

## Faculty of Science and Engineering

### Profile report: Machine Learning (Machine Learning)

- Discipline: Artificial Intelligence
- Level: Tenure-track assistant professor
- Fte: 0,8-1,0 fte

#### 1. Scientific discipline

Machine learning is a subdiscipline of artificial intelligence in which methods are studied and applied that can derive algorithms from data. It has become one of the main success factors of the AI discipline, and is at the forefront of developments in the field.

#### 2. Vacancy

This position is opened by the Board of the Faculty (ref. PT/gl/2100066) and will be embedded in the Bernoulli Institute, basic unit Artificial Intelligence. The criteria and conditions pertaining to the position are described in the document 'Assistant professor with an education profile'.

#### 3. Selection committee (BAC)

Dr. F. Cnossen (Chair)	Director of Education Artificial Intelligence & Computational Cognitive Science
Prof. dr. N.A. Taatgen	Scientific director Bernoulli Institute and Professor Cognitive Modeling
Prof. dr. A. Lazovik	Director of Education Computer Science
Prof. L.R.B. Schomaker	Professor Artificial Intelligence
Prof. R. Verbrugge	Professor of Logic and Cognition
Dr. N. Degens (student)	Lector User-Centered Design Hanzehogeschool

*HR advisor:*

N.F. Clemencia-Lokai

#### 4. Area of expertise

Current results in machine learning are impressive in many applications but the results are realized through a combination of tremendous human effort, large computing resources and the availability of (mostly labeled) big data. Training proceeds in a series of human-guided attempts and there is a separation between a training stage and an operational stage. None of these preconditions are conducive for the development of autonomous 'always-on' cognitive systems. Rather than starting 'from scratch' for each new task or task variant, cognitive systems need to exploit the available functionality, saving valuable computing time.

The strong increase of the importance of Machine Learning in Artificial Intelligence in particular, and in general rise in student numbers in AI, raises the necessity for additional courses in the form of a dedicated course in the AI BSc program taught by a machine learning

expert, and additional specialized electives in the MSc program. Given the speed in which the field develops and the demands of society, additional expertise is necessary to cover all the topics in this emerging field. The rising student intake in the AI Masters also requires more capacity for Master projects in Machine Learning within the institute and in collaboration with societal partners. The new position will also support continuous updating and innovation of education and research needed in this field of AI.

### **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 programmes, seven computer science programmes, and four artificial intelligence programmes. The constituting programmes participate in various national research schools and most of the PhD students are enrolled in an educational programme and take part in other activities offered by these schools. The Bernoulli Institute has a leading role in the cross-disciplinary research theme on Data Science and Systems Complexity (DSSC), in the Center “Groningen Cognitive Systems and Materials” (CogniGron) within the Faculty of Science and Engineering.

The position will be embedded in the Autonomous Perceptive Systems group of the Bernoulli Institute. The Autonomous Perceptive Systems group has a strong experience in large-scale pattern-recognition problems, in reinforcement learning and robot behavior control. The experimental and application platforms span a wide spectrum, ranging from image-based retrieval in historical documents, machine learning in service robots, intelligent control of prosthetic legs and the development of linear sensors for underwater object detection.

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

The Bernoulli Institute has expertise in Cognitive Engineering, Visualization, Cognitive Modeling, Multi-agent systems and Machine Learning. These provide the local context for the position. In addition, there are strong collaborations with the UMCG. Furthermore, the Bernoulli Institute will participate in the new Jantina Tammes school for Digital society, technology and artificial intelligence.

Within the Netherlands, there is a growing interest in Machine Learning as formulated in the NWO AI Research Agenda. Also the Gravitation project Hybrid Intelligence (a collaboration between six Dutch universities, with the Groningen AI department in a leading role) emphasises the topic. In addition, both the EU and the Dutch Government are expected to also invest heavily in this type of AI research.

International collaboration includes a large-scale facility for on-line machine learning in historical manuscript collections, Monk. This system functions as a label-harvesting engine for machine-learning researchers while offering text clustering, dating and search to humanities researchers, worldwide, such as the Radcliffe Institute, Harvard, the Israel Antiquities Authority and many others. Collaboration in robotics concerns the universities of Twente, Nijmegen, Bologna and others (H2020 project MyLeg). Industrial collaborations are with Liebherr and several other companies, in the area of predictive maintenance (H2020 project Mantis). The development of lateral-line sensing arrays is done in H2020

project Lakshmi, together with Tallinn university of technology, Estonia, Heriot-Watt university and several companies.

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

The candidate is expected to contribute to our ambitious programmes by teaching courses in the domain of Machine Learning and AI, and contributing to curriculum development in Machine Learning in the programme. The candidate should co-create an educational culture where AI and CCS students feel supported and teachers foster personal growth in students. Importantly, the candidate is expected to add to a supportive and collaborative environment between colleagues.

The candidate develops relevant courses in Machine Learning within the BSc and MSc programmes in Artificial Intelligence, and, to a lesser degree, the MSc programme Computational Cognitive Science. Bachelor students should acquire knowledge and skills both in general machine learning and pattern recognition, as well as receiving an introduction to deep learning and spiking neural networks. In addition, the candidate contributes to or teaches courses on Research Methods in AI, and possibly Professional Skills. Many of these courses will be developed by the candidate themselves, while the exact topics of the courses co-depend on the expertise and interests of the candidate.

The candidate supervises Machine Learning graduation projects in the BSc and MSc programmes.

The candidate innovates and streamlines the current BSc and MSc curriculums in terms of Machine Learning throughout the programmes (learning lines). They develop innovative teaching methods in Machine Learning, Programming, and Research and Professional Skill Training. One other aspect of this position is to support other staff members with innovating their courses and teaching. To support educational innovation, the candidate applies for grants that support innovation in teaching.

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

The candidate contributes to research in contemporary developments in machine learning fitting and extending the institute. In particular, the institute is interested in developing methods to make Machine Learning more general (i.e., by incorporating transfer), and/or making it less reliant on massive amounts of data by incorporating knowledge (a more hybrid approach). This can translate into continuous, online machine learning, the interface between learning and robotics, or explainable machine learning. The candidate (co-)supervises PhD students, publishes in peer-reviewed journals, and applies for external research funding.

## **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. At the level of FSE, the candidate will contribute to the organization 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 organizations.