Bernoulli Institute for Mathematics, Computer Science and Artificial Intelligence

Faculty of Science and Engineering, University of Groningen, the Netherlands

The Bernoulli Institute is a vibrant community with an international outlook, which fosters talent in all its research areas and disciplines and is active in pure and applied science, and (multi)disciplinary research and teaching. The Bernoulli Institute comprises 16 research groups, distributed over three departments: mathematics, computer science and artificial intelligence.

This document gives an overview of the key expertises and research interests of our staff members. Click on a researchers' name to be redirected to their personal website.

Mathematics Department

1.1 Algebra

Our research focuses on geometry and its applications to number theory, mathematical physics and differential equations. In particular, this includes algebraic and arithmetic geometry, as well as supergeometry and quantisation. Some of our research is concerned with explicit methods in arithmetic geometry and complex multiplication theory.

Chair: prof. dr. Jaap Top (j.top@rug.nl)

Keywords: number theory, algebraic geometry

Dr. Pınar Kılıçer (p.kilicer@rug.nl)

Keywords: Algebraic number theory, algorithmic number theory, complex multiplication, algebraic curves, constructing low genus curves, reduction types of curves

Dr. Arthemy Kiselev (a.v.kiselev@rug.nl)

Keywords: geometry of quantisation, geometry of interaction, graph theory, Poisson geometry, integrable systems

Arthemy Kiselev develops and upgrades algebraic and geometric tools for the mathematical language of fundamental physics.

Dr. Ekin Özman (e.ozman@rug.nl)

Keywords: arithmetic geometry, algebraic number theory, rational points on curves, Brauer-Manin obstruction, modular curves, Q-curves, Prym varieties, invariants of curves over algebraically closed field of characteristic p and Galois towers of curves.

Prof. dr. Steffen Müller (j.s.muller@rug.nl)

Keywords: arithmetic geometry, explicit methods in diophantine geometry

Prof. dr. Cecília Salgado (c.salgado@rug.nl)

My field of research is arithmetic algebraic geometry. More precisely, I'm interested in problems around rational points on algebraic varieties, fibrations on curves and higher dimensional varieties, and applications to coding theory.

1.2 Computational and Numerical Mathematics

The group Computational and Numerical Mathematics is developing advanced mathematical and computational methods for the modeling of fluid flows occurring in applications that are important for society: turbulence modeling, cardiovascular modeling, and climate modeling.

Chair: Prof. dr. ir. Roel Verstappen (r.w.c.p.verstappen@rug.nl)

Keywords: scientific computing, computational fluid dynamics, turbulence, modeling complex fluid flows.

Prof. dr. Cristóbal Bertoglio (c.a.bertoglio@rug.nl)

My research field is the mathematical modeling and numerical simulation of the cardiovascular system. In the last years, my group has intensively worked using clinical data of different complexities for patient-specific cardiovascular modeling. This has also led to contributions in image reconstruction.

Dr. Julian Koellermeier (j.koellermeier@rug.nl)
Keywords: model reduction, rarefied gases, geophysical fluid flows, neuromorphic computing and memristors, shallow water equations, mathematical modeling, numerical simulation, hyperbolic balance laws and non-conservative finite volume models.

Dr. Maike Meier (m.meier@rug.nl)
My research focuses on numerical linear algebra (NLA) and linear inverse problems. I work on randomization in NLA, iterative solvers for least squares problems, Krylov methods for inverse problems, and NLA for experiment design. I am also interested in the intersections between randomized and high-dimensional statistics. More broadly, I work on large-scale fundamental matrix problems in computing.

Prof. dr. ir. Fred Wubs (f.w.wubs@rug.nl)
Keywords: numerical mathematics

1.3 Dynamical Systems, Geometry and Mathematical Physics

Our research activities cover a broad and diverse spectrum of subjects in the fields of fundamental and applied dynamical systems theory, classical, statistical and quantum mechanics and their interfaces in the light of dynamics. Applications to life sciences, meteorology, physics and chemistry play a crucial role.

Chair: Prof. dr. Holger Waalkens (h.waalkens@rug.nl)
Keywords: dynamical systems theory (especially Hamiltonian and integrable systems) and mathematical physics

Dr. Tamás Görbe (t.f.gorbe@rug.nl)
My research focuses on Integrable Systems and their algebraic, geometric, and field-theoretic aspects

Dr. Hildeberto Jardón Kojakmetov (h.jardon.kojakmetov@rug.nl)
My research interests are dynamical Systems in the broad sense but especially those with multiple time scales. Besides, I am interested in developments on Control Theory, Mathematical Biology and Neuroscience, Networks and Complex Systems, among others.

Dr. Çağrı Karakurt (c.karakurt@rug.nl)
Keywords: Low dimensional topology, symplectic geometry, contact geometry, Heegaard-Floer homology.

Prof. Dr. Oliver Lorscheid (o.lorscheid@rug.nl)
Keywords: algebraic geometry, algebra, number theory, combinatorics, matroids, tropical geometry, F1-geometry, quiver representations, automorphic forms

Together with Matt Baker and several (for parts, former) members of our groups (Manoel Jarra, Alejandro Mendez, Eduardo Vital Tong Jin, Philipp Griffins), we are formulating new foundations for matroid theory and tropical geometry, which includes new tools to study classical problems, such as representations of matroids. Some notable side projects are: jointly with Matt Baker, June Huh and Mario Kummer, we explore the relation to Lorentzian polynomials. Jointly with Nathan Bowler and Rudi Pendavingh, we provide a categorical framework for matroids with coefficients.

Together with Roberto Alvarenga and Valdir Perreira Junior, we develop an explicit understanding of automorphic forms for GL(3) over elliptic function fields.

Together with Omid Amini, we develop analytic geometry with orientations, with a possible application to the Macphersonian conjecture.

Dr. Nikolay Martynchuk (n.martynchuk@rug.nl)
Keywords: Integrable Hamiltonian systems (including symplectic geometry and topology of such systems), quantum mechanics, topological dimension theory

Prof. dr. Marcello Seri (m.seri@rug.nl)
Keywords: sub-Riemannian geometry, geometric mechanics, geometry-preserving numerical methods, spectral theory and their applications to problems in mathematical physics

Dr. Alef Sterk (a.e.sterk@rug.nl)
Keywords: nonlinear dynamical systems, attractors and their bifurcations, differential equations, analysis

I am a mathematician with an open mind for both theoretical and applied research. My current research focuses on the predictability and statistics of extreme events in dynamical systems with a particular emphasis geophysical models.

Prof. dr. Roland van der Veen (r.i.van.der.veen@rug.nl)
My research focuses on knot theory and its interactions with low-dimensional topology, representation theory, geometry and physics. Effective computation in knot theory using Feynman integration techniques and quantum groups is my main expertise. As a broader long-term goal I am studying simplicial complexes: structures built from points, lines and triangles etc. This seems to be the right setting to combine numerical mathematics and computer graphics with more abstract ideas from algebraic topology and geometry. I like to dream that this leads to a better grasp of say fluid dynamics.

1.4 Probability and Statistics

The research activities of the probability and statistics unit span a wide range of topics in modern probability theory, theoretical and applied statistics, and discrete mathematics. These include percolation theory, random graphs, stochastic geometry, graphical models, statistical genetics and topological data analysis.

Chair: Prof. dr. Tobias Muller (tobias.muller@rug.nl)
Keywords: combinatorics, probability theory.

My research interests include random discrete structures such as graphs and permutations, percolation, discrete and stochastic geometry, random walks, random matrices, deterministic graphs in various flavours (extremal, coloured, fractional, topological), asymptotic, extremal and probabilistic combinatorics.

Dr. Gilles Bonnet (g.f.y.bonnet@rug.nl)
Keywords: stochastic geometry, probability theory, convex and discrete geometry, random graphs/tessellations/polytopes, high-dimensional phenomena, point processes, extremal events

I explore the fascinating interplay between Probability and Discrete Geometry, and tackle a number of problems related to random geometric structures such as random Graphs,

Tessellations and Polytopes. Among other things, part of my research is focused on extremal events in random geometric structures or on high-dimensional aspects of stochastic geometry.

Dr. Serte Donderwinkel (s.a.donderwinkel@rug.nl)

My research is in discrete probability theory and probabilistic combinatorics. My expertise includes random trees, random graphs, universality principles, bijective sampling and stochastic processes. I am also involved in CogniGron.

Prof. dr. Marco Grzegorczyk (m.a.grzegorczyk@rug.nl)

Keywords: Bayesian statistics, Bayesian networks, statistical modelling

Collaborations & Network: UMCG, CogniGron, Groningen Institute for Pharmacy

The main expertise of my group is on Bayesian statistical modelling. In particular, we are interested in Bayesian networks and other graphical models for learning network structures from data.

Dr. Réka Szabó (r.szabo@rug.nl)

My research interests and experience are Interacting Particle Systems and Percolation Theory; I have worked especially on the Contact Process, Oriented Percolation Models, Probabilistic Cellular Automata and most recently on Bootstrap Percolation.

Prof. dr. Pieter Trapman (j.p.trapman@rug.nl)

Keywords: stochastic models for the spread of infectious diseases

1.5 Systems, Control and Optimization

The research program Systems, Control and Optimization (SCO) is devoted to the analysis, control and optimization of complex dynamical systems. The focus is on fundamental mathematical research, stimulated by collaborations with colleagues from the engineering and natural sciences. Mathematical systems and control theory deals with the modeling and control of open and interconnected systems evolving in time. The dynamical behavior is not only sought to be analyzed, but to be influenced (controlled) and optimized as well; by the addition of feedback loops, and by the interconnection to other dynamical systems (controller design), or the optimal selection of parameters. Furthermore, the systems point of view is emphasized, by viewing complex systems as networks of simpler components. From the optimization perspective, we study convergence and complexity of iterative algorithms, in connection with their underlying dynamics.

Chair: Prof. dr. Kanat Camlibel (m.k.camlibel@rug.nl)

Keywords: differential variational inequalities, complementarity problems, optimization, piecewise affine dynamical systems, switched linear systems, constrained linear systems, multiagent systems, model reduction, and geometric theory of linear systems

Prof. dr. ir. Bart Besselink (b.besselink@rug.nl)

Keywords: modular analysis and design of interconnected systems using contract theory, nonlinear electrical circuits with memristive elements for neuromorphic computing, model order reduction, applications in intelligent transportation systems, network dynamics and control, geometric modeling and control of multi-physics systems, mathematical systems theory

Prof. dr. Juan Peypouquet (j.g.peypouquet@rug.nl)

We investigate several aspects of the convergence analysis of continuous and discrete-time dynamical systems, with an emphasis in the study of convergence rates and complexity, especially in the presence of uncertainty, both from a theoretical perspective and through numerical analysis and simulations.

We study dynamics given by certain ordinary differential equations and inclusions, in order to design and analyze numerical optimization algorithms, aiming at producing fast algorithms for optimization problems with large volumes of data, and establish guarantees for their convergence rates and complexity. In particular, we shall study inertial methods with damping defined by the curvature, as well as inertial iterations of fixed-point type for more general equilibrium problems, envisioning applications in mechanics and game theory. These algorithms use only first order information, allowing them to consider problems with large volumes of data.

Our research focuses primarily on 1) geometric properties of the functions, such as metric regularity, error bounds, Lojasiewicz inequalities and second order information; 2) dynamical aspects, such as inertia, acceleration and relaxation; 3) restarting schemes in order to improve the convergence and performance of optimization algorithms that combine acceleration and stabilization mechanisms; and 4) the effects of intrinsic (by design) and extrinsic (by uncertainty) stochasticity.

Prof. dr. Stephan Trenn (s.trenn@rug.nl)

Keywords: control theory, mathematical modeling, model reduction, fault detection, discontinuous dynamical systems, modeling and control of energy grids

Dr. Henk van Waarde (h.j.van.waarde@rug.nl)

Keywords: direct data-driven control, system identifiability, kernel-based identification of (physical) dynamical system, experiment design, applications to networked systems and neuroscience

My research interests lie in the field of systems and control. I aim to develop a systems and control theory that is grounded on measured data. I work towards mapping raw data into models and control policies with rigorous guarantees on accuracy, stability and performance, while answering key questions such as: how much data is needed? how to handle noise? and how to perform control-relevant experiments?

Computer Science Department

2.1 Computer Architecture

Chair: Prof. dr. Dirk Pleiter (d.h.pleiter@rug.nl)

Keywords: Computer architectures, high-performance computing, co-design

A central theme of my research is the co-design of computer architectures and technologies as well as digital infrastructures. This research aims to look into both, the design of future computers, including high-performance computing systems, and the design of applications to create the knowledge and understanding for shaping optimal solutions.

Dr. Farhad Merchant (f.a.merchant@rug.nl)

Keywords: emerging technology-based computing, hardware-oriented security

I work on the following two areas:

Computing-in-Memory (CiM): Also known as In-Memory Computing (IMC), this area focuses on using emerging technologies to enhance computing performance and achieve energy efficiency. An example of such an emerging non-volatile memory technology is resistive random-access memory. The aim is to use these technologies for neuromorphic computing in analog or digital domains.

Hardware-Oriented Security: My research encompasses both classical CMOS-based and emerging technology-based hardware security. I am particularly interested in topics such as malware detection, side-channel attacks, homomorphic encryption, physical unclonable functions, true random number generators, and more.

These two areas converge to enable the design of secure, reliable, and innovative computer architectures for future generations. For more details you can look at my google scholar profile.

Prof. Dr. Fatih Turkmen (f.turkmen@rug.nl)

Keywords: cybersecurity, privacy, security and privacy of AI, privacy-enhancing technologies, applied cryptography, software security, hardware security.
Ongoing collaborations: CogniGron, TNO, KPN, Ahold, Albert Heijn, MPI-SP (Germany)

As part of the larger Information Systems group, my team, consisting of 5 PhD students, works on cybersecurity and privacy related problems. Some of the focus areas include:

(1) **Privacy Protection in Data-centric Systems**: On one hand, we develop **privacy-preserving** variants of data-intensive computations such as machine learning algorithms by using cryptographic tools that include multi-party computing, differential privacy and zero knowledge proofs among others. On the other hand, we develop techniques to detect attacks (e.g., memorization, membership inference) against such systems and develop defenses against these attacks while minimizing the impact on the overall performance. Our typical use case is genomic data processing and the overarching goal is to enable **decentralization**.

(2) **Security Analysis of Complex Systems**: In this line, we develop **empirical methods** such as fuzz testing to **test** systems (hardware and software) against **security** related errors and vulnerabilities (e.g., side channels). The systems we consider vary between low level hardware such as neuromorphic circuits implementing spiking neural networks to high level

software such as Web applications with many smaller components. Our long-term goal is two-fold: (i) to bring the concept of "**security by design**" into practice in emerging technologies such as neuromorphic computing before they become more complex and (ii) enable automated security analysis of complex systems such as Web-based applications.

Dr. Reza Zare Hassanpour (r.zare.hassanpour@rug.nl)

My primary research interests lie in the areas of computer networks, embedded systems, and the application of machine learning in embedded systems. I am particularly focused on exploring how machine learning can enhance the functionality and efficiency of embedded systems, as well as improving network performance and reliability in various computing environments.

2.2 Distributed Systems

Distributed Information Systems are concerned with the delocalization of computation on several hosts and their coordination via message passing. Looking at today's information systems, one notices that most of them, if not all, have some form of distribution. The key issues that emerge for research become those of addressing heterogeneity, scalability, and run-time adaptation. In the context of distributed systems, the group focuses on a number of sub-areas: Service-Oriented and Cloud Computing, Pervasive Computing, Middleware for Pervasive Computing and Adaptive Communications, Network-centric Real-time Analytics, and Sensor Networks. Interesting applications areas for the group are: Healthcare, Domotics and Smart Energy Systems.

Chair: Prof. dr. Alexander Lazovik (a.lazovik@rug.nl)

My main research interests include AI planning and discrete optimization in highly distributed environments, having the IoT as a main application domain. His research results have been field-tested in a number of existing buildings serving as living labs

Dr. Heerko Groefsema (h.groefsema@rug.nl)

Keywords: Automated formal verification, (regulatory) compliance, conformance, legislation, variability, synthesis of service compositions, business processes, workflows, digital twins.

Collaborations: Commonwealth Scientific and Industrial Research Organisation (CSIRO).

My research is focused on the automated verification of processes and workflows present in distributed systems. Within this setting, I develop formal mathematical techniques to automatically verify whether such processes conform and comply with regulatory requirements as imposed by legislation.

With increasing legislation that impacts key technologies, such as the AI act or GDPR, I aim to develop techniques with practical applications that solve real world challenges faced by industry. Although I apply formal mathematical techniques, I am particularly interested in bringing practical applications and solutions to industry and business.

Dr. Dilek Düştegör (d.dustegor@rug.nl)

Keywords: anomaly detection, digital twin, pervasive computing, ambient intelligence, distributed decision making, technology enhanced education.

Collaborations & Network: Grenoble INP Genie Industriel, UvA, CIGIT Chinese Academy of Sciences, Universitat Politècnica de Catalunya (UPC), Aveco de Bondt, Hulo, EIT Digital, EIT Manufacturing.

My current research is focused on distributed decision making for smart environments, cyber-physical systems and digital twins, and pervasive computing for ambient intelligence, with a particular interest in sustainable applications for critical systems like water and energy management. As an engineer (both in training and at heart), I have always been passionate about practical applications of theoretical knowledge to solve real-world problems and improve existing technologies. I root for the valorization of research, especially through the creation of societal values, which makes me wander at the frontier of academia and industry, through collaborations and the development of training for professionals.

2.3 Fundamental Computing

The Fundamental Computing group aims to contribute to the understanding of the logical and mathematical foundations of computing science and to realize a two-way transfer between this fundamental research and more applied areas of computer science.

Chair: Prof. dr. Jorge Pérez (j.a.perez@rug.nl)

Keywords: programming languages, program verification, concurrency, theoretical computer science, logic
Collaborations and network: Dutch Association for Software Engineering VERSEN, Institute for Programming Research and Algorithmics IPA, NeTCS, Técnico Lisboa (PT), Leiden University (NL), Imperial College (UK), Oxford University (UK)

Embedded in the Fundamental Computing group, my research targets the rigorous verification of communicating programs: computer programs that work by exchanging messages across networks, thus enabling systems that run on different computers to interact.

To tackle this formidable challenge, my group and I investigate the foundations of type systems, techniques that avoid bugs by scrutinizing a program's instructions. A type system prescribes formation rules for programs, which allow us to mathematically prove that well-formed programs are correct. Our unique approach concerns type systems that enforce correctness by adopting principles from resource-aware logics, which allow reasoning about usage of resources.

Dr. Ivan Bliznets (i.bliznets@rug.nl)

Keywords: algorithms, satisfiability, fixed parameter tractable, fpt-algorithms, exact exponential algorithms

Prof. dr. Helle Hansen (h.h.hansen@rug.nl)

Logic and semantics of computation, in particular, modal logic, coalgebra, and algebra, and their applications in the formal specification and analysis of software systems.

Dr. Dan Frumin (d.frumin@rug.nl)

I am a logician and a computer scientist, working primarily on concurrency and reasoning about concurrent systems. In general, I am interested in applications of logic, formal proofs, and category theory to computer science.

My research is focused on verification of (concurrent) systems, using the tools of mathematical logic. I study the behavior of concurrent programs through formal semantics, and I am interested in formulating and verifying safety and security properties of the programs through this lens.

Keywords: logic, type theory, concurrency, formal verification

Dr. Rodrigo Otoni (r.b.otoni@rug.nl)

Keywords: automated reasoning, formal methods, model checking, satisfiability modulo theories, constrained Horn clauses, temporal logic, smart contracts, quantum networks, software-intensive systems.

I investigate the use of logic as a means to ensure robustness of the systems underlying our digital infrastructure. My research focuses on automated reasoning, through the lenses of verification, synthesis, and certification. In particular, I am interested in bridging the gap between theory and practice via techniques that enable push-button automation, such as model checking. My work primarily targets systems which have distribution as a key feature, including blockchains and quantum networks.

On a more technical note, I have experience in topics such as symbolic model checking, SMT and CHC solving, TLA+ specifications, process algebras, smart contracts, and entanglement-based networks.

Dr. Revantha Ramanayake (d.r.s.ramanayake@rug.nl)

Keywords: non-classical logics, proof theory, substructural logic, modal logic, theorem proving, proof assistants, computational complexity, slow and fast growing complexity classes, length theorems on well-quasi-orderings

I specialize in the study of non-classical logics, with a particular focus on substructural and modal logics, through the lens of proof theory. My research interests include exploring the computational properties of these logics, such as establishing upper bounds using techniques like well-quasi-ordering and ordinal-indexed fast-growing function theory, and seeking generalizations of the fundamental proof theoretic property of cut-elimination ("cut-restriction").

2.4 Information Systems

Our research revolves around the three major flavors of information systems:

- Information systems with focus on process automation and workflow management, which are the backbone of modern enterprise systems in combination with service-oriented infrastructures. In particular, our focus is on both theoretical aspects of business processes in a cross-organisational setting, as well as technological aspects of the corresponding middleware and their software architecture and realizations. Exciting application fields are logistics and supply chain management, and eScience and scientific workflows. Current topic of research are: Adaptive service orchestrations and choreographies; Process performance monitoring and improvement, monitoring of KPIs of both orchestrations and choreographies; Data-driven process adaptation, IoT and Data Analytics; Blockchain enabled adaptive service choreographies for business and scientific applications

- Data-driven information systems with focus on image processing, pattern recognition and machine learning. In particular the research interests are in the fields of: Person identification by means of vision-based biometric features; Face analysis; Medical

image analysis; Brain-inspired computer vision; Autonomous health monitoring systems with IoT; Automatic visual quality inspection

- Information systems often deal with (collect, store and process) sensitive data. Our group also performs research on data-centric security and privacy (S&P) at the intersection of authentication and authorization infrastructures, privacy-enhancing technologies (PET) and trust management. The particular research areas include: Formal Methods for (S&P) Analysis; Key Management and computation over encrypted data; PETs applied to (collaborative) machine learning; S&P for Medical Informatics (e.g. genomic privacy); Cloud, IoT and Edge Security; Applications of Blockchain (with a focus on S&P) to various domains

Chair: Prof. dr. Dimka Karastoyanova (d.karastoyanova@rug.nl)
Keywords: BPM and workflow management, autonomic process engineering, data-driven runtime process performance improvement, flexible workflows, collective adaptive systems and systems of systems, provenance for flexible eScience choreographies, service oriented architecture, enterprise application integration, scientific computing eScience

Prof. dr. George Azzopardi (g.azzopardi@rug.nl)
Keywords: Core Computer Science: Pattern Recognition, Predictive Analysis, Computer Vision, Machine/Deep Learning

Collaborations & Network: UMCG, CogniGron, University of Leon (SP), University of Salerno (IT), University of Malta, University of Stellenbosch (SA), University of Twente, Dutch Driving Authority RDW, IT Academy North Netherlands, ASTRON, Researchable

Interdisciplinary Applications: 1) Vision-based: Image/Video Analysis in Medical, Smart Farming, Radio-Astronomy and Forensic, 2) Non-vision based: Explainable AI for Predictive Modeling of Medical Phenotypes

My research interests are in pattern recognition, computer vision, and predictive analysis. I am the academic lead of the PRISMA (Pattern Recognition and Inference: Signals → Models → Applications) research team, which is one of the three pillars within the Information Systems group, and serve as the Coordinator of Applied AI at the Jantina Tammes School. Within the PRISMA team we focus on fundamental research in enhancing the robustness of vision models and developing advanced machine learning methodologies with applications in (bio)medical imaging, radio astronomy, forensic science, and smart farming. Through interdisciplinary collaborations with institutions such as UMCG, ASTRON, RDW, and international universities, the team translates complex data into actionable insights, which help drive innovation across multiple scientific and industrial domains.

PRISMA's current research team includes 6 PhD students and 1 postdoctoral researcher working on deep-learning models inspired by the brain's visual system, segmentation of cellular structures in electron microscopy, and the authentication of facial images to prevent deepfakes. The team's impact has been recognized with prestigious awards, including the Ben Feringa Impact Award (2023) and the ENLIGHT Impact Award (2024) for contributions to forensic image analysis. With a commitment to bridging theory and practice, at PRISMA we aim to continue pushing the boundaries of pattern recognition, and ensure that our research remains both scientifically rigorous and practically relevant.

Dr. Fadi Mohsen (f.f.m.mohsen@rug.nl)

My research interests lie in the field of cyber security, particularly in web, computer and mobile phones security. My research investigates the security and privacy risks of third-party applications in computing system by analyzing the access control mechanisms, finding possible vulnerabilities, implementing countermeasures, and studying users' awareness and comprehension to the vulnerabilities and the countermeasures. Over the last year and a half I have been working on projects that involve using data and text mining techniques to detect Android malicious apps and recommend safe apps for mobile users to download on their phones.

Dr. Mirela Riveni (m.riveni@rug.nl)

Keywords: social computing and crowdsourcing, network science, computer networks, cloud computing, recommender systems

Currently, my work is focused on large-scale network analysis, and specifically disinformation detection and (dis)information spreading analysis, as well as polarization and eco chambers. Current use cases in which I work are from data in decentralized systems (i.e., the fediverse). I work with network science metrics, graph-based algorithms, ML, and NLP. I am also studying provenance in large scale network analysis and other related contexts such as: provenance of code, and provenance in workflows. Furthermore, bias and discrimination issues in recommender systems have been within my interest for years. A special focus of mine are privacy and ethical issues, on which I write and give talks as well. A fairly new research line of mine since I started working at the Information Systems Group, is applying network science in BPM and process mining.

2.5 Intelligent Systems

Our research group covers a variety of theory and application in the context of intelligent systems, machine learning, AI and robotics.

That includes development of machine learning (ML) techniques for interdisciplinary data science, deep learning for medical imaging, morphological filters for efficient and robust large scale image analysis for various domains and agile sensing for cyber physical systems and robotics. We demonstrate our developments in various domains, such as astronomy, medicine, pharmacy, smart industry, remote sensing, agriculture, microscopy, and robotics, bridging the gap between theory and praxis, as well as software and hardware. We also investigate the theory of ML/AI learning systems with frameworks from theoretical physics to understand the theory of (deep) learning among others.

Our group exhibits vast national and international collaborations. This includes partners in the medical field (Birmingham, UMCG), and different data modalities: images (CT, MRT, Xray, ...), genetic + proteomics, bodily fluid data (GCMS, etc.), time-series of treatment, ECG, in particular when dynamic models are involved. We furthermore have lively collaborations with industrial partners within the Netherlands and abroad.

Collaborations & Network: UMCG, University of Birmingham, ENTEG, Belsimpel, VerifAI, Slimmer AI, TNO, Circ, powerchainger, Philips, Arox Logistics, and cooperations in the agricultural sphere. Many European universities, as well as in the US.

Chair: Prof. dr. Kerstin Bunte (k.bunte@rug.nl)

I develop efficient and/or interpretable machine learning (ML) techniques and sparse representations targeted for difficult application domains. This includes ML including expert

knowledge in form of mathematical models (mechanistic models, scientific ML) in science domains where such models exist (pharma, medicine, engineering, physics). Then developments of dimensionality reduction, feature selection, biomarker detection in various domains where information retrieval is important. I also investigate theory of ML in particular when data training data is very limited. I investigate and model the unobserved data to understand over-parameterized models, for example for differential equation systems and its implication for ML. I also investigate the application area of smart industry, where I am interested in robust and efficient solutions to analyze production processes and perception solutions for cyber-physical systems, here again when data is imperfect and scarce.

Sparse representations are also interesting for Astroinformatics where we develop efficient evolutionary computation algorithms incorporating game theoretic principles for the detection and modeling of faint astronomical structures.

Prof. dr. Michael Biehl (m.biehl@rug.nl)

Keywords: Machine Learning and Computational Intelligence, Deep theory and algorithm development for neural networks, Learning Vector Quantization and Relevance Learning, Statistical Physics and Scientific Computing, Theory of neural networks, dynamics of machine learning processes, Monte Carlo simulations of complex systems, Disordered systems, non-equilibrium growth processes

Dr. Jiapan Guo (j.guo@rug.nl)

Keywords: machine learning, pattern recognition, interdisciplinary data analysis, computer vision, medical imaging informatics
Collaboration and network: UMCG (NL), University of Twente (NL), Zhejiang University (China), Harvard Medical School (US)

I am embedded in the intelligent systems group in which we work on applying machine learning and pattern recognition on interdisciplinary (image) data analysis. In particular, I am interested in using deep neural networks for (multimodal) analysis of (visual) data.

Dr. Michael Wilkinson (m.h.f.wilkinson@rug.nl)

Keywords: Digital image analysis, segmentation, mathematical morphology, connected filters, biomedical imaging and visualization, remote sensing, astronomical image analysis, parallel and distributed computing for analysis of massive images and volumes.

2.6 Scientific Visualization and Computer Graphics

The group carries out research in the areas of scientific visualization, information visualization, software visualization, multiscale shape analysis, illustrative computer graphics, innovative interfaces using large displays, geometric modelling, vector graphics, visual perception and VR/AR. We apply our research to fundamental and practical problems from the life sciences (functional brain imaging, bioinformatics), astronomy, the medical domain, as well as the CAD industry. The group participates in the research school Behavioural and Cognitive Neuroscience (BCN), the Advanced School for Computing and Imaging (ASCI) and the Neuroimaging Center (NIC) of the University of Groningen and the University Medical Center Groningen.

Chair: Prof. dr. Jiří Kosinka (j.kosinka@rug.nl)

Keywords: geometric modelling, computer aided (geometric) design, computer graphics, image processing

Prof. dr. Steffen Frey (s.d.frey@rug.nl)

My research concerns the development of methods to gain insights from large quantities of scientific data (typically from experiments and simulations). Meaningful analysis requires addressing challenges both regarding presentation and performance, and involves diverse--but tightly connected--research directions, including machine learning /optimization for visualization, high performance computation (distributed/parallel approaches, in situ visualization), and multifield visualization. An overarching topic is the automatic, data-driven configuration of methods and systems.

Dr. Christian Kehl (c.kehl@rug.nl)

My main research interest is the design, implementation, extension and optimisation of algorithms that integrate observational data (e.g. from remote sensing or domain expert interpretation) in deterministic- and stochastic simulations of dynamic systems (such as fluid flow) as well as uncertain static systems (such reservoir architectures), and the visualisation of those systems on modern, easily-accessible platforms. Visual perception and interaction within those platforms are key aspects to make the visualizations effective.

2.7 Software Engineering and Architecture

Effective software engineering requires healthy software and teams. A healthy software is maintainable, well-performing, with low technical debt, and based on sound design decisions. A healthy team is productive, diverse and inclusive. And healthy software and team amplify each other. Our research enables the software industry to improve their software and team health.

Chair: Prof. dr. ir. Paris Avgeriou (p.avgeriou@rug.nl)

Keywords: software architecture, maintenance and evolution, technical debt, empirical software engineering

Large, complex, and long-lived systems are hard to design and maintain! We need evidence-based tools to make architecture decisions and manage technical debt.

Prof. dr. Vasilios Andrikopoulos (v.andrikopoulos@rug.nl)

Keywords: software architecture, cloud-based systems, distributed systems, sustainable software

To ensure system longevity, reduce environmental footprint, and maintain operational profitability, we need to connect design-time and run time.

Prof. dr. Andrea Capiluppi (a.capiluppi@rug.nl)

Keywords: open source, maintenance and evolution, mining software repositories, AI for software engineering

Building a software system is one thing, but maintaining it is much more expensive: this is the phase we need to prioritize!

Dr. Daniel Feitosa (d.feitosa@rug.nl)

Keywords: software architecture, technical debt, developer tools, mining software repositories, software analytics

If software development is to evolve, we need human-centered tooling to leverage cross-system knowledge sharing. Tools only enable productivity and velocity when they are designed and combined with the team's cognitive processes in mind. My research focuses on understanding and engineering of software systems to support developers in managing and improving the technical sustainability of software products.

Dr. Ayushi Rastogi (a.rastogi@rug.nl)
Keywords: AI for Software Engineering, Empirical Studies, Open Source, Software Analytics, Mining Software Repositories, Software Economics, Developer Productivity, Code Velocity, Fairness, Diversity and Inclusion.

Software data empowers informed decision-making to improve society (e.g., solving fairness problems) and the software industry (e.g., developer productivity).

Dr. Sushant Pandey (s.k.pandey@rug.nl)

I am working on various problems in the software engineering domain using AI tools, such as input prioritization, design pattern recognition, and software defect prediction. I am also working on a data leak issue in computer vision.

Keywords: AI in Software Engineering, AI in Engineering, Empirical Software Engineering, Software Testing, Software Requirements, Autonomous Systems

Prof. dr. Tijs van der Storm (t.van.der.storm@rug.nl)
Keywords: developer tools, domain-specific languages

There’s too much code in the world! We should rethink the software stack with DSLs for better productivity, reliability, and stakeholder communication.

Artificial Intelligence Department

3.1 Cognitive Modelling

The Cognitive Modeling Group studies human cognition by creating cognitive models of complex behavior. Cognitive models are, essentially, theories of how people think, implemented in computer simulations. To test these models, their predictions are compared to human data from behavioral and neuroimaging studies. In particular, we are interested in model-based analyses of neural data, in which a model is used to guide the interpretation of the data.

Cognitive models can be applied in many domains: they can be used as the basis for designing education and training, or they can be used to implement intelligent agents in various applications. Many of the models we build are developed with the ACT-R language/modeling formalism or the PRIMs architecture which was originally developed by our group.

An overarching theme in our group is skill acquisition. We look at it in a variety of contexts, ranging from medical decision-making, to multitasking, and the transfer of skills across domains. We also investigate how people can reduce distraction and improve their mental abilities through meditation and how they acquire and interpret natural language. We also study cognition and learning in low-level spiking neural networks in the context of the Cognigron Center for Cognitive Systems and Materials.

Chair: Prof. dr. Niels Taatgen (n.a.taatgen@rug.nl)

My main specialty is cognitive modeling: using computer simulation to better understand human cognition. The topics I focus on are learning, multitasking, time perception and visual perception. To test the theories, I conduct experiments with human subjects.

Cognitive modeling has many applications in education, human-computer interaction and artificial intelligence. I am especially interested in multitasking in driving, and building cognitive tutors.

Prof. dr. Jelmer Borst (j.p.borst@rug.nl)

My main research interest is the development and improvement of analysis methods that connect computational (cognitive) models to neuroimaging data. Better methods will enable a more fine-grained analysis of the astounding amount of neuroimaging data that is collected worldwide. Ultimately, this should lead to a better understanding of the human mind, which should take the form of computational cognitive models at different levels of abstraction, from higher level process models in the cognitive architecture ACT-R to low-level spiking-neuron models developed in Nengo.

Prof. dr. Fokie Cnossen (f.cnossen@rug.nl)

Keywords: cognitive engineering, cognitive psychology and human factors applied to patient safety, human-machine interaction and usability, human-robot interaction, (medical) skill acquisition, driving behaviour

Prof. dr. Matthew Cook (m.cook@rug.nl)

My long term goal is to understand the brain as a computational system. Thus I study alternative models of computation to expand my understanding of what computation can look like, while I also develop models of information processing guided by neuroanatomy to explore emergent brain-like functionality. My work has included topics such as cellular automata, reversible computing, specialized algorithms for specialized hardware, recurrent neural network architectures, connectomics, Boolean co-clones, DNA computing,

cooperative distributed action selection, simultaneous localization and mapping, and philosophy of computation.

Dr. Stephen Jones (s.m.jones@rug.nl)

Keywords: sentence processing, grammar, prosody, emotion

I'm interested in how the brain reacts when humans have to process sentences. This includes complex sentences, when we have to form links between words that are far apart in the sentence, but also the link between prosody - the "music" of speech - and meaning, and how we respond emotionally when we hear or read things in our mother tongue or in a language that we learned later on in life.

Dr. Jacolien van Rij-Tange (j.c.van.rij@rug.nl)

Keywords: language acquisition, sentence processing, context

I'm interested in the processing of (seemingly) ambiguous sentences. These are sentences that potentially have multiple potential interpretations, such as sentences with pronouns or idioms. For interpreting these sentences correctly, the listeners need to combine different sources of information in a relative short time (for example, world knowledge, visual context, and preceding linguistic information).

My research focuses on 1) how listeners combine different sources of information during sentence processing, and 2) how regularities in the linguistic input may facilitate this process. I combine computational simulations (error-driven learning), experimental studies, and advanced statistical methods to answer my research questions.

Dr. Andreea Sburlea (a.i.sburlea@rug.nl)

Keywords: human centered intelligence

My research interest is multidisciplinary covering neuroscience, brain-computer interfaces, and artificial intelligence (AI).

In the field of neuroscience, I am mostly interested in multimodal data, linking brain activity (mostly EEG), behavioral data (EMG, eye-tracking, kinematics), and computational models in (close to) real-life scenarios that investigate from a cognitive perspective the relation between human perception and action. In the field of brain-computer interfaces, my goals are to leverage signal processing and neuroimaging methods to understand the causal relationship between the perception of stimuli and the triggered action, through neural correlates of error-driven learning in motor behaviour. Furthermore, in artificial intelligence, I apply machine learning techniques and statistical approaches to optimize the design of human-centered closed-loop motor strategies for neuroprosthetic control.

Next to my research, I am very motivated by science education and dissemination at different levels. My focus is on developing methods that use AI to ensure inclusive and equitable quality education and learning opportunities for all. In my current position, I aim to promote learning about AI, learning with AI, and learning for human-AI collaboration.

Dr. Catherine Sibert (c.l.sibert@rug.nl)

I am interested in exploring the mechanisms of thought, with a particular focus on how the structure of the human brain gives rise to human intelligence. I believe that understanding this relationship is vital for informing and improving artificial systems that instruct, supplement, or collaborate with human users.

My work seeks to bridge the gap between neuroscience and AI by using brain imaging data to explore the high level frameworks of cognition proposed by computer science based architectural models and investigating how the constraints of the brain or tasks impact the behavior that results. By expanding on current theoretical accounts of human thought processes, like the Common Model of Cognition, I hope to incorporate insights from the human brain into platforms for general purpose artificial intelligence that more closely resemble our own, and to use artificial intelligence tools to better understand and interpret human behavior.Keywords: human computer collaboration

Dr. Lisa-Marie Vortmann (l.vortmann@rug.nl)

I am fascinated by the role and effects of attentional mechanisms and states because I believe it has a fundamental influence on basically all other aspects of human cognition. Addressing different research questions and motivations regarding human attention, I have worked intensively with machine learning, biosignal data processing (mostly EEG and eye tracking), augmented reality, cognitive modeling, and brain-computer interfaces.

Prof. dr. Marieke van Vugt (m.k.van.vugt@rug.nl)

Keywords: artificial intelligence, computational psychiatry, decision making, EEG, cognitive modeling, mindfulness, attention, social neuroscience, brain decoding

In my lab, we try to understand when, how and why we mind-wander. When is it beneficial, when is it not? In this context, I am particularly interested in depressive rumination, as a specific example of where we get stuck in our thoughts. I examine in collaboration with Prof. Marie-José van Tol (UMCG) how interventions can reduce ruminative thinking. In addition, I am highly interested in biomarkers of mind-wandering and depressive rumination, based on behaviour, EEG, and speech (the latter in collaboration with Prof. Iris Sommer, UMCG). I also try to improve biomarkers of mind-wandering using generative artificial intelligence in a project in collaboration with Prof. Natasha Maurits (UMCG).

Apart from this, I am working on how we coordinate our behaviour using a tacit coordination task in combination with inter-brain synchrony measured with EEG. In a very unique project, I collaborate with Tibetan monks of Sera Jey monastic university (India) to see how a collaborative reasoning and meditation practice–monastic debate–affects cognition and emotion.

3.2 Human-Centered Robotics

The Human-Centered Robotics research group focuses on the foundational methodologies and cutting-edge technologies that enable intelligent robotic systems to seamlessly operate in complex, time-varying environments. Research within the group spans various domains including mechatronic design, perception, learning, and control, with the goal of addressing the diverse challenges inherent in human-robot cooperation and physical/social human-robot interaction. The group employs a diverse array of classical system-theory and machine-learning methodologies, such as model-based and data-driven control, as well as reinforcement learning and (deep) neural networks.

Beyond the commitment to advancing scientific knowledge, the group holds a deep appreciation for societal implications. As such, end-users, relevant industries, hospitals, and a wide spectrum of interdisciplinary stakeholders are actively engaged within the research domains. By fostering collaboration and understanding, the group aims to positively impact society at large.

Chair: Prof. dr. Raffaella Carloni (r.carloni@rug.nl)

The Robotics lab develops robotic systems that are intended to physically interact with uncertain dynamic environments and to cooperate with humans. The group's main goal is the development of novel actuation systems, which are the key enabling components for motion generation. The work is accomplished by developing mechanical designs and intelligent model-based or model-free control architectures. Current research projects focus on bio-inspired soft robots and lower-limb prosthetic devices.

Dr. Hamidreza Kasaei (hamidreza.kasaei@rug.nl)

The Interactive Robot Learning Laboratory (IRL-Lab) focuses on fundamental lifelong robot learning to make robots capable of learning in an open-ended fashion by interacting with non-expert users. In our research, apart from robot self-learning, non-expert human users could interactively guide the process of experience acquisition by teaching new concepts, or by correcting insufficient or erroneous concepts. This way, the robot will constantly learn how to operate effectively in complex environments, adapt to user preferences, and learn from user input without the need for re-programming.

We also work on challenging open problems at the intersection of robotics, computer vision, and machine learning. We develop algorithms and systems to understand the underlying principles of robust sensorimotor coordination in humans with the aim of improving the skills and autonomy of complex robotic systems.

Dr. Paul Vogt (p.a.vogt@rug.nl)

Keywords: social robotics, human-robot interaction, developmental robotics, cognitive science, language development

My research focuses on how to design and develop social robots, and investigate how they can be used to achieve the goals they are designed for. Social robots are robots designed to interact with humans in a socially acceptable manner to support humans in a social, communicative way. My research particularly focuses on designing the communicative abilities of social robots to be applied in the domains of education and healthcare.

3.3 Machine Learning

The machine learning group is a team of scientists working to build the next generation of machines that can safely and responsibly learn to act through interactions with humans, infrastructures, and other machines. We explore scientific breakthroughs in modern machine-learning technologies and real-world applications that can transform industries, improve people's lives, and benefit humanity. Our research focuses on:

1. building trustworthy machine learning models with real-world data for several applications, such as medical AI and Robotics. Our approach involves Uncertainty Estimation, Computer Vision, and Explainable AI.
2. pushing the boundaries of Deep Reinforcement Learning by developing models that can learn complex tasks and adapt and generalize across diverse environments. We envision a future where AI systems seamlessly transfer knowledge between tasks, enabling more robust, efficient, and scalable real-world applications.
3. advancing Natural Language Processing to develop human-centered models, with a focus on personalized education, emotion recognition in conversational systems, and multilingual representation learning for low-resource languages.
4. building the theoretical foundations for collective and social intelligence involving multiple cooperative, competitive, or mixed-motive artificial agents, humans, and

organizations. Our research has formalized centralized planning for the decentralized control paradigm, which provides an elegant and comprehensive framework for reasoning in ecologies of interacting artificial agents with imperfect information. This framework underpins almost all real-world interactions between humans and artificial agents.

Chair: Prof. dr. Jilles Dibangoye (j.s.dibangoye@rug.nl)

Keywords: machine learning, (multi-agent) reinforcement learning, game theory, theory of mind, social understanding, cooperative intelligence, human-machine co-learning, continual learning, AI for social good, AI alignment, safeness, and security.

Dr. Maruf Dhali (m.a.dhali@rug.nl)

Keywords: machine learning, computer vision, pattern recognition, deep learning, AI in historical manuscripts and cultural heritage data, handwriting analysis, continual learning

My research interest lies in multidisciplinary works using machine learning and pattern recognition techniques to practical data and challenges. We use tools ranging from statistical methods to deep learning to state-of-the-art AI techniques to deal with data ranging from multispectral images to cultural heritage data to radiocarbon dating outcomes. My current research projects focus on ancient manuscripts, Dutch cultural heritage data, religious texts, and medical image data. I am also working on several industrial collaboration projects to process their data using CNN and transformer-based models.

Prof. Dr. Herbert Jaeger (h.jaeger@rug.nl)

Keywords: neural networks, energy-efficient computing, brain-like microchips, very complex systems

Jaeger's group ('Modeling Intelligent Dynamical Systems', MINDS) investigates how cognitive-level information processing can be realized in extremely energy-efficient, non-digital, 'brain-like', novel sorts of computing microchips. The MINDS group enjoys close collaborations with materials scientists, unconventional microchip designers, machine learners, and cognitive scientists. In this context, Jaeger's group contributes mathematical modeling methods and formal models of computing systems. Jaeger and his group are closely associated with the Groningen Cognitive Systems and Materials Center (CogniGron).

Dr. Matthia Sabatelli (m.sabatelli@rug.nl)

Keywords: (deep) reinforcement learning

Dr. Tsegaye Tashu (t.m.tashu@rug.nl)

Keywords: Natural language processing (NLP), Multilingual NLP, Sentiment Analysis, Machine Learning, Educational Text mining

Dr. Matias Valdenegro Toro (m.a.valdenegro.toro@rug.nl)

My research interests are in building trustworthy machine learning models with real-world data via two key concepts: estimation of their own confidence, and providing useful explanations about their predictions. Both confidence estimation and explanations are required for machine learning models to gain human trust and be usable in high stakes applications.

Uncertainty in machine learning is about building machine learning models that can estimate their own confidence, in a way human users can infer if the prediction is useful or not, and the model is able to answer "I don't know", which current machine learning models cannot

do. The best example is large language models like ChatGPT giving hallucinations instead of refusing to answer something outside their knowledge.

Explainable machine learning tries to provide explanations and interpretations on why a model made a particular prediction, which improves transparency and trustworthiness and usability for high stakes applications. There are many examples of large language models giving incorrect predictions due to faulty reasoning, and having a natural language interface with a model does not guarantee transparency and reasoning. I also combine explanation methods with uncertainty quantification methods to produce explanation uncertainty, as explanations are also models and can be correct or incorrect.

I focus on several real-world applications, mainly Medical Artificial Intelligence in collaboration with the UMCG (University Medical Center Groningen), where we build fair models for radiotherapy and kidney function estimation, and I also focus on building Computer Vision and Robot perception models with uncertainty estimation.

Dr. Yftah Ziser (y.ziser@rug.nl)

Keywords: Natural language processing (NLP), Large Language Models (LLMs), Alignment, Reasoning, Analysis.

My research focuses on aligning NLP models, primarily large language models, with human values, aiming to make them more reliable, fair, and transparent. A key aspect of my work is designing highly efficient training regimes that optimize data use, particularly for low-resource languages and domains.

Dr. Qing Li (qing.li@rug.nl)

Keywords: Interpretability and Trustworthiness of Large (Multimodal) Language Models, Agentic AI, and Computational Science.

My research focuses on the development of trustworthy and interpretable large language models. Building on this foundation, I am further exploring autonomous, long-horizon LLM-based agentic systems that are capable of perceiving their environment, planning, acting, and learning continuously in a manner similar to human collaborators. I am also interested in AI for mathematics, particularly in identifying the governing equations of dynamical systems from observations.

3.4 Multi-Agent Systems

The Multi-Agent Systems (MAS) Group carries out fundamental research on how to model and design intelligent systems that emerge from the interaction of different agents, human and/or artificial. Our research focuses on:

- Logical and computational models of higher-order social cognition to enhance the development of intelligent interaction between people and computer systems, by supporting their abilities to reason about one another. This has applications to among others systems that help to detect deception and understand the spread of fake news in social networks.
- Formal and computational models of argument and their application in AI and in law. An important aim is to investigate responsible hybrid systems that connect knowledge representation and reasoning techniques with the powers of machine learning.

- Computational models of group decision-making processes, such as voting and deliberation, to support the development of more effective decision-making mechanisms with applications to, among others, Blockchain and eDemocracy.

Chair: Prof. dr. Rineke Verbrugge (l.c.verbrugge@rug.nl)
Keywords: applications of logic in artificial intelligence, multi-agent systems, higher-order social cognition, hybrid intelligence

Dr. Zoé Christoff (z.l.christoff@rug.nl)
My research focuses on collective intelligence: how groups of agents can act smart together. I model collective decision making, opinion formation, social influence, and social network phenomena, using formal tools from logic, artificial intelligence, social network theory, social epistemology, and social choice theory. I am also interested in modal logics, graph theory, social psychology, formal learning theory, philosophy of science, self-reference problems, and limitative results in logic.

Prof. dr. Davide Grossi (d.grossi@rug.nl)
Keywords: collective decision-making, multi-agent systems, governance, game theory, social choice, digital democracy

We apply mathematical and computational methods to the analysis of collective decision-making problems and governance problems, and develop algorithmic solutions for them. We work on problems across a variety of fields: from artificial intelligence (cooperative AI), to blockchain (algorithmic governance), economics (social choice), and democracy (democratic innovations).

Dr. Jakob Schoeffer (j.j.schoeffer@rug.nl)
Keywords: responsible AI, explainable AI, algorithmic fairness, human-AI collaboration, human-centered AI

I study the design and deployment of responsible AI systems for high-stakes decision support, such as in healthcare. For that, I use both empirical and design-oriented research methods common in human-computer interaction.

Prof. dr. Bart Verheij (bart.verheij@rug.nl)
Keywords: responsible AI, explainable AI, AI & law, computational argumentation

Dr. Harmen de Weerd (harmen.de.weerd@rug.nl)
Keywords: multi-agent systems, agent-based modeling, statistics