universität innsbruck
Fakultät für Mathematik, Informatik und Physik

BERUFUNGSVORTRÄGE: „Informatik mit dem Schwerpunkt Künstliche Intelligenz“

Montag, 15. April 2024 **Institut für Informatik (ICT Gebäude) - Raum 3W03**	
Dmitry KOBAK	
14:00 – 14:30	**Lehrevortrag und Diskussion:** **„Neural networks and backpropagation“**
14:30 – 15:10	**Forschungsvortrag und Diskussion:** **„Low-dimensional embeddings and self-supervised learning“** *Tremendous progress in machine learning, in particular in computer vision and natural language processing, achieved over the last few years has been built on the foundation of self-supervised learning (SSL). At the same time, using SSL for data science goals, such as data exploration, data curation, and data visualisation, has so far received much less attention. While existing SSL systems produce high-dimensional image or text embeddings suitable for downstream machine learning applications, humans require low-dimensional, mostly 2D, embeddings to reason about data structure. In this talk, I will present our recent work on low-dimensional SSL and my vision of how it can be developed further to apply to image, text, and multimodal data.* *I will also talk about our recent work on relationships between SSL and neighbour embeddings.*
Donnerstag, 18. April 2024 **Institut für Informatik (ICT Gebäude) - Raum 3W03**	
Paul JÄGER	
08:30 – 09:00	**Lehrevortrag und Diskussion:** **„Neural networks and backpropagation“**
09:00 – 09:40	**Forschungsvortrag und Diskussion:** **„Bridging AI Research and Practice: A Human-Centered Approach towards Beneficial and Trustworthy AI Systems”** *This talk presents a strategy for developing Artificial Intelligence (AI) systems that are both beneficial and trustworthy. The strategy will be outlined in three focus areas: reliable decision making, advancing Explainable AI (XAI), and facilitating human-in-the-loop annotation. The talk will feature publications at international journals and conferences such as NeurIPS, ICLR, and Nature Methods, all of which address the limitations of perceiving AI as fully autonomous "red button systems", and highlight the importance of aligning research practices with real-world applications.*

*) Die Veröffentlichung von Namen und Titel erfolgt nur auf Zustimmung der Vortragenden. Stellungnahmen zu den Vorträgen der Hearing-Teilnehmer richten Sie bitte bis längstens 16:00 Uhr des letzten Vortragstages an Fakultaet-MIP@uibk.ac.at.

Freitag, 19. April 2024 **Institut für Informatik (ICT Gebäude) - Raum 3W03**	
N. N.*	
12:00 – 12:30	**Lehrevortrag und Diskussion:** **„Neural networks and backpropagation“**
12:30 – 13:10	**Forschungsvortrag und Diskussion:** **„Exploring and Learning from Visual Data”** *In this talk, I discuss a selection of my scientific achievements, followed by my research vision. A first part of my achievements concerns exploring visual data using deep visual representations obtained by transfer learning. Contributions are made to instance-level spatial matching and search; the former by observing that local features and visual words emerge in convolutional activations and the latter by ranking data on manifolds using nearest neighbor graphs. A second part concerns learning deep visual representations by exploring visual data with limited or no supervision. Contributions are made to semi-supervised learning by inductive label propagation and to few-shot learning by dense classification, which behaves like implicit data augmentation. A third part concerns large-scale learning of visual representations from scratch, regardless of level of supervision. Contributions are made to interpolation-based data augmentation in the embedding space and to attention-based masked image modeling for self supervision. My research vision is motivated by the massive capacity of the human visual long-term memory. The dominant paradigm in deep learning is to train parametric models on data that is then discarded, leaving the acquired knowledge distributed over the model parameters. On the other hand, non-parametric methods are becoming popular in specific settings. The long-term goal of my research program is to investigate the regime in-between the two extremes, where data becomes an explicit part of the model rather than just the training process. An important direction towards this goal is learning while memorizing.*
Dienstag, 23. April 2024 **Institut für Informatik (ICT Gebäude) - Raum 3W03**	
Dominik GRIMM	
08:30 – 09:00	**Lehrevortrag und Diskussion:** **„Neural networks and backpropagation“**
09:00 – 09:40	**Forschungsvortrag und Diskussion:** **„AI for Life - From Understanding Complex Biochemical Systems to Enabling Sustainable Agriculture and Biotechnology”** *Artificial intelligence is a key technology for studying complex biochemical systems and supporting the transition of our economy to a more sustainable and biological economy. In this talk, I will give a general overview of my lab's research at the intersection of machine learning and bioinformatics, with a particular focus on enabling more sustainable applications in biotechnology, chemistry, and agriculture. In the first part of my talk, I will introduce novel statistical pattern mining and machine learning techniques that help to better understand high-dimensional and complex biochemical systems, their functioning and biochemical properties, followed by some limitations and how we can address or mitigate them in more detail. I will then give some recent examples of how these technologies and methods can help to develop more sustainable applications in biotechnology, as well as in chemistry and agriculture. Finally, I will conclude with some future research directions.*

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N. N.*	
12:00 – 12:30	**Lehrevortrag und Diskussion:** **„Neural networks and backpropagation“**
12:30 – 13:10	**Forschungsvortrag und Diskussion:** **„Egocentric-Exocentric Fusion: Advancing Perception for Human-Robot Collaboration”** *First-person or “egocentric” perception requires interpreting sensory data (images, video, audio, gaze, and motion) as it streams to a person’s wearable, head-mounted device. It entails 3D understanding of physical environments, social contexts, and human-object interactions from a wearer’s perspective. A recent trend is to combine egocentric perception and “exocentric”, third-person video understanding, which opens interesting new perspectives for research. In this seminar I will review our more recent and ongoing work on human action recognition and explainable action anticipation, and discuss my plans to step further into procedural activity recognition which connects data-driven learning with process modeling. I will do so by emphasizing the methodological principles adopted in the design of our methods, clarify on how they are grounded in this context, and conclude by sharing my view on how these may converge in the realm of egocentric-exocentric perception for human-robot collaboration.*
Jörg LÜCKE	
15:00 – 15:30	**Lehrevortrag und Diskussion:** **„Neural networks and backpropagation“**
15:30 – 16:10	**Forschungsvortrag und Diskussion:** **„Probabilistic Generative Models for Large-Scale, Data Efficient, Unsupervised and Semi-Supervised Learning”** *Artificial Intelligence (AI) accomplishes tasks that have previously been reserved for biological (mostly human) intelligence. The success of current AI systems is enabled by large data representations. But such representations conventionally require vast amounts of data, considerable human labor to create large (labeled) datasets, and large amounts of processing resources. However, large datasets, the required human labor and large processing resources are increasingly perceived as problematic for a number of reasons. In my talk I will discuss approaches that allow for learning large-scale representations without requiring human labels and which require less data. Furthermore, the approaches I discuss can statistically accurately model different data types including non-Gaussian and non-metric data, and they provide uncertainty information or more interpretable, flexible and robust representations. The central learning paradigms I apply in my research are unsupervised and semi-supervised learning based on probabilistically grounded objectives such as the ELBO (a.k.a. free energy). I will discuss data models ranging from deep generative models such as variational autoencoders to models based on elementary and intricate graphical models. As one result, I show the largest-scale representations learnable to date for elementary models. Furthermore, I will report on projects that analyze learning theoretically, and on projects applying the developed approaches to medical data, low photon-count images, bio-medical images and acoustic data. Properties of the developed algorithms are discussed and potential future research collaborations at Innsbruck are pointed out.*

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Mittwoch, 24. April 2024 **Institut für Informatik (ICT Gebäude) - Raum 3W03**	
Renaud JOLIVET	
11:00 – 11:30	**Lehrevortrag und Diskussion:** **„Neural networks and backpropagation“**
11:30 – 12:10	**Forschungsvortrag und Diskussion:** **„Bioinspired normative learning in spiking neural networks”** *NeuroAI proposes to use insights from neuroscience to catalyse the development of next-generation artificial intelligence. To this day, the human brain remains the most versatile device capable of intelligence, and it achieves this by using binary and noisy spiking neurons that operate in a resource-limited environment. I will show how this can be the basis of a normative theory of information flows in spiking neural networks. I will then introduce a new three-factor synaptic learning rule that we have derived from these observations. Using this new synaptic learning rule, I will show that limiting resources can improve inference between inputs and outputs of small spiking neural networks, and yields sparse coding with stable representations. Finally, I will show how some of the experimental findings that led to this work can be recovered in these artificial spiking neural networks, looping back to neuroscience. I will conclude with a few words on future directions and developments.*
Donnerstag, 16. Mai 2024 **Institut für Informatik (ICT Gebäude) - Raum 3W03**	
Bo LIU	
12:00 – 12:30	**Lehrevortrag und Diskussion:** **„Neural networks and backpropagation“**
12:30 – 13:10	**Forschungsvortrag und Diskussion:** **„Explainable Reinforcement Learning”** *This presentation identifies a pivotal factor for cultivating trust in autonomous systems: explainability and safety, particularly regarding failure-criticality. To attain human-understandable interpretability in decision-making, I propose novel algorithms that leverage Transformer tokenization, symbolic AI, and data-driven machine learning to facilitate real-world applications. Specifically, addressing the challenge of highly uncertain, implicit, data-hungry, and high-dimensional behavior-level explainability is intricately transformed into deterministic, explicit, data-efficient, and low-dimensional Task-level Explainability Reinforcement Learning (TERL, IJCAI'2018, AAAI'2019, ICLP'2019, IEEE-TETCI'2022, IEEE-TNNLS'2023, AAAI'2024). This approach attains state-of-the-art results in demanding Atari games, such as Montezuma's Revenge, surpassing other methods significantly in data efficiency and performance. Ongoing work will also be discussed, where TERL is further improved by incorporating the emerging Large Language Model.*

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