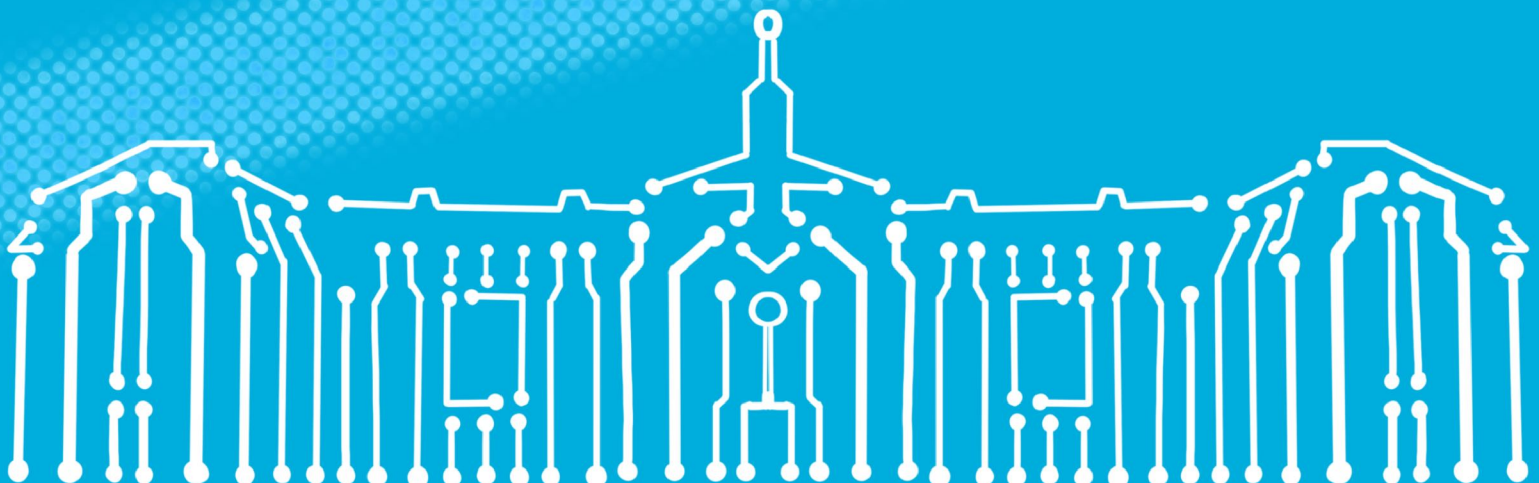
Universität Münster

CDSC

AI Map

Navigating the AI landscape
@ University of Münster



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About this Map

AI and Machine Learning are rapidly expanding in research and teaching at the University of Münster, across all disciplines. This AI Map is intended to help researchers, students and university bodies to maintain an overview of the local AI landscape and to quickly navigate to research groups, institutions, services and contact persons. In particular, the AI Map aims to support researchers at the University of Münster by helping them to pinpoint potential synergies and networks on campus, while at the same time making their own activities visible.

The AI Map is hosted and maintained by the Center for Data Science and Complexity (CDSC). The CDSC emerged from the Center for Nonlinear Science (CeNoS) in mid-2025. As a central scientific institution of our university, the CDSC fosters interdisciplinary networking in research, teaching and transfer in the fields of data science, complex systems, AI and machine learning, scientific computing, mathematical modeling and experimental nonlinear dynamics.

The AI Map is an open system and will be kept up to date: If you would like to be included in the map, or would like to edit or remove your entry, please contact us at cdsc@uni-muenster.de. We will release an updated version of the AI Map on our website at the beginning of each winter term.

We have categorized the contributions by disciplines, recognizing that AI is a cross-disciplinary topic and that individual entries may cut across disciplines. The #keywords assigned to each entry will assist you in browsing the map by methods and applications.

If you have any questions or feedback about the AI Map, please do not hesitate to get in touch with us.

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Computer Science

AI Requires *Fast* & *Portable* Implementation

Computer Science Department

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#aiApplication, #hardwareIndependence, #domainSpecificLanguage.

The success of AI applications depends crucially on the software that implements these applications. Combined with the computing power of modern parallel systems, high-performance software enables AI to become practical, e.g. for speech recognition and image classification.
Our DFG-funded project aims to support the AI domain scientist in developing fast AI applications that are portable over various computer architectures, ranging from large cluster systems to simple mobile devices. In particular, our project develops a formally sound domain-specific language for the AI expert to allow easily expressing the basic building blocks of AI software (such as matrix multiplication and convolutions), independent of hardware and optimization details. These user-defined building blocks are then transformed via our approach, fully automatically, to highly optimized program code, based on concepts from mathematical algebra and numerical optimization. Thereby, our project highly contributes to making AI software practical and available on a wide range of computer devices.

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Multi-Dimensional Homomorphisms (MDH)

Autonomous Intelligent Systems – From Adaptive Behavior to Cognitive Robots

Computer Science Department

Malte Schilling

#autonomousRobots, #decentralizedControl, #deepReinforcementLearning, #intelligentAgent, #adaptiveSystems

Autonomous robots are tasked with producing robust behavior even in unpredictable environments. The Autonomous Intelligent Systems group is leveraging Machine Learning methods to train intelligent agents: First, we take inspiration from biological motor control principles and focus on decentralized control. One example is given in locomotion in animals that can climb on uneven terrain. Adaptive behavior emerges from interaction of simple local control modules. Such a decentralized control structure can be utilized in Deep Reinforcement Learning for faster learning of more robust and general skills.
Secondly, our interest is to extended this towards cognitive systems using predictive neural network models: In cognitive behavior —understood as a form of planning ahead— knowledge on how to execute a behavior can be safely leveraged into novel contexts when using an internal simulation to predict possible outcomes. Our goal is to realize this in adaptive systems that act and interact in the real world.

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Research Group "Autonomous Intelligent Systems"

Computer Vision & Machine Learning Systems (CVMLS) Group

Institute for Geoinformatics

Benjamin Risse (Group Leader), Marlon Becker, Daniel Beckmann, Julian Bigge, Dr. Dominik Drees, Luis Garcia-Rodriguez, Eike Gebauer, Jacqueline Kockwelp, Jonas Konrad, Pascal Kockwelp, Mingkun Tan, Malte Modlich, Constanza Andrea Molina Catricheo, Leon Pielage, Jonathan Radas, Sebastian Thiele

#ai, #algorithmDevelopment, #computerVision, #convolutionalNeuralNetworks, #deepLearning, #imageAnalysis, #imageRecognition, #longShortTermMemoryNetworks, #machineLearning, #medicalImaging, #neuralNetworks, #transformerArchitectures, #biomedicalDeepLearning, #detection, #tracking, #embeddedAi, #opticalNeuralNetworks

We are interested in interdisciplinary research questions involving the development of novel computer vision, machine learning and imaging technologies yielding new approaches to acquire and analyse data. This requires a fundamental investigation of how computers perceive and understand complex real-world situations. By examining the entire process from data acquisition (i.e. sensing hardware) over data interaction (e.g. augmented and virtual reality) to quantitative evaluations (i.e. algorithms) we are seeking for solutions beyond classical image analysis, pattern recognition and artificial intelligence methodologies. Many lessons remain to be learned to tackle the challenges of real-world data which we seek to study and reveal in the coming years to develop novel and sustainable data-driven systems.

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Research Group "Computer Vision and Machine Learning Systems Group"

Machine Learning and Data Engineering (MLDE)

Department of Information Systems

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#ai, #deepLearning, #machineLearning, #neuralNetworks, #convolutionalNeuralNetworks, #transformerArchitectures, #objectDetection, #tinyMachineLearning, #embeddedAi, #remoteSensing, #energySystems, #highPerformanceComputing, #distributedComputing, #parallelComputing, #algorithmDevelopment

The Machine Learning and Data Engineering group focuses on developing efficient and scalable implementations of modern machine learning methods. Our research addresses key challenges such as reducing the computational resources required for the inference phase of large-scale deep learning models or accelerating training through distributed computing. Beyond advancing algorithms, we place a strong emphasis on bridging the gap between theory and practice by designing solutions that can be deployed in real-world, resource-constrained environments. This often involves close collaboration with experts from other domains, including large-scale satellite data analysis or modern energy systems.

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Research Group "Machine Learning and Data Engineering (MLDE)"

Pattern Recognition and Image Analysis: Advanced Algorithm Development and Applications

Department of Computer Science

Prof. Dr. Xiaoyi Jiang (Group Leader)

#computerVision, #patternRecognition, #machineLearning, #deepLearning, #medicalImaging, #bioinformatics, #cheminformatics, #classification, #regression, #clustering, #anomalyDetection, #explainableAI, #generativeAi

The Pattern Recognition and Image Analysis (PRIA) research group within the Department of Computer Science conducts foundational research and develops advanced algorithms in pattern recognition, image analysis, and machine learning. Our algorithms extract information from data, supporting a range of tasks from quantification to high-level semantic understanding, such as clustering, classification, and prediction. Public software tools emerging from our research facilitate the community's adoption and application of these methods. We have established long-term collaborations with researchers in various disciplines to address complex scientific questions. A primary research focus is on biomedical image and pattern analysis, encompassing image processing, multimodal and temporal image registration, image segmentation, shape analysis, motion analysis, and multiscale analysis. We are also investigating the potential of large language models in healthcare. Additional collaborative efforts span fields including chemistry, computer-assisted surgery, and economics.

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Pattern Recognition and Image Analysis (PRIA)

Research Activities of the Research Group Data Science

Computer Science Department

Tanya Braun, Sagad Hamid, Nazli Nur Karabulut

#intelligentAgent, #efficientReasoning, #compactModelEncoding

Developing intelligent agents, i.e., agents that act rationally in their environment, is at the core of many AI applications. Key for such an agent is an internal model that enables making decisions regarding the best possible outcome w.r.t. a specific task. Due to an agent's limited resources, the model must encode large amounts of heterogeneous data compactly and enable efficient reasoning. At this point, our research comes in, investigating and combining a wide range of research areas to facilitate developing efficient models and algorithms for different application scenarios and contexts. In particular, we focus on reducing a model's complexity by leveraging symmetries and regularities in its structure and parameters, allowing us to introduce compact encodings for more efficient reasoning. We apply our methods to a variety of models, ranging from tensor networks for probabilistic inference to partially observable stochastic games for multi-agent decision making.

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Research Group of Jun.-Prof. Dr. Tanya Braun

Safe Learning in Hybrid Systems Using Contracts

Computer Science Department

Julius Laurin Adelt, Pauline Anne Blohm, Paula Herber, Mathis Niehage, Anne Remke

#safetyCriticalSystems, #formalLanguages, #deductiveVerification, #stochasticEvaluation

In the joint research activities of the Embedded Systems and Safety-critical Systems groups at the Computer Science Department, we investigate new methods for the safe use of learning in safety-critical systems, such as autonomous vehicles or critical infrastructures. One of our key concepts is to provide transformations from industrially used design languages into formal languages. We combine these transformations with novel deductive verification and stochastic evaluation techniques to verify the correctness of systems that include learning components. Our main contributions with respect to the verification and analysis techniques are twofold: First, we integrate reusable contracts that define safe behavior of learning components in deductive verification techniques. Second, we investigate novel quantitative analysis and optimization techniques using (statistical) model checking and learning. Besides classical safety properties, we also consider quantitative properties such as performance and resilience, i.e. the ability of a system to dynamically adapt to stressors or external disruptions.

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Research Group "Embedded Systems"
Research Group "Safety-critical Systems"

Visual AI

Computer Science Department

Lars Linsen

#VisualAI

Visual Artificial Intelligence (Visual AI) is a user-centric approach to data analysis. The user-centric approach allows the data analyst to bring his/her expertise and domain knowledge into the analysis process. Visual AI combines automatic and interactive analysis steps. Methods from machine learning including deep-learning approaches are developed and employed to automatically extract information from data sets. This information is presented to the user in the form of visual representations, as visual representations are intuitive for humans and efficient to process. The user can interact with the visual representations to explore the outcome of the information extraction step, refine or adapt the analysis, and trigger the next analysis step. Overall, this leads to an interactive analysis process, where individual computational steps are comprehensible and interpretable for the users.

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Visualization & Graphics (VISIX)

Mathematics

BlockXT

Institute of Applied Mathematics

Alexnder Schell, Christian Engwer

#appliedMathematics, #numericalMethodsForPDEs, #machineLearningHardware, #algorithmDevelopment, #softwareImplementation, #hardwareAwareNumerics

In this DFG funded project we aim at bridging gaps between traditional simulation methods and machine learning. A central part of the success of machine learning methods was and is the possibility to employ instruction level parallelism of dedicated machine learning hardware. This enabled the implementation of methods that were simply to costly before.
Numerical methods for solving partial differential equations (PDE) are of central importance in many fields of application and a promissing path is to incorporate learned components, e.g. material functions, into deterministic simulations. When trying to combine classical numerical methods, like simulations of PDEs, with machine learning a significant challenge is that these numerical methods are not designed to perform well on the new hardware platforms.
In this project we design new numerical methods that improve the efficiently of simulations of instationary PDEs on modern hardware new dedicated numerical methods are necessary. The numerical approach is based on preliminary work on block-Krylov methods. Combining them with parallel-in-time methods facilitates the transparent use of vector units of modern CPUs and by this allows to utilize a significant portion of the attainable peak performance. This offers a basis for efficient training of models involving partial differential equations. We will contribute to an improved hardware efficiency by development of new numerical methods, analysis of their performance, a hardware-efficient implementation and its validation.

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Research Group "Applications of Partial Differential Equations"

DUNE

Institute of Applied Mathematics

Christian Engwer, Alexander Schell, Gunner Birke & the international DUNE team

#algorithmDevelopment, #numericalMethodsForPDEs, #mathematicalFoundation, #dataAnalysis, #softwareImplementation, #scientificSoftware

Solving partial differential equations (PDEs) is an important building block in many data analysis questions. The Distributed and Unified Numerics Environment (DUNE) is joint effort by to develop a modular toolbox that offers infrastructure to implement a wide range of numerical methods. The main focus are grid-based methods for solving PDEs, inparticular using finite element and finite volume methods. DUNE is written in C++, but has interfaces to Python as well.
DUNE offers components to implement a wide range of discretizations, but also supports developing and implementing problem specific parallel solvers for linear and non-linear problems.
The underlying idea of DUNE is to create slim interfaces allowing an efficient use of legacy and/or new libraries. Modern C++ programming techniques enable very different implementations of the same concept using a common interface at a very low overhead. Thus DUNE ensures efficiency in scientific computations and supports high-performance computing applications.

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Dune Project

Mathematical Methods in Machine Learning

Institute of Applied Mathematics

Frederick Jan Altrock, Christian Engwer

#machineLearning, #interpretability, #numericalMathematics, #statistics

State of the art machine learning approaches are mostly driven by heuristic and emperical observations. At the same time mathematical, rigorous statements are most often so limited that they are not applicable to real world problems. We present different approaches to adopt well understood concepts from statistics and numerical mathematics, which can help to improve interpretability and performance of the machine learning methods.

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Research Group "Applications of Partial Differential Equations"

Momentum-SAM: Sharpness Aware Minimization without Computational Overhead

[1] Institute of Applied Mathematics, [2] Institute for Geoinformatics

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#sharpnessAwareMinimization, #deepNeuralNetwork

The recently proposed optimization algorithm for deep neural networks Sharpness Aware Minimization (SAM) suggests perturbing parameters before gradient calculation by a gradient ascent step to guide the optimization into parameter space regions of flat loss. While significant generalization improvements and thus reduction of overfitting could be demonstrated, the computational costs are doubled due to the additionally needed gradient calculation, making SAM unfeasible in case of limited computationally capacities. Motivated by Nesterov Accelerated Gradient (NAG) we propose Momentum-SAM (MSAM), which perturbs parameters in the direction of the accumulated momentum vector to achieve low sharpness without significant computational overhead or memory demands over SGD or Adam. We evaluate MSAM in detail and reveal insights on separable mechanisms of NAG, SAM and MSAM regarding training optimization and generalization.

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Research Group "Computer Vision and Machine Learning Systems"

SAM Meets Gaze: Passive Eye Tracking for Prompt-based Instance Segmentation

Institute for Geoinformatics

Daniel Beckmann, Jacqueline Kockwelp, Benjamin Risse

#eyeTracking, #promptBasedMethods, #segmentAnythingModel

The annotation of large new datasets for machine learning is a very time-consuming and expensive process. Prompt-based methods have been developed to accelerate this label generation process by allowing the model to incorporate additional clues from other sources such as humans. In this project, we explore the usage of a passive eye tracking system to collect gaze data during unconstrained image inspections which we integrate as a novel prompt input for the Segment Anything Model (SAM). We evaluated our method on the original SAM model and finetuned the prompt encoder and mask decoder for different gaze-based inputs, namely fixation points, blurred gaze maps and multiple heatmap variants. Our results indicate that the acquisition of gaze data is faster than other prompt-based approaches while the segmentation performance stays comparable to the state-of-the-art performance of SAM.

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Code Repository
Research Group "Computer Vision and Machine Learning Systems"

Workgroup for Numerical Analysis & Scientific Computing (Prof. Dr. Mario Ohlberger)

Institute for Analysis and Numerics

Prof. Dr. Mario Ohlberger (Group Leader), Dr. Stephan Rave (akad. Rat), Hendrik Kleikamp (PhD Student), Benedikt Klein (PhD Student)

#appliedMathematics, #numericalMethodsForPDEs, #pdeConstrainedOptimization, #inverseProblems, #surrogateModeling, #dimensionalityReduction, #machineLearning, #deepNeuralNetworks, #autoencoders, #kernelMethods, #algorithmDevelopment, #mathematicalFoundation, #softwareImplementation

Many physical, chemical, biomedical, or technical processes can be described by means of parameterized partial differential equations (PDEs) or dynamical systems. A numerical treatment of such problems is usually very computationally demanding and thus requires the development of efficient approximation schemes that are often realized on large parallel computing environments. In the workgroup "Numerical Analysis & Scientific Computing" we are concerned with the development and analysis of novel multi-fidelity learning frameworks to speed up such numerical approaches. In this context, for instance deep neural networks or kernel interpolation methods have been applied successfully in a certified manner with rigorous a posteriori error bounds. Applications of the methods include parameterized time dependent PDEs, large scale parameter optimization problems as well as linear-quadratic optimal control problems and inverse parameter identification problems.

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Research Group "Numerical Analysis & Scientific Computing"

Physics

Intelligent Matter Based on Refractive Microswimmers

Institute of Theoretical Physics

Julian Jeggle, Raphael Wittkowski

#activeMicroparticles, #lightRefraction, #nonequilibriumSystems, #photonicComputing, #physicalReservoirComputing

We present systems of active microparticles driven by the momentum transfer associated with light refraction as a platform for constructing responsive, adaptive and eventually intelligent materials. As equilibrium systems are not capable of exhibiting intelligent behavior, the inherently nonequilibrium nature of active matter and the well-known complexity of its collective behavior make it an ideal candidate for physical implementations of this kind of material. By using a system controlled with structured light, we can achieve a very high degree of control over the particle dynamics. We expect that our approach will further the field of photonic computing and will lead to the development of artificial intelligence systems, e.g., in the form of physical reservoir computing.

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SFB 1459 - Intelligent Matter - Project B01

Machine Learning for Complex Dynamical Systems

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#complexSystems, #dynamicalSystems, #dimensionalityReduction,#systemIdentification, #selfOrganization

Modern science is facing the growing challenge of understanding and predicting the behavior of complex systems. These systems encompass a wide range of phenomena, from the collective behaviour of power grids and the intricate dynamics of the brain to the patterns formed by interacting particles. Machine learning is playing an increasingly vital role in the physical description of complex dynamic systems. By analyzing extensive data sets generated from experiments and computer simulations, we aim to identify mathematical models, predict critical shifts in behavior, and uncover the interactions between different parts of these systems. Various methods are being developed and employed to infer evolution equations from data, forecast critical transitions, and explore causal relationships within these complex systems. Applications of these approaches cover diverse areas, including fluid mechanics, brain dynamics, financial markets and power grids.

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Center for Data Science and Complexity

Machine-learning Off-shell Effects in Top Quark Production at the LHC

Institute of Theoretical Physics

Tomáš Ježo (PhD Supervisor), Michael Klasen (PhD Supervisor), Mathias Kuschick (PhD Student)

#ai, #algorithmDevelopment, #bayesianAlgorithms, #bayesianNeuralNetworks, #classification, #deepLearning, #diffusionModels, #generativeAi, #machineLearning, #neuralNetworks, #particlePhysics, #reweighting

The properties of the top quark are of great importance for understanding many aspects of the universe. It is therefore imperative that the fundamental properties of the top quark are determined precisely. For this purpose, there are already methods that allow an accurate calculation. The most sophisticated of these calculations include enhancements such as radiative corrections or off-shell effects, which makes their evaluation extremely computationally expensive. Modern machine learning techniques such as neural networks could help to make these critical calculations more efficient and ultimately feasible on a large scale. The aim of the research project is therefore to explore the application of these techniques to greatly reduce the computational costs of these calculations.

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Research Group of Prof. Dr. Michael Klasen

Materials Research for More Efficient AI Hardware

Institute of Materials Physics

Prof. Dr. Martin Salinga (Group Leader), Nils Holle (Postdoc), Niklas Vollmar (PhD Student), Sebastian Walfort (PhD Student)

#materialsResearch, #hardwareDesign, #inMemoryComputing, #photonicComputing, #phaseChange-Materials, #atomisticSimulations, #machineLearning, #neuralNetworks, #intelligentMatter

Today, artificial intelligence has become a powerful tool across almost all areas of industry and everyday life. As a result, there is a growing need for computer chips that can tame the huge amounts of energy consumed by neural networks. One possible solution is computing-in-memory using memory elements based on phase change materials (PCMs). In addition, processing with light enables much higher data modulation rates than in any electronic computer chip. We design and fabricate mixed electro-optical in-memory-computing devices using photonic memory cells based on PCMs. This offers the fast processing speed of photonics, while allowing us to electrically adjust weights in small steps by switching individual PCM segments. To study fundamental properties of PCMs in the amorphous phase, we use machine learning to generate interatomic potentials. So, we employ artificial intelligence for materials research aiming at better hardware for artificial intelligence.

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Research Group of Prof. Dr. Martin Salinga

Theoretical Particle Physics

Institute for Theoretical Physics

Prof. Dr. Michael Klasen, Dr. Tomas Jezo, Mathias Kuschick

#ai, #bayesianAlgorithms, #bigData, #classification, #ethics, #explainableAi, #generativeAi, #interpretability, #machineLearning, #neuralNetworks, #particlePhysics, #philosophyOfScience, #sustainability, #teaching.

Transformation of high-dimensional distributions based on diffusion neural networks.
Application: Top quark production at CERN's LHC.

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Research Group of Prof. Dr. Michael Klasen

Chemistry and Pharmacy

Glorius Group - Uncovering Reactivities and Functionalities Through Data-driven Organic Chemistry

Organisch-Chemisches Institut

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#organicChemistry, #cheminformatics, #highThroughputExperimentation, #featurization, #transformer, #gradientBoosting, #dimensionalityReduction

Our research group integrates machine learning (ML) with organic chemistry to drive catalysis and the synthesis of functional molecules. This interdisciplinary approach impacts various scientific and societal domains. Our key focus areas include:

1. **Uncovering complex molecular correlations:** We employ supervised and unsupervised ML algorithms to analyze large datasets, revealing intricate structure-reactivity relationships.

2. **Guided experimental design:** ML models inform our high-throughput experimentation, optimizing data collection for reaction discovery through virtual screening.

3. **Molecular featurization:** We develop genetic and structure-based approaches to create problem-specific, interpretable representations of molecules.

4. **Predictive modeling:** Our ML models quantitatively predict reactivity and molecular properties, accelerating the design process.

By combining ML techniques with chemical expertise, we aim to accelerate discovery in catalysis and molecular design, contributing to advancements in materials science, drug discovery, and sustainable chemistry.

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Research Group of Prof. Dr. Frank Glorius

Group for Theory of Complex Systems: Understanding Machine Learning Interatomic Potentials and Structure-Property Relationships of Molecular Structures Using Machine Learning

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#complexMolecularSystems, #dynamicalSystems, #molecularDynamics, #mlip, #interatomicPotentials, #structurePropertyRelationships, #liquidElectrolyteCompositionAnalysis, #intelligentMatter, #interpretability, #ionicConductivity, #ionicLiquids, #neuralNetworks, #linearRegression, #dimensionalityReduction, #optimization, #activeLearning

During the past years Machine Learning interatomic potentials have become popular, which enable Molecular Dynamics simulations with the accuracy of Quantum Chemistry calculations. Although it is a rapidly evolving field, many questions remain open. Using the Atomic Cluster Expansion and a Lennard-Jones model system, we aim to study effects of system size, temperature and interaction type. Moreover, we aim to fit an interatomic potential for silica-based systems, including lithium ions, to study structure and dynamics in a more realistic system and compare it to the classical Buckingham potential. Especially, the investigation of low energy structures, which appear in glass forming systems is of interest.
Furthermore, we developed the python-based Liquid Electrolyte Composition Analysis package, which can be used to optimize the ionic conductivity as an important bulk property in (organic) electrolytes. We highlight the importance of physics-informed modelling and how Active Learning can improve the effectiveness of planning experiments and reduce the experimental costs. Besides, Machine Learning can be used to investigate structure-dynamics relationships of molecular systems, e.g. for ionic liquids, where dynamic properties like the ionic conductivity or Mean Squared Displacement of molecules can be inferred from static properties like radial distribution functions. Also, neuromorphic computing is investigated, bringing the implementation of Machine Learning models to the hardware level. By modeling a gold-nanoparticle network, important insights may be gained for the formation of logic gates. Furthermore, time-dependencies are investigated in these hardware-level networks, which may be compared to recurrent Neural Networks.

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Research Group of Prof. Dr. Andreas Heuer

KochLab – From Self-organizing Maps to Explainable AI: Molecular Machine Learning

Institute of Pharmaceutical and Medicinal Chemistry

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#ai, #cheminformatics, #clustering, #drugDiscovery, #explainableAi, #dimensionalityReduction, #generativeAi, #deepLearning, #lifeSciences, #machineLearning, #selfOrganizingMaps, #neuralNetworks, #softwareImplementation, #scientificComputing, #reinforcementLearning, #geneticAlgorithms

Drug discovery deals with the discovery and development of new bioactive molecules and therapeutic agents that modulate protein function. The use of AI based methods algorithms, has been part of the computer-based toolbox supporting the drug development for decades, including prediction or physico-chemical properties and biological activity, and the exploration of feasible chemical compounds, called the chemical space.
Our group strives to innovate in all aspects of early-stage drug development pipeline. In these, virtual screening (VS) campaigns, play an important role. To improve screening efficiency, we developed new, learned compound representations that are specifically tailored to discovery tasks using neural networks. Furthermore, we develop new screening tools that scale to modern compute infrastructure, based on self-organizing maps for dimensionality reduction, clustering of large compound data sets and visualization of chemical space.
Moving from early virtual screening campaigns towards lead optimization, we developed PADIF, a ML based target specific scoring function. Unlike traditional models that emphasize ligand structures, PADIF evaluates protein-ligand interactions post-docking, enabling the exploration of new chemical spaces by incorporating both structural and ligand features for drug discovery. Furthermore, we are developing a genetic algorithm base approach. Herein bound ligands are mutated under the constraints of the binding pocket and evaluated via docking, to expend the known space of active, and more potent compounds.
While deep learning method provide promising approaches to increase screening efficiency in drug discovery projects, expert knowledge is still invaluable in the selection of promising drug candidates. To allow these experts to make better informed decisions, we developed Myerson value-based feature importance scores. These highlight features of the molecular graph, that are attributed with the strongest influence on the prediction. This partly removes the black box nature of the predictor, increasing trust the in the model and allowing for further interrogation of areas of interest.

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Research Group of Prof. Dr. Oliver Koch

Quantum Chemistry: Machine-Learning for Molecular Electronic-Structure Theory

Organic Chemistry Institute

Johannes Neugebauer (Group Leader), Andreas Riedmiller (PhD Student), Sakyo Ochi (PhD Student)

#quantumChemistry, #densityFunctionalTheory, #qmQmEmbedding, #molecularProperties, #electronicStructureTheory

Smart quantum chemical methods for selective and efficient calculations on chemical processes in complex environments such as solvents, proteins, molecular crystals, or surfaces are developedand applied. Focus is placed on subsystem-based Density-Functional Theory and density-based(QM/QM) embedding for ground and excited electronic states, with efforts concentrated on the development of these methods for molecular properties, spectra, and reactivity. In this context, the use of machine-learning techniques for molecular electronic-structure theory is explored, in particular regarding the development of new density-functional approximations.

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Research Group of Prof. Dr. Johannes Neugebauer

Medicine

Advancing Machine Learning in Medicine through Infrastructure and Regulatory Compliance

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#personalizedMedicine, #machineLearning, #photonAi, #euAiAct

Recently, the pursuit of personalized medicine has led to a substantial interest in machine learning techniques. However, despite numerous publications, translation to clinical practice is lacking and recent work identified high risk of bias in the majority of analyzed publications. We developed PHOTONAI as a software that simplifies model development and automates the repetitive training, hyperparameter optimization and evaluation tasks. Importantly, it ensures unbiased performance estimates while allowing full customization. Moreover, researchers can integrate heterogeneous data modalities such as neuroimaging-, psychometric-, graph-, time-series, and clinical data. We complement PHOTONAI with Graphical User Interfaces, e.g. to visualize performance, as well as an online model evaluation platform. Furthermore, we are developing practical guidelines to address the regulatory requirements governing AI-based algorithms in the medical domain. The overarching objective is to formulate a comprehensive checklist that translates legal prerequisites, such as the European legal act and international standards, into practical solutions.

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Institute for Translational Psychiatry

Artificial Intelligence in Ophthalmology

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#ai, #classification, #computer-assisted, #deepLearning, #healthcare, #imageAnalysis #largeLanguageModels, #machineLearning, #medicalDiagnosis #medicalImaging, #patternRecognition, #self-supervisedLearning #foundationModels

After radiology, ophthalmology is the field that generates the most **image data**. Consequently, there is a large amount of data that offers many opportunities for automated image data analysis. Research in Münster mainly focuses on the analysis of **optical coherence tomography (OCT)** data in patients with **neovascular age-related macular degeneration (AMD)**. In collaboration with the Institute for Medical Informatics and the Department of Computer Science at the University of Applied Sciences in Darmstadt, Germany, we have developed deep learning algorithms that can accurately distinguish between active and inactive neovascular AMD, automatically detect various changes typical of AMD in OCT images, or **glaucomatous optic nerve changes in glaucoma patients** (Diener et al., 2024; Yildirim et al., 2023). In this case, the algorithm performed as well as a glaucoma specialist when additional metadata were included. Further projects to establish methods for image annotation are in preparation.
In our large BMFTR funded project **EyeMatics - Eye Diseases "Treated" with Interoperable Medical Informatics** we aim to combine ophthalmic records from isolated data sources into a harmonised dataset that can be used for new, customised clinical solutions for AMD patients. Statistical approaches will be combined with advanced machine learning techniques to identify new biomarkers for precision medicine. A clinical dashboard will demonstrate real-time data and new biomarkers across sites will be demonstrated.

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Klinik für Augenheilkunde - Artificial Intelligence
Eyematics Project

Cinnamon: An Accessible Data Protection and AI-Based Synthetization Solution

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#medicalInformatics, #softwareImplementation, #generativeAi, #anonymization, #dataPrivacy, #dataSharing.

The demand for data protection software is high, as the GDPR requires strong data protection, while the GDNG, on the other hand, offers opportunities to use data for research if security requirements are met. As part of the KI-AIM project funded by the BMFTR, we are developing Cinnamon, an open-source software designed to enable researchers to protect their data in accordance with legal requirements. Within this project, we investigate three main research questions:

1. Can conventional anonymization methods be combined with modern AI-based synthetization methods to optimize the privacy and usability trade-off for a dataset?

2. Is it possible to optimize the configuration process so that both non-experts and experts can use the software without losing any protective functions?

3. Is it possible to evaluate the results in terms of their residual risk and AI capabilities and make the results understandable, while at the same time taking into account all relevant information for experts such as data protection officers?

To answer these research questions, we will implement a streamlined and guided workflow that enables users to configure data protection in a structured manner. At the same time, we ensure the platform's adaptability and relevance for different research contexts by using a modular architecture that allows experts to develop custom algorithms and integrate them into the platform. Finally, the results will be evaluated, processed and visualized for the users, to be able to access the most important information directly. These results will be summarized and exportable in a report.
Initially, the platform will support both cross-sectional tabular datasets and FHIR-Bundle resources. Privacy and AI usability will be assessed with the platform through evaluations in real-world scenarios at the UKM skin-cancer facility. These use cases will facilitate the assessment of not only general usability, but also context-specific usability in clinical environments.
The platform has been published and its current development can be followed on GitHub.

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Git Hub: KI-AIM Cinnamon

Cinnamon Documentation
Project "AI-based anonymisation in the medical sector" (KI-AIM)
Institute of Medical Informatics
German Research Center for Artificial Intelligence
Medical Informatics Group at Berlin Institute of Health at Charité
Department of Dermatology at University Clinic Muenster

Classification of Urine Components using Supervised Machine Learning Based on Physical Particle Data Retrieved by Digital Holographic Microscopy

Biomedical Technology Center

Marlene Kallass, Bjoern Kemper, Alvaro Barroso Pena, Jürgen Schnekenburger

#quantitativePhaseImaging, #digitalHolographicMicroscopy, #machineLearning, #urineSedimentClassification, #automatedUrineAnalysis

We used the label free optical tool quantitative phase imaging (QPI) with automated digital holographic microscopy (DHM) in combination with machine learning (ML) approaches for the characterization and classification of urine sediments. Bright-field images and off-axis holograms of a liquid control for urine analysis and from human samples were acquired with a modular DHM system. From the retrieved images, particle morphology parameters were extracted by segmentation procedures. In addition, the ability of supervised ML-algorithms to classify and identify urine sediment components based on biophysical parameters was evaluated. The components of the urine standard were identified with more than 90 % specificity. The cell and particle distribution in human samples could be determined to more than 98 % of the manually annotated ground truth. The results demonstrate DHM in combination with ML as a highly promising tool for automated urine analysis.

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Biomedical Technology Center

Comparison of Feature Extraction Methods for Spike Detection with Artificial Neural Networks: A Focal Epilepsy Case Study

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#artificialNeuralNetworks, #sensitivity, #specificity, #featureExtraction, #spikeClassification, #katzFractalDimension

- Well-trained ANN can even outperform the sensitivity and specificity of expert markers
- ANN classification improved by feature extraction methods.
- Katz FD best represented the spikes for both ANDmarking and ORmarking data.
- Limitations: Only one person's data was classified. Its general use is restricted

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Institute for Biomagnetism and Biosignal Analysis

DUNEuro

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Malte Höltershinken[1], Carsten Wolters[1], Christian Engwer[2] & previous co-authors

#medicalDiagnosis, #numericalMethodsForPDEs, #dataAnalysis, #softwareImplementation

Building on top of the DUNE C++ framework, DUNEuro is a library that supports patient-specific data-analysis of MEG and EEG measurements using state-of-the-art numerical methods. An efficient implementation in C++ solves the respective forward problems in 3D and slim python and matlab interfaces allow the usage in a wide range of data-analysis, optimization and machine-learning toolkits.

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DUNEuro

Employing ML and AI to Identify Biomarkers Within the Human Microbiome

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#humanMicrobiome, #aiMethodologies, #latentRepresentation, #diseaseRiskForecasting, #personalizedMedicine

Our research is dedicated to harnessing the potential of the human microbiome, aiming to gain insights into the microbiome's role in health and disease. By analyzing the diverse microbiomes of the human body, our objective is to extract clinical information that can be utilized for diagnostic, prognostic, or therapeutic approaches. Central to our efforts are advanced AI methodologies to extract latent representation of the complex high-dimensional microbiome data, including Latent Dirichlet Allocation and potentially deep representation strategies like various types of autoencoders. These diverse approaches enable us to identify and interpret complex microbial patterns associated with specific diseases and their trajectories. Our focus is particularly on developing models that offer precise forecasts about disease risks, treatment outcomes, and long-term dynamics. Through these AI-driven analyses, we are making a significant contribution to personalized medicine by exploring and validating new diagnostic and prognostic approaches based on the various human microbiota.

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Enhancement Therapy: AI-Driven Audiobook-Based Treatment of Developmental Language Disorders

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#clinicalLinguistics, #developmentalLanguageDisorders, #largeLanguageModels, #phonology, #supportVectorMachines

One in five German children suffers from a Developmental Language Disorder. Those affected by the most frequent subtype of Phonological Disorder (PA) are unable to pronounce, hear and distinguish speech sounds. Without treatment, PA triggers serious educational, occupational, personal, and social limitations. PA is also associated with reading and spelling disorders.
Our project team aims to improve PA treatment through a novel, family-centered, AI-driven intervention. AI is used to tailor custom-written children's books to the individual PA of each individual patient. Moreover, a novel signal-processing AI is being developed that amplifies the deficient speech sounds. The texts are converted into audiobooks using lifelike speech synthesis; children and their parents listen to the books and perform minor language exercises to strengthen the therapeutic effects.
The therapeutic effects are established through a series of third-party-funded clinical trials. If successful, our novel intervention will become a part of PA standard therapy in the mid-term.

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Overview of clinical studies

Institute of Medical Education and Student Affairs (IfAS) – Revolutionizing Medical Education through AI and VR

[1] Institute of Medical Education and Student Affairs (IfAS), [2] Department of Psychology, [3] Computer Vision and Machine Learning Systems (CVMLS)

Prof. Bernhard Marschall[1] (Group Leader), Dr. Anna Junga[1] (Head of Digital Learning Methods), Ole Hätscher[1,2] (Research Associate), Henriette Schulze[1] (Research Associate), Niklas Tiefenbach[1] (Technical Associate), Prof. Benjamin Risse[3] (Group Leader), Pascal Kockwelp[3] (Research Associate), Leon Pielage[3] (Research Associate)

#medicalEducation, #virtualReality, #virtualAgents, #skinPathologies, #diffusionModels, #medicalTraining, #chatbots, #largeLanguageModels, #doctorPatientInteraction

Our research group, IfAS, is dedicated to transforming medical education by advancing the application of artificial intelligence (AI) in virtual reality (VR) environments. We leverage AI for generating immersive environments, simulating medical pathologies, and creating virtual agents within educational scenarios. From a technical standpoint, we employ state-of-the-art AI models in image generation, speech synthesis, and content creation to enhance the learning experience. Currently, we are pursuing this transformative approach through multiple research projects:

1. **Medical tr.AI.ning:** In this third-party funded collaborative project, we developed an immersive and customizable VR scenario—a full-body dermatological examination. Within this setting, we generated fully AI-based nevi and melanomas using diffusion models, providing a data-protective way of generating skin pathologies for medical training.

2. **AI-Based Verbal Interaction in VR:** Building on the work of medical tr.AI.ning, we aim to make verbal interaction in VR fully AI-driven. This involves integrating advanced AI models for speech recognition (e.g., Microsoft Azure), speech synthesis (e.g., ElevenLabs), and content generation (e.g., GPT-4) to create a virtual agent capable of free-form verbal interaction with users. This development enhances the realism and interactivity of personal interactions in medical simulations.

3. **Revolutionizing Medical Exams with LLMs:** We are exploring the use of large language models (LLMs) to revolutionize examinations in medical education. This includes automated generation and correction of open-ended questions in medical exams, increasing efficiency and objectivity in assessment processes.

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Computer Immersive TRaining Using Simulations (CITRUS)

Institute of Medical Informatics

Institute of Medical Informatics

Dominik Heider

#medicalDataScience, #omics, #bioinformatics, #medicalMachineLearning, #federatedLearning, #medicalDiagnosis, #causality

The Institute of Medical Informatics develops methods for medical data science and medical data integration, thereby addressing crucial aspects of medical data, e.g., data heterogeneity, data imbalance, as well as data protection. We investigate and develop machine learning models able to handle multi-modal and sensitive data and providing insights into biological mechanisms, diagnostics, and prognostics, such as federated and swarm learning approaches, data augmentation, and causality. Medical data comes in many colors, thus, we develop methods for handling omics (e.g., genomics, transcriptomics, microbiomics), tabular data such as health records, and imaging.

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Institute of Medical Informatics

Medical Machine Learning Lab

Institute for Translational Psychiatry

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#medicalMachineLearning, #neuroimaging, #clinicalPsychology, #bayesianAlgorithms, #medicalImageSegmentation

Research at the Medical Machine Learning Lab, spans diverse domains encompassing medicine, psychology, computer science, physics, and mathematics, with a specific emphasis on software engineering and advanced machine learning techniques. Within our interdisciplinary team, we actively pursue methodological solutions to improve healthcare and advance medical research. Our research initiatives span diverse domains, addressing issues in clinical psychology and neuroimaging, while also encompassing the development of machine learning software, medical image segmentation, and the efficient, robust pre-processing of neuroimaging MRI data. Methodologically, our approach involves the application of both shallow and deep machine learning methods, Bayesian analysis, control theory, and normative modeling approaches.

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Institute for Translational Psychiatry

Patient Centred Medicine in the Digital Age

Institute for Ethics, History and Theory of Medicine

Susanne Hiekel, Bettina Schöne-Seifert, Marco Stier

#digitalizedMedicine, #Healthcare, #patientAutonomy, #ethicalImplications, #patientDoctorMachineRelationship

In the near future, medical research and care will be transformed by digital technologies, with AI technologies playing a major role. This development, with big data-driven advances in medical treatment, increasingly digitised communication and patient monitoring and control, presents both opportunities and risks. From an ethical perspective, it is particularly important to examine these developments in terms of their impact on the individual patient. The individual patient must be at the centre of any future normative reflection regarding the design requirements of digitalised medicine. The project explores this context through five core topoi of medical ethical/theoretical debates. These are (1) patient autonomy, (2) privacy and individuality, (3) the patient's self-relationship and understanding of illness, (4) the patient-doctor-machine relationship, and (5) patient trust.

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Project "Ethical and medical-theoretical challenges for the individualised patient benefit of digital medicine"

Personalization TrAIning in Medicine (PerTRAIN) – Integrating State-of-the-Art Personalized Knowledge and Technologies into Medical Education

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#personalityPsychology, #doctorPatientInteraction, #largeLanguageModels, #agentBasedModeling, #medicalEducationSimulation

The interdisciplinary *PerTRAIN* project focuses on modeling the expression of personality in social interactions and translating these insights into practical applications in medical education. Individuals differ in how they perceive, act toward, and reflect on others, which strongly shapes social exchanges. In healthcare, such differences manifest in doctor–patient interactions: some patients vividly describe their symptoms, others minimize them; some are open and trusting, while others are anxious or reserved; some request changes in treatment directly, while others do so subtly. To fully understand a patient's needs, medical professionals must recognize and adapt to these individual differences. To address this challenge, we combine advances in personality psychology with recent developments in artificial intelligence, in particular large language models (LLMs) embedded in agent-based modeling frameworks. Our approach systematically varies interaction scenarios across key aspects of social behavior, using an integrative modeling pipeline that continuously tracks and adapts an agent's personality state. This enables both formal, testable models of personality processes and scalable simulations within interaction systems of varying complexity. We translate these advances into realistic training environments for medical professionals. Virtual patients with diverse personality profiles are embedded in scenarios ranging from text-based chats to immersive AR/VR simulations. Clinicians practice recognizing personality cues, adapting their communication in real time, and receiving targeted feedback—preparing them to connect with patients on a truly individual level.

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Personalized Medical TrAIning (PerTRAIN)

Predicting Antimicrobial Resistance with Machine Learning Algorithms

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#Microbiology, #antimicrobialResistance, #pathogen, #environment, #host, #randomForests, #extremeGradientBoosting, #supportVectorMachines, #regularizedLinearRegressions, #neuralNetworks,

The emergence and spread of antimicrobial resistance is a global concern as it is causing an increasing number of deaths. Therefore, the use of antimicrobials must be improved. Currently, the rational use of antimicrobials is limited by slow diagnostic methods. Rapid antimicrobial susceptibility testing methods are therefore needed.
The risk of infection with antimicrobial-resistant pathogens is not only determined by the pathogen itself, but also by the host/human (e.g. comorbidities) and the environment (e.g. occupational exposure). We therefore want to investigate whether holistic information from pathogen, patient, and environmental data can be used to accurately predict antimicrobial resistance using machine learning (ML) methods. This prediction would be available immediately after species identification, 18–24 h earlier than culture-based methods. Our project also differs from other work in that we aim to predict the exact minimum inhibitory concentration (MIC) rather than just resistance. The MIC is independent of the steadily changing MIC breakpoints at which a pathogen is considered resistant.
We will create a project-specific retrospective database of patients treated for bacterial infection at Münster University Hospital (2021–2023). We will fit and compare different ML models for each combination of species and antimicrobial, including random forests, extreme gradient boosting, support vector machines, regularized linear regressions, and neural networks. The goal is to identify the best ML model and the most important influencing variables and to approximate it by a less complex (sparse) model that can be used in clinical practice. We will validate the generalizability of the predictive ability of the final ML models on a separate dataset from Greifswald, Germany.
In a retrospective patient population, we will test whether predicting antimicrobial resistance using ML algorithms would have improved antimicrobial prescribing. We will compare the ML-based prediction with the prescription of the medical staff.
The project is funded by the German Research Foundation (SCHA 1994/12-1).

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Institute of Medical Microbiology

West German Infection Prevention Network - AI-based Antibiotic Resistance Detection (WIN-KID)

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#microbiology, #genomics, #personalizedMedicine, #machineLearning, #antibioticResistance

Multidrug-resistant bacteria are a major threat for modern medicine. Typically, antibiotic therapy is based on the minimal inhibitory concentration (MIC), but the phenotypic tests to determine the MIC are rather slow. New advances in whole genome sequencing (WGS) enable quicker results but classical bioinformatics methods are insufficient to inform therapy choices. Within the WIN-KID project, long-read WGS and phenotypic MIC data are combined and machine learning is used to predict the MIC from sequencing data. The training dataset will be generated from routine patient sampling. The analysis will follow a hybrid approach, where traditional bioinformatics and machine learning are combined. The feature set will not only contain single nucleotide polymorphisms (SNPs) but also presence/absence of certain genomic targets including extrachromosomal segments like plasmids.

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Research Group of Univ.-Prof. Dr. med. Alexander Mellmann

Geosciences

AI for Remote Sensing and Spatial Modelling of the Environment

Institute of Landscape Ecology

Maiken Baumberger, Laura Giese, Jan Lehmann, Lilian-Maite Lezama Valdes, Jan Linnenbrink, Marvin Ludwig, Hanna Meyer

#remoteSensing, #spatialModelling, #spatioTemporalData, #landscapeEcology, #machineLearning

The Research Group for 'Remote Sensing and Spatial Modelling' is part of the Institute of Landscape Ecology with strong links to the Institute of Geoinformatics. We study and teach the acquisition and analysis of spatio-temporal environmental data in a broad spectrum of landscape-ecological topics. We combine multi-scale remote sensing data with methods of spatial modelling in order to obtain continuous spatio-temporal information from limited ecological field samples. The complexity of environmental systems requires the use of modelling strategies that take complex relationships into account. For this reason, we focus on the application of machine learning methods. In addition to their application for research questions in the context of landscape ecology, we develop new AI methods for spatial and spatio-temporal data - towards reliable spatial predictions and a knowledge gain in the field of geosciences. Here we introduce our research group and focus on our developments and applications of AI.

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Reaserche Group "Remote Sensing and Spatial Modelling"

Secondary Data: A Treasure for Biodiversity Research

Institute of Landscape Ecology, Centre for Integrative Biodiversity Research and Applied Ecology

Nadja Pernat

#secondaryData, #citizenScience, #biodiversityDynamics, #deepLearning, #ecologicalInteractions

Comprehending patterns and drivers of ecological and biological phenomena across various scales heavily relies on collecting extensive data and utilizing existing datasets. This poster aims to explore secondary data, which is the additional information inadvertently embedded in species observations, particularly in multimedia citizen science records. The significance of secondary data lies in its ability to provide ecologically relevant insights, enhancing our understanding of abiotic and biotic interactions and their impact on biodiversity dynamics. However, to realize the full potential of this emerging discipline, hybrid and artificial intelligence will play a key role, complementing the time-consuming manual extraction performed by humans. For example, the use of deep learning models can aid in extracting secondary data by detecting, counting, and classifying specific features of interest. This presentation explores the potential benefits of secondary data, outline its types, and provide a comprehensive overview of the challenges preventing its widespread adoption.

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Centre for Integrative Biodiversity research and Applied Ecology (CIBRA)

Spatial Intelligence Lab

Institute for Geoinformatics

Angela Schwering

#spatialAi, #cognitiveAi

The Spatial Intelligence Lab is part of the Institute for Geoinformatics at the University of Muenster and deals with research problems from the interdisciplinary field of spatial data science, computer science and cognitive science. Our research brings together topics from a diverse array of subject areas under the unified theme „intelligent representation and processing of geospatial information“. We are particularly interested in understanding the techniques that humans employ to structure spatial knowledge and use this understanding to provide better methods for interacting with GI systems. We investigate how geoinformation technologies can best support human cognition and learning processes such that we can better understand and solve spatio-temporal problems. We follow a use-inspired research approach: Gaining scientific knowledge serves to advance practical solutions which were applied in several successful products and spin-offs.

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Spatial Intelligence Lab

TinyAIoT - Energy- and Resource-Efficient Artificial Intelligence for Modern Internet of Things Applications

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#ai, #internetOfThings, #sensors, #sensorNetworks, #edgeComputing, #resourceEfficiency, #energyEfficiency, #optimization, #tinyAi, #embeddedAi, #sustainability, #agriculture, #smartCity, #natureConservation, #environmentalMonitoring

The rapid growth of the Internet of Things fueled the design of devices that are based on microcontrollers, equipped with sensors, and capable of exchanging data. These devices - used, e.g., in smart home applications or to build environmental monitoring stations - enable the collection and analysis of large amounts of data and the development of potentially powerful applications. However, applications are currently limited by the need to exchange collected data via cloud services to use state-of-the-art AI processes, which consumes significant resources in the form of energy, material, and bandwidth. The aim of the TinyAIoT project is to reduce these resource requirements by developing efficient and tiny AI models that can be used on the microcontrollers themselves. This not only extends the range of possible use cases to more powerful applications, but also reduces the required bandwidth and power requirements of applications. This enables microcontrollers to operate autonomously for several weeks to years.
The use cases and projects we are currently pursuing include:

- Utilizing low-resolution depth images to detect dangerously close overtaking maneuvers between bicycles and other vehicles.
- Developing autonomous devices that remotely monitor crop health in rural settings.
- Innovating novel compression techniques for gradient-boosted decision trees.
- Implementing smart city solutions for real-time monitoring of public trash bin fill levels to enhance waste management.
- Creating privacy-centric and energy-efficient methods for pedestrian counting.

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TinyAIoT

Biology

Using AI for Adaptive Feedback and Intelligent Tutoring in Biology Education

Centre for Biology Education (ZDB)

Simon Blauza, Isa Marie Korfmacher, Sascia Zielonka, Benedikt Heuckmann

#education, #adaptiveFeedback, #intelligentTutoringSystems, #personalizedLearning, #bioethicalDebates, #aiAvatars, #preServiceTeacherEducation, #learningAnalytics, #largeLanguageModels

The Centre for Biology Education (ZDB) at the University of Münster explores the integration of AI in educational settings. Our work is focused on three key areas:

1. AI & Biology Teacher Education: We integrate AI into teacher education by using AI for lesson planning, student research projects, and teaching. This includes generating educational materials, personalized lesson plans, and exploring AI tools such as automated assessments.

2. AI & Bioscience Education: Our project "bAIoethic" incorporates generative AI in bioethical debates, allowing biology students to engage with AI avatars to explore ethical viewpoints. This helps them develop critical judgment skills in societal and bioethical discussions.

3. AI & Science Education Research: We are developing an Intelligent Tutoring System (ITS) for high school science education. This system provides personalized feedback to students using AI, focusing on their proficiency in handling uncertainty through simulations. The system also supports educators by collecting data on student performance.

Through these initiatives, we aim to elevate both teacher and science education by leveraging AI to foster personalized learning and critical thinking.

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Centre of Biology Education

Theology and Religious Studies

AI in Theology — Theology in AI

Catholic-Theological Faculty

Janis Jaspers (Student Contact and Initiator), Dr. Matthias Daufratshofer (Faculty Instructor), Dr. Rainer Gottschalg (Faculty Instructor), Marc Heidkamp (Faculty Instructor), Ludger Hiepel (Faculty Instructor), Dr. Raimund Litz (Faculty Instructor), Dr. Michael Pfister (Faculty Instructor)

#theology, #digitalHumanities, #aiLiteracy, #largeLanguageModels, #naturalLanguageProcessing, #textAnalysis, #ocr, #digitalEdition, #ethics, #studentLed, #interdisciplinaryExchange, #innovation

The seminar “AI in Theology — Theology in AI” (start: 10 April 2025) marked the kickoff for a longer-term project aimed at embedding AI competencies and AI literacy within the humanities. At a time when the humanities are sometimes perceived as in decline, this initiative takes seriously the need for reform within theology: artificial intelligence can serve as an engine of innovation while also prompting critical reflection.
In the participatory format “by students for students,” faculty and students have explored experimental projects together — from prayer robots and AI-assisted reconstruction and transcription of damaged manuscript fragments to AI-gods and pastoral care with AI. Building on this pilot phase, the intention is to develop an institutionally supported program expanded over several semesters that teaches students core AI competencies (AI literacy) and establishes theology as an active field for digital innovation.
Methodologically, the project asks across all theological sections: Where can AI be usefully applied to enrich research, teaching, and practice? And at the same time: Where do theological motifs, conceptual figures, or interpretive patterns appear within the technologies themselves? The goal is to provide hands-on experience with Digital Humanities tools (OCR, NLP/LLMs, named-entity recognition, TEI workflows, RAG setups) and to foster a well-founded reflection on the social, epistemic, and ethical implications of AI in theology.

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KI trifft Theologie: Innovatives Hauptseminar von Studierenden für Studierende
Catholic-Theological Faculty

Faith – Certainty – Truth (Working title)

Institute for Religious Studies

Daria Hartmann (PhD Student)

#bertopic, #dataVisualization, #digitalHumanities, #naturalLanguageProcessing, #religiousStudies, #socialMedia, #textAnalysis

This dissertation project investigates QAnon's practices of truth construction through the lens of esoteric concepts of truth. In an era of digital media transformation and increasingly fragmented public spheres, QAnon emerges as a distinctive phenomenon that constructs and propagates hidden, occult knowledge purportedly accessible only to an initiated elite. The movement's claims to exclusive truth and its integration of esoteric elements make it a compelling case study for understanding contemporary forms of alternative knowledge construction.
The methodological framework combines computational topic modeling with qualitative discourse analysis to examine the complex, cross-platform nature of QAnon discourse. The study employs BERTopic, a state-of-the-art topic modeling technique, to identify thematic patterns and developments within extensive text collections gathered from multiple digital platforms. This quantitative approach reveals discursive connections and traces how narratives evolve and spread over time and across different platforms. The topic modeling serves as a methodological compass, guiding the subsequent qualitative discourse analysis through the identification of significant topic clusters and moments of interest. This strategy enables both targeted and efficient selection of datasets for in-depth analysis, while the visualization of results illuminates the complex interconnections and contextual relationships among themes within QAnon discourse.
Through the application of this mixed-methods approach to content from influential QAnon influencers, the research examines the interplay between esoteric and conspiracy theoretical approaches in the construction and dissemination of alternative truth claims. The dissertation analyzes how religious motifs and narratives are transformed and recoded as they move across different platform environments, each with its own affordances and constraints. This approach offers new insights into how conspiracy theories adapt and spread within digital spaces. The project thus contributes both to our understanding of the QAnon phenomenon specifically and to the advancement of methodological approaches for studying digital discourses and conspiracy theories more broadly.

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Research Centre for Theology of Artificial Intelligence

Prof. Dr. Ahmad Milad Karimi (Director)

#ai, #anthropology, #ethics, #epistemology, #interdisciplinaryExchange, #philosophyOfScience, #spirituality, #society, #theology

Dealing with the constantly advancing field of artificial intelligence (AI) is essential for theology, which currently wants to maintain its existence as an academic discipline. The FSTKI is therefore dedicated to researching and exploring AI in a theological context and, from the resulting theological understanding of AI, strives particularly for the self-understanding, localization and thus also for the re-evaluation of theology for the contemporary context. An analytical, critical and socially relevant as well as sustainable theology of AI, which proceeds in a dialogical and transdisciplinary manner, should illuminate learning processes and dynamic networks of relationships of human reality and reveal their theological significance in social, ethical and religious terms

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Research Centre for Theology of Artificial Intelligence

Law

Anti-Discrimination Law as a Limit to Automated Decision-Making

Chair of Civil Law, Labor Law and Social Law

Friederike Malorny

#antiDiscriminationLaw, #autonomousSystems, #legalProtection

With the help of intradisciplinary legal comparison and on the basis of legal theoretical considerations, the project analyses the extent to which anti-discrimination law restricts or should restrict decisions based on autonomous systems. Labour law, private law and social law serve as reference areas. All selected constellations are based on similar interests: on the one hand there are usually economic considerations, on the other hand there is a special (protective) interest due to structural inferiority (employees, consumers, tenants) or a sovereign relationship (job seekers, legally insured persons). The aim is to abstract the findings from the specific constellations and to identify underlying concepts. In addition, reform options for legal protection against discrimination will be developed. The focus is on standardising and simplifying the law without losing sight of the different levels of protection.

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Chair of Civil Law, Labor Law and Social Law

Artificial Decision-Making and Anthropocentric Private Law

Chair for Private Law, Philosophy of Law, and Private International Law

Prof. Dr. Stefan Arnold, Dr. Anna Kirchhefer-Lauber

#anthropology, #privateLaw, #autonomy, #cognitiveLinguistics, #politicalTheory, #philosophy

By using interdisciplinary methods of Legal and Cognitive Linguistics, Political Theory and Philosophy "Artificial Decision-Making and Anthropocentric Private Law" examines the anthropocentric legal language in German Private Law, rethinks the relationship between Private Law and Politics, and reflects Private Law's moral foundations in the face of the need to accommodate Artificial Intelligence.
The four central theses are:

1. Private law theory must address the anthropocentric elements of private law by distinguishing and identifying epistemic and normative anthropocentrism.

2. Legal language influences the interpretation of law, determines dogmatic reasoning and law-making, but it also exhibits the self-perception of humans and allows to reflect upon the normative expectations resulting from it.

3. private law discourse on AI is a political discourse, because it is about power and forms of inclusion and exclusion through law.

4. Private law theory must develop a technology-responsive concept of autonomy and redesign the moral foundations in the light of AI.

At the same time, the project pursues the goal of methodically reflecting and enriching legal scholarship through interdisciplinary openness by testing whether findings from cognitive linguistics, political theory and philosophy can be transferred to the inherent rationality of private law in a technology-responsive manner.

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Chair for Private Law, Philosophy of Law, and Private International Law

Impact of AI on the Future Work of Law Enforcement Agencies

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Stefanie Kemme[1], Wilfried Honekamp[2]

#lawEnforcement, #criminalsAndAi, #criminologicalPerspective, #aiApplication, #delphiTechnique

The police are increasingly using AI applications to cope with the flood of data when solving crimes. Criminals are also relying more and more on AI to prepare and commit crimes. There is currently a certain amount of enthusiasm among the police about the benefits and opportunities of new AI technologies for crime prosecution. The risks and dangers, also with regard to the perpetrators, are still largely unknown. The cooperation project planned by the University of Münster and the German Police University aims to investigate future developments from a criminological and technical perspective. To this end, the tools already developed for police work will be comprehensively analyzed and the potential and dangers of AI applications on both the pursuer and perpetrator side will be investigated. Based on these findings, future developments will be predicted using the Delphi technique in order to derive recommendations for action.

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PTIonline

Legal Framework for the use of Artificial Intelligence in German Public Saving Banks

Freiherr-vom-Stein-Institute

Professor Dr. Hinnerk Wißmann (Supervisor), Laurenz Döring (Research Associate)

#regulatoryFrameworks, #publicBankingLaw, #discrimination, #decisionMaking, #euAiAct

The dissertation project presents the particular legal challenges of the use of artificial intelligence in the German public saving bank sector (Sparkassenwesen). As part of the indirect state administration, public savings banks face restrictions in their economic activities due to their public mandate. In contrast to private banks, they are also subject to a direct commitment to fundamental rights. At the same time, as market players, savings banks are bound by the principle of economic efficiency, not least in order to be able to fulfil their important public mandate in the long term. The abolition of guarantor liability and the comprehensive modification of the maintenance obligation due to European jurisprudence further intensified this conflict. The use of artificial intelligence enables consumer banks to achieve economic optimisation, which in the case of the Sparkasse could potentially jeopardise the adequate fulfilment of the public mandate. The expected scientific value of the work lies precisely in the illumination of this conflict of objectives, which is unique for the consumer banking sector.

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Limits and Possibilities of Social Control through the Use of Data Science Systems

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Klaus Boers, Marcus Schaerff

#socialControl, #totalSurveillance, #machineLearning, #behavioralNorms, #automatedAlgorithms

The goal of the research project is to investigate the functionality of social control under the condition of total surveillance. In current times, total surveillance refers to the potential of surveillance under unlimited access (legally or technically) to all existing data and its analysis with automated algorithms (machine learning). Consequently, total social control means that (almost) every behavior deviating from social norms is subject to more or less lenient or severe social sanctions.

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Institute for Criminal Law and Criminology

Business and Economics

Artificial Intelligence and the Changing Nature of Work

[1]Chair for Transformation of Work, [2]Junior Professorship for Digital Transformation and Society

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#change, #transformation, #work, #organizations, #informationTechnology, #ai

The Chair for Transformation of Work and the Junior Professorship for Digital Transformation and Society investigate in cooperation with the ERCIS Competence Center Smarter Work how the proliferation of AI systems transforms organizations and affects the future of work. As organizations increasingly implement AI systems to support or automate human work, their management faces the challenge of rethinking established governance, processes, work practices, and tasks. Additionally, employees may need new competencies to work efficiently with AI systems and to evaluate their outputs. In various research projects, funding applications, and cooperations with business partners, this working group studies these transformative changes and their impact on organizations.

One of the research projects is funded by BASF Coatings and investigates the implementation of generative AI applications in the company. The project commences with a case study in the communications department to identify suitable use cases for generative AI. In a second stage, the research project is going to extend the scope of the investigation to study the impact of generative AI systems on the company structure and culture.

Further research in this working group addresses the use of machine learning in financial planning in a DAX 40 company, the use of Microsoft Copilot in an IT consultancy, and the use of AI for idea generation in teams working on non-routine tasks. A funding proposal by the working group suggests investigating the impact of AI systems at the workplace on meaningful work. The working group regularly publishes its findings in leading academic journals and presents its research results at international management and information systems conferences as well as on practitioner-oriented events.

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Chair for Transformation of Work
Junior Professorship for Digital Transformation and Society

Economic Modeling Meets Deep Reinforcement Learning - An Empirical Analysis

Institute of Econometrics and Economic Statistics

Simon Haastert

#reinforcementLearning, #dynamicModels, #economicModels, #deepNeuralNetworks, #optimization

Solving large-scale dynamic models hinges on methods capable of optimizing functions efficiently. Whereas classic dynamic programming methods are known to converge to optimal solutions, they generally are computationally too expensive to solve large-scale economic models. While reinforcement learning usually approximates the value function not as precise, it applies to much more complicated problems. Combined with function approximations like deep neural networks, reinforcement learning has recently been successfully applied to robotic control, board games and economic models. However, while popular deep reinforcement learning algorithms have been tested extensively on arcade games, it is an open question how they perform in terms of solving dynamic systems of equations. This paper reviews several widely used deep reinforcement learning algorithms and applies them to various economic models. Their performance is rigorously tested in different settings to find strengths and weaknesses regarding sample efficiency, robustness, computational resources, and ease of use.

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Institute of Econometrics and Economic Statistics

Innovation, Sustainability and AI

Department of Information Systems, Digital Innovation and the Public Sector

Lea Püchel, Shariga Sivanathan, Tobias Brandt

#informationSystems, #publicSector, #largeLanguageModels, #unitedNationsDevelopmentProgram, #curate, #humanMachineInteraction, #inclusion, #education, #higherEducationTeaching, #euAiAct, #generativeAi, #interdisciplinaryExchange, #sustainability, #knowledgeGraph, #retrievalAugmentedGeneration, #transparency, #startUps, #dataVisualization, #performanceEnhancement.

LLMs Sustainable Data
We leverage a database maintained by the Sustainable Energy Hub within the United Nations Development Program to integrate Knowledge Graphs into Large Language Models to enhance the accessibility and extraction of data analysis while mitigating 'hallucinations'—instances where the models generate factually incorrect statements.
Generative AI in the Public Sector: The Role of Power Dynamics
This project aims at identifying the role of the geographical location of AI service providers in the decision-making process of actors from the public sector regarding the implementation of AI and how control and influence shifts with it.
CURATE: Co-created Student Centered Incubator Programme
CURATE will blend AI with entrepreneurial training in an incubator program, offering migrant students a challenge-based platform tailored to their learning needs and equipping them with essential skills. This project is done in cooperation with 5 partners of the Ulysseus European University Alliance.
Leveraging LLMs in Higher Education
This project focuses on the integration of AI into higher education. As an initial step, a course was introduced in the summer semester of 2023 that specifically required students to utilize generative AI in their coursework and seminar theses, from which we generated valuable insights.

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Chair of Digital Innovation and the Public Sector

3D Social Research: Using Computer Vision to analyze behavior in social interactions

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Nicolas Legewie[1], Doron Shiffer-Sebba[2], Yoav Goldstein[3], Jannes Jacobsen[4], Jörg Dollmann[4,5]

#behavior, #computerVision, #socialInteraction, #discrimination, #interDisciplinary

"3D Social Research (3DSR)" is a method that allows the computer-assisted video analysis of 21 points on human bodies (e.g., hands, head, shoulders, etc.), locating them over time and with centimeter accuracy in three-dimensional space. This method makes it possible to analyze distancing behavior (proxemics), movement behavior (kinesics), and body posture in great detail, and to scale such analyses up for inference-based studies. Our current research focuses on two areas:

1. Applying 3DSR to phenomena of avoidance behavior in public space
2. Linking detailed measurements of behavior in interactions with established theories and instruments across disciplines, addressing aspects such as affect, stress levels, mimicking behavior, or dual-process theory.

Our project group is committed to intensive interdisciplinary collaboration. We welcome interest from colleagues at the University of Münster.

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3D-Social-Research

AI and Sustainability

Department of Political Science

Doris Fuchs, Benedikt Lennartz

#Sustainability, #regulatoryFrameworks

As part of the InterKI project, the AI and sustainability module explores the multifaceted relationship between sustainability and AI-systems. It considers both the application of AI technologies to enhance sustainability efforts and the challenges to sustainability posed by the development and deployment of AI-systems. To do so, the field distinguishes between two perspectives on the field: AI for sustainability and the sustainability of AI, analyzing the impact of AI-systems in the ecological, social, and economic dimensions. Additionally, the project examines the role of regulatory frameworks in shaping the development of sustainable AI technologies and practices and the role sustainability considerations play in regulatory processes. By providing a comprehensive analysis of both the opportunities and challenges at the intersection of AI and sustainability, the research offers insights into how AI can be leveraged for sustainable development while mitigating its adverse impacts. The module also offers a seminar focused on these issues.

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Chair of Sustainable Development

Appropriation Behaviour of Adult and Continuing Education Teachers towards Generative AI

Institute of Education

Joshua B. Wilhelm

#adultEducation, #teaching, #lifelongLearning, #informalLearning, #chatbots #generativeAi, #ai

The low threshold and free access to generative AI poses new challenges for the education sector. Examinations need to be rethought, learning content adapted and didactics reconsidered. In this development, adult educators are caught between the wishes of their target groups and the requirements of their institutions. At the same time, the responsibility for further training lies with the teachers themselves, which threatens to widen the gap between the digital avant-garde and the digitally left behind. In this qualitative dissertation project, interviews are conducted with adult education and continuing education teachers to gain insights into whether, how and why they engage with generative AI. The aim of the study is to understand the basic conditions under which teachers approach the topic, what aspects they learn and what they pass on to their target groups.

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Joshua Wilhelm

Auditing LLM-based chatbots

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Nicolas Legewie[1], Lisette Espín-Noboa[2,3], Jannes Jacobsen[4]

#largeLanguageModels, #auditing, #bias, #diversity, #politicalAttitudes

AI chatbots play an increasing role in information retrieval and content production. It is therefore important to understand their outputs, especially on divisive political topics. This project investigates the political leanings of leading chatbots by prompting them to discuss politically salient topics such as DEI, climate change, inequality. The study will collect responses across LLM models and over time, and analyze responses using natural language processing (NLP) tools and human coder validation. We will compare responses within and across models, as well as over topics and time to learn about the nature and trajectory of chatbots' political leanings.
In a related project, we audit LLM-based chatbot systems for bias in medical recommendations among different ethnic groups.

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Nicolas Legewie

Creations of the Human. The Question of Personhood in Social Manifestations of Artificial Intelligence

Institute of Sociology

Carsten Ohlrogge (PhD Student)

#humanTechnologyRelations, #socialization, #posthumanism, #ai, #personhood

The PhD project is dedicated to the phenomena of “Affective Computing” and “Digital Afterlife” as two recent social manifestations of Artificial Intelligence. It focuses on how humans appear as persons in these technological associations and how they are represented digitally. Therefore, (1) the current situation of digital human-machine relations is first outlined, whereby a critical-posthumanist perspective is decisive, through which increasing interdependencies between humans and machines become visible. Subsequently, (2) an understanding of the person is developed that is based on the genesis of human socialization as a temporal-bodily self. Based on this, (3) the two phenomena central to this study are then described with the aim of (4) identifying new forms of personhood and conceptualizing them in terms of Socialization Theory. To what extent the human being is created differently in the encounter with digital machines and what consequences this has for a sociology of the digital forms (5) the concluding remarks of the work.

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Carsten Ohlrogge

Digital Media and Computational Methods

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#communicationScience, #computationalSocialScience, #digitalHumanities, #onlinePlatformResearch, #publicSphereResearch, #innovationResearch, #largeLanguageModels, #textAnalysis, #automatedVisualAnalysis, #sequenceAndTimeAnalysis, #networkAnalysis, #deepLearning, #bigData, #researchSoftwareDevelopment

The research group of Digital Media Computational Methods is dedicated to the study of communication platforms and the advancement of automated data collection and analysis techniques. As part of our ongoing research programme, we are investigating the potential of artificial intelligence as a research method for the computational social sciences as well as digital humanities, and the means of validating the automated results. Several projects are utilising artificial intelligence. Examples include automatically generating summaries of research articles on medieval inscriptions and automated textual and visual analyses of extensive social media content. In this context, we are developing research software, workflows, and infrastructures. We are also exploring the implications of artificial intelligence for society, for example by conducting surveys on the diffusion and use of AI.

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Digital Media & Computational Methods

Human - AI Collaboration on Disinformation Campaign Detection in Social Media

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#socialMedia, #Disinformation, #computationalSocialScience, #onlineCommunication

The working groups on Online Communication (Institute for Communication Science) and Computational Social Science and Systems Analysis (Department for Information Systems) present their interdisciplinary joint work on disinformation campaign detection in social media. The research integrates social and technical perspectives on this timely and pressing topic and provides important insights into the working principles, dynamics, and technological limitations of campaigning - specifically when it comes to the application of AI. The poster shows how technologies of malign actors developed, how AI is used to support the fight against disinformation, and what the role of humans in this context is.

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HybriD

ProKIS - Processes of AI-related Change in Schools

Professorship for Didactics of the Social Sciences

Katrin Hahn-Laudenberg (Project Leader), Christine Achenbach-Carret (Research Assistant), Marcus Kindlinger (Project Coordinator)

#education, #teaching, #socialSciences, #digitalTransformation, #digitalLiteracy, #digitalCitizenshipEducation

The ProKIS project (*Prozesse KI-bezogenen Wandels in der Schule*) is designed to support teachers in managing AI-related changes within schools through various professional development opportunities. As AI tools like ChatGPT challenge familiar learning formats, such as homework, educators need guidance and spaces for reflection on how these tools can be integrated into schools to improve the overall learning environment. As part of the larger SchuDiDe initiative (*Schulentwicklung: digital-demokratisch*), ProKIS emphasizes the importance of collaboration between school leaders, teachers, students, and parents to develop concrete strategies that guide schools through the AI-driven changes they face.
By adopting a participatory Design-Based-Research approach, ProKIS explores innovative methods and approaches to enhance schools' roles as democratic institutions in a digital age. We offer professional development courses and develop training materials for educators and other stakeholders in teacher education. Both our courses and our materials are planned to outline practical strategies for teaching with AI, while also incorporating methods like Design Thinking to promote democratic decision-making in school development. The goal is not only to address immediate challenges but also to create long-term strategies for fostering participatory and democratic practices in schools, leveraging the potential of AI technologies for educational development.

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ProKIS

Societal Polarization and AI Research Methods | Research Unit “Empirical Research Methods”

[1] Department of Political Science, [2] "Religion and Politics" – Cluster of Excellence,

Prof. Bernd Schlipphak[1] (Leader of Research Unit “Empirical Research Methods”), Paul Drecker[1] (PhD Student / Research Assistant), Lucienne Engelhardt[2] (PhD Student)

#politicalPsychology, #politicalCommunication, #computationalSocialScience, #dataScience, #bigData, #largeLanguageModels, #networkAnalysis, #textAnalysis, #topicModelling, #classification, #transformer

The Research Unit Empirical Research Methods (ERM, Prof. Dr. Bernd Schlipphak) at the Department of Political Science focusses on three main methodological topics, Survey Design/Analysis, Automated Content Analysis of Political Communication and Data Linkage. Currently, the Research Unit works on three projects using AI, all of them focusing on societal polarization.
In the first project on the polarization of climate change debates, Paul Drecker investigates coherence and robustness of new topic modeling models based on pre-trained transformer models in comparison to classical models such as LDA, and analyzes the effects of different parameters choice on coherence. In the second project on the role of religious markers in polarizing communication, Lucienne Engelhardt employs a pre-trained language transformer to perform an automated text classification task.
The third project entitled “The communication of religiously framed threats” takes place within the framework of the Cluster of Excellence “Religion and Politics” and is co-directed with Mitja Back (Department of Psychology). In this project, the project members work on the automated classification of threat intensity within politically relevant texts. To do so, they employ different Large Language Models included in the UniGPT framework of University of Münster, focusing on Llama and Mixtral. The findings of the automated classification will be triangulated by human coding of texts. Furthermore, the outcomes will then be used to analyze the impact of threat-intensive communication on citizens’ perceptions of threat.

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Prof. Dr. Bernd Schlipphak

Supporting Teaching with Generative AI: Offers by Zentrum für Hochschullehre

Zentrum für Hochschullehre

Dr. Jens Riehemann

#higherEducationTeaching, #interdisciplinaryExchange, #socialInteraction, #generativeAi

Integrating generative AI comes along with both, opportunities and barriers to learning and teaching. Zentrum für Hochschullehre (ZHL) offers support to university lectures in professionalizing their (digitally supported) teaching. For this purpose, ZHL offers diverse training courses (mainly in german) as well as counseling and exchange on teaching-related topics. Beyond that, ZHL initiates the integration of AI in higher education from three perspectives:

1. Special courses provide comprehensive examples for exploring the academic integration of AI tools, particularly Natural Language Processing (NLP). The courses focus on meaningful teaching applications, student responsibility, and adapting assessments. Educators will also learn how to use text-generating tools to enhance their teaching practices.

2. In addition to the overarching counseling service that supports reflection on teaching-related topics, guidance is available for addressing current questions about integrating AI into teaching. Cooperation with the ZHL staff is recommended, as they can provide advice on individual didactic scenarios and their implementation in current or planned courses.

3. The Teach Tank serves as an information hub within Learnweb, facilitating discussions on (digitally supported) teaching and learning while keeping stakeholders informed about AI developments in higher education. Additionally, we offer opportunities to deepen knowledge, such as an online self-study course on using AI prompts in higher education teaching.

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Zentrum für Hochschullehre

Sustainable AI: Socio-technological Perspectives on AI Infrastructures

Department of Communication

Prof. Dr. Sigrid Kannengießer (Group Leader), Dr. Anne Mollen (Postdoc), Anastasia Glawatzki (PhD Student)

#ai, #digitalTransformation, #discrimination, #diversity, #ecology, #economics, #education, #ethics, #generativeAi, #humanMachineInteraction, #publicSector, #safety, #socialMedia, #socialInteraction, #sustainability, #teaching

The Media Sociology and Sustainability research group at the Institute of Communication is exploring technologies of automation, especially generative AI from a socio-technical perspectives. Our research is connected to fields like sustainable AI, algorithmic fairness, Machine Learning ethics, sustainable media practices, socio-technological imaginaries etc. By investigating AI systems from an infrastructural and sociomaterial perspective, we are interrogating how power structures and inequalities manifest in the ways we are designing, developing, implementing, and using AI and how AI infrastructures are and can be shaped in more sustainable ways. This implies analyzing the social shaping of AI, including how future societal imaginaries are inscribed into AI systems and narratives. Examples include journalistic media and policy as well as business narratives on AI, practices of sustainable AI, e.g. fair production of technologies, transnational algorithmic fairness, market concentration in the AI industry and ensuing democratic implications. Following a transformative approach, we aim for more equitable and sustainable approaches to automated systems. In our research we cooperate with colleagues from different academic fields as well as actors, especially non-governmental organizations, e.g. by co-organizing the Bits and Bäume NRW events since 2024 in which sustainable AI is one of the core topics.

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Research Group "Media Sociology and Sustainability"

Using Computational Thinking to Promote Problem-solving Skills in School and Education – How the Professional Digital Competence of (pre-service) Teachers Can Be Enhanced by the Use of Educational Robotics

Institute of Education

Dr. Raphael Fehrmann

#pedagogy, #education, #computationalThinking, #algorithmDevelopment, #educationalRobotics, #problemSolving, #decisionMaking, #digitalTransformation, #primarySchool, #robotics, #creativity

In order to teach, learn and live in a world shaped by digitalization, it is crucial that learners develop the ability to use digital systems responsibly. In particular knowledge about the functioning and effects of algorithms is highly relevant. Computational thinking makes it possible to promote the development of problem-solving skills systematically by algorithmically structured problem-oriented thinking.
But how assess pre-service teachers their professional digital competence in order to initiate competence acquisition with a focus on computational thinking among pupils? And how can these competences be extended in university teaching?
In the research project "Lernroboter im Unterricht" pre-service teachers gain hands-on experiences in the use of educational robotics as part of university seminars.
A quantitative longitudinal study shows that pre-service teachers (N=295) assess their professional digital competence as rather low. Participation in the seminar significantly increased professional digital competence in various areas, whereby gender-specific differences were compensated.
DOI:10.17879/78978632588
The project also developed teaching materials that are be made available as open educational resources.

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Lernroboter im Unterricht

Virtual Influencer Marketing

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#ai, #consumerBehavior, #dataMining, #textAnalysis, #humanMachineInteraction

Our project focuses on understanding consumer reactions towards virtual influencers, a rapidly emerging phenomenon in digital marketing. By employing a multimethod approach, we combine qualitative and quantitative techniques to gain comprehensive insights into this evolving landscape. At the core of our efforts is the use of advanced **artificial intelligence** (AI) to generate realistic virtual influencers that resonate with audiences. Utilizing generative adversarial networks (GANs) incorporated in Adobe Firefly, we create lifelike digital avatars, enhancing their relatability and effectiveness in engaging consumers.
To analyze consumer behavior, we leverage various **data mining** and **text analysis** tools. By extracting large volumes of data from social media platforms, particularly Instagram, we gain insights into user interactions and sentiment towards these virtual personas. Our approach includes the application of **natural language processing** (NLP) techniques to conduct e.g. sentiment analysis, allowing us to gauge consumer feelings about specific influencers and brands. Furthermore, we implement topic modeling to identify emerging trends and themes within user-generated content, which can inform marketing strategies.
This comprehensive research not only contributes to the academic discourse surrounding digital marketing but also provides valuable insights for practitioners aiming to navigate the complexities of influencer marketing in the digital age. By bridging the gap between AI technology and consumer behavior, our work paves the way for innovative marketing strategies that leverage the unique attributes of virtual influencers to enhance brand communication and consumer engagement.

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Chair of Marketing Management (IfM - Institut für Marketing)

Psychology and Sport Sciences

Artificial Intelligence in Sport - Quantitative Study on Students Perceptions, Expectations, and Concerns Regarding the Use of Generative AI (AIS)

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Dr. Dennis Krämer[1] (Principal Investigator), Anja Bosold[2], Dr. Martin Minarik[2], Dr. Cleo Schyvinck[3], Prof. Dr. André Hajek[4]

#higherEducation, #digitalLiteracy, #academia, #ai, #quantitativeResearch, #germany, #chatGpt, #largeLanguageModels, #crises, #uncertainty, #risks, #perception, #engagement

Generative Artificial Intelligence (AI) has a crucial impact on academic research and teaching. However, empirical data on how students perceive the increasing influence of AI, which types of tools they use in their daily academic tasks, and their concerns regarding are still limited. The project "Artificial Intelligence in Sport" (AIS) aims to address this empirical gap through a quantitative study through a quantitative survey conducted among sports students of all semesters in Germany using an online questionnaire. It explores aspects such as students' usage behavior, motivational factors, and uncertainties regarding the potential impact of AI on academia in the future. Furthermore, the social climate is being investigated to provide a general overview of the current situation of the students. Data collection took place between August and November 2023, addressing all sports departments at German universities, with a total of 262 students participating. The next step of the AIS project is to extend the data collection to other study programs and universities in the EU. Our Findings indicate that students have a strong interest in using AI tools in their studies, expecting them to improve their overall academic performance, understand the complexity of scientific approaches, and save time. They express confidence that the proliferation of AI will not compromise their critical thinking skills and are positive about integrating more AI-related topics into the curriculum and about lecturers using more AI-based teaching methods.
However, our findings also underline that students have concerns about plagiarism, lecturer preparedness and their own skills and future skill development. In light of our empirical findings, we suggest that universities address this ambivalent situation by educating students on how to generate reliable information with AI and avoid misinformation. It is imperative that students have both practical and critical knowledge about the use and implications of a new technology that is rapidly spreading in academia. This will enable them to better understand the impact and also the limitations of a technology that only emerges through its practical use.

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Published article

BackLab – Advancing Personality and Social Relationship Research Using Natural Language Processing and Machine Learning

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#personalityPsychology, #personalityDevelopment, #socialJudgement, #socialInteraction, #reactivities, #automaticAssessment, #machineLearning, #naturalLanguageProcessing, #chatbots, #largeLanguageModels, #explainableAI

The research of our workgroup focuses on the expression and development of personality in social context. To predict, explain, and target underlying social interaction processes at scale, we make use of the increasing availability of digital traces, recordings of social interactions, and more accessible computational resources. Specifically, we integrate theoretical advances from personality psychology with machine learning to extract, create, and integrate psychologically meaningful behavioral cues from complex and semi-structured data sources (e.g., text, videos, smartphone data) into models predicting psychologically relevant outcomes (e.g., applicant performance, learning success) in combination with traditional psychological methods (e.g., surveys and experiments). We currently pursue this approach in four research projects. First, we apply automatic means of cue extraction and machine learning-driven cue integration to better understand how individuals form social judgments (e.g., applicant selection and dating decisions). Automatic cue extraction allows us to consider a wider variety of potentially impactful behaviors beyond what is possible with manual coding, while machine learning-driven cue integration can combine this large array of behaviors into meaningful prediction or explanation models. Second, we investigate why individuals react differently to social situations (e.g., a conflict) or societal events (e.g., elections), thereby applying a combination of multilevel modeling with novel machine learning to large-scale intensive longitudinal data collections. Third, we deploy machine learning (e.g., open vocabulary methods) and deep learning (e.g., LLM zero-shot inference) to code text data for psychologically meaningful constructs automatically (e.g., coding individual agency and communion motives in life narratives; assessing the degree of threat communication in media). Fourth, we apply KI methods in the educational context, both to better predict individual differences in learning trajectories, and to develop language-based agents representing different personalities that can be used to provide scalable trainings for professional personalized interactions (e.g. in medical, psychotherapy, and teacher education).

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BACKLAB

Comparing Image Representations in Deep Neural Networks and Human Memories

Department of Psychology

Niko Busch

#eventMemorability, #cognitivePsychology, #computerVision, #deepNeuralNetworks, #visualScenePerception

Why are some events still remembered after a long time while others are so quickly forgotten? Psychological research has shown that an event's memorability is determined by the extent to which its features are distinct from those of other events. Most of this research has employed simple, abstract stimuli, whose distinctiveness is easy to quantify based on features such as size or loudness.
Our project bridges this gap by integrating computer vision and cognitive psychology. We investigate how humans perceive and remember photographs of complex visual scenes and how these processes are affected by the scenes' distinctiveness and typicality. Importantly, we quantify scene features based on representations in deep neural network models, allowing for unprecedented precision and objectivity.
These computational approaches allow us to address long-standing questions in cognitive psychology: What makes an image memorable and how does the structure of representations in neural networks compare to human memory?

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Busch-Lab

Exploring Social Dynamics in Human-AI Interaction

Sozialpsychologische Grundlagen von Erziehung und Unterricht, Institut für Psychologie in Bildung und Erziehung (IPBE)

Prof. Dr. Regina Jucks

#socialPsychology, #higherEducation, #chatbots, #anthropomorphism, #humanComputerInteraction, #epistemicTrustworthiness, #socialInteraction

Our research concentrates on communication with and through technology like spoken dialogue systems (SDS) and chatbots. With a background in psychology and education we are interested in language use, trust, and dimensions of social cognition. The research contributes to the design and usage of genenerative AI in (higher) education.

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Research Group of Prof. Dr. Regina Jucks (IPBE)

Machine Learning in Locomotion and Gaze Behavior

Department of Psychology

Gianni Bremer, Taravat Anvari, Malte Scherff, Markus Lappe

#locomotionPrediction, #eyeMovements, #timeSeriesPrediction, #virtualReality, #poseEstimation, #gazeTracking, #transformer, #humanComputerInteraction, #selfMotion, #opticFlow #ai, #classification, #deepLearning, #humanMachineInteraction, #longShortTermMemoryNetworks, #machineLearning, #movementScience, #neuralNetworks, #regression, #userCentricity

Our group applies non-linear models to contexts involving interactions of eye gaze and human motion.
One goal is predicting locomotion intention from gaze behavior. This helps optimize the utilization of physical space in VR environments or gaze-driven wheelchairs for motor-impaired users. Deep networks outperform conventional methods for this challenge. We treat this task as a time series prediction problem and use both RNNs and transformers. A distinctive aspect of our work is its emphasis on eye movements, contributing to its novel predictive capabilities. We conducted experiments in custom virtual environments with various tasks using joysticks and real walking. The results show that gaze data is a valuable tool for locomotion prediction. We aim to integrate these models with brain signals and deploy our locomotion intention decoders into wheelchairs built by our partners evaluating practical real-time applications.
Another research focus is the integration of gaze and motion for enhanced 3D pose estimation to support lifelike VR interactions. The project introduces GaMo, a dataset combining motion capture and eye gaze data during complex human-object and human-human interactions. Building on this, we present PoseFusionNet, a model that integrates gaze vectors and motion data using an LSTM and Transformer-based architecture. PoseFusionNet demonstrates that gaze, an informative but often overlooked cue, significantly improves 3D body pose prediction. Our model performs real-time estimation using just three tracking points (head and hands) plus gaze data, offering an efficient yet powerful approach for immersive systems. Applications span avatar animation, behavioral modeling, and intent recognition in HCI.
Additionally, we develop a neurologically inspired computational model for optic flow processing. This model predicts parameters of self-motion, such as walking direction and eye movements, the depth structure of the surrounding scene, and the presence and location of independently moving objects, based on moving light patterns on the retina.

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Lappe Lab

Machine Learning in Movement Science

[1] Dept. of Movement Science, [2] Otto Creutzfeldt Center for Cognitive and Behavioral Neuroscience, [3] Center for Data Science and Complexity (CDSC)

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#movementScience, #neuralNetworks, #machineLearning, #spinalCord, #meanFieldTheory, #internalModels, # poseEstimation, #featureImportance, #clinicalBiomechanics

There are many ways in which artificial intelligence can be used in the field of movement science. In our lab, we use machine learning methods to (1) model biological structures and (2) improve movement assessments.
For the first, we use reservoir computing neural networks as abstract models of the spinal cord. In one project, we investigate the influence of the ratio of inhibition to excitation as well as the connection strength (spectral radius) on the network dynamics and performance on a locomotor task. Our results indicate that increased spinal excitation leads to a decrease in locomotor complexity. In another project, we train a reservoir computer in a more biologically inspired manner by using sensory feedback, rather than muscle activation, as the target signal. We do this by coupling the main network to internal feedforward and feedback models. We're also investigating whether such internal models could be combined into one single neural circuit; the Inverse Forward Recognition Model, a.k.a. "InFoRM".
For the second, we use convolutional (CNNs) and recurrent neural networks (RNNs) to improve the accuracy of motion capture systems and to provide comprehensive kinematic and kinetic information to, e.g., physicians and athletes. We also aim facilitate self-assessments of gait and balance in people with chronic ankle injury, by employing machine learning models such as support vector machines (SVMs) and random forest (RF) models. Finally, we use feedforward artificial neural networks (FNN) to improve the joint kinematics predicted by open-source pose estimation models in various dynamic movement tasks.

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Department of Movement Science

Machine Learning Methods in Psychological Statistics

Department of Psychology

Steffen Nestler

#statisticalMethods, #networkAnalysis, #machineLearning, #mixedEffectsModels, #causalMachine-Learning

The statistics and psychological methods working group is interested in the advancement of statistical methods for the analysis of complex psychological data stemming from classic experimental research but also non-experimental research that uses, for example, smartphones. Our research projects mainly refer to social relations and social networks models, structural equation models, mixed-effects models, and also meta-analysis. In all of these cases, we combine the respective statistical approaches with machine learning methods. For instance, we recently suggested combinations of the mixed-effects model with gradient tree boosting, random forests, and Lasso regression and examined the predictive performance of these combinations in case of intensive longitudinal data (Nestler & Humberg, 2022; Salditt et al., 2024). We also examined the statistical properties of regularized structural equation models (Scharf & Nestler, 2019) and we started to investigate the suitability of causal machine learning methods to estimate heterogeneous (person-specific) treatment effects (Salditt et al., 2024).

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Research Group "Statistics & Psychological Methods"

Motivated Trust in Artificial Intelligence: An Integrative Model Considering Multiple Stakeholder Perspectives

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Guido Hertel[1], Sandra L. Fisher[2], Jenna Van Fossen[3],

#ai, #humanResourceManagement, #trustInAi, #stakeholderPerspectives

Artificial Intelligence (AI) applications are increasingly used in business organizations and their human resource management (HRM). Our research group is interested both in developing suitable AI solutions for HRM (e.g., social robots in recruiting) as well as in optimizing the interaction between humans and AI in this context. For instance, one central precondition for the successful implementation of AI in HRM is that such applications are trusted by the involved persons. In addition to cognitive aspects of trust, we consider motivational influences on trust in technologies that are particularly important to understand and predict different stakeholder views on trust in AI. In a new integrative model of trust in AI, we specify motivational drivers and cognitive processes for separate stakeholder perspectives in HRM: employers, decision makers (e.g., supervisors), decision targets (e.g., employees or job applicants), and HR professionals. While empirical validation of this model is in progress, the conceptualization of different stakeholder perspectives already offers interesting avenues for further research and for practical recommendations in HRM. Moreover, we also apply the model of motivated trust in AI to other fields, such as AI applications to support judges in criminal proceedings (together with colleagues at the Faculty of Law). Finally, we explore AI as support of scientific work in Organizational and Business Psychology by combining deductive theory building with data-driven machine learning approaches (e.g., Eisbach, Mai Hertel, 2024).

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Organizational and Business Psychology

Trying AI-Tools in Teaching for Coding, Writing, Literature Research, and Revision

Institute of Psychology

Daniela Feistauer

#psychology, #diversity, #higherEducationTeaching, #generativeAi, #performanceEnhancement, #immediate&adaptiveFeedback, #tutorialSystems, #practicalApplication, #exploringAiForClassroomUse, #digitalProfessionalDevelopment

In our research we focus on applying AI tools to enhance learning experiences in psychology courses. One area is using AI in teaching R. We introduced AI tools (ChatGPT) to increase students' self-efficacy. While the results did not show significant improvements, students were motivated to explore AI, suggesting potential for future use.
Another focus is how AI can provide personalized, real-time feedback. We explored whether AI-based feedback can reduce cognitive overload, particularly in coding. While the integration of AI into classrooms has shown promise, more work is needed to ensure its pedagogical soundness.
We also compare AI-generated feedback with that from human evaluators, investigating if students value AI feedback on essays as much as feedback from peers or professors.
Additionally, we are exploring AI's ability to grade open-ended exam answers, which are crucial in psychology to assess reasoning and interpretation. Early tests about reliability and validity are promising, but legal concerns remain.
Together, with these research themes we aim to explore the diverse ways in which AI can enhance educational practice, particularly in psychology, while addressing challenges related to reliability, validity, practicality, and user acceptance.
Additionally, staff and students discuss regularly on how AI can (not) be integrated into teaching.

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Learnweb course
Daniela Feistauer

History

Asking the Pope for Help – Petitions by Jewish Victims of the Holocaust Kept in the Vatican Archives

Seminar for Medieval and Modern Church History

Jana Haack, Sascha Hinkel, Maik Kempe, Lorena König, Elisabeth-Marie Richter, Judith Schepers, Barbara Schüler, Hubert Wolf

#churchHistory, #dataVisualization, #ai, #digitalEdition, #digitalHumanities, #knowledgeGraph, #largeLanguageModels, #naturalLanguageProcessing, #retrievalAugmentedGeneration, #textAnalysis, #textEncodingInitiative

Desperately pleading, begging for help or rationally describing their own situation: thousands of Jewish people in need wrote to Pope Pius XII and the Catholic Church during the Shoah. The project "Asking the Pope for Help" aims to present an online edition of all their "petitions", kept in various Vatican archives. Additionally, the corresponding Vatican sources and other relevant documents shall be edited and the petitioners' biographies will be reconstructed. The basis for this edition is an XML database and the open-source software "ediarum" developed by the Berlin-Brandenburg Academy of Sciences and Humanities. These two applications were integrated and adapted to the project's needs. The documents will be edited using innovative digital methods, including AI-assisted OCR/HCR and semi-automated TEI-XML coding such as Named Entity Recognition or georeferencing. To cross-check the personal data records with biographical entries in other databases on the Shoah, an AI-based metasearch engine will be developed.

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Asking the Pope for Help

Global Trade, European Consumer Culture and Exotic Remedies in the German-speaking World – A Digital History Project

Historisches Seminar

Christine Fertig

#exoticRemedies, #earlyModernPeriod, #textMining,

The project traces the development of trade in and the development of knowledge about exotic remedies in the early modern period. It uses an extensive sample of digitised publications from the 17th to 19th centuries to trace the genesis of new knowledge about substances that came to the German lands from distant Asia and the New World with European expansion and the development of long-distance trade. Complete transcriptions of extensive, sometimes multi-volume works such as handbooks, encyclopaedias and guidebooks can be used to find references that cannot be found by simply reading them. The historical sources are transcribed using AI-powered text recognition (Pero OCR) and analysed using text mining and a mixed-methods approach.

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Research Group "Modern and Social History"

Philosophy

AI Writing as a Cultural Technique in Philosophy Education

Institute of Philosophy

Dr. Markus Bohlmann

#education, #teaching, #textAnalysis, #ai

Based on Sybille Krämer's understanding of AI writing as a cultural technique, the conditions and possibilities of using AI in philosophy lessons at school are examined. This project is loosely connected to the DFG network Philosophy of Digitality and a sub-project of my habilitation project, which deals with the change of conceptual thinking in the digital world. The investigation of AI writing as a cultural technique includes parts of empirical educational research, but also theoretical-conceptual work.

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Dr. Markus Bohlmann

Philology

AI-based Conversational Agents in Education: Assessing Students Learning Experience

Research Centre for Innovation and Transfer of Digital Teaching

Christian Flinspach, Moritz Michael Flottmann, Jan-Martin Geiger

#conversationalAgents, #selfRegulatedLearning, #generativeAi, #educationalAssessment, #learning-Experience

Due to their ability to provide adaptive feedback, conversational agents (CA) are seen as a promising tool for self-regulated learning. Hence, CA are adopted in various disciplinary educational contexts and are expected to postpone learning experiences as well as educator's responsibilities. In this poster, we (1) present a framework based on generative AI for integrating CA within two distinct fields of education, namely financial education and grammar training. We (2) describe the development of an assessment tool that allows to identify relevant aspects of learning with AI based CA and thus capture the subjective learning experience. The assessment tool is intended to contribute to opening up new perspectives for impact research relating to tutorial systems on the one hand and to enrich the assessment spectrum of educators for assessing learning and supporting learners on the other.

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Research Centre for Innovation and Transfer of Digital Teaching

Machine Learning for Discourse Effects on Morphosyntax

Institute of Linguistics

Alexander Zahrer (Project Coordinator)

#linguistics, #morphosyntax, #machineLearning, #decisionTrees

Modern linguistics increasingly depends on corpus data. While corpora of written texts are constantly growing, data from oral speech is more difficult to obtain, due to a transcription bottleneck, and more complex to handle, due to messy data and the interactionality of conversational speech (e.g. the meaning of an utterance depends not only on what I said but also on what was said before). The investigation of morphosyntactical features in oral speech therefore often relies on qualitative methods, investigating a subset of carefully chosen examples. In contrast, our current research explores how machine learning can be used to quantify effects of discourse variables (e.g. what function a given utterance serves in a given context) on the formal features of an utterance (i.e. its morphosyntax) and vice versa. In a pilot study, we trained a random forest classifier to predict wether a certain combination of utterance features represents agreement or disagreement with the interlocutor. Currently, we are working on a DfG grant proposal to study the possibilities of applying machine learning methods at the interface between discourse and morphosyntax more thoroughly.

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Dr. Alexander Zahrer

Semantic Coherence and Topic Continuity in HI

Institute of German Studies

Anna Greilich, Netaya Lotze

#humanMachineInteraction, #voiceUserInterfaces, #multiTurnCommunication, #topicContinuity, #chat-bots

HMI has entered humans' daily life, however, voice user interfaces and chatbots still operate with short commands, e.g. "Alexa, turn the lights on". As linguists, we analyse multi-turn HMI, focusing on semantic coherence and topic continuity which are key characteristics of multi-turn communication in humans. We base our analysis on data sets providing interactions with chatbots and Amazon Alexa in German. In our mixed-methods studies (corpus analysis, conversational analysis, and production experiments), we ask, to what extent dialogues between humans and chatbots are coherent.
Users are likely to change their behaviour throughout the interaction with the chatbots because of the interplay between dialogue-external factors and dialogue-internal factors. We analyzed topic continuity in Alexa on the level of referring expressions, syntax, and prosody. Users formulate utterances as isolated requests for information, anticipate a lack of shared knowledge by the system and prefer to keep the utterances explicit.

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Anna Greilich

Using AI for Compiling and Analyzing Large Speech Corpora

Chair for English Linguistics

Ulrike Gut, Philipp Meer

#linguistics, #speechRecognition, #digitalHumanities, #ai, #bigData, #bayesianAlgorithms, #decisionTrees, #dimensionalityReduction, #randomForests, #regression

Research in linguistics is increasingly relying on large corpora of authentic language use. We are compiling speech corpora for English as it is used in Nigeria, Cameroon and Ghana in order to explore the phonological similarities and differences between these three West African varieties of English. For this, we employ the AI-based automatic speech recognition software WhisperX for the creation of orthographic transcriptions. In addition, we use the forced aligner FAVE-align to create phonemic annotations. Acoustic phonetic analyses of West African vowel productions are one of the key components of the project. To that end, we use a Bayesian-style vowel formant frequency estimation algorithm (FAVE-extract) that emulates how humans measure vowels acoustically. Data analysis will make use of linear and generalized linear mixed-effects modelling, conditional inference trees, principal components analysis, random forests, and other approaches.

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The phonology of Nigerian English

Interdepartmental Institutions, Services and Contact Points

English for Academic Purposes – with AI

Language Centre

Heike Mersmann-Hoffmann (English Teacher)

#languageLearning, #efl, #academicEnglish, #education, #generativeAi

The **Language Centre** at the University of Münster is the central point of contact for all language-related inquiries outside of the philology departments. Each academic year, it offers around 400 courses in 14 languages, which are attended by more than 6,000 students. In addition to general language courses and interdisciplinary courses open to students from all faculties, the Language Centre offers subject-specific programmes for law, economics, the humanities and social sciences, medicine, and the natural sciences. The *Lehrgebiet DaF* (German as a Foreign Language department) prepares prospective students from abroad for regular degree programmes in German, and students take the *DSH (Deutsche Sprachprüfung für den Hochschulzugang* - German university entry language test) there. The *Supportstelle Englisch* (English Support Service) provides a modular English training programme for administrative staff, operates a translation service, and assists researchers through the Scientific and Academic Editing Service.
The course **English for Academic Purposes – with AI** is an AI-based language class open to students of all subjects who already have a good knowledge of spoken and written English and who wish to improve their academic language skills further. Emphasis will be laid on broadening academic vocabulary, brushing up grammar and improving academic writing skills. To achieve this, you will, of course, be doing 'classic' assignments. However, you will also be introduced to the various ways in which AI tools can be used to learn and improve your English, e.g. to enhance your vocabulary expansion, to create different ways to revise language topics, and to structure and revise your English texts. We will explore the opportunities AI tools offer and reflect on the dangers and pitfalls that we have to deal with when using AI in language learning. Materials will be made available on Learnweb.
Please refer to the Language Centre website for enrolment information.

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Language Centre
Courses - dates and deadlines
Heike Mersmann-Hoffmann

GenAI Lab: Hands-on AI training for Doctoral and Postdoctoral Researchers

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Friedrich Bach[9], Dr. Nils Beese[11], Dr. Jan-Martin Geiger[6,9], Ludger Hiepel[4], Dr. Oliver Kamps[1,7], Dr. Martin Korth[8], Heike Mersmann-Hoffmann[10], Dr. Anne Mollen[5], Dr. Iva Ognjanovic[2] (Initiative Lead), Dr. Filipe Pessoa[3], Dr. Stefan Roski[12], Dr. Katrin Schmietendorf[1,7]

#generativeAi, #genericSkillsTraining, #academicProfessionalism, #doctoralResearchers, #postdocs

Jointly designed and conducted by several institutions at the University of Münster, **GenAI Lab** is a practice-oriented workshop series tailored for doctoral and postdoctoral researchers eager to leverage the potential of Generative AI (GenAI) technology in their academic work. Each workshop focuses on a specific area and includes practical examples or case studies from various disciplines. Participants will engage in interactive activities, hands-on exercises (including prompting techniques), and reflective discussions.
This training is ideal for **curious researchers** who have **little to no prior knowledge or hands-on experience** but wish to make their research activities more efficient, impactful, and innovative using GenAI tools. It is also perfect for **researchers with basic knowledge and application experience** seeking advanced insights into specific GenAI tools and wishing to improve their usage without delving too deeply into technical details.
Our heartfelt thanks go to Benedikt Lennartz (FB06, ZIN) and Prof. Dr Benjamin Risse (FB10/CDSC) for their invaluable insights and support during the conceptualisation phase.

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Münster Centre for Emerging Researchers (CERes)

InterKI - AI Teaching, Research and Interdisciplinary Exchange

[1] Center for Data Science and Complexity (CDSC), [2] Institute for Theoretical Physics

Oliver Kamps[1], Katrin Schmietendorf[1] (Project Coordinators), Uwe Thiele[1,2] (Project Leader)

#teaching, #interdisciplinaryExchange

The Interdisciplinary Teaching Program on Machine Learning and Artificial Intelligence at the University of Münster, InterKI, is a project funded by the Federal Ministry of Education and Research (BMBF) as part of the "Artificial Intelligence in Higher Education" funding initiative. It is coordinated by the Center for Data Science and Complexity (CDSC), formerly the Center for Nonlinear Science (CeNoS). InterKI aims to establish a multi-level university-wide teaching program on Machine Learning and Artificial Intelligence. AI is taught as an interdisciplinary, cross-cutting topic that has a wide range of potential applications in basic research as well as in the business and social sectors, while also posing social, ethical and ecological challenges. InterKI closely integrates research and teaching and is accompanied by numerous research and PhD projects. Including mathematics, computer science, physics, chemistry and pharmacy, sports science, medicine as well as sustainability, philosophy of science, start-ups and teacher training, InterKI naturally functions as a broad interdisciplinary exchange platform that is also open beyond the project boundaries.

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InterKI

IVV NWZ Self-study Course Data Science/Machine Learning

IVV NWZ

Martin Korth

#dataScience, #machineLearning, #selfStudyCourse

IVV NWZ is a joint operating unit of the Departments of Biology, Chemistry/Pharmacy and Physics. It organizes the decentralized IT infrastructure in these departments in coordination with the CIT and the other IVV units. Its services include the setup, maintenance and operation of cross-institutional IT systems (devices, operating systems, and software applications), as well as the provision of educational resources for IT-related topics.
The **Self-study Course Data Science/Machine Learning** guides students in a structured manner through a number of external video, audio, text and software resources, so that they will be able to self-study the topic of Data Science with a focus on Machine Learning. Example topics are an introduction to data handling and analysis, machine learning algorithms, and data science software packages and tools. The course focuses on the technical aspects of ML, but points to further educational resources at Uni MS were available.

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self-study course Data Science/Machine Learning

REACH Incub.AI

REACH Euregio Start-up Center

Friedrich Bach, Jonathan Wandscheer

#aiSoftwareDevelopment, #Sustainability, #neuralNetworks, #highPerformanceCluster, #naturalLanguageProcessing

With REACH Incub.AI, we make it easier for start-ups and university members to access the productive development of AI software by providing user-friendly tutorials for the most common AI frameworks and introducing deployment on university resources using Docker, Git, OpenStack and Kubernetes. We also address the training of neural networks on the university's High Performance Cluster. The aim is to use the principles of sustainable software development to turn applications developed as part of research into market-ready applications that can also run on commercial cloud services. In addition, we offer regular events on start-up-relevant AI topics and are developing a practical workshop series for students and employees.
As part of our interdisciplinary work, we are currently developing an NLP-based trend radar for analyzing patent data. In collaboration with the start-up Colloc.AI and FB09, a chatbot is being created that is specially tailored to a course as a tutor.

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REACH

Service Center for Digital Humanities (SCDH)

Service Center for Digital Humanities (SCDH)

Dr. Jan Horstmann (Head of SCDH), Dr. Immanuel Normann (Software Development Coordinator,) Katharina Dietz (Research Software Engineer), Ingo Frank (Knowledge Engineer), Christian Lück (Research Software Engineer), Jan-Erik Stange (User Experience Design), Dennis Voltz (Research Software Engineer), Dr. Benjamin Weber (Research Software Engineer), Mirko Westermeier (Research Software Engineer)

#digitalHumanities, #classification, #computerVision, #dataMining, #dataVisualization, #deepLearning, #digitalTransformation, #history, #imageAnalysis, #imageRecognition, #largeLanguageModels, #linguistics, #machineLearning, #naturalLanguageProcessing, #textAnalysis, #userCentricity.

The Service Center for Digital Humanities (SCDH) supports the community of DH researchers at the University of Münster by providing professional project advice and guidance from proposal submission to publication. The SCDH is located at the University and State Library (ULB). In the context of the digital transformation of the humanities, the work of the SCDH also repeatedly touches on aspects of machine learning and artificial intelligence. We see great potential for integrating the possibilities of e.g. large language models into the processes of digital humanities research in the future, for example in text recognition, the automated analysis of research objects or the translation of other languages or earlier language stages.

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Service Center for Digital Humanities

The Centre for Philosophy of Science

Centre for Philosophy of Science

Stefan Roski

#philosophyOfScience, #interdisciplinaryResearch, #ai, #explainability, #authorship, #intelligence

The Centre for Philosophy of Science provides services in teaching, networking, and outreach in connection with the philosophy of science. We fund interdisciplinary workshops and lecture series, and we connect researchers from over twelve faculties of Münster University. Recently we helped organize several events connected to philosophical issues with artificial intelligence such as authorship, explainability, and intelligence. We value interdisciplinarity across all disciplines of the university, ranging from the formal sciences to the humanities. Due to our multi-faceted group of active members, we are an ideal networking hub to develop ideas and start new research projects off the beaten track.

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Centre for Philosophy of Science

List of #keywords