JKU LIT Project "LOGTECHEDU"

Theses and Job Openings

LOGTECHEDU (Logic Technology for Computer Science Education) is a project of the Johannes Kepler University (JKU) Linz Institute of Technology (LIT) pursued from 2018 to 2019 jointly by the Institute for Formal Methods and Verification (FMV: Armin Biere, Martina Seidl) and the Research Institute for Symbolic Computation (RISC: Wolfgang Schreiner, Wolfgang Windsteiger) in cooperation with the Department of MINT/STEM Education of the Linz School of Education (Barbara Sabitzer, Markus Hohenwarter).

Topics The project pursues novel **logic-based software tools for education**, with focus on undergraduate university courses in computer science and mathematics. The project pursues various **research strands** on

- Solver Guided Exercises,
- Teaching Solver Technology,
- Proof Assistants for Education (Theorema),
- Specification and Verification Systems for Education (RISCAL), and
- Logic across the Subjects in Primary, Secondary and Higher Education.

Students The project offers **students of computer science or mathematics or STEM/MINT didactics** various possibilities to engage in

- student projects,
- bachelor and master theses, and
- PhD theses.

Student positions are financially supported by corresponding **tutorship and fellowship positions**. Applications are possible continuously throughout 2018 and 2019.

If you are interested to participate, send an informal email explaining your background and motivation to the contact address given below.

Graduates Furthermore, we are seeking to fill a **PostDoc position** for the holder of a **PhD degree in computer science or mathematics or MINT/STEM didactics** to

- conduct independent research in some of the areas pursued by the project,
- co-supervise students in the project, and
- prepare a project proposal to continue funding of the project.

If you want to apply for the position, send an email with an application letter explaining your background and motivation, your CV, and preferably a list of recommendations (names and contact addresses) to the contact given below. Applications are expected until end of April but are possible until the position is filled.

Contact: Prof. Armin Biere <biere@jku.at>
Institute for Formal Models and Verification
Johannes Kepler University (JKU), A-4040 Linz, Austria

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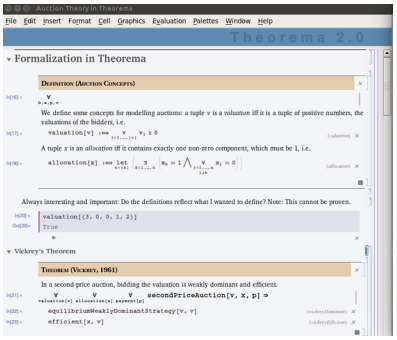
LOGTECHEDU Research Strands

Solver Guided Exercises Many exercises in undergraduate computer science courses have compact logical formalizations. A formalization in logic and appropriate tool support allows not only students to solve such exercises automatically, but also makes it possible to generate and grade such exercises automatically. In combination with web-technology exercises can be individualized and adapted to the skills of each student. The aim of this subproject is to explore solving technology, such as core based diagnosis, to detect faults and map them back to a misunderstanding of logical concepts, which can be used to generate exercises focusing on the misunderstanding. On top of this deductive part machine learning technology might be considered to maximize effectiveness of the students learning process.

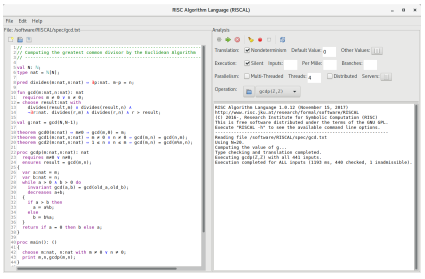
Teaching Solver Technology The FMV institute develops world-leading solving technology for various formalisms like SAT, QBF, and SMT. For a wide-spread applicability, our solvers expect the input formulas to be formulated in the standard formats established by the research communities. However, these formats are often designed to be easily processable for programs, but not for humans. Because of this entrance barrier, it is very challenging to integrate practical solving exercises into our courses. In this project, we aim to develop tool chains that guide the encoding of reasoning problems and that also provide high-level insights about the processes that are happening inside a solver. For example, one approach could be the development of a simple domain-specific language (DSL) which contains only exactly those concepts students need for formulating problems. http://fmv.jku.at/software

Proof Assistants for Education The *Theorema* system is a mathematical assistant system, whose main goal is to support mathematicians in proving mathematical theorems. *Theorema* offers a natural syntax reminiscent of classical mathematical syntax including all well-known flavors of mathematical notation. On top of this, *Theorema* generates mathematical proofs automatically in a human-comprehensible style. The goal of this strand is to formalize certain mathematical theories that are relevant for undergraduate students including the proofs of interesting theorems in the *Theorema* system. The content should then be organized reasonably from an educational perspective. We expect applicants to be keen on computer-representation of mathematics, concise argumentation, and mathematics education.



See also http://www.risc.jku.at/research/theorema/software.

Specification and Verification Systems for Education The "RISC Algorithm Language" (RISCAL) is a specification language and associated software system for describing algorithms and formally specifying their behavior based on mathematical theories. By design of the language, the specified model is of finite size; thus the correctness of algorithms, specifications, and theories can be automatically decided by model checking. The goal of this research strand is to further enhance the technology of RISCAL, to develop educational content on the basis of the system, and to develop educational concepts for its application. http://www.risc.jku.at/research/formal/software/RISCAL.



Logic across the Subjects in Primary, Secondary and Higher Education Students and graduates will work in the COOL Lab, a Teaching-Learning-Lab, which mainly aims at teaching computational thinking respectively computer science concepts t o children, students and (future) teachers and integrating it in all subjects. Specifically we will

- analyze curricula of primary and secondary schools regarding logic as part of different subjects,
- develop, test and evaluate teaching units and materials for primary, secondary and higher education,
- elaborate didactical implications for teaching logic on different levels and evaluate them.

Applications are welcome from students and graduates in computer science, mathematics or other fields with, at least, basic competences in logic, computer science and (STEM)-didactics as well as a post-doc assistant with experiences in empirical research, who will contribute to publications and the development of project proposals.