Faculty of Science and Engineering

Profile report: Software-intensive Systems

- Discipline: Computer Science
- Level: Tenure-track Assistant/Associate/Full Professor
- Focus: Research
- Fte: 0.8-1.0 FTE

1. Scientific discipline
The research area of Software-intensive systems includes any system where software influences the design, construction, deployment, operation and evolution of the system as a whole. This includes systems of systems, mobile applications, embedded systems, product lines, business processes, scientific computations and even whole enterprises, including systems processing huge amounts of data for AI and other data- and compute-intensive applications. The area draws on a wide variety of scientific fields such as software and systems engineering, information systems, theoretical computer science and distributed systems.

Therefore, the expected candidate profile is in the area of Software-Intensive Systems and may fit any or a combination of the following research fields in terms of methodologies and expertise: Software Engineering, Theoretical Computer Science, Information Systems, and Distributed Systems.

2. Vacancy
These positions are opened by the Board of the Faculty in the context of the sector plans and will be embedded in the Bernoulli Institute. The positions can be embedded in one of the following basic units: Software Engineering, Fundamental Computing, Information Systems or Distributed Systems, depending on the candidate's profile. The positions fall within the framework of 'Career Paths in Science and Engineering', which outlines the criteria and timeline for promotion, up to full professor.

3. Selection committee (BAC)

Prof. dr. Niels Taatgen	Scientific director Bernoulli Institute and Professor of Cognitive Computing
Prof. dr. A. Lazovik	Professor of Distributed Systems, Program director (BSc) Computer Science
Prof. dr. ir. P. Avgeriou	Professor of Software Engineering
Prof. Dr. Jorge Pérez	Professor of Software Foundations
Prof. Dr. Dimka Karastoyanova	Professor of Information Systems
Prof. Dr. Elisabetta Di Nitto	External member, Professor of Software Engineering, Politecnico di Milano
Channa Dias Perera	Student member

Advisors:

F. Postma, MSc	HR advisor

4. Research areas

Software is the invisible force enabling the digital services critical to society, from commerce and transport to healthcare, energy, finance, communication, scientific research and education. Our reliance on (reliable) software is one of today's most pressing challenges. The research in the area of Software-intensive systems needs to receive even greater attention due to the advancements in the field of AI and its increasingly crucial role in software systems and for society. In response to these challenges, the Bernoulli Institute has identified Software-intensive systems as one of the prominent clusters of scientific challenges to address in future and with this position our goal is to strengthen our expertise in this research discipline.

The scientific fields of software engineering, theoretical computer science, information systems and distributed systems address different aspects of software-intensive systems. Enabling synergies of these fields towards full and coherent coverage of the life cycle of software-intensive systems is a strong part of our mission.

In this context, there is a need for development of rigorous methods for ensuring correct and reliable software execution by design as well as investigation of the best-of-breed practices of architecting such systems. Furthermore, in order to enable operational adaptability and reliability of, as well as continuous maintenance and infrastructure support for software-intensive systems, further research is necessary on the interface of AI and software engineering, data- and process-driven improvement, and the inherent, extreme distribution of the systems, including consideration of the current huge leaps in machine learning research and thus drawing upon the transformative potential of ML and AI. Methods and techniques for monitoring software-intensive systems and for their flexible operation, and thus technological sustainability, are strict requirements in many domains like predictive water and energy management, healthcare, logistics and supply chain, manufacturing, including AI research and applications as a domain of its own right. Companies active in these domains expect the software systems supporting their operations to be able to deliver these benefits and at the same time ensure smooth integration with their legacy systems.

There is a strong expectation for the candidate to work towards close collaboration on the topic of Software-Intensive Systems among (at least some of) the four groups as such interdisciplinary research in the area will strengthen the department's position and reputation in software-intensive systems. The position is intended to contribute to addressing the strategic research challenges related to tomorrow's Software Intensive Systems of the Bernoulli Institute's research agenda.

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 modeling, computation, cognition and software systems and infrastructures with a focus on science and technology, keeping a balanced mix of fundamental and applied aspects. The Bernoulli Institute comprises five mathematics programmes, seven computer science programmes, and four artificial intelligence programmes, which participate in various national research schools. The Bernoulli Institute has a leading role in the cross-disciplinary research theme on Data Science and Systems Complexity (DSSC), and in the

Groningen Cognitive Systems and Materials Center (CogniGron) within the Faculty of Science and Engineering.

The candidate, depending on their profile, will work in one of the following groups: Software Engineering Fundamental Computing, Information Systems, and Distributed Systems; all four groups are embedded in the Bernoulli Institute.

The Software Engineering group covers the broader discipline of Software Engineering with emphasis on empirical research methods as well as social/human aspects, AI for Software Engineering, software analytics, Software Engineering for sustainability, and automation tools.

The Fundamental Computing group's research spans multiple topics of Theoretical Computer Science, 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.

The Information Systems group focuses on concepts, systems and infrastructures for data- and KPI-driven process automation and improvement, sustainable and adaptive information systems within different societal domains (manufacturing, healthcare, supply chains), flexible data processing pipelines and supporting AI-enabled infrastructures.

The research activities of the Distributed Systems group revolve around how to build distributed supporting infrastructures that allow for processing of large amounts of data especially in the context of the recent developments in AI, including focus on big data processing and cloud computing, pervasive computing and smart environments, smart industry and IoT, digital twin, adaptive and scalable infrastructure for distributed AI.

6. Local and (inter)national position

Nationally, most universities have strong research efforts in one or more of the fields mentioned above. The Computer Science Department of the Bernoulli Institute has a significant concentration of knowledge and expertise in all fields relevant and essential for research in Software-intensive systems from both fundamental and applied perspectives making us a leader in the area, which we aim to strengthen with this position.

At the national level, the department participates in the School for Information and Knowledge Systems (SIKS), in the Dutch computer science research schools Advanced School for Computing and Imaging (ASCI), Dutch Research School in Logic (OZSL) and the Dutch Research School in Programming and Algorithmics (IPA).

At the international level the department is involved in numerous EU and NWO funded research projects (*e.g.*, Human Brain Project, Smart Homes, GreenerBuildings, AIMS5.0, UCCS), has established collaborations with major companies (Philips Research, IBM, ASML) and technological institutes (Astron, TNO, NLR, ECN), and has cooperation and exchange programs with many international universities.

7. Expected contributions to research

The candidate is expected to extend their research program in the field of software-intensive systems broadly understood and within the context of the research disciplines mentioned above. The research should compete on a worldwide level and lead to publications in top journals and conferences. Obtaining substantial external funding for

PhD projects is pivotal. Supervision of PhD students is an important part of the envisioned research activities. The research is expected to broaden the existing efforts in the field of Software-intensive systems within the Computer Science department and the Bernoulli Institute and should lead to a strengthening of their national and international reputation.

8. Expected contributions to teaching

The candidate is expected to contribute to the bachelor and master programs of the faculty, in particular those in Computer Science, and also be actively involved in the development of new courses related to the research area of software-intensive systems. Furthermore, the candidate will supervise final research projects of bachelor and master students. Upon appointment, depending on experience and formal qualifications to date, the candidate may be required to enter a nationally standardized tertiary teaching skills certification trajectory (BKO or Basis Kwalificatie Onderwijs), successful completion of which is a condition for contract extensions and tenure.

9. Expected contributions to the organization

The candidate is expected to have an active interest and to provide a positive contribution to the management and organizational tasks of the institute. The candidate will furthermore contribute to the organization of the faculty, for example by participating in working groups and committees, in the domains of education, research and management. The candidate will contribute to relevant organizational activities on the national and international level.