

## Faculty of Science and Engineering

### Profile report: Theoretical Computer Science

- Discipline: Computing Science
- Level: Tenure-track assistant professor with an education profile
- Fte: Full time (0.8-1.0 FTE)

#### 1. Scientific discipline

Theoretical Computer Science (Theoretical CS) concerns the foundations of Computer Science and serves as the basis of any research-oriented educational program in the field. Theoretical CS concerns subjects like design and analysis of algorithms, formal languages and automata theory, program verification, and models and semantics of computation (such as concurrency).

#### 2. Vacancy

This position is opened by the Board of the Faculty (PT/gl/22/00181) and will be embedded in the Bernoulli Institute for Mathematics, Computer Science and Artificial Intelligence, basic unit Fundamental Computing. The criteria and conditions pertaining to the position are described in the document [‘Assistant professor with an education profile’](#).

#### 3. Selection committee (BAC)

|                              |                                                                                |
|------------------------------|--------------------------------------------------------------------------------|
| Prof. dr. A. Lazovik (chair) | Program and Education Director for Computing Science                           |
| Prof. dr. J.A. Pérez         | Professor Software Foundations                                                 |
| Prof. dr. Jiri Kosinka       | Professor of Geometric Modelling and Computer Graphics                         |
| Prof.dr. N. Taatgen          | Professor of Artificial Intelligence, Bernoulli Institute<br>Research Director |
| Prof. dr. ir. R. Verstappen  | Education Director for Mathematics                                             |
| Prof. dr. H. H. Hansen       | Professor of Formal Modeling                                                   |
| Dr. Z.L. Christoff           | Assistant Professor in Cognitive Artificial Intelligence                       |
| Dr. B. Luttik                | External member, Eindhoven University of Technology                            |
| Floris Westerman             | Student member                                                                 |

#### *HR advisor:*

M. Laning, MSc

#### *Advisors:*

A.G. Gringhuis, MSc                      Policy Officer Bernoulli Institute

#### 4. Area of expertise

Theoretical CS spans multiple research topics and disciplines of the utmost importance, including algorithm design, data structures, computational complexity, models and paradigms of computation (such as concurrency), model checking, rewriting systems, automated verification, and interactive proof assistants. Examples of complementary areas in the scope of this position include programming languages, multi-agent systems, quantum computing, and logic.

Theoretical CS plays a fundamental role in designing innovative solutions for today's IT challenges. Given this importance but also the increasing intake of students in our

educational programs, the Bernoulli Institute needs to strengthen both its teaching activities and research on this area.

In addition to delivering foundational and advanced courses on Theoretical CS, the candidate will strengthen the research profile of the institute in the field, coordinate the development of a consistent learning trajectory across BSc and MSc programs, oversee individual research-oriented supervision at various levels, and lead the introduction of innovative teaching and assessment methods.

### **5. Embedding: institute (and base unit)**

The Bernoulli Institute for Mathematics, Computer Science and Artificial Intelligence is part of the Faculty of Science and Engineering (FSE). The profile of the institute centers around modelling, computation, and cognition with a focus on science and technology, keeping a balanced mix of fundamental and applied aspects. The Bernoulli Institute comprises five mathematics research groups, seven Computer Science groups, and four groups in Artificial Intelligence. The constituting research groups participate in various national research schools and most PhD students are enrolled in an educational program and take part in other activities offered by these schools. The Bernoulli Institute aims to strengthen the current research portfolio by expanding both in fundamental areas that have a prominent role in education as well as in directions that are essential for new technological and societal developments.

The Bernoulli Institute has a leading role in the recently established cross-disciplinary research theme on Data Science and Systems Complexity (DSSC) within the Faculty of Mathematics and Natural Sciences. This concerns a research cluster of 60+ researchers in several basic disciplines (mathematics, computer science, artificial intelligence, systems & control, engineering, astronomy) and various scientific application domains. The ambition is to understand and solve big data problems by exploiting the joint perspectives from both data science and complexity science.

The institute is also heavily involved in the Groningen Cognitive Systems and Materials Center (CogniGron), which is a joint venture between the Bernoulli Institute and the Zernike Institute for Advanced Materials. It comprises researchers from materials science, physics, chemistry, mathematics, computer science and artificial intelligence. The center provides structure, coherence, and visibility for a joint research program in the direction of cognitive systems and materials.

The position will be embedded in the Fundamental Computing group, which already counts with research expertise on modal logic, coalgebra, proof theory, and concurrency theory. The candidate will suitably complement and reinforce the education and research activities of the Fundamental Computing group.

### **6. Local and (inter)national position**

The Bernoulli Institute participates in the following national Computer Science research schools: the Advanced School for Computing and Imaging (ASCI), the Dutch Research School in Logic (OZSL), the School for Information and Knowledge Systems (SIKS), and the Dutch Research School in Programming and Algorithmics (IPA). The Fundamental Computing group actively contributes to the activities organised by IPA, which is the school most relevant for this position. At the international level, the BI is involved in several EU research projects (e.g., Human Brain Project, Smart Homes, Visual Analytics), has

established collaborations with major companies (Philips Research, IBM) and technological institutes (Astron, TNO, NLR, ECN), and has cooperation and exchange programs with many universities (e.g., Rome, Leipzig, Birmingham, Barcelona, Ghent, ESIEE-Paris, Tampere).

In Computer Science, the BI has a strong position (as evidenced by participation in NWO and EU projects, publications in renowned journals and conferences, memberships of editorial boards and program committees, conference chairing, etc.). Its expertise lies in intelligent systems (biologically inspired computational modelling, machine learning, morphological image processing); pervasive middleware and energy distribution infrastructures; architecting of software-intensive systems and object-oriented software design; adaptive information systems, middleware, enterprise, services and cloud computing and autonomous process performance improvement; computer architecture, microarchitecture and reconfigurable computing; data and information visualization, and visual analytics. The research profile of the BI in Theoretical CS has been recently strengthened with several research-oriented hires.

National research groups in Theoretical CS (and neighboring areas) include those in [Amsterdam](#), at the Radboud University Nijmegen ([Software Science](#)), at the Eindhoven University of Technology ([Formal System Analysis](#) and [Algorithms, Geometry and Applications](#)) and at the University of Twente ([Formal Methods and Tools](#)), among others.

The importance of Theoretical CS at the (inter)national level is therefore unquestionable. An education TT position in Theoretical CS will allow the BI to strengthen its expertise in education, close the existing gap in our educational programs, and thus meet the need to deliver up-to-date education to our students.

## **7. Expected contributions to teaching**

The candidate will contribute to our educational programs in Computing Science by teaching courses in the domain of Theoretical CS and by contributing to curriculum development in Theoretical CS. The candidate is expected to act as course coordinator, lecturer and examiner in existing courses, for example on Discrete Mathematics, Program Correctness, Automata Theory, Complexity Theory, and Formal Verification. Direct involvement in programming-related courses, such as Algorithms and Data Structures, Imperative Programming, and Functional Programming, will be highly desirable.

The candidate is expected to lead the design and implementation of new courses, on topics that strengthen the profile of Theoretical CS at the MSc level. The candidate is required to ensure the high quality of education on Theoretical CS within the educational programs by overseeing all the related education-related activities. Moreover, the candidate will supervise research-oriented projects for BSc and MSc students.

The candidate will innovate and streamline the current BSc and MSc curriculums in terms of Theoretical CS throughout the educational programs. They will actively develop innovative teaching and assessment methods in theoretically-oriented courses, suited to our high student intake. The candidate will support other staff members with innovating their courses and teaching. To foster educational developments, the candidate will apply for grants that support teaching innovation.

## **8. Expected contributions to research**

The candidate is expected to contribute to the ongoing research activities of the Fundamental Computing group. The group already has expertise generally related to the application of logic in Computer Science; there is special interest in strengthening this research profile to cover areas in Theoretical CS not currently represented in the group and the institute. The research contributions will depend on the candidate's profile and ambitions. The co-supervision of PhD students will be a concrete mechanism for contributing to the group's research efforts. Additionally, the candidate is expected to carry out research in the field of education, connected to the development of new didactic methods for courses in Theoretical CS.

## **9. Expected contributions to the organisation**

The candidate is expected to have an active interest and to provide a positive contribution to the management and organisational tasks of the institute. At the level of FSE, the candidate will contribute to the organisation of the faculty, for example by participating in working groups and committees in the area of education. The candidate will participate in relevant national and international organisations.