

## Faculty of Science and Engineering

### Profile report: Human-Computer Collaboration

- Discipline: Artificial Intelligence
- Level: Tenure-track assistant professor
- Fte: Full time (1,0)

#### 1. Scientific discipline

This position focuses on enhancing human-computer collaboration by employing methodology from cognitive engineering, brain computer interfacing and models of multi-agent interaction. It will strike a balance between data-driven approaches that exploit machine learning techniques and theory-driven approaches in which practical choices are derived from general principles. The goal is to work towards designs in which collaborations between humans and machines are superior to either in isolation.

#### 2. Vacancy

This position is opened by the Board of the Faculty in the context of the sector plans and will be embedded in the Bernoulli Institute, basic unit Artificial Intelligence, Cognitive Modeling group. The position falls within the framework of 'Career Paths in Science 4' ('Bèta's in Banen 4'). Please see link for [criteria and conditions](#).

#### 3. Selection committee (BAC)

Prof. dr. J.B.T.M. Roerdink	Scientific director Bernoulli Institute and Professor Scientific Visualization and Computer Graphics
Dr. F. Cnossen	Program director Artificial Intelligence & Human Machine Communication
Prof. dr. N.A. Taatgen	Professor Cognitive Modeling
Prof. dr. H.B. Verheij	Head of AI department, associate professor Artificial intelligence and Argumentation
Prof. dr. L.C. Verbrugge	Professor Logic and Cognition
Prof. dr. M.A. Neerincx	Professor Human-Centered Computing at the Delft University of Technology, senior research scientist TNO Perceptual and Cognitive Systems

<Student lid to be determined>

#### *Advisor:*

Dr. F. Turkmen	Assistant professor Information Assurance and Security
----------------	--------------------------------------------------------

#### *HR advisor:*

N.F. Clemencia-Lokai

#### **4. Research area**

Within the field of Artificial Intelligence, human-computer collaboration can take different forms. One is that of synergistic collaboration between an AI system and a user, another is the interaction between a robot and a human. At the same time, new interactive techniques such as Virtual and Augmented Reality are also developing fast, allowing for new ways in which humans and computers collaborate.

Although Artificial Intelligence has been very successful in developing algorithms that can solve a wide variety of problems, it has been less successful in computer-human collaborations. From prior research we know that successful collaboration between machine learning algorithms and human experts can lead to superior results compared to either alone. However, for successful collaboration it is necessary that the results of algorithms are presented in a form that is understandable to the user, fitting with the user's mental model and situational awareness of the task, and that they elicit appropriate trust levels in the user. This aspect is also central to the research area of *Explainable AI*, which is an area of increasing growth.

Human-robot interaction is a rapidly growing field that also hinges on the question how machines should be designed so as to help humans achieve their goals in a better way. Areas of interest include health care applications, e.g., patient self-management, lifestyle change support, elderly care, mental health therapy, and there are also applications in education.

Virtual Reality (VR) and Augmented Reality (AR) are new interaction techniques that could potentially revolutionize the way humans interact with (big) data and systems. While attention has traditionally been focused on the technical aspects of VR and AR, the optimal way to interact with such systems has not yet been determined, and therefore also offers scientific challenges.

Synergy between humans and machines can also be achieved if the machine can deduce the mental state of the human. This can be through conventional means (i.e., behavior), but also through some form of brain-computer interfacing. The institute has some experience with deducing mental states from eye-movement, EEG and fMRI, and would like to expand this into practical domains, such as medical applications, in which aberrations in the mental state can be detected and classified. In Artificial Intelligence there is a growing interest in the issues involved. The Bernoulli Institute has a broad expertise in models of human intelligence, as well as expertise in machine learning and cognitive design. Moreover, the Bernoulli Institute has chosen to strengthen its position in Human-Computer Interaction as well. The position on Human-Computer Collaboration is at the cross-roads of these ambitions, enabling connections between AI and Computer Science.

#### **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), and in the Center “Groningen Cognitive Systems and Materials” (CogniGron) within the Faculty of Science and Engineering.

The candidate will work in the Cognitive Modeling group of the Department of Artificial Intelligence of the BI. The group leader is Prof. dr. N.A. Taatgen. The position is complementary to current HCI research and education in the AI department that has a cognitive engineering focus. It is also complementary to the position on Human-Computer Interaction (HCI), which focuses more on new interactive techniques and the technical design of computer interfaces. There are connections with the NWA route NeuroLabNL.

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

The Bernoulli Institute has expertise in Cognitive Engineering, Visualization, Cognitive Modeling, Multi-agent systems and Machine Learning. These, and the research by the new staff member in Human-Computer Interaction will provide the local context for the position. In addition, there are strong collaborations with the UMCG and with Experimental Psychology at the RUG, and the researcher is expected to participate in the Research School for Behavioral and Cognitive Neuroscience (BCN).

Within the Netherlands, there is a growing interest in human-computer collaboration in the context of Artificial Intelligence, as formulated in the NWO AI Research Agenda. Also the recently awarded Gravitation project Hybrid Intelligence (a collaboration between six Dutch universities, with the Groningen AI department in a leading role) emphasises human-computer collaboration. In addition, the EU is expected to also invest heavily in this type of AI research.

Internationally, the BI collaborates with the Anderson group at Carnegie Mellon University, the Eliasmith group at the University of Waterloo, the Computer Science department at Drexel University (Philadelphia) and the cognitive modeling group at the Technische Universität Berlin, among others.

## **7. Expected contributions to research**

The candidate is expected to set up a research group on the topic of human-computer collaboration, in close cooperation with the staff members in human-computer interaction and cognitive engineering. The research should compete on a worldwide level and lead to publications in top journals. Obtaining substantial external funding for PhD projects is crucial. Supervision of PhD students is an important part of the

research activities. The research is expected to strengthen the existing efforts within the Bernoulli Institute in the field of human-computer collaboration and interaction.

### **8. Expected contributions to teaching**

The candidate is expected to contribute to the education programmes of the bachelor and master programs of Artificial Intelligence and Human-Computer Communication. He/she will also be actively involved in the development of new courses related to the research area. Furthermore, he/she will supervise final research projects of bachelor and master students.

### **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 the FSE, the candidate will contribute to the organization of the faculty, for example by participating in working groups and committees, in the fields of teaching, research and management. The candidate will participate in relevant national and international organizations.