

The formalization approach requires more rigor, but it opens more possibilities to access the knowledge, beyond just searching and browsing. One should be able to use, e.g., a proposition in the query and find out whether it follows from the knowledge base (theorem proving), or to find out what

"interesting consequences" can be drawn from the knowledge base (theory exploration). Hence, in these approaches, one can distinguish proving vs searching, and exploration vs browsing.

The formalized approach to mathematical knowledge management opens new perspectives in archiving and retrieving of information in scientific publications, discovering "hidden" knowledge from the (formalized) literature, automation of quality control, etc. The methods can be applied to manage formalized knowledge coming from other fields, e.g., computer science, biology, physics, engineering, etc. In a long run, this can have a profound effect on mathematics publishing: articles will contain automatically verifiable statements, reviewers will be assisted by tools to check their validity, and the emphasis of reviews will be switched to the importance of the results. I can imagine the JSC to become the first journal to implement such a publishing model.

However, there is still a long way to get there. Meanwhile, I think the JSC should offer the space to the current developments in mathematical knowledge management, working closely with the community that organizes the annual Conference on Intelligent Computer Mathematics (CICM). A starting point could be organizing regular special issues on the topic. Also, one can think about commissioning a survey article, which describes current achievements, difficulties, problems, and future directions.

Motivation Letter

Temur Kutsia

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At RISC, we have a special attitude towards the Journal of Symbolic Computation. It is the main thematic journal for the institute. It is prestigious to have a paper there or to be involved in the editorial and reviewing activities. And there is also the important factor of Bruno, the founder both of the journal and the institute. To serve the community in the role of the editor of such a journal is a big honor and a big responsibility.

I can say that my personal connection with the journal is even more special. One of my areas of research, unification, aims at solving equations in algebraic structures and can be seen as a subfield in the intersection of algebra and logic. Hence, JSC is a natural publication venue for the unification community and, indeed, many important results on unification and related topics have been published in this journal. The first special issue on unification was also hosted by the JSC back in 1989. If one looks at my record in the DBLP, can see that the JSC is on the top of my publication venues, reflecting both articles and edited special issues.

I see bridging the gap between computer algebra and computational logic communities as one of the missions of the JSC. If I am elected, I will work towards this goal, promoting interactions, organizing corresponding special issues and survey articles. I will build on the already existing experience of the journal in this direction. However, it does not mean that "pure" algebraic or logic submissions will be considered second-class. The Journal of Symbolic Computation will continue its tradition and welcome high-quality submissions about all topics and aspects of symbolic computation.