SECAI: School of Embedded Composite AI

Annual Report 2024

SECAI School of Embedded Composite Artificial Intelligence

TECHNISCHE UNIVERSITÄT DRESDEN

UNIVERSITÄT LEIPZIG

With funding from the:

Federal Ministry of Research, Technology and Space

DAAD Zuse Schools
Konrad Zuse Schools of Excellence in Artificial Intelligence

Dear Reader,

for SECAI, 2024 has been a transformative year in many ways. At its start, the 18-month old Zuse School had only just welcomed its annual batch of new graduate school members and scholarship holders. Almost everybody funded by SECAI at this time had been with the project for less than a year. Now, at the end of 2024, SECAI has grown to its full size, more than a hundred research articles have appeared, and the first successful PhD has been awarded.

Markus Krötzsch, SECAI Director

As part of this impressive journey, SECAI has continued its organizational and professional development. This involved reviewing the largest number of applications for PhD positions and scholarships that the school has yet received, and welcoming the talented individuals who were selected. More than ever before, SECAI has realized the potential of the idea of the Zuse Schools as institutions that foster AI excellence at all levels of higher education and research.

This annual report of SECAI gives an overview of the rich activities of the school and recounts the main achievements of 2024. Most recent updates and announcements of new application rounds can always be found on our web portal https://secai.org.

Have a good read!

CONTENTS

SECAI

[zekai]

SECAI Advances Excellence in AI Research

We view AI as an interdisciplinary long-term challenge that requires experts from many areas. SECAI's foundational research brings together computer scientists, mathematicians, electrical engineers, and experts in law and society; our applied research in digital health and medical informatics ensures practical relevance.

SECAI Educates the Next Generation of AI Experts

Our structured training programs foster new AI talents from undergraduate studies to completed PhD. Studying in SECAI comes with priority access to leading AI experts and attractive funding programs.

SECAI Builds Research-Oriented AI Networks

Our extensive national and international research network creates synergies and fosters collaboration. From student exchange to joint research projects, being part of SECAI is being part of a global academic community.

SECAI is Visible

We believe that AI research is a concern to all of research and a fundamental societal concern. By taking part in the public discourse, we foster transparency and establish SECAI as a label for excellence in AI.

SECAI Makes a Lasting Impact

Our activities are designed to create lasting effects on the research and teaching at our host institutions and in German AI in general. We work closely with the universities to build sustainable structures.

SECAI brings together researchers from different research domains

SECAI AT A GLANCE

A Short Introduction to the Zuse School in AI

The School of Embedded Composite Artificial Intelligence (SECAI) is a joint project of TU Dresden and Leipzig University that fosters AI research and higher education. SECAI integrates university studies, academic research, and industrial applications by sponsoring students, improving teaching, funding researchers, and supporting exchange.

Research

SECAI is distinguished by its inclusive view on AI that encompasses foundational research – especially in symbolic and statistical AI methods – as well as applied research – especially in the medical domain. Learn more *on page 12*.

Education

SECAI educates future AI professionals and researchers on many levels. It supports AI-related MSc study programs in Dresden and Leipzig, offers scholarships to outstanding students *(see page 14)* and runs an own Graduate School for doctoral researchers *(see page 16).*

THE DAAD KONRAD ZUSE SCHOOLS OF EXCELLENCE IN AI

SECAI is part of a targeted funding program that aims to boost AI research and education in Germany. The DAAD Konrad Zuse Schools of Excellence in AI are conceived as national centers for innovative education of outstanding young AI researchers at MSc and PhD level. Each Zuse School brings together several German universities with an excellent standing in AI research and a forward-looking concept for future university education. The three Zuse Schools ELIZA, RelAI, and SECAI have started their operations in July 2022.

More information about the Zuse School program can be found online:
www.daad.de/en/the-daad/zuse-schools/

SECAI

School of
Embedded Composite
Artificial Intelligence

SECAI Facts and Figures

Title
School of Embedded Composite AI

Participating organizations
TU Dresden (coordinator), Leipzig University, University Hospital "Carl Gustav Carus" Dresden

Current funding period
07/2022 – 12/2027

Funding volume
13.2 M EUR

Funding bodies
Federal Ministry of Research, Technology and Space (BMFTR) via German Academic Exchange Service (DAAD)

TU Dresden, Faculty of Computer Science

Leipzig University, Faculty of Computer Science

THE SECAI CONSORTIUM

Places Where the Future of AI is Shaped

TU Dresden

Dresden University of Technology is one of the largest Universities of Technology in Germany and is among the leading and most dynamic universities in the country. With 17 Faculties across five Schools, it offers a widespread range of 119 degree programs and covers a broad spectrum of research. Its focuses on Life Sciences, Quantum Materials, Microelectronics, Tactile Internet, Materials Science, Data-Intensive and Digital Sciences, Circular Economy and Societal Change are considered exemplary across Europe.

TU Dresden is leading the SECAI consortium, with participation of the faculties of Computer Science, Electrical and Computer Engineering, and Arts, Humanities and Social Science. Markus Krötzsch of the Chair for Knowledge-Based Systems is the project leader and current director of SECAI.

Leipzig University

Founded in 1409, Leipzig University is one of Germany's largest universities and a leader in research and medical training. With around 31,000 students and more than 5,000 members of staff across 14 faculties, it is at the heart of the vibrant and outward-looking city of Leipzig. Leipzig University offers an innovative and international working environment as well as an exciting range of career opportunities in research, teaching, knowledge and technology transfer, infrastructure, and administration.

Leipzig University is a partner in SECAI with participating fellows affiliated with the Department of Mathematics and of Computer Science, Faculty of Medicine, the Max-Plank-Institute for Mathematics in the Sciences and the Frauenhofer Institute for Cell Therapy and Immunology. The SECAI co-director in Leipzig is Peter F. Stadler, head of the Bioinformatics Research Group in the Institute for Computer Science.

University Hospital Dresden, National Center for Tumor Diseases

University Hospital Carl Gustav Carus Dresden

The University Hospital Dresden commits to excellence in medical care, medical research and training, and health services for patients throughout the region. As an internationally outstanding academic-medical center, it is playing an important role in medical AI research.

In SECAI, the University Hospital is in particular involved via the Else Kröner Fresenius Center for Digital Health (EKFZ), which has its topical focus in research areas of high relevance for AI, including robotics and coworking, sensors and medical devices, as well as connected care. SECAI co-director Stefanie Speidel is a professor at the National Center for Tumor Diseases (NCT) in Dresden and member of EKFZ.

WIDENING THE VIEW

Making the Case for a Broader Perspective on Artificial Intelligence

As with any major progress in research or technology, we like to attribute breakthroughs in AI to single causes: brilliant concepts that fundamentally enable computers to be intelligent. In reality, however, practical AI systems are the result of combining ideas and methods from many sources, making them work together through careful engineering. In all of this, the human user and the demands of the target application must be taken into account.

SECAI therefore pursues an approach that conceives AI as a broad endeavor that brings together foundational and applied research from a wide range of topics. To organize this breadth in a productive and beneficial way, SECAI research is centered around five Research Focus Areas. These areas communicate intensely, and many SECAI researchers contribute to more than one of them, but they also provide topical fields that encourage researchers to go deep into the field where they can contribute most.

Composite AI

Hybrid methods and algorithms that combine strengths of distinct AI techniques

While traditional AI was driven by the search for one single paradigm to create intelligent behavior, most modern AI success stories embody a synergistic combination of multiple paradigms, known as hybrid or composite AI. While “pure” methods achieve

a certain success, recent composite approaches accomplish similar performance at much lower cost. As widespread as hybrid approaches are in AI today, the combination of methods is often a feat of engineering, whereas a principle understanding of composite methodologies and their effective use is lacking. In SECAI, we assemble internationally recognized experts across a broad spectrum of hitherto segregated AI approaches, ranging from symbolic methods to machine learning.

AI Compute Paradigms

Fundamentally new computing hardware and its effective use in AI

The recent leaps of AI have been inextricably connected to the advancement of computing hardware. The present wave of AI breakthroughs started with the insight that graphics hardware (GPUs) can be harnessed to scale known machine learning (ML) methods to much larger data sizes, and AI has since been associated with massive computation usage. Specialization is now a major trend in microelectronics: CPUs and GPUs today compete with field-programmable gate arrays (FPGAs) and application-specific integrated circuits (ASICs). The success of innovative hardware crucially depends on embedding: (1) the physical embedding of the hardware in intelligent devices and (2) the logical embedding of AI algorithms in the computational framework of the underlying hardware. SECAI aims at dealing with both aspects by developing future AI compute paradigms.

Intelligent Medical Devices

Cyber-medical AI systems and clinical embedded AI applications

The specific needs of relevant application domains yield guidelines for the future development of AI that are at least as important as hardware and algorithms. In SECAI, a suitably concrete application scope is provided by the multitude of exciting and prospering uses of AI in life science and medicine. The field's demanding requirements for hardware (small, energy-efficient, real-time capable) and methods (robust, scalable, trustworthy) make it an ideal test bed for interdisciplinary AI solutions.

AI Methods for Health

AI for bio-medical data analysis and knowledge management

With the growing amount and complexity of data in healthcare, AI methods become increasingly prevalent in biomedical research, promising to generate new insights by revealing latent patterns hidden in the data. Applications range from computer-aided drug design and medical image analysis to diagnostic expert systems and cyber-medical systems. As the success of the such methods is very sensitive to the quality of the input data, solutions for large-scale data management are required.

Societal Framework for AI

Cross-cutting research on wider societal concerns and policies

Technological breakthroughs can only unfold their practical benefits if they are aligned with the broader frameworks that govern societal acceptance, legal approval, and economic viability. The European Commission's recent Artificial Intelligence Act has drawn attention to the formidable difficulty of regulating AI in a way that protects citizens from risks like discrimination and still fosters innovation and economic growth. Through its focus on medicine and health care, SECAI deliberately connects to a field that – like AI – is inseparable from far-reaching questions of ethics, law, and societal acceptance. SECAI builds on the partners' substantial experience in topics like data protection and regulatory affairs in medical contexts, while also taking political and philosophical aspects into account.

SECAI is training the next generation of AI experts

“WHERE CAN I STUDY AI?”

The AI Teaching Portfolio at TU Dresden and Leipzig University

The acute shortage of AI professionals is met by a huge interest among students to study “AI”. Their choice, however, is not always easy: AI is a vast area that requires many different skills, and technology often changes faster than study plans. SECAI therefore supports several MSc training programs, which cover a breadth of skills and focus on methods and concepts of lasting relevance. Scholarships are available.

The following master-level programs each have a two-year curriculum. For broader programs that support different specializations, SECAI supports teaching offers and students with a strong focus on AI.

AI@TU Dresden

Computer Science
The MSc program in computer science offers a broad range of courses on AI methods, including fields such as computer vision, robotics, data analysis, and symbolic AI. A particular emphasis of the program is on foundational and research-oriented topics. From 2025 on, the CS master program of TUD is switching to English as its primary teaching language, a move that is perfectly aligned to SECAI’s internationalization goals.

Computational Modeling and Simulation

This innovative, international study program spans several faculties and a range of interdisciplinary and applied topics in data science, AI, bioinformatics, and applications. Students of CMS enroll for a specific track that defines their topical focus. For those with an interest in AI, the most important tracks are *Computational Life Science* and *Visual Computing*, as well as the new track *Applied Artificial Intelligence* that was created as part of the SECAI teaching activities (first students will start in 2025).

Nanoelectronic Systems

Dresden, the center of the European semiconductor industry, is an ideal location for studying cutting-edge electronics. The international MSc program Nanoelectronic Systems endows students with key skills related to the fundamental technologies, design, and applications of today's increasingly miniaturized computing systems. In particular, this also includes modules on AI-specific hardware accelerators and novel compute paradigms.

AI@Leipzig University

Data Science

Students of this MSc program focus on recent topics in data analytics, scalable data management, and data mining. This builds a bridge between fundamental AI methods and applications.

Bioinformatics

This program brings together computer science and biology to focus on one of the most important and successful interdisciplinary fields in AI. Students acquire knowledge in the sciences, computing, and mathematics, and learn to combine their skills in relevant application fields.

Medical Informatics

This interdisciplinary program incorporates many aspects of digital health and medical information systems. The interface of computer science and medicine defines the methodological center of the training, and also touches upon applications.

Computer Science

Students may select a limited number of AI modules from the above mentioned specialties for their studies in Computer Science.

SUPERCHARGE YOUR STUDIES IN AI

SECAI Scholarships

Talented students of AI have access to a range of financial support programs that help them to make the most of their studies, kick-start their research career, and build their professional network. SECAI offers residency scholarships, which cover living expenses in Germany, as well as mobility grants to foster international exchange. See **secai.org/students/scholarship_programs.**

Yearly Application Rounds for New MSc Students

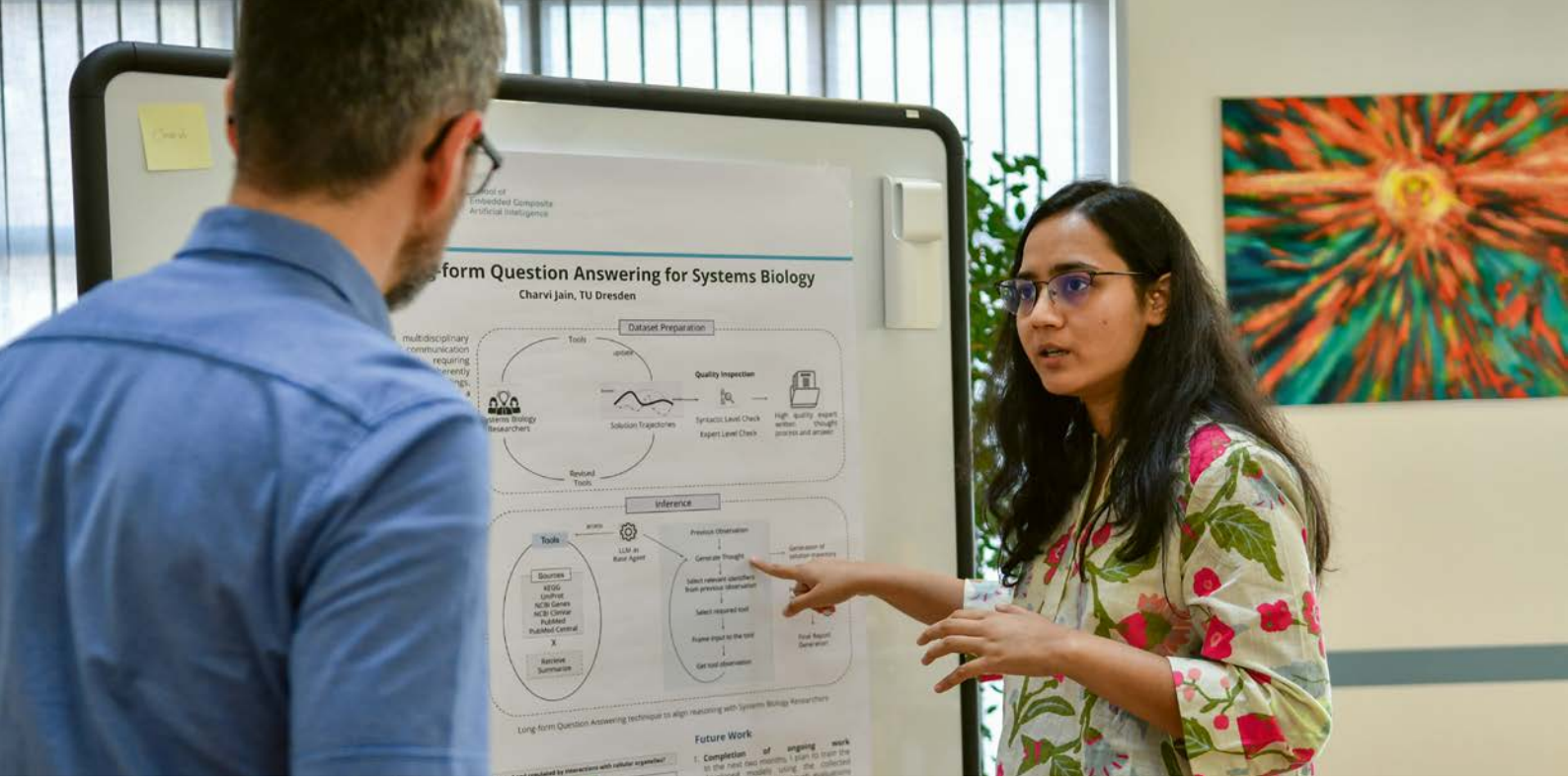
Students who plan to start in an MSc program at TU Dresden or Leipzig University can apply for SECAI scholarships in May and June of the same year and receive timely notifications. The scholarships are initially awarded for a limited time, and can be extended based on the result of intermediate reviews of study progress.

Mobility Grants

SECAI strongly encourages international exchange and offers dedicated mobility grants. Students in Dresden and Leipzig can receive grants to visit international partners and research events, and students from international sites can receive grants to visit Dresden or Leipzig. SECAI fosters sustainable travel and covers extra costs to avoid short-distance flights.

Offers for Current Students

SECAI support is not limited to students at the start of their MSc, but can be applied for at any stage of the studies. Just ask!



Charvi Jain is presenting her research at a SECAI meeting

STARTING A CAREER IN AI

The SECAI Graduate School is a Training Ground for Future AI Experts

The research-oriented graduate program is an integral part of the activities in SECAI. In a fully-funded 3-year training program, researchers have the opportunity of obtaining their PhDs under the guidance of renowned researchers in Dresden and Leipzig.

Researching Together

SECAI is taking in graduate researchers in yearly cohorts, starting in autumn for a smooth transition from the MSc programs. By the end of 2024, the Graduate School has grown to a total of over 30 researchers. Each doctoral student and clinician scientists is supervised by a primary supervisor and at least one second supervisor, typically a SECAI Fellow from the same research focus area. SECAI values communication and exchange, and supports researchers in widening their professional network – a highly inspiring environment. A list of Graduate School members is found *on page 48.*

PhD Students and Clinicians

Due to the specific interdisciplinary profile of the school, the graduate program includes both doctoral students and clinician scientists. The latter is a training model at university clinics that allows physicians to conduct research in parallel to their specialist training (German *Facharztausbildung*), enabled by a reduction of their medical service duties. At the end of this structured academic pathway, clinician scientists do usually not obtain an (additional) doctorate but a visible research output and have an optimal preparation for a research-oriented career in their field.

Roads to Success

The school favors three-year model for completing doctoral theses, but also understands that this plan may need adjustment due to interdisciplinary differences (e.g., clinician scientists often finish in two years), personal circumstances (e. g., family planning), and professional causes (e. g., unforeseen developments in the research area). SECAI strives to support this diversity in individual research paths and seeks out individual solutions in exchange with supervisors and researchers. Two elected graduate school representatives have voting right in the regular decisions of the SECAI Steering Group *(see page 46)*.

Fast Track to Research

A dedicated Fast-Track PhD program supports the transition from MSc student to doctoral researcher. The program blends the final MSc semester with the first half year of doctoral studies by aligning MSc topic and future PhD topic, and providing financial support. For the latter, the SECAI scholarship programs have proven to be very effective.

Mini Projects

SECAI's special program for mini projects allows graduate researchers to obtain small-scale funds for activities of their own choice, e. g., for special equipment, compensations for participants in empirical studies, or organization of own events or guest invitations. Applications follow a simple and unbureaucratic process, but will receive expert feedback to prepare candidates for own future proposals. Since the start of SECAI, 27 project grants have been awarded overall *(see table)*.

SECAI MINI PROJECTS (AS OF 2024)

- **Research stays:** 4 projects
- **Research materials:** 4 projects
- **Summer school and workshop participation:** 10 projects
- **Student assistants:** 9 projects

- **TOTAL: 27 PROJECTS**

PhD students meet their supervisors regularly

The joy of interdisciplinary research experiences

Exchange at the annual meeting of the German Zuse Schools

Robot-assisted surgery can improve patient outcomes

AI MADE IN GERMANY

SECAI Bridges the Gap Between Academia and Industry

To support Germany's pioneering role in AI, SECAI creates a platform for intensive exchange between academia and industry. The interdisciplinary nature of SECAI allows not only research exchange between discipline but places it at a prime position to transfer cutting-edge research to industry, which requires a holistic view instead of isolated solutions.

A prime example is the robotics industry, which will form the basis for a flourishing society and economy in the coming years. Several research groups in SECAI engage in different aspect of robotics, from human-machine interaction over the digitization of touch to applications in robot-assisted surgery.

SECAI therefore also contributes to regional and national networks such as the Robotics Institute Germany (RIG), which is set to become a driving force for German robotics to meet challenges such as labor shortages, demographic change, and climate change. SECAI's activities in RIG – led by Fellows Stefanie Speidel and Frank Fitzek – focus on the development and implementation of innovative educational modules and student research and incubator programs within the RIG educational program, the establishment of a medical robotics cluster and participation in other AI-based robotics clusters, as well as the implementation of outreach concepts.

Also beyond RIG, SECAI's research and industry network is complemented by support structures that facilitate the transfer to industry. Dedicated

Stefanie Speidel at the 1st German Robotics Conference, organised by RIG

partner initiatives, such as LaunchHub42 in Dresden and SMILE in Leipzig, support young researchers in turning their research into successful start-ups. The success of these collaborations is testified by people such as Christian Vielhaus, member of the SECAI Graduate School and supervised by Frank Fitzek: together with two colleagues, he has recently co-founded the start-up Soron Systems, which develops innovative SLAM (Simultaneous Localization and Mapping) technologies to enable mobile robots and drones to navigate efficiently and autonomously.

Christian's story is not the only example of successful transfer from AI research into practice (see info box), but with the first cohort of SECAI PhD researchers reaching their graduation only in 2025, we expect many more such cases for the future. Backed by the experience and partner network of SECAI, upcoming cohorts of SECAI researchers will have great opportunities for turning their expertise into economical and societal benefits.

FIRST SPIN-OFFS FROM SECAI

- **Soron Systems:** autonomous navigation of mobile robots and drones
- **StratifAI:** multimodal AI models for meaningful prognostic insights to guide treatment decisions in oncology
- **AI-DT:** accelerated protein design with computational AI methods

Julia presenting her research at the Zuse Schools Event in Munich

DESIGNING THE NEXT GENERATION OF MEDICATION

An Interview with SECAI PhD Student Julia Belyaeva

Julia Belyaeva has joined the SECAI Graduate School in September 2023 and is part of the Elgeti Lab at the Institute for Drug Discovery at Leipzig University, led by Prof. Jens Meiler. Her PhD research, supervised by Dr. Matthias Elgeti and Prof. Jens Meiler, aims to create structural models of proteins to further design novel medications with fewer adverse effects. She has a Master's degree in Bioengineering and Bioinformatics from Lomonosov Moscow State University in Russia, with a strong background in structural biology and computational biochemistry. With already two publications, she is well on track towards her PhD.

Julia, you work on facilitating the development of more effective medication with fewer side effects. Can you tell us what your research is about and why we can be excited about it?

One of the biggest challenges in developing new medicines is avoiding unwanted side effects. Most medications work by binding to proteins in our body. This binding usually stabilizes a specific shape of the protein – one that is responsible for activating the desired physiological process. However, a medication might also stabilize a different shape of the protein – one that can trigger not only the desired function but also an unintended one. This can lead to unwanted side effects.

Our research aims to help solve the problem of side effects. A promising strategy is to develop medication molecules that target a specific protein shape responsible for activating only one physiological function. However, these shapes are rare, short-lived, and often impossible to capture using current experimental techniques. I am developing a computationally efficient approach that integrates experimental data with AI and molecular modeling methods to build structural models of these elusive conformations. With these models, we can design novel medications – ones that are safer, smarter, and focused on doing exactly what they're meant to do.

SECAI strives to foster AI research and education, especially with its Graduate School. How did the environment offered by SECAI influence your decision where to start your PhD?

Before starting my PhD, I was looking not only for reasonable financial support but also for a research environment where I could work on a topic I truly care about, exchange ideas with researchers from around the world, and gain a deeper understanding of how science operates both in academia and in industry. SECAI offered all of that. What made it even more exciting was that the PhD project I applied for perfectly matched both my skills and interests. I'm especially grateful that Prof. Jens Meiler and Prof. Sayan Mukherjee offered this project within SECAI.

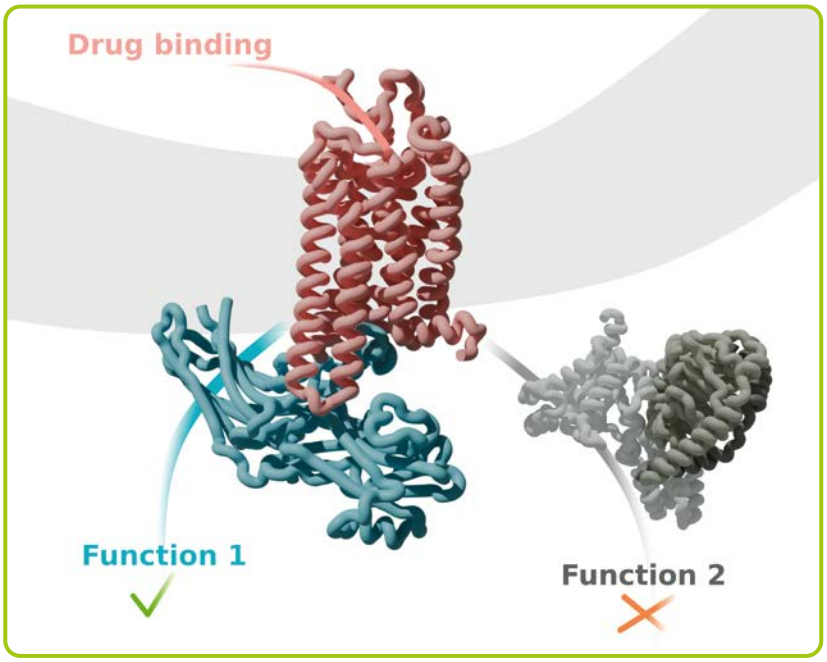
As for Leipzig University – there's a good story. Six years before my PhD, I visited Leipzig as a tourist, and was amazed by the city's energy, beauty, and welcoming atmosphere, full of diverse and enthusiastic people. I even tossed a coin into a fountain, hoping to return someday – and that wish came true. Leipzig is also home to the research group led by Dr. Matthias Elgeti, which I planned to join. This group has provided excellent opportunities to work on my PhD project while also expanding my knowledge of experimental techniques, protein biology, and computational methods.

As pursuing a PhD is a deep dive into research, what makes you passionate about your research and how do you stay motivated?

Regarding research, projects related to structural biology and medicine have always inspired me. I'm especially drawn to some challenges in modern healthcare that remain unresolved. One such challenge, which is becoming increasingly common due to the growing number of implanted medical devices – such as artificial heart valves, pacemakers, and dental implants – is the development of bacterial infections and sepsis.

Under certain conditions, bacteria can form biofilms on implant surfaces, allowing them to grow and eventually spread into the bloodstream. These infections are often difficult to detect in their early stages and can be hard to treat, especially with the rising prevalence of antibiotic-resistant strains. Sepsis, which may result, is a severe and life-threatening condition. I've been considering the possibility of designing a research project focused on better understanding the mechanisms of sepsis and exploring new treatment approaches. This would require thorough preparation – reviewing the literature, shaping the concept, and engaging in discussions with specialists. The topic remains a strong source of motivation for me.

Beyond science, I've been practicing contemporary pole dance for almost three years. This style combines elements of ballet and gymnastics with the pole, offering intense physical activity and a powerful way to release emotions and express feelings through movement. I can honestly say that dance has become a key part of supporting my mental health. Additionally, we have two cats at home: an orange male cat named Nuance and a white female cat named Korichka. They brighten my everyday life – and sometimes, when I'm working from home, they lie beside my computer and help with my research."



◂ Structural models help to predict properties of novel medications

Cityscape of Tokyo

TWO CONFERENCES AND A RECEPTION AT THE EMBASSY

A SECAI PhD Student's Busy and Award-Winning Trip to Japan

PhD student Jonas Karge receives Marvin Purvis Student Best Paper Award at PRIMA

The journey to Japan that SECAI PhD student Jonas Karge made in November 2024 was clearly a success: after representing the three DAAD Zuse Schools at an international event in Tokyo, he moved on to receive a best paper award for his research in Kyoto. And there was even some time left to appreciate Japan.

Jonas, who is a PhD student at TU Dresden and member of the SECAI Graduate School, started his busy schedule at the conference *Generative AI: Pathways to Democratization, Transparency and Sustainability* in Tokyo, which brought together researchers and representatives from industry from a broad range of disciplines. As part of the conference, Jonas was warmly welcomed to the German Embassy in Tokyo as a representative of the DAAD Konrad Zuse Schools of Excellence in AI.

The conference was dedicated to a variety of AI topics, with a particular focus on the latest developments in Large Language

Models (LLMs) such as ChatGPT, and their lack of democratization and sustainability. As an expert specializing in social choice theory, multi-agent systems and epistemology, Jonas contributed his research on voting systems. Further topics at the conference were the fairness of LLMs in a global context, adequate support for smaller languages, biases arising from imbalanced training data, and the immense environmental footprint caused by the use of energy and hardware throughout the LLM lifecycle.

Next, Jonas went on to Kyoto to attend the 25th International Conference on Principles and Practice of Multi-Agent Systems (PRIMA-24), where he presented his research work "Taming Dilation in Imprecise Pooling". This research is concerned with the challenges that arise when combining the beliefs of multiple AI agents, especially in the case where these beliefs are themselves endowed with some uncertainty. An important concern in this context is dilation, the phenomenon that, in some cases, the acquisition of new information inevitably leads to an increase in uncertainty. In the paper, he develops a first formal model for dilation, and describes the precise conditions under which and to what extent dilation is expected to occur in a recently proposed aggregation approach.

Jonas Karge represents the Zuse Schools at the DAAD confernce Generative AI: Pathways to Democratization, Transparency and Sustainability

For this research contribution, Jonas was honored with the Martin Purvis Student Best Paper Award. With its first editions dating back to 1998, PRIMA is a well-established conference in the multi-agent research community, which generally studies the interaction of autonomous agents in a shared environment. In the 2024 edition of PRIMA, papers on coordination and cooperation, logical aspects of multi-agent systems, and computational social choice were particularly represented.

SECAI GRADUATE SCHOOL ALUMNI 2024

The first cohort of SECAI PhD students will only start to graduate in 2025, but the research training of Clinician Scientist is planned for two years, and PhD students, too, can sometimes have shorter research times if they started research before joining SECAI. By the end of 2024, SECAI already has two graduate school alumni:

Carolin Schimmelpfennig successfully defended her PhD thesis "Characterization and evaluation of gene fusions in prostate cancer" at Leipzig University in July 2024 (supervisor Kristin Reiche).

Gregory P. Veldhuizen completed his clinician scientist training in SECAI with a total of nine articles on uses of AI in medicine, including a first author publication in the Springer journal Gastric Cancer on the use of deep learning for carcinoma subtyping (supervisor Jakob Kather).

Participants of the Touch Sensing and Processing Summer School

KEEPING IN TOUCH

SECAI Hosts the First Touch Sensing and Processing Summer School

Keynote speaker Zaki Hussein sharing his insights at the Summer School

The sense of touch is a human super power that is essential for handling objects, interacting with their surroundings, and analysing unknown materials. In comparison to hearing and vision, however, the understanding of touch in AI is still in its infancy. SECAI Fellow Roberto Calandra is committed to change this.

When it comes to tasks that cognitively challenge us humans, computers and AI technologies are already far ahead in certain areas. However, as soon as robotic systems are required to physically interact with their environment, they often achieve no more than the motor skills of a small child. An important reason is that the mere processing of image data provides insufficient information about the properties of the objects that such systems are supposed to manipulate. Material properties such as surface structure, weight, and hardness play a key role if robots are to be used flexibly in a variety of different applications. Tactile sensors therefore offer a promising opportunity to achieve the next breakthrough in robotic manipulation.

Roberto Calandra of the Chair of Machine Learning for Robotics at TU Dresden is a leading expert for touch in AI. His research has made important contributions to the field, e. g., by co-developing affordable touch sensors, but he is also active in fostering the budding AI touch research community. Backed by the support of SECAI, Calandra initiated the first Touch Sensing and Processing Summer School, which was held in September 2024. Co-chaired by Calandra and SECAI's Zdravko Dugonjić and Philipp Hanisch, the event brought together 40 participants from 15 nations in Pirna near Dresden. The main goal was to offer a platform for international researchers to receive input and discuss their research topics with leading international experts from academia and industry.

Invited speakers included Mark R. Cutkosky and Monroe Kennedy III (both University of Stanford), Merle Fairhurst (TU Dresden), Zaki Hussein (Touchlab), and Mike Lambeta (Meta AI). Accordingly, lecture topics covered hardware aspects, practical use in robotics, multi-modal sensing, and even social and psychological aspects of touch in human-computer interaction. In addition to the presentations, the event included a wide range of interactive modules, including workshops, discussions, and a poster session. Surrounding social activities provided additional opportunities for networking and exchange. Participant Zain Murtaza summed up the experience: "We all lived together here, and in all social interactions we discuss these ideas in a friendly and open way. I really like this atmosphere and I also benefit from the experience of some outstanding researchers". Calandra agrees that the event was a great success: "I hope that we can continue the Summer School for Touch Sensing and Processing for many years to come, because we urgently need events that bring our research community together and encourage new doctoral students who want to work in this field."

SECAI FELLOW ROBERTO CALANDRA

Prof. Roberto Calandra joined TU Dresden in 2023 and was elected as an Academic Fellow of SECAI in 2024. His research aims to improve collaboration between humans and machines in real, virtual, and remote environments. Besides touch for robotics, he is also working on decision-making under uncertainty, reinforcement learning, Bayesian optimization, and robot learning and control. Prospective applications of his work also include the use of touch sensing in medical diagnostics, e. g., for analyzing tissue inside the human body during surgery. In 2024, he received the Early Academic Career Award in Robotics and Automation of the IEEE Robotics and Automation Society (RAS).

Sebastian Rudolph (right) with postdoctoral researcher Hannes Strass (left)

"ARTIFICIAL INTELLIGENCE IS MORE THAN JUST CHATGPT"

An Interview with SECAI Fellow Sebastian Rudolph

Many people thing that AI is what language agents such as ChatGPT are doing, and even researchers sometimes believe AI to be largely the same as machine learning. But AI encompasses a much broader set of methods and ideas. In December 2024, Klaus Lüber of DAAD conducted an interview with Sebastian Rudolph on this topic.

Professor Rudolph, you are an expert in computational logic and knowledge representation. Can you explain what these fields encompass and which role they play in modern artificial intelligence?

The field of computational logic is concerned with how logical deductive reasoning can be described in mathematical terms, and automated with the aid of suitable algorithms. Knowledge representation is about formally structuring the knowledge related to a particular area and storing it in a computer system. It can take various forms, including concrete fact-based knowledge, general background knowledge, and operational knowledge. All this knowledge is then combined automatically to solve demanding tasks, such as responding to complex inquiries or dealing with planning problems. Logic-based knowledge representation is part of the field of symbolic artificial intelligence and is widely used in practice.

Sebastian Rudolph in conversation with Carsten Lutz

Since the huge success of ChatGPT, artificial intelligence is frequently equated with machine learning. Is this too simplistic a view?
It's true that public perception is primarily focused on machine learning just now. This is hardly surprising given the impressive advances in so-called sub-symbolic methods we have seen in recent years – especially in language and image processing. A small number of experts even now believe that symbolic methods will end up becoming superfluous. However, most are of the opinion that it will only be possible to combine the strengths and offset the weaknesses of the two worlds by integrating them. I am also convinced that artificial intelligence is more than just ChatGPT.

"Symbolic methods can provide guarantees of their correctness and reliability."

Can you give us an example of the strengths of symbolic methods?
One key strength in my view is that symbolic methods can provide guarantees of their correctness and reliability. As a rule, it is even possible to prove mathematically that a symbolic method will solve a task correctly within a specific time. This is vitally important when dealing for example with safety-critical applications such as the automated planning of complex processes in industrial facilities or power plants. Such guarantees are much more difficult to obtain with sub-symbolic methods. And indeed, it is a well-known fact that language models such as ChatGPT have a tendency occasionally to "hallucinate", that is to simply invent facts for which there is no real basis.

How important are symbolic methods when it comes to developing explainable AI?
The term "explainable AI" emerged because people frequently ended up asking why AI systems arrived at particular judgments or decisions. It is often very difficult, especially with sub-symbolic AI models, to provide a comprehensible explanation of the outcome to the human user. Symbolic methods make it easier: the logical deductive reasoning chains they use to reach a result can be broken down into their individual stages to retrospectively explain the process.

If I have understood you correctly, it is ultimately about combining the strengths of different AI methods. This is also one of the areas focused on at the Konrad Zuse School of Excecellence in Embedded Composite AI (SECAI).
Combining symbolic and sub-symbolic methods is indeed a central focus at SECAI, as the word "composite" in the school's name is intended to highlight. There are many similar terms used in the field, including "neuro-symbolic AI" and "bilateral AI", which also indicates that the need to integrate the different approaches has been widely acknowledged. Parallels are often drawn here with decision-making processes in humans: symbolic methods correspond to a rational "head-based" approach to problem-solving, whereas sub-symbolic methods are more intuitive and based on "gut instinct". Probably the best way forward – for both artificial and natural actors – is to combine the two!

"Symbolic methods correspond to a rational approach to problem-solving, whereas sub-symbolic methods are more intuitive."

Even the best algorithms are worthless if they don't have any hardware to direct. How can they be put into practice?
The fact that SECAI also includes the hardware side in its considerations – that's what the word "embedded" in the name refers to – is what sets the Zuse School apart. This is the natural result of the technical excellence of the participating universities in this field and the importance of the "Silicon Saxony" region for German and European chip production. To put it in very general terms, the growing demand for time- and space-saving – not to mention energy-efficient – AI systems requires constant improvements and advances in terms of hardware. This encompasses everything from new kinds of switching elements on the nano scale to innovative mainframe computers that can process more and more data and processes in parallel. SECAI works on this entire spectrum of different aspects.

Developments in AI are highly dynamic, which must surely make the training of future experts very demanding. Are there certain core skills that students can be taught – irrespective of the detailed aspects that are changing so rapidly just now?
All branches of AI require a solid mathematical foundation – discrete mathematics in the case of symbolic methods, while sub-symbolic methods require vector algebra and analysis. Probability calculus and statistics are very important in both cases. In addition, students need a good basic grasp of computability and complexity theory and of algorithmics. Armed with this technical expertise that is taught in the first few semesters, students can understand the frequent and considerable changes in the approaches to and optimization of AI methods quite easily and quickly. Specialist lectures and seminars then go into further detail.

SEBASTIAN RUDOLPH

Sebastian Rudolph is professor for Computational Logic at TU Dresden since April 2013. He is also the managing director of the Institute of Artificial Intelligence at the Faculty of Computer Science. Additionally, Professor Rudolph is a member of the Advisory Board of the Konrad Zuse School of Excellence in Embedded Composite Artificial Intelligence (SECAI). Within the framework of an ERC grant, Sebastian Rudolph is researching the issue of decidability in knowledge representation.


SECAI
School of Embedded Composite Artificial Intelligence
ADVANCING AI TOGETHER


Preprocessing
512x512 pixels

Table Mountain in Cape Town

FROM THE CAPE TO THE ELBE

SECAI's International Research Exchange Programs for Students

Attracting talents at early career stages is a top priority for the Zuse Schools, and a key factor to their lasting impact on AI in Germany. Towards this goal, SECAI's scholarship programs for students at bachelor and master level have proven highly effective. An exciting offer for outstanding individual students are the international exchange programs with SECAI's academic partners worldwide.

When Aidan Bailey presented research for his ongoing Master's studies at the University of Cape Town (UCT) in January 2024, he did not know that this would set him on a path of international research collaboration that would soon lead to Germany. Together with fellow students Lucas Carr and Luke Slater, he was among the selected individuals to speak at Cape-KR 2024, a South African AI research event for knowledge representation and reasoning organized by SECAI partner Tommie Meyer and co-sponsored by SECAI and the Center for Artificial Intelligence Research South Africa (CAIR). SECAI Fellow Sebastian Rudolph, who gave an invited talk at Cape-KR, remembers being impressed with the students' works: "The quality of the presentations and discussions at the event showed that UCT and CAIR really attract some very good students."

Soon after the event, concrete plans were made for an exchange program between SECAI and UCT, and in April 2024, Aidan, Lucas, and Luke were already on their way to an extended research stay at TU Dresden. The three students came well-prepared and ready to expand their know-

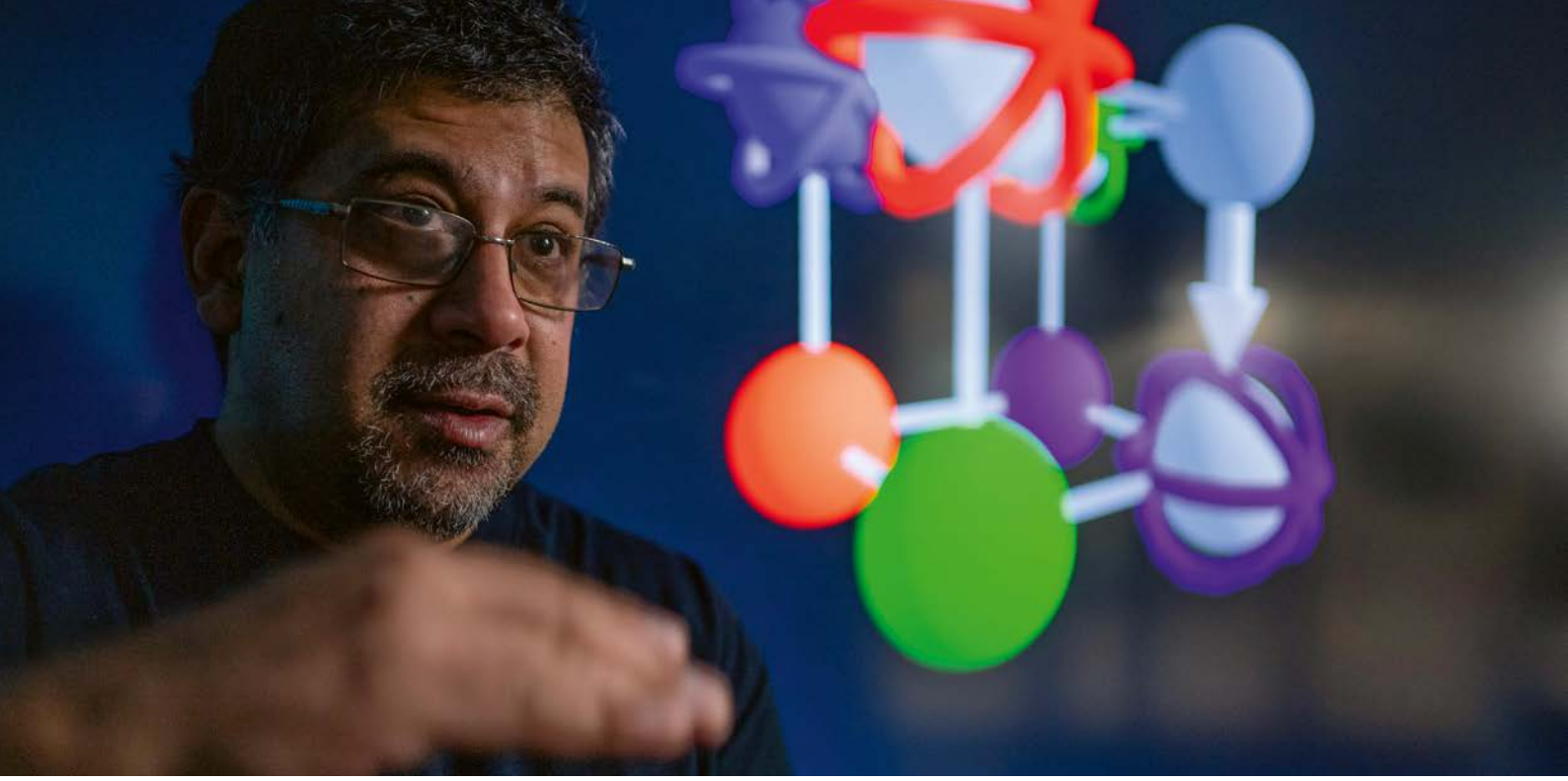
ledge and professional networks. "I am planning to use this opportunity primarily for my personal development and to focus on improving my research skills and expanding my academic knowledge. I will spend a lot of time working on my own research and take the opportunity to get advice from all the other scientists here," says Luke Slater, who is specializing in knowledge compilation, the task of pre-processing symbolic AI models in a way that will increase efficiency. Aidan Bailey already had gathered first experiences in academic research: "During my Honours year, under the supervision of Professor Tommie Meyer, I investigated the generation of knowledge bases for testing optimizations of reasoning algorithms. My work, with the help of two fellow students, Joon Soo Park and Joel Hamilton, was published in the Proceedings of the Southern African Conference for Artificial Intelligence Research in 2022." For his time in Dresden, he planned to focus on uses of Answer Set Programming (ASP) for automating the optimized configuration of circuits.

Lucas Carr has studied philosophy alongside his activities in computer science and is now attempting to combine the two disciplines in his Master's. His research interests lie at the interface between logic and knowledge representation. With his undergraduate degree in philosophy having deepened the foundations of structured reasoning and conceptual analysis, he is currently focusing on Formal Concept Analysis, a mathematical framework for identifying and representing structures underlying data. Lucas says: "One of the reasons I came to TU Dresden was to be introduced to other subfields of knowledge representation and reasoning and perhaps find one that piques my interest."

All three students were completely immersed in the day-to-day work of the research groups, had many intensive meetings with SECAI researchers and presented their work in research seminars at TU Dresden. SECAI played a crucial role by providing both the necessary financial support through its exchange scholarships, and the professional environment to ensure that the stays were beneficial.

The example shows how the Zuse Schools can use their scholarship funds and their close ties with leading researchers to enable particularly intensive and targeted forms of international exchange. Similar exchange activities have happened with other SECAI partners, and more are planned for the future. Moreover, SECAI exchange programs are always designed to go both ways, and similarly support research visits of outstanding German students at leading international partner institutions. So far, individual exchanges have proven to be mutually beneficial in all cases, and the additional orchestration effort (in comparison to the more standardized scholarship programs in the SECAI study programs) certainly seems justified. Regarding the future collaboration with UCT, new exchanges in 2025 are already being planned.

Aidan Bailey (left), Lucas Carr (center), Luke Slater (right)



SAYAN MUKHERJEE

1971 – 2025

Sayan Mukherjee died unexpectedly in March 2025 while this annual report was still in preparation. Highly respected for his mathematical brilliance and likable personality, our colleague, mentor, and friend will dearly be missed.

Sayan Mukherjee was the Alexander von Humboldt Professor for Artificial Intelligence at Leipzig University and a full professor at Duke University, Durham, USA. His work in mathematical statistics made important contributions to the theory of machine learning and found applications in medical data analysis and bioinformatics. He died unexpectedly in Leipzig on March 31, 2025, at the age of 54 years.

"Sayan had an exceptional intellectual presence," recalls SECAI Director Markus Krötzsch, "He had this amazing energy and clarity of thought that would immediately inspire those around him." This impressive energy is also evident from his academic activity. After completing his PhD at MIT and a Sloan Postdoctoral Fellowship at the Broad Institute, Sayan joined Duke University where he had been a full professor since 2015. In acknowledgment of his "crucial work in the still young field of topological data analysis", he was awarded the prestigious professorship of the Alexander von Humboldt Foundation in 2022. He then joined Leipzig University and became a Fellow at the Max Planck Institute for Mathematics in the Sciences, a Principal Investigator at the National AI Competence Center ScaDS.AI, and an Academic Fellow in SECAI. In all of these roles and places, Sayan made valued contributions and will dearly be missed. "Sayan was a colleague teeming with ideas and a unique way of thinking," says SECAI Co-Director Peter Stadler, "His loss deeply saddens me."

Sayan Mukherjee's international renown was founded in a multitude of outstanding contributions. His specialty discipline was topological data analysis, a field at the intersection of statistics, mathematics, and machine learning that asks how the rich structure of complex data sets influences algorithms and analytical methods. Insights towards this question have the potential to increase the performance of statistical computations and the quality of the predictions they produce. Besides (and by means of) his theoretical works, Sayan has contributed to relevant applications, e. g., in medical imaging and bioinformatics. He was also involved in the development of Gene Set Enrichment Analysis (GSEA), a statistical process that can produce insights about the biological function of human genes and their role in cancer formation. It was the unique combination of deep mathematical work and important applied contributions that became the basis of his international reputation.

However, many of those who knew Sayan remember him not just for his contributions to research, but for his open-minded and unpretentious way of approaching just about anything and anyone, and for his characteristic warmth and good humor. As we mourn the loss of this outstanding scholar and exceptional personality, our thoughts and condolences are with his colleagues, friends, and family.

Sayan was widely respected as an expert in AI and medical applications. The photo shows him on his way to the G20 Health Minister Meeting in 2023. Also in the picture are German Health Minister Karl Lauterbach and SECAI Fellow Jakob Kather.

A REVIEW OF 2024

A Year Full of Research, Teaching, and Networking

January

Hiring of 2nd Cohort Complete

As SECAI gathers excellent researchers from around the world, the hiring process including application for visa, might take some time. While the majority of the 2nd cohort of our Graduate School has already started in 2023, welcoming Haadia Amjad and Charvi Jain marked the end of the hiring process of this cohort. In total, twelve new researchers – six woman and six men – have joined SECAI.

Fellow Mikolajick Among Most Cited Researchers

At the start of each year, Clarivate releases its list of *Highly Cited Researchers* that identifies the world's most influential researchers based on citation numbers in the last decade. In 2024, Fellow Thomas Mikolajick is among the 336 Germany-based researchers who made the list. Mikolajick promoted the research on the effect of ferroelectricity in hafnium oxide, first discovered by a doctoral student at former company Qimonda, and together with his team was the first to publish papers in this field. In the recent years, they also used ferroelectric hafnium oxide to realize in-memory computing concepts such as those used in AI, including concepts inspired by synapses and neurons for neuromorphic systems.

Sebastian Rudolph (right) and Tommie Meyer (left) at Cape-KR

AI Around the World: Cape-KR

Cape-KR is a research event dedicated to the advancement of Knowledge Representation and Reasoning (KR). Organized by Associate Fellow Tommie Meyer at the University of Cape Town (UCT), it is intended as a platform for exchange and international networking, and features a unique blend of international and local, as well as senior and junior researchers. SECAI supported Cape-KR to foster research exchange and to increase visibility for the Zuse Schools. The meet-up was also used for planning SECAI's exchange program with UCT *(see page 30)*.

February

Winter School on AI and Law in Padua

Fellow Stephanie Schiedermair contributed to a winter school entitled *"Artificial Rights? Legal Challenges in the era of A.I."* at the University of Padua (Italy). The Winter School was a joint event with Leipzig University, University of Haifa (Israel), and Sapir College (Israel). The program alternated lectures and workshops by professors and practitioners in law, computer science, and physics – resonating with SECAI's interdisciplinary understanding of AI. The format is a continuous collaboration of the institutions with further joint events in the future.

Frank Fitzek

Fellow Fitzek Starts 6G Partnership

Fellow Frank H.P. Fitzek and Prof. Tommaso Melodia signed a Memorandum of Understanding between Northeastern University Boston (NEU) and TU Dresden, focusing on the creation of a shared roadmap and the development of joint research activities on 6G, the next generation of wireless networks and the tactile Internet. By exchanging researchers and combining world-leading testbeds, NEU and TU Dresden aim to drive innovation in wireless networks and next-generation applications that require seamless and ubiquitous connectivity with ultra-low latency.

StratifAI Raises € 1.5 M in Pre-seed Funding

The start-up StratifAI, co-founded by Fellow Jakob Kather, raised € 1.5 M in pre-seed funding to advance AI-based precision oncology. This pre-seed funding is instrumental in furthering the development of StratifAI's cutting-edge technology, expanding its team of experts, and accelerating the market readiness of its digital oncology platform. StratifAI develops multimodal artificial intelligence models that deliver meaningful prognostic insights from routinely available histology images and clinical data to guide treatment decisions in oncology.

March

Getting Together at the SECAI Retreat

The annual SECAI Retreat is the most intensive of SECAI's all-hands project meetings, with researchers gathering for several days in a (somewhat) remote location. This time the retreat took place at the former convent *Kloster Nimbschen* near Leipzig. For members of the SECAI Graduate School, the retreat is an important event on their road to PhD, as it offers the opportunity to present their research and receive feedback. In addition to the working sessions, discussions, and keynotes, the retreat offered the space for networking and gaining new perspectives. As special guests, members of the internationally successful Leipzig-based robot football team *HTWK Robots* presented their robots and use of AI.

Roberto Calandra Joins SECAI as Academic Fellow

SECAI welcomes the newly appointed professor Roberto Calandra as new Academic Fellow. Originally from Italy, he works in the fields of machine learning and robotics and holds the newly established Chair of Machine Learning for Robotics at TU Dresden. He not only excels in research but also contributes to SECAI through close ties to global industry and research partners such as Meta AI (Facebook AI) and the Robotic Lab in Menlo Park (now part of Embodied AI), which he founded. His research aims to improve collaboration between humans and machines, for instance by endowing robots with a sense of touch *(see page 24)*.

Studying Abroad With SECAI: Taiwan

As part of the Semiconductor Talent Incubation Program (STIPT), SECAI scholarship holders Anurima Mallick and Shradha Sandesh Komatwar were given the opportunity to take part in a six month academic and practical exchange in Taiwan. The four-month academic part of the study visit began at the National Taiwan University (NTU). The students completed a practical training at TSMC's Newcomer Training Centre and gained insights into its production facilities in Taichung. The STIPT program is made possible through close collaboration between the Free State of Saxony and TU Dresden, aiming to prepare STEM students as highly skilled specialists for challenging roles in the semiconductor industry.

Celebrating the first SECAI Alumna

With the successful defence of her PhD thesis, Carolin Schimmelpfennig becomes the first member of the SECAI Graduate School to complete her doctorate. In her doctoral thesis, she investigated gene fusions in prostate cancer (PCa), characterised potential new candidates, and researched their role as prognostic markers for PCa progression. Fellow Kristin Reiche and Markus Kreuz supervised her work at the Fraunhofer Institute for Cell Therapy and Immunology (IZI). Carolin was able to complete in the second year of SECAI since she had already started her PhD research before joining the graduate school.

April

Clinical AI Day in Dresden

The Dresden Clinical AI Day at the University Hospital campus provided a platform for interdisciplinary research to showcase AI applications in everyday clinical practice. Around 150 participants gained insights into the latest developments, explored practical demonstrators, and exchanged ideas. In addition, government representatives spoke about the federal government's digital policy initiatives.

Stefanie Speidel (center) and Jakob Kather (right) at the Clinical AI Day

AI in Conversation

Mathematics in Conversation is a series of public events organized by *Erlebnisland Mathematik*, Dresden, where guest researchers in mathematics and related fields present their work to a wider audience. In April, Fellow Markus Krötzsch followed the invitation to speak about the capabilities and limitations of current AI systems, especially Large Language Models, from the viewpoint of theoretical computer science. A subsequent chat with host Prof. Andreas Thom gave the audience plenty of opportunity for comments and questions.

Stefanie Speidel (center) discusses the impact of AI with the Ministerpresident of Saxony Michael Kretschmer

Saxon AI Congress in Dresden
At the two-day Saxon AI Congress, organized by the Free State of Saxony, Fellow Stefanie Speidel engaged in a panel discussion with Minister-president of Saxony Michael Kretschmer. Special emphasis was put on the importance of lighthouse projects such as SECAI and the DFG Clusters of Excellence. The event further highlighted the importance of close cooperation between research and politics.

Honorary Doctorate for AI Pioneer
Dresden-born AI pioneer Richard Socher received an honorary doctorate from the Faculty of Computer Science at TU Dresden for his outstanding achievements in research and development in the fields of deep learning and natural language processing. Besides his influential academic publications, which have attracted over 200 thousand citations, Socher has also built a successful career as AI entrepreneur in Silicon Valley, most recently with his startup "you.com".

Training The Next Generation: Girls Day
Girls' Day, which aims to support young girls and women on their STEM path, is also a great opportunity to spark enthusiasm for the world of bioinformatics in young girls. In April, researchers of the Chair of Bioinformatics at Leipzig University, led by Fellow Peter Stadler, welcomed girls aged 15 – 17 at their research group. A female doctoral researcher, a female postdoc, and a female professor introduced the career field and were available to answer questions. The highlight of the day was an escape room, in which participants had to solve tricky bioinformatics puzzles to make progress.

May

SECAI is Hiring Again
Each year in spring, SECAI publishes the call for application for the next Graduate School cohort, which consists of around ten doctoral students and clinician scientists starting in September. The positions are fully funded for three years and benefit from SECAI's support measures for doctoral students, such as the Mini Projects program that supports early independence in research activities *(see page 16)*. Further support is given by the Graduate Academy at TU Dresden and Research Academy at Leipzig University, which offer comprehensive programs for training, consulting, funding, and networking.

IEEE Career Award for Fellow Calandra
Fellow Roberto Calandra received the 2024 Early Academic Career Award in Robotics and Automation by the IEEE Robotics and Automation Society (RAS) for his "contributions to touch sensing, processing, and their application to manipulation." The award recognizes the work he and his team have done in the field of touch sensor technology: from hardware design and software development to applications in gripping and manipulation. In general, the Early Academic Career Award recognizes achievements in the field of robotics and automation based on their current and potential future impact.

Visiting Students From South Africa
Starting off the new student exchange activities with the University of Cape Town (UCT), SECAI welcomed the first three Master students from UCT – Luke Slater, Lucas Carr, and Aidan Bailey – for the Summer Semester at TU Dresden. The exchange is part of strengthening the collaboration between SECAI and its partner UCT *(see page 30)*.

Fellow Lauber-Rönsberg Elected Deputy Constitutional Judge

Fellow Anne Lauber-Rönsberg was elected as a deputy non-professional judge member of the Constitutional Court of the Free State of Saxony by the Saxon State Parliament. Constitutional jurisdiction at both state and federal level is the central foundation of our constitutional order. This also applies to the use of digital technologies, which increasingly raise questions within the jurisdiction of the Constitutional Court and require clarification. With Anne Lauber-Rönsberg the Constitutional Court has a knowledgeable expert in this evolving field at its side.

Best Paper Award at HSCC

Doctoral researcher Rajab Aghamov received the Best Paper Award at the ACM *International Conference on Hybrid Systems: Computation and Control* (HSCC 2024) for his paper *Linear dynamical systems with continuous weight functions*. The work addresses the computation of quantitative aspects such as mean payoff, total accumulated weight, and discounted accumulated weight using continuous and polynomial weight functions. Rajab's recognition at such a prestigious conference is a testament to the quality and impact of his research.

Studying Abroad with SECAI: United States

SECAI Scholarship holder Enrik Geissler completed a research internship at the Beth Israel Deaconess Medical Center in Boston, where he engaged in cutting-edge research under the guidance of Professor Tyler Berzin, a renowned gastroenterologist and associate professor at Harvard Medical School. The results from this research internship were submitted to *Digestive Disease Week*, the major conference in the field of gastroenterology. As part of its program Research in Academic Projects for Students (RAPS), SECAI funds internships like this to support and inspire young researchers.

June

Call for the Next Scholarship Holders

The SECAI scholarship programs supports outstanding students during their studies or research visit connected to AI or a related field at TU Dresden or Leipzig University. AI is viewed as an interdisciplinary undertaking that requires talents in computer science, engineering, mathematics, social science, law, the natural sciences, and application areas such as medicine. Each year SECAI offers about twenty residency scholarships, whose application period is in May and June.

Teaching Price for Fellow Krötzsch

Markus Krötzsch and his team have received the 2024 Teaching Prize by the student Council of Computer Science (iFSR) for his courses "Formal Systems" (Winter Semester 2023/24) and "Theoretical Computer Science and Logic" (Summer Semester 2024). The award recognizes his commitment to encouraging and inspiring teaching of "difficult" theoretical subjects. An award ceremony was held in May at the OUTPUT.DD event in Dresden.

Saxony Media Solution Prize
Doctoral researcher Lidia Roszko was honoured with the Saxony Media Solution prize for the best master's thesis in the field of software technology. She received the 1,000 euro prize for her design of a technology- and domain-abstracted reference architecture for adaptive, mobile information provisioning systems, intended for wearables in medical environments. With her research, she aims to support hospital professionals in navigating extensive patient information, ensuring it is available at the point of care.

July

Top Students, Top Research
Is it possible to engage in international top research during one's master studies in Germany? With SECAI, the answer clearly is yes: In July, scholarship holder Lucas Fabian Naumann presented his paper *Box Facets and Cut Facets of Lifted Multicut Polytopes* at the International Conference on Machine Learning (ICML), a top outlet for machine learning research. The joint work with Fellow Bjoern Andres and his team, answers formerly open questions related to high-dimensional geometric objects known as lifted multicut polytopes.

Laying of the foundation stone for a new building for AI Cancer Research

A Future Home for AI in Cancer Research
With the foundation ceremony for a new building for the German Cancer Research Centre (DKFZ) in Dresden, the Free State of Saxony is reaffirming its commitment to fostering research on new methods for cancer prevention and treatment, including AI-based approaches such as those researched by SECAI members. The new site of DKFZ will provide 1,350 square metres of space across five floors to interlink oncological research and cancer prevention in various areas. Saxony is supporting the construction with 20 million euros.

SECAI Mini Projects: Research Stays
On their road to PhD, SECAI encourages their doctoral researchers to stay at an international academic partner or research-oriented industry partner. SECAI Mini Projects *(see page 16)* can give the necessary financial support. Doctoral researcher Patrick Schöfer used the opportunity to initiate a research collaboration with the University of Waterloo in Canada together with his supervisor Martin Bogdan. Their visit, aligned with their ongoing investigation into whether Machine Learning can experience a state of boredom, facilitated a valuable interdisciplinary exchange with Prof. Dr. James Danckert, an expert on the psychological aspects of boredom. The collaboration aims to bridge the fields of artificial intelligence and psychology, fostering deeper insights through joint publications and continued research exchanges in the future.

August

SECAI Mini Projects: Summer Schools
August is a high time for summer schools, and many SECAI members took the opportunity to broaden their knowledge and expand their network. Haadia Amjad participated in the *Human Aligned AI Summer School* at Charles University in Prague, which focussed on AI alignment to human goals and safety. Susu Hu attended the *London Geometry and Machine Learning Summer School* (LOGML), where she worked on a project involving causal inference with graph neural networks. Danush K. Venkatesh participated in the *Eastern European Machine Learning Summer School* (EEML) in Serbia, an initiative led by Google DeepMind, and received the Best Poster Award for his research on synthesizing surgical datasets with diffusion models.

Get Together in Dresden
At the annual SECAI on-site meeting, SECAI researchers gather at one of the partner sites for presentations and discussions. It is also a first opportunity for new Graduate School members to meet with everyone in SECAI. The program in 2024 involved introductions by new doctoral researchers, a poster session, and keynotes by SECAI Fellows. Sebastian Rudolph introduced Standpoint Logic, a multimodal logic 'add-on' that can model a plurality of viewpoints in AI knowledge representation, and Stephanie Schiedermair spoke on the goals and challenges of AI regulation, especially in the light of the European AI Act.

Arguing Intelligently
In addition to the research content of this year's SECAI on-site meeting, the participants also enjoyed a workshop on debating skills. All research involves active discourse, and putting forward new ideas often requires the ability to motivate and defend positions against scepticism. The workshop offer by the *Leipziger Debattier- & Disputations-Gesellschaft* introduced participants to the basics of argumentation techniques and rhetorical style in academia.

A Gainful Collaboration Across Zuse Schools
Together with Gitta Kutyniok (Zuse School of Excellence in Reliable AI) and Holger Boche from TU Munich, SECAI Fellows Stefanie Speidel and Frank Fitzek hosted the kick-off meeting of the collaborative AI project GAIn – *Next Generation AI Computing*. The pilot project tackles new AI hardware and software concepts to reduce energy consumption and increase reliability for various applications, such as surgical robotics. Supported by the Free States of Saxony and Bavaria, GAIn has secured funding of six million euros until 2027, along with an additional three million euros from TU Dresden.

Participants of the SECAI On-Site Meeting 2024 in Dresden

Faculty of Computer Science, TU Dresden

September

SECAI Summer School on AI Touch
During a beautiful late summer week in September, the SECAI-sponsored Touch Sensing and Processing Summer School drew 40 international participants to Pirna near Dresden to learn about the expanding new field of touch in AI. A detailed account of this successful event can be found *on page 24*.

Graduate School at Full Size
The start of September was also the official start of the third cohort of the SECAI Graduate School, although individual starting times can actually vary slightly around that time. With the start of this third round, the SECAI Graduate School has reached its full capacity at around 30 researchers.

Supporting AI Events Around the World
SECAI takes part in – and shapes – the international research discussion on multiple levels. In addition to Fellows presenting their research, SECAI supports renowned and upcoming international events. The goal is twofold: to create international visibility for SECAI and the Zuse Schools, and to support the development of AI fields where SECAI has a specific research focus. An example for 2024 was the *International Joint Conference on Conceptual Knowledge Structures* (CONCEPTS), which brought together researchers and practitioners in formal concept analysis, conceptual structures, and related fields in Cadiz, Spain.

Clinician Scientists: A Successful Model
After two research-intensive years in SECAI, clinician scientist Gregory Veldhuizen "graduates" from the SECAI Graduate School. Clinician scientists are an alternative training model to the classical PhD training, which offers medical doctors an opportunity to deepen their research skills and to obtain visibility in academic research. This is accomplished by a specifically funded research phase with reduced medical service duties. Gregory has made the most of this time, which can be seen from his many publications and research collaborations. In particular, his research stay at Pearson Lab at the University of Chicago resulted in a fruitful collaboration and joint publications. We wish him all the best for his upcoming endeavours, and look forward to further collaborations with him.

Clinician Scientists Gregory Veldhuizen (center) completed his time with SECAI

October

Language Models in Medical Care

Over one hundred participants attended the *Symposium on Large Language Models in Medicine* at the Center of Regenerative Therapies of TU Dresden to explore how LLMs are transforming healthcare and to discuss related challenges. A primary focus in this respect was the application of LLMs in oncology care. The event was kicked-off by Marco Gustav and SECAI Fellow Jakob Kather with an engaging Science Slam.

Get Together at the Zuse Schools Event Munich

The annual meeting of the DAAD Konrad Zuse Schools of Excellence in Artificial Intelligence – ELIZA, SECAI, and relAI – was hosted by relAI in Munich. The event celebrated the second anniversary of the Zuse Schools with a dynamic program featuring welcome speeches, academic and industry keynotes, student presentations, and an inspiring panel discussion.

Welcoming new Scholarship Holders

Since October the new cohort of scholarship holders started their studies in the study programs within SECAI at TU Dresden and Leipzig University. The new students were welcomed at the ASCII student café in the Faculty of Computer Science at TU Dresden for an initial get-together and exchange. Chosen from nearly 130 applicants, this cohort includes 28 outstanding scholarship holders from four continents.

The Dresden robot conductors have gained international media attention

AI in Charge: A Robot Leading the Dresden Symphony Orchestra

For the 25th birthday of the Dresden Symphony Orchestra, an innovative concert merged technology and music in unprecedented ways. After a normal first part with a human conductor, the baton was passed to a three-armed collaborative robot. This innovative technological tool then led the musicians through complex rhythmic passages, highlighting how robotics can expand the compositional and performative possibilities of music. The technical realization of the event was coordinated by SECAI Fellow Frank Fitzek, whose team worked closely with conductor and musicians to enable this unique performance.

Participants of the Zuse Schools Event Munich

TU Dresden Opens Liaison Office in India

A delegation from Saxony that included Prof. Ursula Staudinger, Rector of TU Dresden, and SECAI Fellow Ronald Tetzlaff, CTIO of TU Dresden, officially opened the Saxon Science Liaison Office India in Chennai on behalf of Saxon's Minister of Science, Sebastian Gemkow, and the other 13 Saxon Universities. The Science Liaison Office will foster cooperation between scientists and entrepreneurs in India and in Saxony, and support strategic student selection for study programs in STEM subjects at Saxon Universities. TU Dresden operates the Chennai-based office on behalf of all Saxon universities and research institutions.

Delegation including Fellow Ronald Tetzlaff (right) opened a Saxon Science Liaison Office India in Chennai

November

Best Paper Award at PRIMA

SECAI doctoral researcher Jonas Karge received the Martin Purvis Student Best Paper Award for his contribution *Taming Dilation in Imprecise Pooling* at the 2024 edition of the International Conference on Principles and Practice of Multi-Agent Systems (PRIMA24) in Kyoto, Japan. More information about Jonas and his eventful trip to Japan can be found *on page 22*.

Democracy, Transparency, and Sustainability

Also in Japan in November, the DAAD Konrad Zuse Schools of Excellence in AI – SECAI, ELIZA and relAI – contributed at the conference Generative AI: *Pathways to Democratization, Transparency and Sustainability* in Tokyo. The key question in this multi-disciplinary event was how generative AI systems in particular can uphold these important values *(see page 22)*.

Best Paper Award at KR

SECAI doctoral researcher Alex Ivliev, scholarship holder Simon Meusel, and Fellow Markus Krötzsch together with Lukas Gerlach and Jakob Steinberg received the Best Paper Award in the "KR in the Wild" track at the prestigious *International Conference on Principles of Knowledge Representation and Reasoning*, held in Hanoi, Vietnam. The award-winning paper *Nemo: Your Friendly and Versatile Rule Reasoning Toolkit* describes an AI system for rule-based reasoning that emphasizes scalability, versatility, and ease of use.

December

A SECAI Winter School

The SECAI-supported international winter school *Artificial Intelligence, Media and Democracy* took place in Leipzig, co-organized by Fellow Stephanie Schiedermair. The school is a cooperation between the University of Leipzig, the University of Padua (Italy), and Sapir Academic College (Israel), and ties in with the Winter School *Artificial Rights? Legal Challenges in the Era of AI*, which took place at the University of Padua at the beginning of the year.

Supporting the Next Generation of Women in AI

With the closing ceremony in December, the second round of the mentoring program for female students and early-career researchers at TU Dresden concluded. Since April, a total of 35 female students and 12 female early-career researchers have received support in career planning, reflection, and networking. The mentoring program, which is supported by equal opportunities funding from various research areas, aims to support and specifically encourage participants to apply, expand their skills, and establish supportive relationships with other female researchers. SECAI doctoral researcher Haadia Amjad supported the mentoring program and accompanied four interested female students as a mentor on their way towards research.

A LOOK AHEAD

Objectives and Plans for 2025

The end of 2024 also marks the end the financial ramp-up phase for the Zuse Schools, and 2025 is the first year for SECAI to receive its full annual funding. More and more alumni of the training and support programs that started at the beginning of the school are now ready to enter industry and research, and the long-term sustainability of SECAI's impact becomes an important concern.

The Zuse School in Full Motion

With the end of the ramp-up phase, SECAI is now fully established and will continue all of its key activities, including graduate school recruiting, scholarship calls, teaching activities, and research meetings. SECAI will further consolidate its activities in these essential areas, and refine and strengthen the underlying processes and quality standards based on the experiences from past years.

Supporting Alumni

In the course of 2025, the number of SECAI alumni will increase significantly. The first regular scholarship round was awarded MSc students starting in winter term 2023 and graduating in summer 2025. Likewise, most PhD students of the first cohort started around January 2023, so that their 36 month PhD period will also come to an end. SECAI will expand its activities for alumni but also seek ways to support successful graduations in cases where some more time is required.

Reaching Out to Industry

With more SECAI alumni emerging, new opportunities for collaboration with industry are arising as well. In 2025, SECAI will therefore explore new formats for transferring experiences and talents between the universities and their industrial partners. This is a two-way process that will benefit students as well as companies, and which ultimately contributes to strengthening AI competence in German economy and to attracting international partners who rely on well-educated AI professionals.

Boosting International Exchange

SECAI is already fostering international academic exchange by means of its scholarship programs, international research events, and individual exchanges *(see page 30)*. The goal for 2025 and beyond is to further develop structured exchange programs with selected international partners, and to support students across all stages of professional training. The possibility of joint PhD programs will also be explored.

Broadening AI Study Offers

SECAI has contributed to the extension and internationalization of AI-related study options at its host universities. In 2025, two major programs will accept students for the first time: the new "Applied AI" track in the MSc program Computational Modeling and Simulation and the English-language computer science master, both at TU Dresden. It is expected that these measures will attract many additional students, who will be integrated into SECAI activities.

Starting up Entrepreneurship

Start-up companies are a perfect environment for creating AI innovation and economic impact. SECAI will therefore also encourage its alumni to become founders and turn their academic expertise and creativity into practical success. To achieve this, SECAI will draw from its extensive local network of start-up companies and industry federations, but also seek new collaborations with related initiatives on campus.

The Zuse Schools Beyond 2027

With the scheduled end of the current funding phase in 2027, ensuring the long-term impact and sustained operation of the Zuse Schools is an urgent concern. Some of the outcomes of SECAI are designed for lasting impact (e. g., the modernized, more international study programs), but most of SECAI's programs rely on continued funding to operate. 2025, the first fully funded year of the school, will also be the first year where graduate school members can no longer be supported for a complete 3-year PhD period from SECAI's own funds. SECAI will seek bridge funding, but it is clear that the unique scope of the Zuse Schools as a training ground for upcoming AI professionals cannot be supported in full through traditional research funding programs or a patchwork of smaller measures. SECAI will continue to contribute to the discussions about the future strategy for developing the Zuse School model.

GOVERNANCE

Decision Making in a DAAD Zuse School of Excellence in AI

The SECAI Board

The SECAI Board is responsible for the operational management of the School and is elected by the Fellows at the General Assembly. The Board consists of a director and two deputy directors, with at least one person from Dresden and one from Leipzig. Currently, the Board consists of the director Markus Krötzsch and the two deputy directors Stefanie Speidel and Peter Stadler. The Board makes operational decisions, organizes meetings, and develops proposals for action.

Contact: secai-board@groups.tu-dresden.de

Markus Krötzsch
Chair of Knowledge-Based Systems, TU Dresden

Stefanie Speidel
Chair of Translational Surgical Oncology, National Center for Tumor Diseases Dresden

Peter Stadler
Chair of Bioinformatics, Leipzig University

The SECAI Steering Group

The Steering Group makes decisions on the practical implementation of the School and planned measures. In addition to the members of the Board, the group consists of four more Fellows and two Graduate Representatives. Other Fellows, Associated Fellows and further guests may be involved in decision-making processes.

Martin Bogdan
Chair of Neuromorphic Information Processing, Leipzig University

Christian Mayr
Chair of Highly-Parallel VLSI Systems and Neuro-Microelectronics, TU Dresden

Sebastian Rudolph
Chair of Computational Logic, TU Dresden

Stephanie Schiedermair
Chair of European Law, Public International Law and German Public Law, Leipzig University

Deianira Fejzaj
Student Representative, TU Dresden

Max Beining
Student Representative, Leipzig University

ACADEMIC FELLOWS

The Researchers and Teachers Behind SECAI

SECAI is the effort of a group of Academic Fellows, who are jointly responsible for the research goals and educational activities of the School. In addition to the members of the SECAI Board and Steering Group, the following researchers were Academic Fellows in 2024.

Bjoern Andres
Chair of Machine Learning for Computer Vision, TU Dresden

Christel Baier
Chair of Algebraic and Logical Foundations of Computer Science, TU Dresden

Roberto Calandra
Chair of Machine Learning for Robotics, TU Dresden

Frank Fitzek
Deutsche Telekom Chair of Communication Networks, TU Dresden

Jochen Hampe
Chair of Internal Medicine and Gastroenterology, TU Dresden

Jakob Kather
Chair of Clinical Artificial Intelligence, TU Dresden

Anne Lauber-Rönsberg
Chair of Civil Law, Intellectual Property, Media and Data Protection Law, TU Dresden

Jens Lehmann
Principle Scientist Amazon Alexa AI, Amazon

Carsten Lutz
Chair of Knowledge Representation, Leipzig University

Jens Meiler
Humboldt Professor and Director of the Institute for Drug Discovery, Leipzig University

Thomas Mikolajick
Chair of Nanoelectronics, TU Dresden

Guido Montúfar
ERC Group Leader for Mathematical Machine Learning, MPI of Mathematics in the Sciences

Sayan Mukherjee
Humboldt Professor in AI, Leipzig University

Sabine Müller-Mall
Chair of Legal and Constitutional Studies with Interdisciplinary Relations, TU Dresden

Kristin Reiche
Deputy Head Department of Diagnostics, Fraunhofer Institute for Cell Therapy and Immunology IZI

Ivo Sbalzarini
Chair of Scientific Computing for Systems Biology, TU Dresden

Ronald Tetzlaff
Chair of Fundamentals of Electrical Engineering, TU Dresden

Max von Renesse
Chair of Stochastics, Leipzig University

SECAI GRADUATE SCHOOL

The PhD Students and Clinician Scientists of SECAI

The following doctoral students and clinician scientists were member of the SECAI graduate school in 2024.

1st Cohort

Rajab Aghamov
Supervisor: Christel Baier
Co-Supervisor: Markus Krötzsch

Max Beining
Supervisor: Jens Meiler
Co-Supervisor: Christian Mayr

Max Braungardt
Supervisor: Martin Bogdan
Co-Supervisor: Thomas Mikolajick

Deianira Fejzaj
Supervisor: Thomas Mikolajick
Co-Supervisor: Martin Bogdan

Adnan Haidar
Supervisor: Ronald Tetzlaff
Co-Supervisor: Thomas Mikolajick

Simon Hosemann
Supervisor: Carsten Lutz
Co-Supervisor: Sebastian Rudolph

Johnny Alexander Jimenez Siegert
Supervisor: Jens Meiler
Co-Supervisor: Christian Mayr

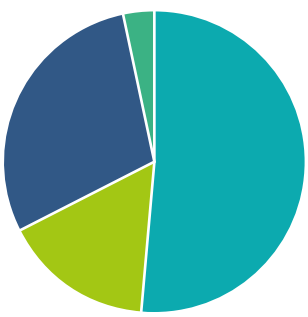
Radhika Juglan
Supervisor: Jakob Kather
Co-Supervisor: Sayan Mukherjee

Tim Langer
Supervisor: Christian Mayr
Co-Supervisor: Stefanie Speidel

Carolin Schimmelpfennig
Supervisor: Kristin Reiche

Gregory Veldhuizen
Supervisor: Jakob Kather

Danush Kumar Venkatesh
Supervisor: Stefanie Speidel
Co-Supervisor: Bjoern Andres



2nd Cohort

Haadia Amjad
Supervisor: Ronald Tetzlaff
Co-Supervisor: Stefanie Speidel

Julia Belyaeva
Supervisor: Jens Meiler
Co-Supervisor: Sayan Mukherjee

Zdravko Dugojic
Supervisor: Roberto Calandra
Co-Supervisor: Stefanie Speidel

Minh Hoang
Supervisor: Dao Ivo Sbalzarini
Co-Supervisor: Peter F. Stadler

Susu Hu
Supervisor: Stefanie Speidel
Co-Supervisor: Guido Montúfar

Charvi Jain
Supervisor: Jens Lehmann
Co-Supervisor: Ivo Sbalzarini

Johannes Klier
Supervisor: Kristin Reiche
Co-Supervisor: Jens Meiler

Charlotte Langer
Supervisor: Stephanie Schiedermair
Co-Supervisor: Sabine Müller-Mall

Lidia Roszko
Supervisor: Jochen Hampe
Co-Supervisor: Jakob Kather

Patrick Schöfer
Supervisor: Martin Bogdan

Jonas Schulz
Supervisor: Frank H.P. Fitzek

Christian Vielhaus
Supervisor: Frank H.P. Fitzek
Co-Supervisor: Stefanie Speidel

3rd Cohort

Tom Friese
Supervisor: Bjoern Andres
Co-Supervisor: Markus Krötzsch

Moritz Hehl
Supervisor: Guido Montúfar
Co-Supervisor: Max von Renesse

Alex Ivliev
Supervisor: Markus Krötzsch
Co-Supervisor: Sebastian Rudolph

Jonas Karge
Supervisor: Sebastian Rudolph
Co-Supervisor: Markus Krötzsch

Deniz Kucukahmetier
Supervisor: Sayan Mukherjee
Co-Supervisor: Ivo Sbalzarini

Dominik Rusovac
Supervisor: Sebastian Rudolph
Co-Supervisor: Markus Krötzsch

Maximilian Salomon
Supervisor: Peter Stadler
Co-Supervisor: Sayan Mukherjee

SECAI SCHOLARSHIP HOLDERS

Residency scholarships for students of TU Dresden and Leipzig University

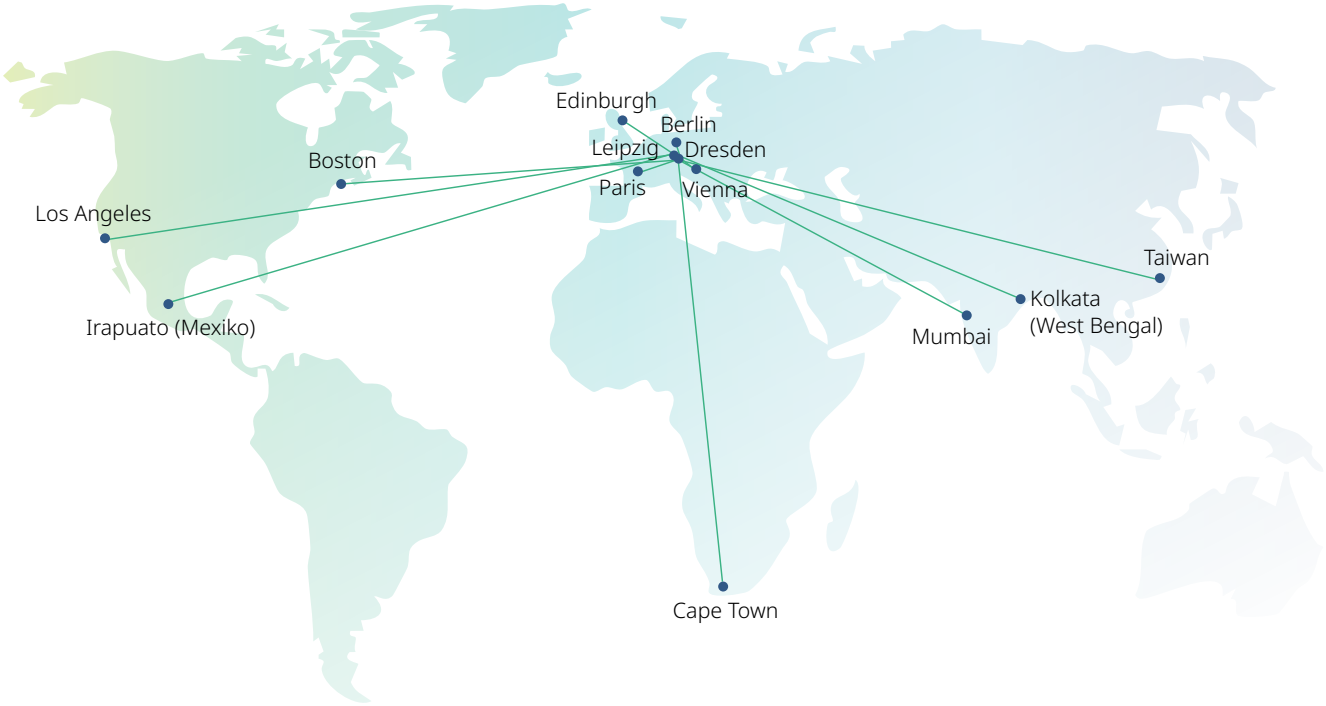
	Call 2024	Active Scholarships	Overall Scholarships
Female	12	32	36
Male	12	37	44
Total	**24**	**69**	**80**

	Call 2024	Active Scholarships	Overall Scholarships
Germany	10	27	33
Europe (without Germany)	2	4	6
Asia	7	32	35
Africa	4	5	5
America	1	1	1

Overview of merit-based residency scholarships for students of TU Dresden and Leipzig University; column Call 2024 lists the number of scholarships awarded during the regular call in 2024; column Active Scholarship lists the number of scholarships in 2024; column Overall Scholarship lists the number of scholarships.

The SECAI Scholarship Program Fosters Research Exchange

In addition to the regular merit-based scholarships, SECAI awards scholarships for research exchange, as part of the program Research Experience for Undergraduates (REU), where undergraduate students visit TU Dresden or Leipzig for a shorter period of time, and the program Research in Academic Projects for Students (RAPS), where international MSc or PhD students visit a research group of SECAI or students from TU Dresden or Leipzig University visit a partner research group abroad *(see world map)*.



- Dresden to Taiwan: **2**
- Dresden to Boston: **1**
- Dresden to Edinburgh: **1**
- Cape Town to Dresden: **4**
- Irapuato (Mexiko) to Leipzig: **1** (in 2023)
- Los Angeles to Leipzig: **1**
- Kolkata (West Bengal) to Leipzig: **1**
- Mumbai to Dresden: **1**
- Wien to Dresden: **1**
- Paris to Dresden: **2** (in 2023)
- Berlin to Dresden: **1** (in 2023)

SECAI PARTNERS

Academic Partners

The following international universities and research institutions are part of the SECAI network.

- École normale supérieure, PSL, France
- TU Wien, Austria
- Uniwersytet Wroclawski, Poland
- King's College London, United Kingdom
- University of Cape Town, South Africa
- Centre for Artificial Intelligence Research (CAIR), South Africa
- Carnegie Mellon University, USA

Industry Partners

The following industry partners are part of the SECAI network.

Companies

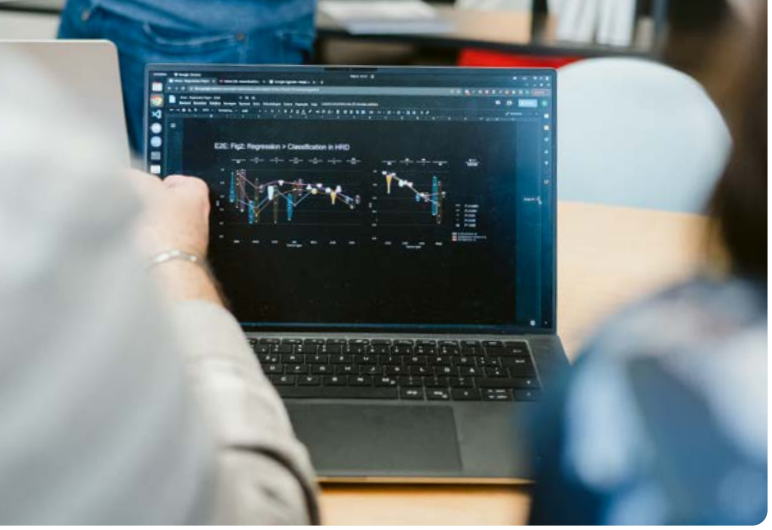
- Global Foundries, Dresden
- IBM Deutschland, Research & Development, Böblingen
- IBM Deutschland, AI & Analytics, München
- Infineon, Dresden
- Siemens, RDA Business Analytics and Monitoring, München
- Siemens Healthcare, Technology and Innovation Management, Erlangen
- Unite Network SE, Leipzig
- Zeiss, Innovation Hub, Dresden

Start-Ups

- CampusGenius, Dresden
- Cell.Copedia, Leipzig
- CO.DON, Leipzig
- MediaInterface, Dresden
- Meshmerize, Dresden
- Mimetic, Dresden
- Navigo Proteins, Halle
- SpiNNcloud Systems, Dresden
- Wandelbots, Dresden

Industrial Federations

- Silicon Saxony, Dresden
- Smart Systems Hub, Dresden



SECAI supports students early on in their research career

STUDY PROGRAMS

SECAI's Master-level Programs Cover a Broad Range of AI Topics

SECAI creates a vibrant study environment

SECAI fosters higher education in AI by supporting a strong Master education on a high technical level at both TU Dresden and Leipzig University. The School enhances the already existing teaching offers and research activities, creates new opportunities for both current and future students, supports Master students with a scholarship program, enables research exchanges, provides an environment for research discussions and knowledge transfer, and kick-starts the students' paths in both academia and industry.

SECAI therefore increases the international visibility and attractiveness of the study programs at TU Dresden and Leipzig University, thereby improving the applications to those programs both quantitatively and qualitatively. A detailed description of the study programs in SECAI can be found *on page 14*.

Site	Study Program	Applications (female ratio, international ratio)	Registrations (female ratio, international ratio)
TU Dresden	Nanoelectronics Systems	506 (24 %, 99 %)	62 (26 %, 95 %)
	Computational Life Science (CMS Track)	50 (42 %, 86 %)	15 (47 %, 80 %)
	Logical Modelling (CMS Track)	179 (26 %, 96 %)	42 (36 %, 95 %)
	Visual Computing (CMS Track)	207 (27 %, 98 %)	46 (28 %, 98 %)
	TU Dresden Total	**942 (26 %, 98 %)**	**165 (31 %, 95 %)**
Leipzig University	Data Science	109 (20 %, 22 %)	50 (18 %, 4 %)
	Bioinformatics	65 (54 %, 22 %)	14 (57 %, 0 %)
	Medical Informatics	40 (48 %, 13 %)	13 (38 %, 0 %)
	Leipzig University Total	**214 (36 %, 20 %)**	**77 (29 %, 3 %)**
	Total	**1,156 (28 %, 83 %)**	**242 (30 %, 65 %)**

CMS stands for Computational Modeling and Simulation. We only specify statistics for the study tracks that have a close relationship to AI. Students in CMS must select a single track when applying to the program. The track is part of their registration and will be shown on the final certificates. Changing the track is possible at most once, pending approval by the responsible teachers and commissions.

The column Registrations specifies the total number of students who have eventually registered as students in the respective programme. This number is typically lower than the number of admissions, since not all accepted students will always decide for the programme, and since international students may also be prevented from doing so because of delays in obtaining their visa.

PUBLICATIONS

The Research in SECAI

Rajab Aghamov, Christel Baier, Toghrul Karimov, Joël Ouaknine, Jakob Piribauer (2024): **Linear dynamical systems with continuous weight functions**. In Proceedings of the 27th ACM International Conference on Hybrid Systems: Computation and Control, HSCC 2024, ACM. 10.1145/3641513.3650173.

Kossi Amouzouvi, Sahar Vahdati, Bowen Song, Bernard O. Bainson, Nur A. Zarin Nishat, Jens Lehmann (2024): **A Study of LFT Embeddings in the Second Order Clifford Algebra Cl(R2)**. In IEEE Access, IEEE. 10.1109/ACCESS.2024.3514303.

Kossi Amouzouvi, Bowen Song, Sahar Vahdati, Jens Lehmann (2024): Knowledge GeoGebra: **Leveraging Geometry of Relation Embeddings in Knowledge Graph Completion**. In Calzolari N., Kan M.-Y., Hoste V., Lenci A., Sakti S., Xue N., eds., Proceedings of the Joint 30th International Conference on Computational Linguistics and 14th International Conference on Language Resources and Evaluation, LREC-COLING 2024, European Language Resources Association (ELRA).

Lea Bauer, Jonas Karge (2024): **Multi-agent Opinion Pooling by Voting for Bins: Simulations and Characterization**. In Mathieu P., De la Prieta F., eds., Proceedings of the 22nd International Conference on Practical Applications of Agents and Multi-Agent Systems, PAAMS 2024, Springer. 10.1007/978-3-031-70415-4_5.

Julia Belyaeva, Matthias Elgeti (2024): **Exploring protein structural ensembles: Integration of sparse experimental data from electron paramagnetic resonance spectroscopy with molecular modeling methods**. In eLife, eLife Sciences Publications, Ltd. 10.7554/eLife.99770.

Volodymyr Bondarenko, Jonas Schulz, Giang T. Nguyen, Frank H. P. Fitzek (2024): **Latency Visualization Emulation Scheme for Interactive Cloud XR Gaming**. In Proceedings of the 2024 IEEE International Conference on Pervasive Computing and Communications Workshops and other Affiliated Events, PerCom Workshops 2024, IEEE. 10.1109/PerComWorkshops59983.2024.10503547.

James A. Brooks, Michael Kallenbach, Iuliana-Pompilia Radu, Annalisa Berzigotti, Christoph F. Dietrich, Jakob Nikolas Kather, Tom Luedde, Tobias P. Seraphin (2024): **Artificial Intelligence for Contrast-Enhanced Ultrasound of the Liver: A Systematic Review**. In Digestion, S. Karger AG. 10.1159/000541540.

Benjamin P. Brown, Richard A. Stein, Jens Meiler, Hassane S. Mchaourab (2024): **Approximating Projections of Conformational Boltzmann Distributions with AlphaFold2 Predictions: Opportunities and Limitations**. In Journal of Chemical Theory and Computation, American Chemical Society. 10.1021/acs.jctc.3c01081.

Lucas Carr, Nicholas Leisegang, Thomas Meyer, Sebastian Rudolph (2024): **Non-monotonic Extensions to Formal Concept Analysis via Object Preferences**. In Gerber A., Maritz J., Pillay A.W., eds., Proceedings of the 5th Southern African Conference for Artificial Intelligence Research, SACAIR 2024, Springer. 10.1007/978-3-031-78255-8_28.

Elias Crum, Antonio De Santis, Manon Ovide, Jiaxin Pan, Alessia Pisu, Nicolas Lazzari, Sebastian Rudolph (2024): **Enriching Ontologies with Disjointness Axioms using Large Language Models**. In Razniewski S., Kalo J.-C., Singhania S., Pan J. Z., Nguyen T.-P., Zhang B., eds., Proceedings of the Joint of the 2nd Workshop on Knowledge Base Construction from Pre-Trained Language Models and the 3rd Challenge on Language Models for Knowledge Base Construction, KBC-LM-LM-KBC 2024, CEUR-WS.

Julia Di, Zdravko Dugonjić, Will Fu, Tingfan Wu, Romeo Mercado, Kevin Sawyer, Victoria Rose Most, Gregg Kammerer, Stefanie Speidel, Richard E. Fan, Geoffrey Sonn, Mark R. Cutkosky, Mike Lambeta, Roberto Calandra (2024): **Using Fiber Optic Bundles to Miniaturize Vision-Based Tactile Sensors**. In IEEE Transactions on Robotics, IEEE. 10.1109/TRO.2024.3492375.

Zdravko Dugonjić, Adrien Pupier, Benjamin Lecouteux, Maximin Coavoux (2024): **What has LeBenchmark Learnt about French Syntax?**. In Calzolari N., Kan M.-Y., Hoste V., Lenci A., Sakti S., Xue N., eds., Proceedings of the Joint 30th International Conference on Computational Linguistics and 14th International Conference on Language Resources and Evaluation, LREC-COLING 2024, European Language Resources Association (ELRA).

Omar S. M. El Nahhas, Chiara M. L. Loeffler, Zunamys I. Carrero, Marko van Treeck, Fiona R. Kolbinger, Katherine J. Hewitt, Hannah S. Muti, Mara Graziani, Qinghe Zeng, Julien Calderaro, Nadina Ortiz-Brüchle, Tanwei Yuan, Michael Hoffmeister, Hermann Brenner, Alexander Brobeil, Jorge S Reis-Filho, Jakob Nikolas Kather (2024): **Regression-based Deep-Learning predicts molecular biomarkers from pathology slides**. In Nature Communications, Nature Research. 10.1038/s41467-024-45589-1.

Omar S. M. El Nahhas, Marko van Treeck, Georg Wölflein, Michaela Unger, Marta Ligero, Tim Lenz, Sophia Janine Wagner, Katherine J. Hewitt, Firas Khader, Sebastian Foersch, Daniel Truhn, Jakob Nikolas Kather (2024): **From whole-slide image to biomarker prediction: end-to-end weakly supervised deep learning in computational pathology**. In Nature Protocols, Springer Nature. 10.1038/s41596-024-01047-2.

Dyke Ferber, Georg Wölflein, Isabella Catharina Wiest, Marta Ligero, Srividhya Sainath, Narmin Ghaffari Laleh, Omar S. M. El Nahhas, Gustav Müller-Franzes, Dirk Jäger, Daniel Truhn, Jakob Nikolas Kather (2024): **In-context learning enables multimodal large language models to classify cancer pathology images**. In Nature Communications, Nature Research. 10.1038/s41467-024-51465-9.

Letian Fu, Gaurav Datta, Huang Huang, William Chung-Ho Panitch, Jaimyn Drake, Joseph Ortiz, Mustafa Mukadam, Mike Lambeta, Roberto Calandra, Ken Goldberg (2024): **A Touch, Vision, and Language Dataset for Multimodal Alignment**. In Salakhutdinov R., Kolter Z., Heller K., Weller A., Oliver N., Scarlett J., Berkenkamp F., eds., Proceedings of the 41st International Conference on Machine Learning, ICML 2024, ML Research Press.

Niklas Funk, Erik Helmut, Georgia Chalvatzaki, Roberto Calandra, Jan Peters (2024): **Evetac: An Event-Based Optical Tactile Sensor for Robotic Manipulation**. In IEEE Transactions on Robotics, IEEE. 10.1109/TRO.2024.3428430.

Bernhard Ganter, Tom Hanika, Johannes Hirth, S. Obiedkov (2024): **Collaborative Hybrid Human AI Learning through Conceptual Exploration**. In Ericson P., Khairova N., De Vos M., eds., Proceedings of the 3rd International Conference on Hybrid Human-Artificial Intelligence, HHAI-WS 2024, CEUR-WS.

Lukas Gerlach, David Carral, Markus Hecher (2024): Finite Groundings for ASP with Functions: **A Journey through Consistency**. In Larson K., eds., Proceedings of the 33rd International Joint Conference on Artificial Intelligence, IJCAI 2024, International Joint Conferences on Artificial Intelligence.

Lukas Gerlach, David Carral, Markus Hecher (2024): **Finite Groundings for ASP with Functions: A Journey through Consistency (Extended Abstract)**. In Gierasimczuk N., Heyninck J., Heyninck J., eds., Proceedings of the 22nd International Workshop on Nonmonotonic Reasoning, NMR 2024, CEUR-WS.

Marcos E. González Laffitte, Peter F Stadler (2024): **Progressive Multiple Alignment of Graphs**. In Algorithms, Multidisciplinary Digital Publishing Institute (MDPI). 10.3390/a17030116.

Marcos E. González Laffitte, Klaus Weinbauer, Tieu-Long Phan, Nora Beier, Nico Domschke, Christoph Flamm, Thomas Gatter, Daniel Merkle, Peter F Stadler (2024): **Partial Imaginary Transition State (ITS) Graphs: A Formal Framework for Research and Analysis of Atom-to-Atom Maps of Unbalanced Chemical Reactions and Their Completions**. In Symmetry, Multidisciplinary Digital Publishing Institute (MDPI). 10.3390/sym16091217.

Marco Gustav, Nic G. Reitsam, Zunamys I. Carrero, Chiara M. L. Loeffler, Marko van Treeck, Tanwei Yuan, Nicholas P. West, Philip Quirke, Titus J. Brinker, Hermann Brenner, Loëtitia Favre, Bruno Märkl, Albrecht Stenzinger, Alexander Brobeil, Michael Hoffmeister, Julien Calderaro, Anaïs Pujals, Jakob Nikolas Kather (2024): **Deep learning for dual detection of microsatellite instability and POLE mutations in colorectal cancer histopathology**. In npj Precision Oncology, Nature Research. 10.1038/s41698-024-00592-z.

Grover E. C. Guzman, Peter F Stadler, Andre Fujita (2024): **Cavity approach for the approximation of spectral density of graphs with heterogeneous structures**. In Physical Review E, American Physical Society. 10.1103/PhysRevE.109.034303.

Tianyu Han, Laura Zigutyte, Luisa Huck, Marc Sebastian Huppertz, Robert Siepmann, Yossi Gandelsman, Christian Blüthgen, Firas Khader, Christiane Kuhl, Sven Nebelung, Jakob Nikolas Kather, Daniel Truhn (2024): **Reconstruction of patient-specific confounders in AI-based radiologic image interpretation using generative pretraining**. In Cell Reports Medicine, Cell Press. 10.1016/j.xcrm.2024.101713.

Tianyu Han, Sven Nebelung, Firas Khader, Tianci Wang, Gustav Müller-Franzes, Christiane Kuhl, Sebastian Foersch, Jens Kleesiek, Christoph Haarburger, Keno K. Bressem, Jakob Nikolas Kather, Daniel Truhn (2024): **Medical large language models are susceptible to targeted misinformation attacks**. In npj Digital Medicine, Nature Research. 10.1038/s41746-024-01282-7.

Philipp Hanisch, Markus Krötzsch (2024): **Chase Termination Beyond Polynomial Time**. In Proc. ACM Manag. Data, ACM. 10.1145/3651594.

Katherine J. Hewitt, Isabella Catharina Wiest, Zunamys I. Carrero, Laura Bejan, Thomas O Millner, Sebastian Brandner, Jakob Nikolas Kather (2024): **Large language models as a diagnostic support tool in neuropathology**. In Journal of Pathology: Clinical Research, John Wiley and Sons Inc. 10.1002/2056-4538.70009.

Lars Hilgers, Narmin Ghaffari Laleh, Nicholas P. West, Alice Westwood, Katherine J. Hewitt, Philip Quirke, Heike I. Grabsch, Zunamys I. Carrero, Emylou Matthaei, Chiara M. L. Loeffler, Titus J. Brinker, Tanwei Yuan, Hermann Brenner, Alexander Brobeil, Michael Hoffmeister, Jakob Nikolas Kather (2024): **Automated curation of large-scale cancer histopathology image datasets using deep learning**. In Histopathology, John Wiley and Sons Inc. 10.1111/his.15159.

Hanna Hoffmann, Isabel Funke, Philipp Peters, Danush Kumar Venkatesh, Jan Egger, Dominik Rivoir, Rainer Röhrig, Frank Hölzle, Sebastian Bodenstedt, Marie-Christin Willemer, Stefanie Speidel, Behrus Puladi (2024): **AIxSuture: vision-based assessment of open suturing skills**. In International Journal of Computer Assisted Radiology and Surgery, Springer. 10.1007/s11548-024-03093-3.

Hernan Inojosa, Isabel Voigt, Judith Wenk, Dyke Ferber, Isabella Catharina Wiest, Dario Antweiler, Eva Weicken, Stephen Gilbert, Jakob Nikolas Kather, Katja Akgün, Tjalf Ziemssen (2024): **Integrating large language models in care, research, and education in multiple sclerosis management**. In Multiple Sclerosis Journal, SAGE Publications Ltd. 10.1177/13524585241277376.

Alex Ivliev, Lukas Gerlach, Simon Meusel, Jakob Steinberg, Markus Krötzsch (2024): **Nemo: Your Friendly and Versatile Rule Reasoning Toolkit**. In Marquis P., Marquis P., Ortiz M., Pagnucco M., eds., Proceedings of the 21st International Conference on Principles of Knowledge Representation and Reasoning, KR 2024, AAAI. 10.24963/KR.2024/70.

Alex Ivliev, Lukas Gerlach, Simon Meusel, Jakob Steinberg, Markus Krötzsch (2024): **Nemo: A Scalable and Versatile Datalog Engine**. In Alviano M., Lanzinger M., eds., Proceedings of the 5th International Workshop on the Resurgence of Datalog in Academia and Industry, Datalog-2.0 2024, CEUR-WS.

Xiaofeng Jiang, Michael Hoffmeister, Hermann Brenner, Hannah S. Muti, Tanwei Yuan, Sebastian Foersch, Nicholas P. West, Alexander Brobeil, Jitendra Jonnagaddala, Nicholas Hawkins, Robyn L Ward, Titus J. Brinker, Oliver Lester Saldanha, Jia Ke, Wolfram Müller, Heike I. Grabsch, Philip Quirke, Daniel Truhn, Jakob Nikolas Kather (2024): **End-to-end prognostication in colorectal cancer by deep learning: a retrospective, multicentre study**. In The Lancet Digital Health, Elsevier Ltd. 10.1016/S2589-7500(23)00208-X.

Caleb A. H. Jones, Benjamin P. Brown, Daniel C. Schultz, Julie Engers, Valerie M. Kramlinger, Jens Meiler, Craig W. Lindsley (2024): **Computer-Aided Design and Biological Evaluation of Diazaspirocyclic D4R Antagonists**. In ACS Chemical Neuroscience, American Chemical Society. 10.1021/acschemneuro.4c00086.

Jonas Karge (2024): **Taming Dilation in Imprecise Pooling**. In Arisaka R., Ito T., Sanchez-Anguix V., Stein S., Aydoğan R., van der Torre L., eds., Proceedings of the 25th International Conference on Principles and Practice of Multi-Agent Systems, PRIMA 2024, Springer. 10.1007/978-3-031-77367-9_32.

Jonas Karge, Sebastian Rudolph, Juliette-Michelle Burkhardt, Dominik Rusovac (2024): **To Lead or to be Led: A Generalized Condorcet Jury Theorem under Dependence**. In Proceedings of the 23rd International Conference on Autonomous Agents and Multiagent Systems, AAMAS 2024, International Foundation for Autonomous Agents and Multiagent Systems (IFAAMAS). 10.5555/3635637.3662953.

Jakob Nikolas Kather, Dyke Ferber, Isabella Catharina Wiest, Stephen Gilbert, Daniel Truhn (2024): **Large language models could make natural language again the universal interface of healthcare**. In Nature Medicine, Nature Research. 10.1038/s41591-024-03199-w.

Kathlen Kohn, Guido Montúfar, Vahid Shahverdi, Matthew Trager (2024): **Function Space and Critical Points of Linear Convolutional Networks**. In SIAM Journal on Applied Algebra and Geometry, Society for Industrial and Applied Mathematics Publications. 10.1137/23M1565504.

Fiona R. Kolbinger, Gregory P. Veldhuizen, Jiefu Zhu, Daniel Truhn, Jakob Nikolas Kather (2024): **Reporting guidelines in medical artificial intelligence: a systematic review and meta-analysis**. In Communications Medicine, Springer Nature. 10.1038/s43856-024-00492-0.

D. Kosakin, S. Obiedkov, E. Rakhilina, I. Smirnov, A. Vyrenkova, E. Zalivina (2024): **Russian Learner Corpus: Towards Error-Cause Annotation for L2 Russian**. In Calzolari N., Kan M.-Y., Hoste V., Lenci A., Sakti S., Xue N., eds., Proceedings of the Joint 30th International Conference on Computational Linguistics and 14th International Conference on Language Resources and Evaluation, LREC-COLING 2024, European Language Resources Association (ELRA).

Nils Küchenmeister, Alex Ivliev, Markus Krötzsch (2024): **Towards Mass Spectrum Analysis with ASP**. In Dodaro C., Gupta G., Martinez M.V., eds., Proceedings of the 17th International Conference on Logic Programming and Non-monotonic Reasoning, LPNMR 2024, Springer. 10.1007/978-3-031-74209-5_16.

Charlotte Langer (2024): **Decision-making power and responsibility in an automated administration**. In Discover Artificial Intelligence, Springer Nature. 10.1007/s44163-024-00152-1.

Jens Lehmann, Dhananjay Bhandiwad, Preetam Gattogi, Sahar Vahdati (2024): **Beyond Boundaries: A Human-like Approach for Question Answering over Structured and Unstructured Information Sources**. In Transactions of the Association for Computational Linguistics, MIT Press Journals. 10.1162/tacl_a_00671.

Nicholas Leisegang, Thomas Meyer, Sebastian Rudolph (2024): **Towards Propositional KLM-Style Defeasible Standpoint Logics**. In Gerber A., Maritz J., Pillay A. W., eds., Proceedings of the 5th Southern African Conference for Artificial Intelligence Research, SACAIR 2024, Springer. 10.1007/978-3-031-78255-8_27.

Fabian Liessmann, Lukas von Bredow, Jens Meiler, Ines Liebscher (2024): **Targeting adhesion G protein-coupled receptors. Current status and future perspectives**. In Structure, Cell Press. 10.1016/j.str.2024.10.022.

Chiara M. L. Loeffler, Omar S. M. El Nahhas, Hannah S. Muti, Zunamys I. Carrero, Tobias Seibel, Marko van Treeck, Didem Cifci, Marco Gustav, Kevin Bretz, Nadine T. Gaisa, Kjong-Van Lehmann, Alexandra Leary, Pier Selenica, Jorge S Reis-Filho, Nadina Ortiz-Bruechle, Jakob Nikolas Kather (2024): **Prediction of homologous recombination deficiency from routine histology with attention-based multiple instance learning in nine different tumor types**. In BMC Biology, BioMed Central Ltd. 10.1186/s12915-024-02022-9.

Carsten Lutz, Lukas Schulze (2024): Description Logics with Abstraction and Refinement: From ALC to EL. In Marquis P., Marquis P., Ortiz M., Pagnucco M., eds., Proceedings of the 21st International Conference on Principles of Knowledge Representation and Reasoning, KR 2024, AAAI. 10.24963/KR.2024/51.

Carsten Lutz, Quentin Manière (2024): **Adding Circumscription to Decidable Fragments of First-Order Logic: A Complexity Rollercoaster**. In Marquis P., Marquis P., Ortiz M., Pagnucco M., eds., Proceedings of the 21st International Conference on Principles of Knowledge Representation and Reasoning, KR 2024, AAAI. 10.24963/KR.2024/50.

Tim S. Lyon, Jonas Karge (2024): **Constructive Interpolation and Concept-Based Beth Definability for Description Logics via Sequents**. In Larson K., eds., Proceedings of the 33rd International Joint Conference on Artificial Intelligence, IJCAI 2024, International Joint Conferences on Artificial Intelligence. 10.24963/ijcai.2024/386.

Lucas Fabian Naumann, Jannik Irmai, Shengxian Zhao, Bjoern Andres (2024): **Box Facets and Cut Facets of Lifted Multicut Polytopes**. In Salakhutdinov R., Kolter Z., Heller K., Weller A., Oliver N., Scarlett J., Berkenkamp F., eds., Proceedings of the 41st International Conference on Machine Learning, ICML 2024, ML Research Press.

Anna Niarakis, Reinhard Laubenbacher, Gary An, Yaron Ilan, Jasmin Fisher, Åsmund Flobak, Kristin Reiche, María Rodríguez Martínez, Liesbet Geris, Luiz Ladeira, Lorenzo Veschini, Michael L. Blinov, Francesco Messina, Luis L. Fonseca, Sandra Ferreira, Arnau Montagud, Vincent Noël, Malvina Marku, Eirini Tsirvouli, Marcella M. Torres, Leonard A. Harris, T. J. Sego, Chase Cockrell, Amanda E. Shick, Hasan Balci, Albin Salazar, Kinza Rian, Ahmed Abdelmonem Hemedan, Marina Esteban-Medina, Bernard Staumont, Esteban Hernandez-Vargas, Shiny Martis B, Alejandro Madrid-Valiente, Panagiotis Karampelesis, Luis Sordo Vieira, Pradyumna Harlapur, Alexander Kulesza, Niloofar Nikaein, Winston Garira, Rahuman S. Malik Sheriff, Juilee Thakar, Van Du T. Tran, Jose Carbonell-Caballero, Soroush Safaei, Alfonso Valencia, Andrei Zinovyev, James A. Glazier (2024): **Immune digital twins for complex human pathologies: applications, limitations, and challenges**. In npj Systems Biology and Applications, Nature Research. 10.1038/s41540-024-00450-5.

Jan M. Niehues, Gustav Müller-Franzes, Yoni Schirris, Sophia Janine Wagner, Michael Jendrusch, Matthias Kloor, Alexander T. Pearson, Hannah S. Muti, Katherine J. Hewitt, Gregory P. Veldhuizen, Laura Zigutyte, Daniel Truhn, Jakob Nikolas Kather (2024): **Using histopathology latent diffusion models as privacy-preserving dataset augmenters improves downstream classification performance**. In Computers in Biology and Medicine, Elsevier Ltd. 10.1016/j.compbiomed.2024.108410.

S. Obiedkov, Barış Sertkaya (2024): **Probably Approximately Correct Ontology Completion with pacco (Extended Abstract)**. In Giordano L., Jung J.C., Ozaki A., Ozaki A., eds., Proceedings of the 37th International Workshop on Description Logics, DL 2024, CEUR-WS.

Iuliia Ozerova, Jörg Fallmann, Mario Mörl, Matthias Bernt, Sonja J. Prohaska, Peter F Stadler (2024): **Aberrant Mitochondrial tRNA Genes Appear Frequently in Animal Evolution**. In Genome Biology and Evolution, Oxford University Press. 10.1093/gbe/evae232.

Raquel Perez-Lopez, Narmin Ghaffari Laleh, Faisal Mahmood, Jakob Nikolas Kather (2024): **A guide to artificial intelligence for cancer researchers**. In Nature Reviews Cancer, Nature Research. 10.1038/s41568-024-00694-7.

Antonia Sophia Peter, Dieter S. Hoffmann, Johannes Klier, Christina M. Lange, Johanna Moeller, Victoria Most, Christina K. Wüst, Max Beining, Sevilay Gülesen, Hannes Junker, Birke Brumme, Torben Schiffner, Jens Meiler, Clara T. Schoeder (2024): **Strategies of rational and structure-driven vaccine design for Arenaviruses**. In Infection, Genetics and Evolution, Elsevier B.V.. 10.1016/j.meegid.2024.105626.

Tieu-Long Phan, Klaus Weinbauer, Thomas Gärtner, Daniel Merkle, Jakob L. Andersen, Rolf Fagerberg, Peter F Stadler (2024): **Reaction rebalancing: a novel approach to curating reaction databases**. In Journal of Cheminformatics, BioMed Central Ltd. 10.1186/s13321-024-00875-4.

Michelle Philipp, Christopher W Moth, Nikola Ristic, Johanna K. S. Tiemann, Florian Seufert, Aleksandra Panfilova, Jens Meiler, Peter W Hildebrand, Amelie Stein, Daniel Wiegreffe, René Staritzbichler (2024): **MutationExplorer: a webserver for mutation of proteins and 3D visualization of energetic impacts**. In Nucleic Acids Research, Oxford University Press. 10.1093/nar/gkae301.

Nic G. Reitsam, Veselin Grozdanov, Chiara Maria Lavinia Löffler, Hannah S. Muti, Bianca Grosser, Jakob Nikolas Kather, Bruno Märkl (2024): **Novel biomarker SARIFA in colorectal cancer: highly prognostic, not genetically driven and histologic indicator of a distinct tumor biology**. In Cancer Gene Therapy, Springer Nature. 10.1038/s41417-023-00695-y.

Nic G. Reitsam, Bianca Grosser, David F. Steiner, Veselin Grozdanov, Ellery Wulczyn, Vincenzo L'Imperio, Markus Plass, Heimo Müller, Kurt Zatloukal, Hannah S. Muti, Jakob Nikolas Kather, Bruno Märkl (2024): **Converging deep learning and human-observed tumor-adipocyte interaction as a biomarker in colorectal cancer**. In Communications Medicine, Springer Nature. 10.1038/s43856-024-00589-6.

Nic G. Reitsam, Johanna Sophie Enke, Kien Vu Trung, Bruno Märkl, Jakob Nikolas Kather (2024): Artificial Intelligence in Colorectal Cancer: **From Patient Screening over Tailoring Treatment Decisions to Identification of Novel Biomarkers**. In Digestion, S. Karger AG. 10.1159/000539678.

Dominik Rusovac, Markus Hecher, Martin Gebser, Sarah Alice Gaggl, Johannes K. Fichte (2024): **Navigating and Querying Answer Sets: How Hard Is It Really and Why?**. In Marquis P., Marquis P., Ortiz M., Pagnucco M., eds., Proceedings of the 21st International Conference on Principles of Knowledge Representation and Reasoning, KR 2024, AAAI. 10.24963/KR.2024/60.

Farid Saberi-Movahed, Bitasta Biswas, Prayag Tiwari, Jens Lehmann, Sahar Vahdati (2024): **Deep Nonnegative Matrix Factorization with Joint Global and Local Structure Preservation**. In Expert Systems with Applications, Elsevier Ltd. 10.1016/j.eswa.2024.123645.

Anahy Santiago Arguello, Guillaume E. Scholz, Peter F Stadler (2024): **Core Potentials: The Consensus Segmentation Conjecture**. In Mathematics in Computer Science, Birkhauser. 10.1007/s11786-024-00593-y.

Stephanie Schiedermair (2024): **The Civil Service and Artificial Intelligence**. In The Handbook of Civil Service in Europe, Karl-Peter Sommermann / Adam Krzywoń / Cristina Fraenkel-Haeberle (eds.).

Stephanie Schiedermair (2024): **Between Efficiency and Loss of Control: The Use of Artificial Intelligence by the Public Administration in the Mirror of the Law**. In Quo vadis Artificial Intelligence in Nuclear Waste Management?, Bundesamt für die Sicherheit der nuklearen Entsorgung (BASE) (Hrsg.).

Richard Schroedter, Adnan Haidar, Ronald Tetzlaff (2024): **Fault Impact Map for Memristive Crossbar Neural Networks**. In Proceedings of the 13th International Conference on Modern Circuits and Systems Technologies, MOCAST 2024, IEEE. 10.1109/MOCAST61810.2024.10615515.

Jonas Schulz, Clemens Dubslaff, Patrick Seeling, Shu-Chen Li, Stefanie Speidel, Frank H. P. Fitzek (2024): **Negative Latency in the Tactile Internet as Enabler for Global Metaverse Immersion**. In IEEE Network, IEEE. 10.1109/MNET.2024.3375522.

Ameera Vaheeda Shanavas, Manoj Changat, Peter F Stadler (2024): **On the Cut-Vertex and the Interval Transit Functions of Hypergraphs**. In Graphs and Combinatorics, Springer. 10.1007/s00373-024-02864-8.

Sudharshan Suresh, Haozhi Qi, Tingfan Wu, Taosha Fan, Luis Pineda, Mike Lambeta, Jitendra Malik, Mrinal Kalakrishnan, Roberto Calandra, Michael Kaess, Joseph Ortiz, Mustafa Mukadam (2024): **NeuralFeels with neural fields: Visuotactile perception for in-hand manipulation**. In Science Robotics, American Association for the Advancement of Science. 10.1126/scirobotics.adl0628.

Yidan Tang, Rocco Moretti, Jens Meiler (2024): **Recent Advances in Automated Structure-Based De Novo Drug Design**. In Journal of Chemical Information and Modeling, American Chemical Society. 10.1021/acs.jcim.4c00247.

Daniel Truhn, Chiara M. L. Loeffler, Gustav Müller-Franzes, Sven Nebelung, Katherine J. Hewitt, Sebastian Brandner, Keno K. Bressem, Sebastian Foersch, Jakob Nikolas Kather (2024): **Extracting structured information from unstructured histopathology reports using generative pre-trained transformer 4 (GPT-4)**. In Journal of Pathology, John Wiley and Sons Ltd. 10.1002/path.6232.

Gia-Bao Truong, Thanh-An Pham, Van-Thinh To, Hoang-Son Lai Le, Phuoc-Chung Van Nguyen, The-Chuong Trinh, Tieu-Long Phan, Tuyen Ngoc Truong (2024): **Discovery of Vascular Endothelial Growth Factor Receptor 2 Inhibitors Employing Junction Tree Variational Autoencoder with Bayesian Optimization and Gradient Ascent**. In ACS Omega, American Chemical Society. 10.1021/acsomega.4c07689.

Michaela Unger, Jakob Nikolas Kather (2024): **A systematic analysis of deep learning in genomics and histopathology for precision oncology**. In BMC Medical Genomics, BioMed Central Ltd. 10.1186/s12920-024-01796-9.

Michaela Unger, Jakob Nikolas Kather (2024): **Deep learning in cancer genomics and histopathology**. In Genome Medicine, BioMed Central Ltd. 10.1186/s13073-024-01315-6.

Brinda Vallat, Benjamin M. Webb, John D. Westbrook, Thomas D. Goddard, Christian A. Hanke, Andrea Graziadei, Ezra Peisach, Arthur Zalevsky, Jared Sagendorf, Hongsuda Tangmunarunkit, Serban Voinea, Monica Sekharan, Jian Yu, Alexander A. M. J. J. Bonvin, Frank DiMaio, Gerhard Hummer, Jens Meiler, Emad Tajkhorshid, Thomas E. Ferrin, Catherine L. Lawson, Alexander Leitner, Juri Rappsilber, Claus A.M. Seidel, Cy M. Jeffries, Stephen K. Burley, Jeffrey C. Hoch, Genji Kurisu, Kyle Morris, Ardan Patwardhan, Sameer Velankar, Torsten Schwede, Jill Trewhella, Carl Kesselman, Helen M. Berman, Andrej Sali (2024): **IHMCIF: An Extension of the PDBx/mmCIF Data Standard for Integrative Structure Determination Methods**. In Journal of Molecular Biology, Academic Press. 10.1016/j.jmb.2024.168546.

Danush Kumar Venkatesh, Dominik Rivoir, Micha Pfeiffer, Fiona R. Kolbinger, Marius Distler, Jürgen Weitz, Stefanie Speidel (2024): **Exploring semantic consistency in unpaired image translation to generate data for surgical applications**. In International Journal of Computer Assisted Radiology and Surgery, Springer. 10.1007/s11548-024-03079-1.

Sarah von Löhneysen, Mario Mörl, Peter F Stadler (2024): **Limits of experimental evidence in RNA secondary structure prediction**. In Frontiers in Bioinformatics, Frontiers Media SA. 10.3389/fbinf.2024.1346779.

Isabella Catharina Wiest, Dyke Ferber, Jiefu Zhu, Marko van Treeck, Sonja K. Meyer, Radhika Juglan, Zunamys I. Carrero, Daniel Paech, Jens Kleesiek, Matthias P. Ebert, Daniel Truhn, Jakob Nikolas Kather (2024): P**rivacy-preserving large language models for structured medical information retrieval**. In npj Digital Medicine, Nature Research. 10.1038/s41746-024-01233-2.

Isabella Catharina Wiest, Falk Gerrik Verhees, Dyke Ferber, Jiefu Zhu, Michael Bauer, Ute Lewitzka, Andrea Pfennig, Pavol Mikolas, Jakob Nikolas Kather (2024): **Detection of suicidality from medical text using privacy-preserving large language models**. In British Journal of Psychiatry, Cambridge University Press. 10.1192/bjp.2024.134.

Jiajing Zhang, Lyuqiao Zhong, Yushan Yang, Jonas Schulz, Giang T. Nguyen, Frank H. P. Fitzek (2024): LEON: **Simulating Handover Integrating Non-Terrestrial Networks with 5G and beyond**. In Proceedings of the 10th Workshop on Micro Aerial Vehicle Networks, Systems, and Applications, DroNet 2024, ACM. 10.1145/3661810.3663470.

Laura Zigutyte, Thomas Sorz-Nechay, Jan Clusmann, Jakob Nikolas Kather (2024): **Use of artificial intelligence for liver diseases: A survey from the EASL congress 2024**. In JHEP Reports, Elsevier B.V.. 10.1016/j.jhepr.2024.101209.

IMPRINT

Editorial Office
Editor
Markus Krötzsch
Contributors
Philipp Hanisch, Ludwig Chan Steiger

Publisher
SECAI Office
Chair of Knowledge-Based Systems
Faculty of Computer Science
TU Dresden
01062 Dresden

E-Mail: secai-office@tu-dresden.de
Phone: +49 351 463 43507
WEB: https://secai.org

Layout
Ö GRAFIK agentur für marketing und design, Dresden

Images and Graphics
Aditya – generated with AI – stock.adobe.com: p. 44
Thomas Bennie – unsplash.com: p. 30
Photomontage using © bmf-foto.de:
generated with AI – stock.adobe.com: p. 12
SeanPavone – elements.envato.com: p. 22
travelview – stock.adobe.com: p. 10 / 11 (Leipzig University)

NCT / UCC / Frank Blümler: p. 11
DAAD / Nathan Dreessen: p. 17, 26, 29, 35, 41, 47, 53, 54
Nils Eisfeld: p. 10 | Sven Ellger: p. 31, 50
Humboldt-Stiftung: p. 32 | Christian Hüller: p. 8, 9, 48, 53
Michael Kretzschmar / UKD: p. 36
Matthias Meißner: p. 16 | Krishna Moorthy: p. 43
DAAD / PAUL KUCHEL PYKADO: p. 17, 29, 53 | RIG: p. 19
Ludwig Schmutzler: p. 25 | Maik Simon: p. 34
David Sünderhauf: p. 42
DAAD / Siegfried Michael Wagner: p. 17, 18, 20, 27, 29, 35, 42, 53
Sebastian Weingart: p. 14, 29, 51 | Gordon Welters: p. 47

Acknowledgements
This work is supported by BMFTR (Federal Ministry of Research, Technology and Space) in DAAD project 57616814 (SECAI, School of Embedded Composite AI) as part of the program Konrad Zuse Schools of Excellence in Artificial Intelligence.
The responsibility for the content of this publication remains with the editorial office and authors.

With funding from the:

Federal Ministry of Research, Technology and Space

DAAD Zuse Schools
Konrad Zuse Schools of Excellence in Artificial Intelligence