Book of Abstracts: AI Summer School 2023

This book contains abstracts of posters that have been accepted for the AI Summer School 2023, organized by Friedrich Schiller University Jena. The collection of posters within these pages offers insights into the diverse and innovative research presented during the event, curated by the participated Bachelor's and Master's students. The majority of the posters analyzes and observes existing methods across various facets of artificial intelligence, contributing to a deeper understanding of these techniques and their cutting-edge applications. The posters are available online through this URL: https://ai.uni-jena.de/posters.html

The committee:

M.Sc. Shima Bani,
Prof. Dr. Alex Breuer,
Prof. Dr. Martin Bücker,
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Prof. Dr. Peter Dittrich,
M.Sc. Valentin Kasburg,
Prof. Dr. Gerhard Zumbusch

AI in Cancer Research

Rayk Kretzschmar[1]

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Abstract: Artificial intelligence (AI) has the potential to revolutionize cancer research and treatment. AI can be used for early detection, diagnosis, treatment planning, precision medicine, and clinical decision support. By harnessing the power of AI, we can accelerate progress in cancer research and improve patient outcomes.

AI has been applied to a variety of oncology-related medical areas, including cancer radiology, pathology, radiation oncology, gastroenterology, and clinical oncology. The most devices approved by the FDA for AI-associated use in oncology are for general cancers, breast cancer, lung cancer, prostate cancer, colorectal cancer, and brain tumors. AI-associated devices are being used to develop new cancer drugs and treatments, improve the accuracy of cancer screening and diagnosis, and identify biomarkers, predict treatment responses, and optimize treatment plans.

AI algorithms analyze vast amounts of medical data to aid in the early detection and diagnosis of cancer. Machine learning models can detect subtle patterns and anomalies that may be indicative of cancer. AI helps healthcare professionals make accurate diagnoses and identify tumors at earlier stages. AI plays a critical role in precision medicine by analyzing genetic data, clinical records, and treatment outcomes.

AI has the potential to transform cancer research and treatment. AI could enable more precise diagnoses, personalized treatments, and improved patient outcomes. However, there are significant challenges that need to be addressed, such as data privacy and security, algorithm transparency and interpretability, biases in data and algorithms, and regulatory and ethical considerations.

This scientific poster provides an overview of the current state of AI in cancer research and treatment. It highlights the potential of AI to revolutionize cancer care, as well as the challenges that need to be addressed in order to realize this potential.

AI-based High-Level Decision Making in Highway Autonomous Driving

Jiachen Gong[1]

[1]Technical University of Munich, Germany

Abstract: In this poster I first introduced the backgrounds of AI and autonomous driving. Then I introduced 4 algorithms which are used in autonomous driving. After that I also discussed the performance and requirements of the algorithms. At least I draw a conclusion.

Alphafold

Colin Zach[1]

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Abstract: Das Poster beleuchtet die innovative Anwendung von AlphaFold, einem neuronalen Netzwerk, das die Proteinfaltung revolutioniert. Wir untersuchen seine Strukturberechnung, Vertrauensbewertung und Auswirkungen auf die Proteinforschung.

Artificial Intelligence in Laser Beam Machining

Anukul Jovial Augustine[1]

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Abstract: AI techniques such as artificial neural networks (ANN), fuzzy logic (FL) etc., can be used to model, optimize, monitor, and control the laser beam machining (LBM) process leading to better quality and reduced costs. This poster focusses on how AI can be used to optimize and model different attributes involved in LBM quality characteristics, such as geometry characteristics, metallurgical characteristics, material removal rate (MRR), and surface quality. It also presents the practical implications of AI in LBM and its future directions.

Automatic Symbolic Differentiation for Tensor Expressions

Farin Lippmann[1]

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Abstract: AI relies on solving optimization problems with respect to tensor-valued variables. For my bachelor's thesis I implemented a calculus for automatic symbolic differentiation of tensor expressions of arbitrary order, using the einsum-notation for tensor products.

Backpropagation-based visualization methods for explaining CNNs

Christian Ickler[1]

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Abstract: In contemporary machine learning, the proficiency exhibited by artificial neural networks is indisputable; however, their decision-making processes are often difficult to comprehend. This lack of transparency poses significant problems, particularly in critical domains such as healthcare and law enforcement, where comprehending AI-driven decisions is of great importance to gain trust in the systems. This poster examines three popular backpropagation-based visualization methods for convolutional neural networks (CNNs): DeepLIFT, Integrated Gradients and Grad-CAM. These methodologies try to indicate pixel or feature relevance by using gradients of the output passed backwards. After a detailed analysis of these techniques, a comparison is made to show their individual limitations. This aims to assist the reader in selecting a suitable method for specific use cases.

Causes for the Failure of Machine Learning Projects in Productive Use

Mia Ohlrogge[1]

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Abstract: Machine learning (ML) is one of the fastest-growing technology areas and is considered one of the most disruptive innovations for businesses today. Data availability and advances in computing power have enabled great growth in the research and practice of ML.

Studies show that companies using ML models increase their operational efficiency, develop new value propositions and perceive a significant competitive advantage. Consequently, the adoption of ML is reaching its inflection point as technological, societal, and competitive pressures push enterprises to transform and innovate.

However, the real value of ML models can only be harnessed when they are actually deployed in a productive environment. Converting an algorithm into a business valuable ML model is a time-consuming and complex task. Several studies conclude that 87% of ML projects ultimately do not make it into production.

Chip Design with Deep Reinforcement Learning

Bohdan Babii[1]

[1]Friedrich Schiller University Jena, Germany

Abstract: Chip foorplanning is the engineering task of designing the physical layout of a computer chip. Despite fve decades of research, chip foorplanning has defed automation, requiring months of intense efort by physical design engineers to produce manufacturable layouts. Here we present a deep reinforcement learning approach to chip foorplanning. In under six hours, our method automatically generates chip foorplans that are superior or comparable to those produced by humans in all key metrics, including power consumption, performance and chip area. To achieve this, we pose chip foorplanning as a reinforcement learning problem, and develop an edge-based graph convolutional neural network architecture capable of learning rich and transferable representations of the chip. As a result, our method utilizes past experience to become better and faster at solving new instances of the problem, allowing chip design to be performed by artifcial agents with more experience than any human designer. Our method was used to design the next generation of Google's artifcial intelligence (AI) accelerators, and has the potential to save thousands of hours of human efort for each new generation. Finally, we believe that more powerful AI-designed hardware will fuel advances in AI, creating a symbiotic relationship between the two felds.

Best Poster Award

Computing einsum expressions using LIBXSMM

Max Koch[1]

[1]Friedrich Schiller University Jena, Germany

Abstract: The Einstein summation convention (einsum) is a powerful notation to express operations on tensors. In my research, I tried to find an approach to compute einsum expressions in a way that reduces memory overhead.

Best Poster Award

DB Systems optimised for ML

Tamino Steinert[1]

[1]Friedrich Schiller University Jena, Germany

Abstract: It was demonstrates that machine learning (ML) can be directly integrated into data management systems (DMS) by adding two new optimised operators for gradient descent and automatic differentiation. The integration has positive effects. Data doesn't need to be copied and managed outside a DMS. It can used for model reproducibility and versioning. It can also help by creating multi-user data access and workflows. It enables safe hardware sharing to improve hardware utilisation.

Exploring Optical Artificial Neural Inference

Matin Dehghani[1]

[1]Friedrich Schiller University Jena, Germany

Abstract: Artificial Neural Networks have great potential in various applications, but their reliance on increasing computing power poses challenges for speed and energy efficiency. Researchers are exploring optical neural computing, an approach harnessing minimal energy consumption and intrinsic parallelism to boost computational speed. This poster reviews two research papers: Diffractive Deep Neural Networks (D2NN), an all-optical framework using diffractive surfaces for parallel computation, and Nanophotonic Neural Medium (NNM), employing scattering inclusions for information processing.

Forward Looking Active Retrieval Augmented Generation

Lukas Zeit-Altpeter[1]

[1]Friedrich Schiller University Jena, Germany

Abstract: Generative question answering systems work by using knowledge encoded within their large language models' weights. A significant challenge these systems face is the phenomenon of hallucination, where incorrect or misleading answers are generated. The integration of document retrieval to provide contextual information for generating accurate responses can help mitigate this issue. This poster presents an approach called Forward Looking Active Retrieval (FLARE) that uses the confidence of generated tokens as a guiding mechanism for determining when to retrieve additional contextual documents. By leveraging this strategy, the proposed FLARE approach demonstrates superior performance compared to existing retrieval-augmented generation question answering methods.

MSNovelist: de novo structure generation from mass spectra

Jonas Emmert[1]

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Abstract: Mass spectrometry is vital in metabolomics and non-targeted analysis, providing valuable information about unknown compounds. However, current methods for structure annotation like database search have limitations in identification and representation of novel compounds and underrepresented analyte classes. To address this, MSNovelist presents a novel approach that directly generates candidate structures from MS/MS spectra, bypassing the need for databases. This is accomplished by using SIRIUS and CSI:FingerID results (molecular formula and fingerprint, respectively) as input to an RNN generative model.

Self Supervised Learning for Robustness and OOD Detection

Nick Würflein[1]

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Abstract: Neural Network (NN) Models can be used to solve various tasks, including image classification and object segmentation. Usually, these tasks are solved using a so-called supervised learning approach, in which training data is passed through the network and the model output is compared to previously known labels. Another approach is to use so-called self-supervised learning (SSL). In this scenario, no labels are previously known; rather, a label is automatically generated during the learning process. The goal of out-of-distribution (OOD) detection is to detect if new input data is drawn from the probability distribution modeled by the NN. This can be useful in the deployment of NN models in critical situations, for example in autonomous driving or in the medical field, because inputs that are not modeled by the NN can be refused and errors can be avoided. Another aspect that can be improved by using SSL methods is model robustness. Broadly speaking, model robustness describes how well a model can work around different types of noise. In this contribution, we want to highlight SSL and its advantages for increased robustness in image tasks, as well as improved OOD detection compared to the respective state-of-the-art methods. To this end, we summarize the work of Chen et al. as well as Hendrycks et al.

StyleGAN-Structure and Applications

Lucas Fabian Naumann[1]

[1]Technische Universität Dresden, Germany

Abstract: StyleGAN is a generative model introduced in 2018 that gained a lot of attention due to its at that time unmatched image quality. Although it is no longer the best model for photorealistic image generation, its unique structure allows fine-grained control over the generated images making it still valuable for diverse applications. The first part of this poster provides an overview of the StyleGAN structure, focusing especially on the used adaptive instance normalization layers and the style space. In the second part, the usage of StyleGAN is demonstrated in four applications: generation of counterfactual explanations for image classifiers, local semantic editing of images, human reposing and fast text-to-image synthesis.

Best Poster Award

Summarizing: A Machine Learning Approach For Classifying Ischemic Stroke Onset Time From Imaging

Daria Glaser[1]

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Abstract: Stroke is the 2nd most common cause of death and the 3rd most common cause of long-term disability worldwide. The usual treatment consists of thrombolysis by administration of tPA (tissue plasminogen activator) within <4.5h after onset of symptoms (time-since-stroke, TSS). Approximately of patients have to be excluded from thrombolysis treatment as TSS cannot be determined (e.g. wake-up strokes, unwitnessed strokes). These patients receive special magnetic resonance (MR) imaging (DWI-FLAIR) in order to determine if tissue with reversible brain damage is still left. However, DWI-FLAIR-mismatch method only has a moderate inter-observer-agreement as it requires extensive clinical training. Therefore, a machine learning model was introduced in order to improve patients' outcome and overcome the difficult DWI-FLAIR evaluation. The presented results are the intellectual property of Ho et al.

Best Poster Award

The Long Road to Artificial General Intelligence

Daniel Motz[1]

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Abstract:

- Artificial Neural Networks (ANNs) are mostly of a »black-box« nature and difficult to interpret.
- ANNs have not yet shown great transferrability of domain specific knowledge.
- ANNs tend to overestimate themselves
- Introspection is currently limited

Using Tensor Processing Units for Neural Networks

Jonas Engicht[1]

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Abstract: This poster presents an overview of Tensor Processing Units, which are custom hardware devices that Google developed to accelerate machine learning applications. It describes the key features and design choices of the four generations of TPUs, focusing on their differences in numerical formats, instruction sets, hardware components and performance. The poster compares and contrasts the benefits and drawbacks of each TPU generation. It is also explained how TPUs can be accessed through Google Cloud Platform using two different architectures: the TPU VM architecture and the TPU Node architecture.

Wie lernen Künstliche Intelligenzen?

Paula Kecke[1]

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Abstract: In diesem Poster werden drei Wege der Strategieoptimierung vorgestellt, mit Vor- und Nachteilen betrachtet und basierend auf einer Seminarfacharbeit verglichen.