ETH AI Center
Annual Report 2023

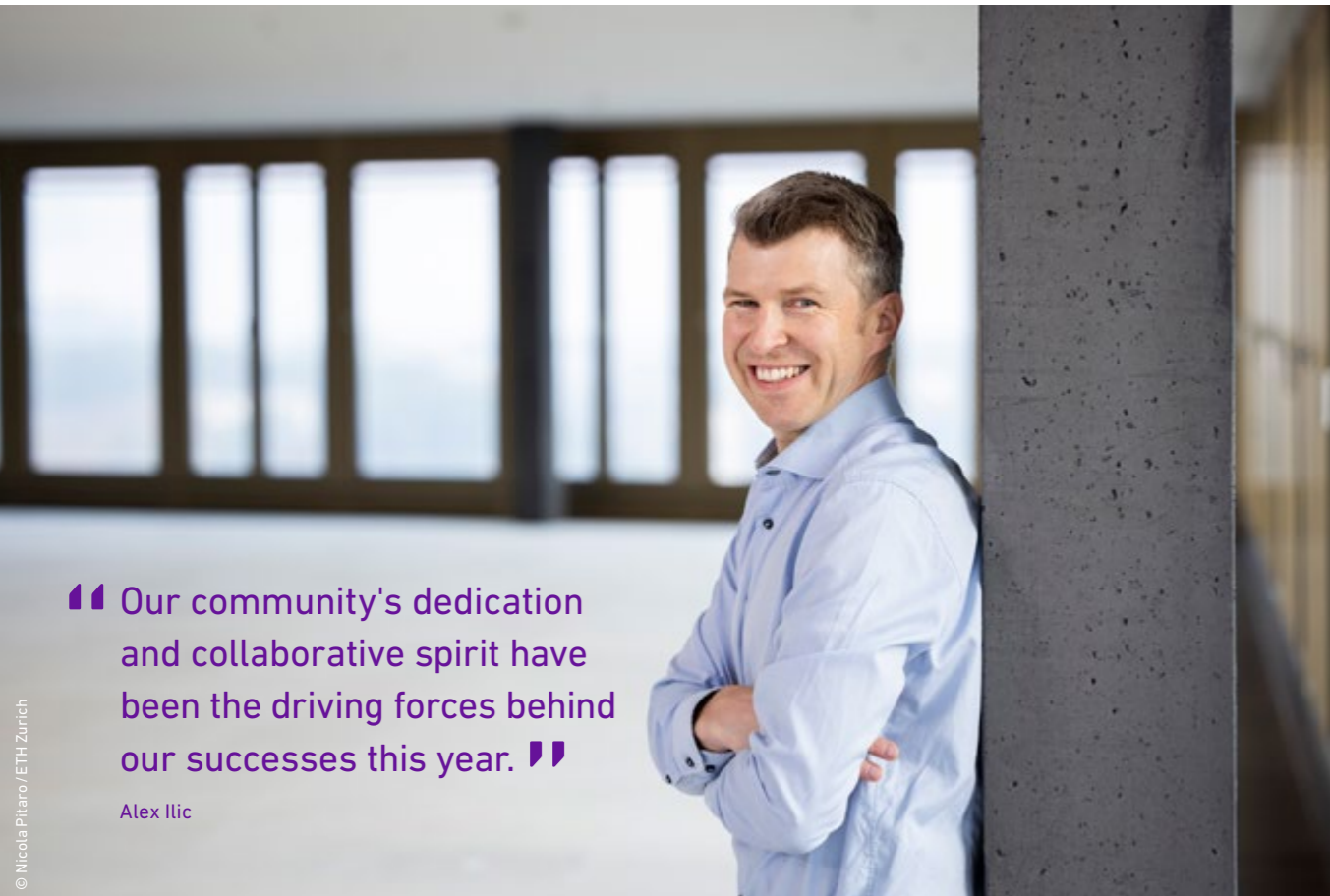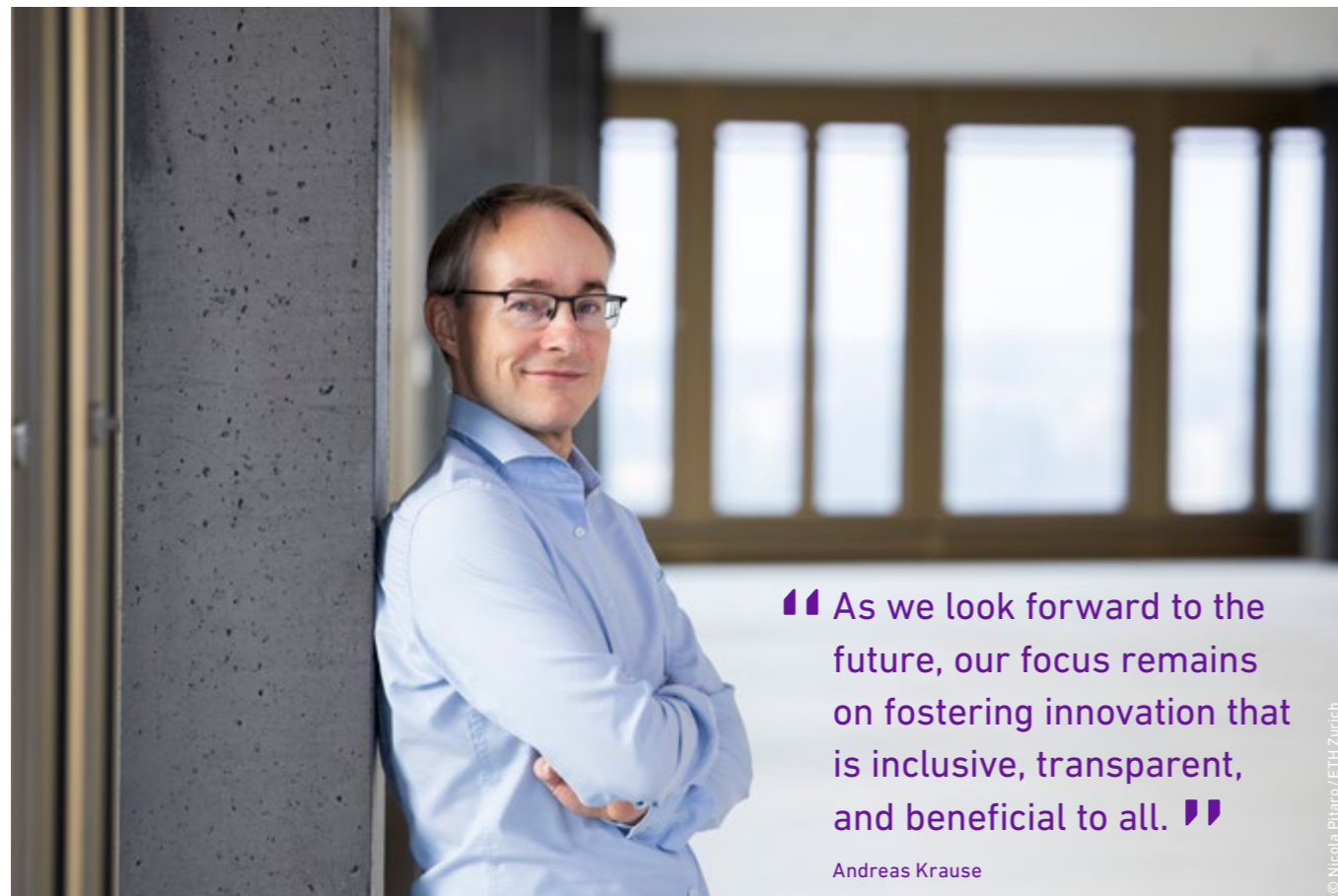**ETH AI CENTER**

❝ Our community's dedication and collaborative spirit have been the driving forces behind our successes this year. ❞

Alex Ilic

PD Dr. Alexander Ilic, Executive Director of ETH AI Center

❝ As we look forward to the future, our focus remains on fostering innovation that is inclusive, transparent, and beneficial to all. ❞

Andreas Krause

Prof. Andreas Krause, Chairman

Executive Summary by Chairman & Executive Director

Dear Colleagues and Friends,

2023 marked the year AI truly entered the mainstream. Following the launch of Chat GPT in late 2022, the first half of 2023 was dominated by discussions about its impact on (higher) education, the arts, journalism, the job market, and businesses big and small. This surge in interest was keenly felt at the ETH AI Center: Many of our fellows and faculty had the opportunity to present their work and comment on ongoing developments in the legacy media, reaching audiences that are often challenging to engage with. Striking a balanced view amidst sensationalist headlines and fear mongering, though, remains a challenge.

Against this backdrop, in early summer, Switzerland's Department of Foreign Affairs approached us with a proposal to collaboratively develop a comprehensive framework for assessing and mitigating risks associated with the expanding use of AI across various applications. This initiative, later named the "Swiss Call for Trust and Transparency in AI", led to the inception of two strong networks aimed at advancing beneficial and trustworthy AI, while adhering to European standards of privacy, fairness, and human alignment.

In a field developing as rapidly as AI, it is essential to ensure effective tech transfer and enable Swiss companies to become agile users of new technologies. Only then can they fully benefit from these advancements. We have therefore continued our efforts to bolster innovation in Switzerland by connecting stakeholders from academia, the startup scene, and the private sector, and by playing a key role in bringing the Rise Europe network to life.

The launch of the Swiss AI Initiative in the second half of the year marked an increased emphasis on national efforts, complementing our ongoing international collaborations. This collaborative effort, led by ETH Zurich and EPFL, aims to use the capabilities of the Swiss Supercomputing Centre CSCS as well as the collective expertise and resources of Switzerland's research institutions to build large AI models. At this point, the Swiss AI Initiative leverages 10M GPU-hours which rivals the compute requirements of even the largest AI projects today. We aim to leverage these outstanding capabilities to collaboratively shape and create AI models that help safeguard Switzerland's digital sovereignty.

We are pleased to share with you our achievements this year and our ongoing efforts to promote trustworthy, accessible, and inclusive AI systems for the benefit of society.

Prof. Dr. Andreas Krause
Chairman

PD Dr. Alexander Ilic
Executive Director

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The Year at a Glance

A quick look at the main achievements and developments at ETH AI Center in 2023:

› The Center has thrived, experiencing significant growth and accomplishments. We successfully onboarded the third cohort of fellows, now connecting 50 research groups across all departments of ETH Zurich, University of Zurich, and the local University Hospitals.

› 17 new faculty members joined the Center, representing 8 different departments of ETH and UZH, broadening the expertise and range of research interests at the Center.

› The executive office of ETH AI Center expanded its staff, hiring new members for event management, industry relations, and entrepreneurship.

› Our flagship event, the AI + X Summit, once again welcomed over 2,000 participants from academia, industry, and startups, solidifying its status as the premier networking opportunity for the AI innovation community in and around Zurich.

› In collaboration with EPFL and other academic partners, we launched the Swiss AI Initiative, which aims to advance the capabilities of large AI systems to serve societal needs by harnessing the collective expertise and resources of Switzerland's research institutions.

› We partnered with the Swiss Federal Department of Foreign Affairs to launch the Swiss Call for Trust and Transparency in AI, bringing together experts from academia, civil society, governance, and industry to develop ideas for making AI more secure and trustworthy. This initiative led to the creation of two networks: one focusing on Red Teaming of AI systems and the other promoting collaboration to facilitate access to know-how, data, and compute resources for the global south.

› Together with Merantix and Swisscom, we launched AI House Davos, a multi-stakeholder platform dedicated to AI during the WEF in Davos in early 2024.

› We expanded and deepened connections between the European startup and academic ecosystems through the networks of Rise Europe and ELLIS. ∎

❝ Navigating the complexities of AI development requires a balanced approach, one that fosters innovation while ensuring ethical considerations remain at the forefront. ❞

Alex Ilic

RESEARCH

Research Community at the Center

As a competence center of ETH Zurich, the ETH AI Center's core mission is to foster exchange and collaboration across disciplines and departments. This approach is particularly promising in the context of AI and ML.

ETH AI Center is the academic home to a group of doctoral and post-doctoral fellows that each work with two faculty PIs from different backgrounds to foster exchange and close co-development of methods and applications. The fellowship program has concluded its third selection round, with 59 PhD and post-doctoral fellows currently employed by the AI Center. The group remains highly diverse, with 50% female researchers and representation from over 30 nationalities, sending a powerful signal of inclusivity and diversity.

In 2023, seven postdoctoral researchers concluded their fellowships at the ETH AI Center with resounding success: with four of them secured professorships at ETH and other European research institutes of excellence.

Attending and presenting at conferences is a major aspect of our early researchers' career, who presented their work at the major global AI and machine learning conferences (ICML, ICLR, NeurIPS), which included pre-conference events such as the NeurIPS poster session where 11 fellows prepared and practiced presenting their successful submissions to their peers.

In addition to the Fellowship program, the ETH AI Center also offers association for early-career ETH researchers excited to become an active part of the Associated Researcher community, which by the end of 2023 included 209 doctoral students and 59 post-doctoral researchers across all departments at ETH Zurich. The Associated Researcher community now hosts the Zurich NLP - the leading meet-up in Zurich for researchers in the area of natural language processing involving not only researchers at ETH but also from other research institutions and companies

such as Meta, Google, and others. Another example is the AI & Environment Summit which attracts over 100 participants and is completely organized by the community.

Internal networking events by the AI Center provide a platform for faculty, fellows and associated researchers to meet and exchange across disciplines and departments. Examples from 2023 include the six Faculty Workshops, which focussed on a specific area of exploration such as "AI & Digital Health", "AI for Scientific Discovery", and "AI for Sustainability", bringing together top academic researchers from Zürich and Switzerland, but also researchers from industry (Google Earth, Meta, Disney, Microsoft), the public health sector (University Hospital Zürich, University Clinic Balgrist), and the many ETH-affiliated and external startups from the region (see Annex for details). Another research exchange format hosted by the AI Center is the Research Talk Series. Starting in late 2023 with talks from academic and industrial speakers from Google Deepmind, Helmholtz AI, and the University of Leeds; the series has attracted speakers from various backgrounds to contribute.

In May 2023, Professor Peter G. Kirchschlaeger, an ethics expert and Full Professor of Theological Ethics and Director of the Institute of Social Ethics ISE at the University of Lucerne, was appointed as a Visiting Professor at Prof. Benjamin Grewe's Lab and the AI Center. Alongside AI+Art Curator Adrian Notz, Kirchschlaeger organized two seminars during the spring and autumn semesters: "AI, Entrepreneurship, Ethics, and Art" in spring, and "Ethics in Technology" in autumn. These seminars have enriched the educational program of the ETH AI Center by providing in-depth discussions on the ethical dimensions of AI research and applications. ∎

Awards to Our Faculty and Fellows

We take immense pride in highlighting the numerous awards and recognitions bestowed upon the faculty and fellows of the ETH AI Center in 2023.

Of particular significance is the appointment of Prof. Andreas Krause, Chair of the ETH AI Center, to the UN advisory body on Artificial Intelligence. In response to critical technological advancements, the United Nations has established an external global AI Advisory Body to address risks, opportunities, and international governance of AI. Bringing together experts from diverse disciplines worldwide, the board aims to provide perspectives and options on governing AI for the common good, aligned with human rights and the Sustainable Development Goals.

Another outstanding recognition is the appointment of Prof. Torsten Hoefler as Chief Architect for Machine Learning at the Swiss National Supercomputing Centre (CSCS). In this capacity, Hoefler will play a pivotal role in shaping the center's strategy concerning these innovative technologies. Renowned for his expertise in HPC and ML, Hoefler has long served as a crucial liaison between CSCS and researchers in classical scientific fields like physics, climate research, and materials research, particularly within the interdisciplinary projects linked to the Platform for Advanced Scientific Computing (PASC) in Switzerland.

Mathematician Prof. Siddhartha Mishra has been honored with the Rössler Prize for his groundbreaking research on solutions for highly complex flow and wave phenomena. Valued at 200,000 Swiss francs, this prestigious award is ETH Zurich's most generous research accolade. Mishra's pioneering work not only advances the field of nonlinear partial differential equations but also bridges the gap between mathematical theory and practical applications in research and industry. His development of robust

algorithms enables faster and more accurate simulations of nonlinear partial differential equations on supercomputers, opening new avenues for solving real-world problems across various research domains.

Professors Manu Kapur (D-GESS), Marc Pollefeys (D-INFK), Luca Benini (D-ITET), Nicolai Meinshausen (D-MATH), Jan Vermant (D-MATL), Daniel Ahmed (D-MAVT), and Daniela Domeisen (D-USYS), all associated faculty members of the ETH AI Center, have been recognized as winners of the Dandelion Award for Entrepreneurship in 2023.

Additionally, our fellows have received awards for outstanding research. PhD Fellow Jakub Macina was featured in "Forbes 30 Under 30" in the Science & Education category in his home country of Slovakia. Karin Yu, who commenced her PhD fellowship at the ETH AI Center in 2023, was honored with the Hilti Prize for Innovative Research for her Master's Thesis, titled "Distributed Virtual Sensing via Bayesian Filtering for Wind Energy Structures." And Prof. Mennatallah El-Assady, who completed her Postdoctoral fellowship in 2023, received the EuroVis Early Career Award.

Furthermore, Dr. Alexander Ilic was recognized among the "Digital Shapers 2023" by the Swiss economics magazine "Bilanz," along with several founders of ETH AI Center-affiliated startups. These include Paulina Grnarova, founder of DeepJudge; Simon Heckler, founder of Aegis Rider; and Lucas Vandroux, founder of VU Engineering. ∎

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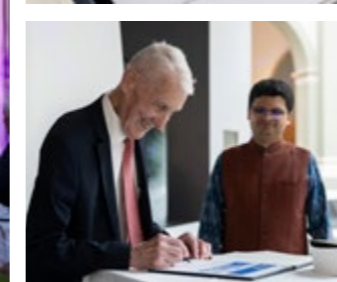
Alumni 2023

Dr. Alexander Marx

Alexander was a postdoctoral fellow at ETH AI Center under the supervision of Prof. Julia Vogt, Prof. Joachim Bühlmann and Prof. Gunnar Rätsch from 2021 to 2023.

He will be joining the Research Center Trustworthy Data Science and Security at TU Dortmund University, Germany, as a professor in summer 2024.

Dr. Amartya Sanyal

Dr. Amartya Sanyal is an incoming Assistant Professor in Machine Learning in the Department of Computer Science in University of Copenhagen, starting his faculty position in Summer 2024. He wil also be an Affiliated Assistant Professor in the Department of Mathematics.

He was a postdoctoral fellow at ETH AI Center under the supervision of Prof. Fanny Yang, Prof. Bernhard Schölkopf and Prof. Rima Alairafi from 2021 to 2023.

Dr. Giorgia Ramponi

Dr. Giorgia Ramponi is an incoming faculty member at University of Zurich (UZH), where her research focuses on Reinforcement Learning and Multi-agent Learning.

She was a postdoctoral fellow at ETH AI Center under the supervision of Prof. Niao He and Prof. Andreas Krause from 2021 to 2023, sponsored by Google Deepmind.

Prof. Dr. Mennatallah El-Assady

Menna is an Assistant Professor at the Department of Computer Science of ETH Zurich where she leads the Interactive Visualization and Intelligence Augmentation Lab (IVIA).

She was a postdoctoral fellow at ETH AI Center under the supervision of Prof. Joachim Buhmann and Prof. Mrinmaya Sachan from 2021 to 2023.

Prof. Dr. Nikola Konstantinov

Nikola Konstantinov is now a faculty member at INSAIT, Sofia University, where he leads the machine learning group. His research focuses on trustworthy and collaborative machine learning.

He was a postdoctoral fellow at ETH AI Center under the supervision of Prof. Martin Vechev and Prof. Fanny Yang in 2022 to 2023.

Dr. Martino Sorbaro

Martino was a postdoctoral fellow at ETH AI Center under the supervision of Prof. Benjamin Grewe and Prof. Giacomo Indiveri from 2021 to 2023.

He now works as a teacher in Italy.
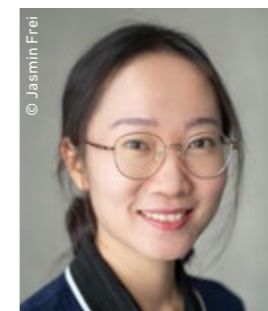
Dr. Xinwei Shen

Xinwei was a postdoctoral fellow at ETH AI Center under the supervision of Prof. Peter Bühlmann and Prof. Nicolai Meinshausen.

She will be joining the Department of Statistics at the University of Washington as an assistant professor in fall 2025.

Menna El-Assady Is Committed To an AI With a Human Face

The ongoing development of artificial intelligence is often presented as a race between humans and machines. ETH professor Menna El-Assady takes a different approach: as head of the Interactive Visualization and Intelligence Augmentation Lab at ETH Zurich, the young scientist wants to develop an AI that can be used interactively and that shapes its capabilities only in collaboration with humans.

› By Stefan Betschon

It doesn't look good. When the world's powerful gathered in Davos at the beginning of the year for the World Economic Forum (WEF), they were faced with gloomy predictions for the future. The latest edition of the "Global Risk Report", compiled by the organizers of the forum, points to a new danger in addition to issues that have been worrying politicians and business leaders for years such as climate change, armed conflicts, uncertain economic development: Rapid technological change. The technology referred to here is computer technology, or more precisely, artificial intelligence (AI). It therefore comes as no surprise that AI was one of the most discussed topics at the WEF 2024 in Davos. Numerous panel discussions, lectures and media conferences revolved around this key field of software technology. For many media representatives and WEF participants, the focus of interest was on a young American: Sam Altmann. He is the CEO of the US company Open-AI, which has become world-famous within a very short space of time thanks to ChatGPT. The American manager represents AI in the perception of many media consumers.

Artificial intelligence as a tool

But AI also has another face: it is the face of a young woman who works as an assistant professor at ETH Zurich: Menna El-Assady. She wants to create an AI that does not replace human abilities, but complements them. An AI that proves itself as a tool in the hands of a human. An AI that can be used interactively, that not only provides answers, but also allows questions to be asked. "I see it as a personal challenge," she says in a face-to-face interview, "to build bridges between people and machines."

At ETH Zurich, within the Department of Computer Science, El-Assady heads the Interactive Visualization & Intelligence Augmentation Lab. Research here focuses on the interfaces between humans and AI systems. Collaboration between humans and AI agents is a "co-adaptive process", emphasizes El-Assady. This means that humans must also continue to develop.

"We want to design interfaces that help users to get an idea of what a model can do," explains El-Assady. "These models can do a lot, but they can't do everything. People need to develop an understanding of what data and basic assumptions are contained in a model. Only then can they correctly interpret the answers they receive. We call this 'human empowerment': people should be enabled to use AI in a meaningful way. It's about taking away their fear of technology, but at the same time keeping a certain skepticism alive so that they don't believe everything."

From Alexandria to Zurich - Menna El-Assady's path to interdisciplinary research

Having grown up in the Egyptian metropolis of Alexandria, El-Assady came to Konstanz University at the age of 18. "I actually wanted to study physics at first, but then I switched to computer science after just a few weeks." Initially, she was fascinated by the mathematical basics of the field, the algorithms; then she became interested in natural language processing.

El-Assady speaks three languages fluently and has learned to navigate different cultures. This multicultural background has sharpened her sense of the different tonalities in political debates. She calls this "framing". Because she sourced information on current events from different channels, she noticed how big the differences in "framing" can be and was interested in exploring this insight as part of a computer-aided argumentation analysis. As part of her doctoral thesis, she was able to work on a project that involved analyzing the transcripts of political debates with the help of computers. The aim was to process the discussions, in which dozens of citizens had participated over many days, in such a way that the back and forth of the arguments could be explored interactively on the screen at various levels of abstraction. The methods of visual analytics, a sub-discipline of computer science, made it possible for people to grasp large amounts of data and complicated argumentation patterns at a glance.

This is how the biography of this scientist brings together disciplines that are otherwise separate: Natural Language Processing, Machine Learning, Visual Analytics, Interface Design, Human-Computer Interaction and more. Each of these disciplines is the center of its own scientific community with its own journals and conferences. In her research and teaching, El-Assady wants to unite these disciplines and thus create the conditions for interactive machine learning and artificial intelligence that places people front and center.

El-Assady is convinced that you cannot have one – human-centered AI – without the other – interdisciplinarity. Interdisciplinary approaches are particularly valued at ETH Zurich, says El-Assady. She also had offers from other universities, but chose ETH Zurich because the AI Center fosters exchange between disciplines.

Can a university research laboratory in a small country compete with large American tech companies? Yes, believes El-Assady. There is a global trend in AI research towards open source models. On this basis, ETH Zurich, together with other Swiss universities and in particular with the support of the Swiss National Supercomputing Center in Lugano, is very well able to develop its own Large Language Models (LLM). El-Assady refers to the Swiss AI Initiative launched at the end of 2023, with which Switzerland aims to position itself as a leading global location for the development and use of transparent and trustworthy artificial intelligence, and to a network of international collaborations in the field of artificial intelligence, including the European Laboratory for Learning and Intelligent Systems (ELLIS) and the International Computation and AI Network (ICAIN).

AI at the turning point: opportunities and risks of the key technology of our time

The WEF's Global Risks Report sees the greatest global risk in the mid-term as "foreign and domestic actors using misinformation and disinformation to further deepen social and political divides". An "explosive increase in fake information", which can be produced and circulated on an industrial scale with the help of AI, is on the horizon, the report says. What should be done? Legislators are called upon to act, according to the Global Risks Report. However, there are also AIs that can counteract the mass spread of fake news. Not by simply trying to neutralize misinformation with mass-produced "correct" information. But rather by providing people with tools that enable them to quickly and interactively sift through large amounts of data, complicated issues and widely ramified discussions. This is the AI that El-Assady is championing.

Such AI supports people, multiplying their intellectual powers in the same way that a bicycle enables a person to move faster without taking the wheel out of their hands. This contrasts with the AI of the privately organized American tech giants, where humans are a kind of cargo that is transported from A to B at breakneck speed inside a windowless capsule: Once they reach their destination, they rub their eyes, not knowing what has happened to them. ∎

"I want to build bridges between people and machines"

Menna El-Assady
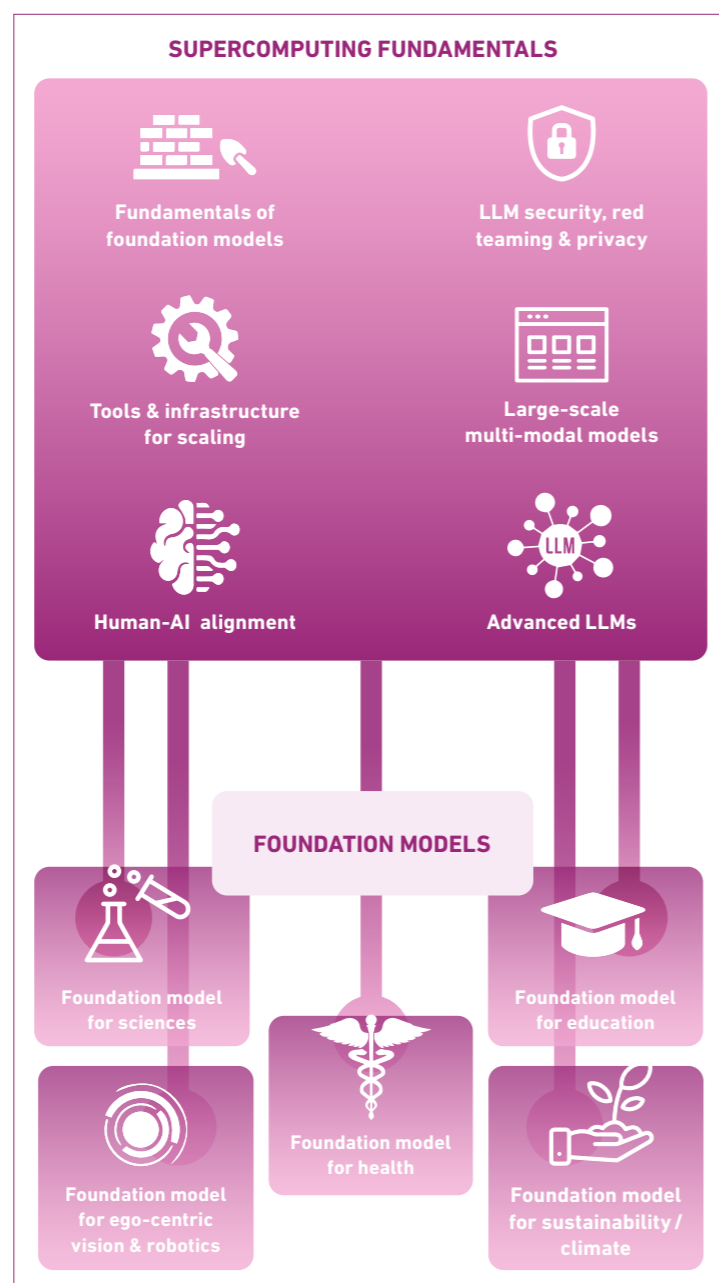
The Swiss AI Initiative

The Swiss AI Initiative, a collaborative effort led by ETH Zurich and EPFL, aims at advancing the capabilities of large and advanced AI systems to serve societal needs. At it's core is the ambition to harness the collective expertise and resources of Switzerland's research institutions, fostering an environment where innovation can flourish.

With the new Alps supercomputer, Switzerlands public research institutions command computing power that rivals that of big tech companies. Launched with a focus on leveraging these outstanding capabilities, the Swiss AI Initiative has set ambitious goals for its initial phase running from August 2023 to September 2024. These include the utilization of over 10 million GPU hours to support research and development in large-scale AI systems. By promoting an open science approach, the initiative aims to make AI technologies accessible to a broad spectrum of stakeholders, including startups, SMEs, large corporations, and the public sector, both within Switzerland and internationally.

Financially, the initiative aspires to secure over 100 million CHF from both public and industry sources. The technical milestones for the first year include training models of unprecedented scale, achieving over 70 billion parameters, and fostering collaborative research that results in joint publications between EPFL and ETH Zurich. Additionally, the Swiss AI Fellows Program aims to further enrich the ecosystem by facilitating exchanges among researchers and engineers.

The organizational structure of the initiative is designed to promote efficient collaboration and resource allocation. A Scientific Steering Committee oversees the distribution of computational resources, while principles of collaboration, parity, and trust guide the operational ethos. The kick-off workshop held in Zurich on August 25, 2023, marked a significant step in consolidating the efforts of over 38 leading professors and researchers from across Switzerland in the field of AI.

Looking ahead, the Swiss AI Initiative is dedicated to contributing to a national alliance that supports the co-design of an ecosystem for the research and exploitation of generative AI technologies. This endeavor aims not only to reinforce Switzerland's leading role in AI research but also to establish the country as a thought leader in the responsible use of AI globally. ∎

SUPERCOMPUTING FUNDAMENTALS

- Fundamentals of foundation models
- LLM security, red teaming & privacy
- Tools & infrastructure for scaling
- Large-scale multi-modal models
- Human-AI alignment
- Advanced LLMs

FOUNDATION MODELS

- Foundation model for sciences
- Foundation model for education
- Foundation model for ego-centric vision & robotics
- Foundation model for health
- Foundation model for sustainability / climate

Research with the Alps Supercomputer is distributed over Horizontals that tackle challenges applicable to AI models of differing scope and scape, such as privacy, safety, and human-AI alignment, whereas Verticals focus on a specific area of application, such as healthcare, scientific discovery or climate modeling.

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Exchange, connect and collaborate: ETH AI Center hosts numerous events throughout the year to advance Greater Zurich's AI ecosystem.

Fostering Collaboration Across Europe and Beyond

The Mission of the AI Center to connect and support people active in the field of AI extends beyond its national academic borders to include our colleagues in other countries and sectors.

Active exchange between all stakeholders is key to tackling the most prominent and challenging research questions in both foundational and domain-specific fields. We especially encourage our fellows to take part in internship programs to expand their network and to gain insight into different approaches and research strategies. Placements of our fellows Google Deepmind and the Avedon Science team (Microsoft).

The ties to industry and 'real world' data and challenges is also made accessible to young researchers through the AI Center's "Data Science Lab". Taking place every semester, the goal of this course is for computer science master students to gain experience in dealing with data science and machine learning applications "in the wild". Students are expected to go through the full process starting from data cleaning, modeling, execution, debugging, error analysis, and quality/performance refinement. Every student in the challenge groups will dedicate 30 to 40h per week over the semester to solving real-word challenges from both academia and industry. Challenge topics range from wind turbine damage prediction, to electronic health record analysis and are a great way for students to network with industry representatives. Those in turn have the chance to have students become familiarized with a sector's representative challenges, which often leads to internship or master theses opportunities. This year alone saw 66 masters students tackle 20 challenges posed by academics and industry partners.

Guests from other academic and governmental bodies were welcomed to the AI Center to strengthen ongoing collaborative ties and discuss shared challenges. Visitors included the Wallenberg AI, Autonomous Systems and Software Program (Sweden), and the IDEAS NCBR National Centre for Research and Development in AI (Poland), and governmental Head of Directorate-General "European and International Cooperation in Education and Research" (German Federal Ministry of Education and Research) with the Swiss ambassador, Head of International Relations Division (State Secretariat for Education, Research and Innovation).

The Center continues to promote the exchange between different research hot spots in Europe. On the one hand this is achieved through networks such as ELLIS (European Laboratory for Learning and Intelligent Systems) & CLS (Center for Learning Systems; joint MPI-IS & ETH initiative). By 2023, ELLIS programs focusing on high-impact problem areas had ETH AI Center faculty contributing to 8 of the 14 programs offered across the research institutes and a total of 15 faculty with ELLIS member or fellow status. Moreover, the MPI and ETH CLS collaboration has yielded over 300 publications to date (of which 60 were co-authored by both institutions), 66 faculty members (of which 45 are from ETH), over 45 academic dissertations, and 59 young researchers (PhD & Post-Docs). As well as contributing to young researcher mobility and European interconnectivity, such pan-European networks also serve as platforms to collate and broadcast Europe's AI contributions in a collective manner. Locally organized yet broadly coordinated events such as the ELLIS pre-NeurIPS conference poster session "NeurIPS Fest 2023" brought visibility to 152 NeurIPS posters from 11 ELLIS Units across Europe, reaching 900 participants in person and many more via the ELLIS and respective unit's outreach channels. ∎

"In a way, all mathematics is an approximation."

Siddharta Mishra

A Good Solution's Secret

Mathematician Siddhartha Mishra has been awarded this year's Rössler Prize for his research on solutions for highly complex flow and wave phenomena. He is being recognised for his contributions to faster and more accurate predictions of weather, climate and tsunamis, and for the computer simulations that enable them.

› first published on 29.06.2023 at ETH News, by Florian Meyer

Initially, Siddhartha Mishra intended to study physics. In his childhood in Bhubaneswar, the capital of the Indian state of Odisha, he dreamed of finding out "what makes the stars shine". In his studies, he realised that the mathematical approach to the world appealed more to him than the experimental one, and so he graduated in mathematics. The turn to the real world and to physical phenomena has remained with him to this day. The topics he studies as a mathematician typically include dynamic flows, liquids or gases (fluids), which play a role in weather, climate or avalanches, for example, as well as wave-like phenomena such as those that occur in tsunamis or exploding supernovas.

When a mathematician like Mishra investigates a phenomenon of nature or tackles a technical question, he first considers it as a system. All these systems, their behaviour, their evolution, and their changes can be described mathematically in the form of certain equations. Since their invention by Isaac Newton (1642-1726) and Gottfried Wilhelm Leibniz (1646-1716), the equations that are particularly applicable to processes coupled to movement and change have been called differential equations. They are central to Siddhartha Mishra's research.

Building bridges for chaotic fluid flows

Mishra made two of his most extraordinary breakthroughs with the so-called Euler equations: these equations are named after the Swiss mathematician Leonhard Euler (1707-1783). He designed an important class of partial differential equations that describes fluid flows, such as those that occur around an aerofoil. Mishra solved a question of the Euler equations that had been open for 30 years by proposing a new algorithm for an approximation method. He also developed a solution approach for certain Euler equations, which allows the dynamics of unstable, chaotic and turbulent flows to be determined more precisely.

For his research in the field of nonlinear partial differential equations, Siddhartha Mishra has received the 2023 Rössler Prize. In addition, ETH Zurich's most highly endowed research prize recognises that Mishra bridges the gap between mathematical fundamentals and their application in research and industry. For example, he has designed robust, efficient algorithms that enable faster and more accurate simulations of nonlinear partial differential equations on supercomputers. These simulations pave new ways to solve real-world problems in research areas such as astrophysics, solar physics, geophysics, climate dynamics, and biology.

Abstract equations for real-world problems

Real-world problems are the be-all and end-all of Siddhartha Mishra's research: "The phenomena I deal with have a real-world impact," says Mishra, "and understanding the effects of changes is key to understanding physical and engineering processes in the real world." Typical questions for his research include, "How much does drag decrease when the shape of the wing on an aircraft is changed in a certain way? And how much carbon emissions can be saved by designing the shape to be more aerodynamic?" Characteristic of Mishra is his orientation towards applications. He regularly collaborates with engineering researchers and industry. For example, together with researchers at Empa, he has developed fast algorithms to simulate an additive, industrial manufacturing process for 3D printing. This involves using Mishra's algorithms to position a laser beam in real time so that it mills the desired shape out of a metal block.

"The amazing thing about mathematics is how its abstract equations keep enabling new solutions and highly relevant applications for the economy and society," says Max Rössler, the donor of the Rössler Prize, who himself studied mathematics at ETH Zurich, did his doctorate on orbit calculations in space travel and taught at the Institute for Operations Research. "Siddhartha Mishra's research impressively demonstrates the incredible applicability of mathematics, as his equations support predictions of weather, earthquakes or tsunamis, for example, or also enable productive applications such as 3D printing with metals in industrial manufacturing."

Approximations to complex situations

As a rule, the nonlinear partial differential equations that Mishra studies relate to real phenomena that – like clouds, tornadoes or solar storms – are very complex and multidimensional and contain many dependencies, interactions, and uncertainties. These problems are often so complex that simple formulas cannot fully describe them. A solution satisfies an equation if, by inserting concrete values, it produces a true statement consistent with the measured facts.

In the case of highly complex, multidimensional natural phenomena, a mathematician like Mishra works with approximations to the solutions of the equations. Real-world problems typically cannot be solved at all without approximations. "Nature itself and the equations we use to model nature are very often too complex to ultimately allow anything other than approximations," says Mishra, "in a way, all mathematics is an approximation, as the ancient Greeks and the Indian mathematicians in the first century already said."

Today, mathematicians like Mishra have high-performance computers at their side. "Supercomputers can solve the differential equations for complex systems approximately," says Mishra. Mishra also receives the Rössler Prize for very carefully formulating the "weaker" approximate solutions and converting them into algorithms. The quality of his algorithms is that they preserve the structure of a mathematical equation particularly well and in this way increase the accuracy of the simulations. However, not only do numerical approximation methods have a practical use for Mishra, but they also play a fundamental role in proving the validity, scope, and impact of an equation.

Machine learning for speed and accuracy

Recently, Siddhartha Mishra, who is a member of the ETH AI Center, has started designing very powerful machine learning algorithms. Initially, he was concerned with shortening the computational time of the simulations. Now, questions are increasingly coming up about how machine learning could increase the accuracy of a simulation and solve previously unsolvable problems.

Mishra already has a few examples to show of speeding up computational time using machine learning:

– In the case of the 3D printing process for metals, his approach reduced the computational time of the simulation from around four hours to one tenth of a second (0.1 s).
– In the case of a tsunami early warning system, the computational time with Mishra's learning approach is around one hundredth of a second (10-2s). Previously, it took about an hour to predict from the earthquake event how a tsunami would evolve and spread.

"Machine learning simulations are supposed to be not just ten times faster, but ten thousand to a hundred thousand times faster," says Mishra. One example of how learning algorithms increase the accuracy of a simulation comes from Geophysics research. Together with Yunan Yang, who most recently was a researcher at the Institute for Theoretical Studies, and other collaborators, he proposed a new machine learning algorithm to identify sub-surface geophysical properties by seismic imaging, i.e., by sending seismic waves into the ground and recording their reflections at measuring stations on the surface. Mishra and Yang's algorithms are four to five times faster than previous algorithms, and they are also two to four times more accurate.

Mishra also uses physics as inspiration for his machine learning algorithms: on the one hand, he uses machine learning for physics problems. On the other, he uses physics principles and concepts to develop more powerful, robust and reliable machine learning systems - for example, to refine imaging in neurology. ◼

INTERNATIONAL INITIATIVES

The Swiss Call for Trust and Transparency in AI

The "Swiss Call for Trust & Transparency in AI" addresses the urgent need for effective governance in the rapidly evolving field of artificial intelligence.

Recognizing the potential for both unprecedented benefits and significant risks, Katharina Frey, Deputy Head of Division for Digital Foreign Policy at the Swiss Federal Department of Foreign Affairs (EDA), approached the leadership of ETH AI Center in early 2023 with the proposition of launching an initiative that brings together a coalition of experts from academia, industry, and diplomacy. The goal was to create a realistic framework for assessing AI risks and to implement actionable measures for responsibly managing these risks. By focusing on concrete outcomes and prioritizing transparency and accountability, the initiative aims to ensure that AI development aligns with humanity's best interests, fostering trust and confidence in AI technologies.

The joint effort led to a series of three workshops that took place in July and early September at ETH AI Center in Zurich Oerlikon, and a third one that happened during the Gesda Summit mid October in Geneva. All three meetings were attended by a wide range of experts from academia, industry and governance.

The groups discussed the most pressing issues around AI safety and governance, then identified actionable measures that could help address the challenges in a responsible yet effective way. Over the course of the three meetings, the output condensed into two main outcomes. The first is an international red teaming network specifically (but not exclusively) for generative AI, the second an international coalition that aims to make data, compute resources, infrastructure and knowledge accessible for disadvantaged stakeholders in the global south.

Red Teaming Network

Early on in the workshops of the Swiss Call for Trust and Transparency in AI, the idea of an AI threat exploration and response network emerged. The experts proposed a red teaming approach to tackle the multifaceted risks presented by Large Language Models (LLMs) such as ChatGPT, which encompass biased and

Katharina Frey, Deputy Head Digitalisation Divison at the Swiss Foreign Ministry of Federal Affairs, FDFA – Statesecretariat, Andreas Krause, Professor of Computer Science at ETH Zurich and Chair of ETH AI Center, Ambassador Benedikt Wechsler, Head Digitalisation Divison at the Swiss Foreign Ministry of Federal Affairs, FDFA – Statesecretariat and Petri Myllymäki, Professor for Computer Science at the University of Helsinki and vice-director of the Finnish Center for AI, at the GESDA Annual Summit 2023 (from left to right)

inaccurate content, vulnerability to misuse, legal challenges, and the potential for harmful advice. The initiative's primary objective was to forge a unified, transparent system for identifying, sharing, and mitigating AI-related threats. By encouraging collaboration across tech companies and public research institutions, the network aims to ensure that AI systems are verified, audited, and beneficial. This approach not only promotes the safe adoption of AI technologies but also supports the creation of effective regulatory standards for AI testing and risk management.

ICAIN

The second initiative from the "Swiss Call for Trust and Transparency in AI" focuses on developing an International AI and Computational Fund. It recognizes AI's immense potential to impact the environment and society and calls for a collaborative, globally-informed approach to harness AI for good. Acknowledging the significant energy consumption of the internet and AI technologies, the initiative stresses the importance of equitable AI deployment and fostering beneficial uses aligned with the UN Sustainable Development Goals.

The vision includes forming a consortium for in-kind contributions to support projects that promote local culture and values, with a return mechanism through intellectual property sharing, equity stakes, or fund contributions for successful projects. This model aims for inclusive access, sustainability, and overcoming access
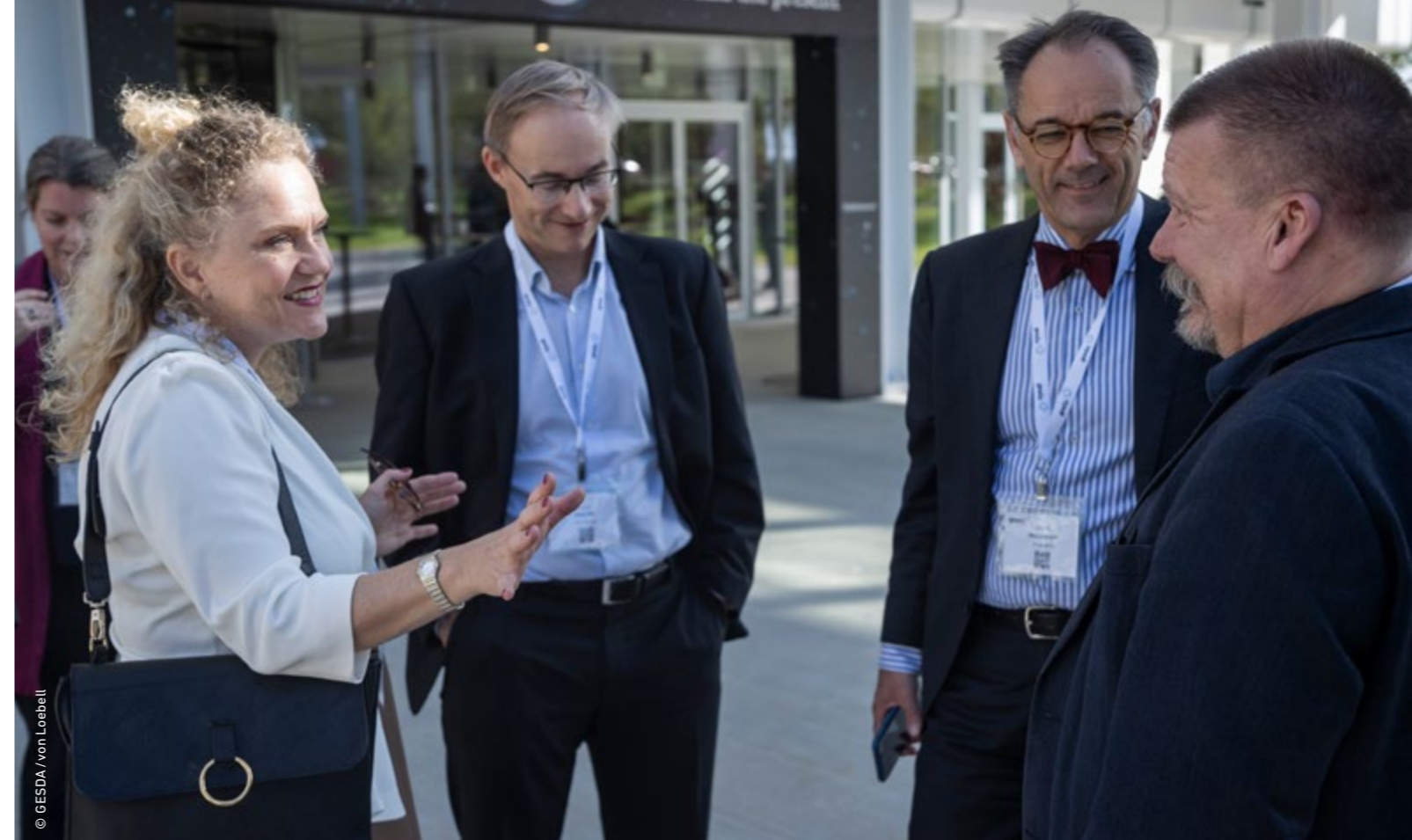
barriers, ensuring AI serves as a positive force for global challenges. It was, at a later stage, dubbed "International Computation and AI Network" (ICAIN).

Next steps

We are deeply grateful of the Swiss Federal Department of Foreign Affairs for entrusting us with this pivotal project and co-initiating the "Swiss Call for Trust and Transparency in AI". It's a matter of pride for us to have successfully convened a diverse array of stakeholders, including tech companies, NGOs, AI researchers, and government experts. Together, we have embarked on a journey to forge pragmatic, effective steps towards advancing trustworthy AI technology through public-private partnerships.

Throughout our three meetings, the concepts of a red teaming network and an international compute fund have maturely evolved and taken form. The culmination of these efforts was marked by the official launch of the initiatives on the sidelines of the World Economic Forum 2024 in Davos.

Our collective efforts are reflected in Prof. Andreas Krause's recent appointment to the UN advisory board on AI. We're proud to see his relentless dedication to the development of safe and trustworthy AI – as a researcher, educator, and innovator – along with his critical role in shaping the "Swiss Call for Trust and Transparency in AI", recognized at the highest level. ∎

Audience members attentively listening at the GESDA Summit 2023.

A Development Freeze Would Jeopardize Transparency

In an open letter, tech luminaries from the worlds of science and industry are calling for a freeze on training new AI models that are more powerful than GPT-4. Andreas Krause and Alexander Ilic from the ETH AI Center consider this to be difficult to enforce and associated with risks.

› first published on 31.03.2023 on ETH News, by Anna Janka

ETH News: Mr Krause, the letter calls for a freeze in the training of artificial intelligence (AI) systems that are more powerful than GPT-4. Is such a drastic measure necessary?
Andreas Krause: I doubt that this demand can be enforced because there are huge commercial and strategic interests behind its development. What's more, it is difficult to determine what they are specifically calling for to be restricted without distorting competition and jeopardising innovation in its application. Even if such a moratorium were to be declared, nobody could prevent work on training such models from continuing to be carried out covertly.

That would lead to less transparency.
Krause: Exactly. This would give rise to the danger that development that was previously largely open and transparent would become inaccessible and intransparent. And it would render it virtually impossible, for example, to understand the sets of data that current models have been trained on and the associated bias or flaws. There are already indications of this happening today.

So putting a freeze on development is not a good idea.
Alexander Ilic: No, because there are big question marks about the trustworthiness, reliability and interpretability of the language models currently being used. These elements are of crucial importance and definitely need to be researched even more and critically called into question across disciplines.

What do you suggest as an alternative?
Krause: While fundamental research is needed to develop the next generation of a safer and more trustworthy AI technology, we should also move interdisciplinary research forward and show how these technologies can be used for the benefit of humankind. AI can only be used appropriately in healthcare, for instance, and serve as a useful tool for society when it is reliable and trustworthy.

What role does the ETH AI Center play in all this?
Krause: At the ETH AI Center we combine fundamental and interdisciplinary research. Our goal is to promote technologies and areas of application that are of benefit to society. And, what's more, our research is open and transparent.

Ilic: We want to counteract the trend we are witnessing of AI research being increasingly conducted behind closed doors and focus on open and interdisciplinary cooperation between research, industry and start-ups. We believe that important contributions will emerge, especially at the interface of disciplines (e.g. AI and medicine, AI and the humanities). We have therefore created a fellowship programme to attract the world's best talent and bring them together at the ETH AI Center. With a 50% share of women, and employees from over 26 countries, we have also been able to create a culture right from the start that critically discusses the opportunities and risks of AI and helps to shape it responsibly.

The authors are also calling for the creation of an independent review body to develop safety protocols for AI design and development during the moratorium. What do you think of that?
Ilic: The development of testing procedures and certification of AI-based technology is certainly an important issue and must be pursued in the context of specific applications. But it is also important that we train new language models transparently and actively shape research rather than devoting ourselves fully to auditing and reviewing existing models. This is the only way we can ensure that systems become more trustworthy, safe and reliable. The tech giants pursue commercial interests and will therefore tend to focus on the biggest markets and cultural, linguistic regions.

For this reason, we have joined the European AI research network ELLIS to help shape the AI world according to European values. But there is still a lot of potential here to promote diversity even further. For example, we could specifically build open data sets on different cultural and linguistic groups or, in the case of feedback from humans, researchers could pay attention to respondents' cultural backgrounds and by doing so reduce any later bias. You won't be able to force commercial providers to do this themselves. But research could make it easier for companies to make their systems more trustworthy by handling their own data openly and transparently.

The open letter also warns that new language models could spread propaganda and lies. Do you agree with this?
Krause: There has been a rapid development in generative AI models in recent months that enables the generation of ever-more realistic text and images. They can indeed be used for misinformation campaigns. Although research is also being carried out into how we can recognise such text and images, this development does pose a real risk.

The authors also see the danger of people losing their jobs through the use of AI, or of even being automated away by machines at some point. Isn't that exaggerated?
Krause: It annoys me that no distinction is being made between risks that we need to take seriously – such as the worry about misinformation – and science fiction – our world being taken over by machines. This makes it difficult to engage in any informed discussion and dialogue about the actual risks. AI will certainly change the professional world permanently. It is always more difficult to imagine which new jobs and occupational fields will emerge than those that might be automated away.

Ilic: There were similar concerns in the past in the context of new technologies (industrialisation, digitalisation, etc.). People will more likely be replaced by those who can work with AI than their jobs being completely replaced by AI. For this reason, it will be essential to support the population and industry in this transformation. ■

Andreas Krause is Chair of the ETH AI Center and Professor of Computer Science at ETH Zurich, where he heads the Learning & Adaptive Systems group.

Alexander Ilic is Executive Director of the ETH AI Center.

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AI House Davos

In 2023, intense preparations unfolded for the inaugural AI House Davos, scheduled to open its doors on January 15, 2024. Serving as a multi-stakeholder platform, AI House Davos facilitates knowledge sharing, collaboration, agenda-setting, and collective action to drive responsible AI progress.

The journey commenced with the conception of the idea and the selection of a fitting venue along the Davos Promenade. A dynamic collaboration with Merantix ensued, aimed at welcoming partners into this groundbreaking initiative. Alongside the ETH AI Center and Merantix, four esteemed initiators—Swisscom, the Institute for AI and Beyond (a collaborative endeavor by the University of Tokyo and SoftBank), G42, and Hewlett Packard Enterprise—joined at the pinnacle partnership tier. A remarkable assembly of over 30 organizations, encompassing partners, sponsors, and contributors such as the European Commission, the European Innovation Council, Forbes, ISO, ICRC, EPFL, TUM, and Ericsson, actively participated. Furthermore, Switzerland and its Federal Department of Foreign Affairs proudly embraced its role as the inaugural host country for the AI House, setting the stage for a tradition expected to be passed on annually. The partners brought forth diverse geographical, industrial, and expertise backgrounds, rendering AI House Davos a genuinely multi-stakeholder platform. This inclusivity ensured a comprehensive array of perspectives, epitomizing the diversity essential for advancing responsible AI practices.

As a primary initiator of the AI House Davos, ETH AI Center activated its internal and external research community to contribute to a sound, science-based dialogue. The active contribution from the ETH AI Center came in two main parts—the program curation and the operations concept. The operations concept covered staff, catering, security, logistics, and cleaning. As a public university, ETH AI Center actively ensured that one of the two floors of the AI House Davos would be accessible to the general public. The curation was led by ETH AI Center but actively engaged the other project stakeholders. A curation team was formed, including members from all initiators, and individual sessions were co-organized with collaborators from the partner network, tapping into their expertise and network. The sessions led by ETH AI Center spanned topics as diverse as AI safety, AI and the future factory, and whether AI will create the next tech giants. The final speaker lineup featured 24 ETH speakers, including Joël Mesot, Andreas Krause, Torbjørn Netland, and Menna El-Assady. Projects like the Swiss AI initiative, the AI redteaming network, and ICAIN were given a center stage at the AI House, ensuring cohesiveness in the ETH AI Center project portfolio and that its initiatives mutually support and amplify each other. ∎

© ETHZ / Andreas Eggenberger

Alexander Ilic, Executive Director of ETH AI Center, and Rasmus Rothe, Founder of Merantix, at the WEF Annual Meeting 2023

Rise Europe

The ETH AI Center has started close collaborations with other AI ecosystems all across Europe. The most notable partners are CyberValley (Tübingen/Stuttgart), UnternehmerTUM (München), Campus Founders (Heilbronn), and EPFL. In 2023, the ETH AI Center became a founding member of Rise Europe, bringing together the leading ecosystem builders across Europe.

Rise Europe, established at Schloss Elmau in May 2023, unites outstanding individuals and innovation drivers from Europe's most dynamic entrepreneurship hubs. By addressing transitions and global challenges like the climate crisis and resource scarcity, Rise Europe aims to support startups in creating a safe, prosperous, and future-oriented society.

The network's members are committed to combining their strengths to accelerate startup teams, thereby contributing to European technological sovereignty. With the ambition to match the innovativeness of countries like the USA and China, Rise Europe strives to help European startups scale and become sustainable global market leaders. The network comprises members from Austria, Denmark, Estonia, Finland, France, Germany, Ireland, Netherlands, Portugal, Spain, Sweden, Switzerland, and the United Kingdom. ∎

An AI Future Worthy of Humanity

Ethicist Peter G. Kirchschlaeger highlights how artificial intelligence can be regulated worldwide – and is pleased to have the support of leading international figures.

› first published on 27.06.2023 on ETH Zukunftsblog , by Peter Kirchschlaeger

"Human rights are focusing on the essentials and encourage innovation."

Peter G. Kirchschlaeger

Artificial intelligence would be more accurately described as data-based systems (DS) because their performance is due to their ability to analyse vast amounts of data, and some areas of intelligence are beyond the reach of DS: social and emotional intelligence remain inaccessible to them because they are unable to experience real feelings. Moreover, they lack the freedom required to possess moral capability.

DS present humanity with enormous opportunities as well as risks. In the form of assistance systems, for example, DS can help people with disabilities lead a more autonomous life. But such assistance systems and search engines can also violate our privacy and data protection. They can even subvert people's self-determination: since they can draw on such vast amounts of data about us, DS can manipulate us. Figuratively speaking, this means they know precisely which piano keys to press to produce the desired tune – in other words, to make us buy the things or vote the way they want us to. Along with fake news and disinformation, this kind of political manipulation poses a massive threat to democracy.

To make long-term use of the ethical opportunities of DS – and to be able to overcome or avoid the ethical risks – DS must be subject to international regulation. The EU's proposed AI Act1 is a step in the right direction because it puts people and their rights ahead of the business interests of a few multinational tech companies and limits the scope for governmental misuse. This legislation could be improved by adding protections for refugees and by simplifying the options for lodging complaints in cases where DS have caused damage to people.

Due to the vastness of the opportunities and risks associated with DS, and since this is a global issue, the approach taken must also be global. When considering all the relevant ethical factors and decisions involved in designing and using DS, it is worth using human rights as a guide. Human rights offer the major benefit of being based on a simple concept and focusing on the essentials: they define the minimum standards that guarantee people can lead a life worth living. They also encourage innovation by protecting people's freedom to think, express their opinion and access information, and promote pluralism by respecting each person's right to self-determination. ∎

Industry Partnerships

In 2023 we gained traction with a range of additional industry partners from a variety of industry sectors: from tech and adtech (IBM, Google, Meta), banking (Julius Bär), insurance (Coop Rechtsschutz), venture capital (ACE & Company), corporate venture building (Creative Dock) and digital services (Filmlight, Lucht Probst Associates).

The currently 20+ total industry partners of the ETH AI Center are very heterogeneous in terms of size and stage: they range from large scale multinationals and public companies to SMEs (Small Medium Enterprises) and even startups.

While multinationals and larger companies are naturally more inclined to become fellowship funders compared to smaller companies due to budgetary constraints, they also exhibit long sales cycles. For that reason a stronger emphasis was made in 2023 to build up a proper sales pipeline – for valuing ongoing efforts and improving forecasting – including a CRM to capture the various industry related interactions. Constant efforts to build more scalable services were partially successful. 'Partially' only due to the very diverse needs of the variety of industry partners and growing portfolio of industry partners in need for proactively managing any needs not in support of scalable offerings. With the introduction of customer success activities towards Q4 of 2023, the professionalization was further advanced. Such efforts however, will require constant further refinement and continuous improvement.

Countless links were established between industry players, affiliated startups and our research community in forms of knowledge transfer during topical (AI+topic) and networking events, workshops, executive and board delegation visits, semester projects, master theses, internships and PoCs (proof of concepts). Furthermore, more than two-thirds of industry partners participated in Faculty workshops and shared specific industry challenges as part of the Data Science Lab, enabling them to submit 'challenges' to Computer Science Master students and familiarize them with data sets and problems from their own industry domain. ∎

In late 2023, we forged a strategic partnership with IBM research to drive especially AI for scientific discovery. The picture shows Daniel Naeff, head of industry relations and entrepreneurship at ETH AI Center, Prof. Andreas Krause, chair of ETH AI Center, Arvind Krishna, CEO of IBM, Alex Ilic, Executive Director of ETH AI Center, and Mateja Kramar, Customer Success Manager at ETH AI Center (left to right).

© AI House Davos / Alex Mundt

Case Study Ethonai: Premium Chocolate Production Perfected

Lindt & Sprüngli, a global leader in the premium chocolate sector, has partnered with EthonAI, a spin-off from ETH Zurich. EthonAI develops software tools that support manufacturers achieving operational excellence using causal AI. Lindt & Sprüngli is leveraging EthonAI's tools to perfect the production of their chocolate and achieve best-in-class performance.

The "Lindor" truffles from Lindt & Sprüngli are world-renowned among chocolate lovers. These truffles have been sold since 1969, when they were introduced as a seasonal treat and used as actual decorations to hang on Christmas trees. Half a century later, billions of Lindor truffles are made every year. To produce at such a large scale while maintaining quality excellence, Lindt & Sprüngli runs several high-end factories in Europe and the US.

Producing Lindor truffles is a complex process that spans from ensuring the quality of the cocoa beans, through manufacturing, to logistics. The production of Lindor truffles involves multiple production steps such as molding, filling, and packaging. While the overall production setups are consistent across factories, local differences in factory infrastructure, product variants, and machine age create challenges in finding the optimal parameter settings for obtaining perfect Lindor truffles. Additionally, seasonal variations in conditions like air humidity and ambient temperature play critical roles in the production process. Therefore, understanding the interplay between process parameters and environmental factors is essential to ensure consistently high quality – and that's where EthonAI comes in.

A complex, multi-step process

Lindt & Sprüngli has a strong commitment to excellence that goes beyond the quality and taste of their products. "Our employees have vast knowledge that we use to improve our production." says Jessica Valli, Program Manager for Digital Transformation in Operations, "to support them, we must provide them with relevant facts and information." For this, Lindt & Sprüngli records a lot of process and quality data. "We were looking for new ways to leverage it," explains Valli. "For example, a recurring problem was to identify and eliminate the root causes behind quality deviations and inefficiencies in production. We were happy to learn that EthonAI could help us solve this important problem."

ETH AI Center startup affiliate EthonAI spun out of the Chair of Production and Operations Management at ETH Zurich to develop software tools that detect, monitor, and prevent quality losses in manufacturing. The tools use causal AI technology to help discover and understand the physical relationships between process parameters and quality outcomes. In this way, manufacturers can fine-tune their processes, and thereby prevent costly quality losses.

Standardizing quality management across countries

At Lindt & Sprüngli, the EthonAI tools connect the process data from the Lindor production lines with the data from factory quality control systems. This gives the line managers and production teams a holistic overview of their production lines with their dozens of parameters and quality measurements. All these data matter for optimizing local production. In addition, it provides Lindt & Sprüngli a birds-eye view on data and performance from several factories, enabling group-level learning and standardization in quality management across countries in a simple format. The EthonAI software is live in Lindt & Sprüngli factories in three countries across two continents.

By understanding the complex interactions between the process parameters and negative quality outcomes the process experts at Lindt & Sprüngli are able to take action more quickly and decisively. Ultimately, the focus is on the prevention of production issues, and discovering root causes from the real-time data fed into the EthonAI analysis tool is essential for going beyond reactive measures. For example, production experts use EthonAI's software to fine-tune machine temperatures or mold configurations to avoid quality losses proactively. This is possible because EthonAI's tools rely on causal AI to go beyond mere correlations, and suggest improvement actions ranked by their overall impact on the final quality. In essence, EthonAI's causal AI can simulate the effect of potential improvement actions, so it can be tried out before adjusting the physical production.

"It's great to see an industry leader like Lindt & Sprüngli taking such strides to implement the latest developments in AI," says Dr. Julian Senoner, Co-founder of EthonAI. "Gartner, one of the most renowned market research firms in the technology sector, had predicted the rise of causal AI in 2-5 years. Yet, Lindt & Sprüngli is leveraging this technology already now."

Collaboration is key

The collaboration between Lindt & Sprüngli and EthonAI showcases the great potential of combining Swiss industry leadership with startup innovation from ETH Zurich. This relationship not only benefits both parties but also sets a precedent for other industry leaders. "By embracing new technologies and being willing to adapt, the Swiss manufacturing sector remains relevant and competitive in today's fast-paced digital world." says ETH Professor Torbjørn Netland, a faculty member of ETH AI Center.

The ETH AI Center has supported EthonAI since its graduation from the Talent Kick program in 2021. "I am excited to see our affiliated startup, EthonAI, making a difference in the industry. The partnership between Lindt & Sprüngli and EthonAI reaffirms our commitment to driving innovations that benefit the broader Swiss industrial ecosystem." says Alexander Ilic, Executive Director of the ETH AI Center. By bridging the gap between cutting-edge research and real-world applications, the AI Center ensures that the Swiss industry continues to lead on the global stage, marrying tradition with innovation. ∎

ETH AI Center Industry Partners as of December 31, 2023

ACE & Company

coop rechtsschutz
einfach anders.

Creative Dock

D|ONE
WE MAKE SENSE.

Google

IBM

Julius Bär

kaiko.

lpa_

Magic Leap

LAKE STAR

Meta

NAUTILUS

markant

UNIQUE

VISECA

VP BANK

(w)c
Walden Catalyst

wenger vieli

YData

Entrepreneurship

The ETH AI Center strongly promotes entrepreneurship, acting as a bridge between research and societal innovation. Drawing on a global network of collaborators, we provide a breeding ground for high-performing entrepreneurs and AI startups across Europe.

The community of ETH AI Center affiliated startups is growing quickly. In 2023, we welcomed 21 new startups, bringing our total to 31 – a threefold increase within the year alone. These startups, which must be linked to a faculty member and their research groups, have showcased their AI solutions at various events like the Launch AI+X Summit and the ETH Industry Day, and have contributed to our community by sharing their entrepreneurial insights at the ETH AI Center Alpreneur Events. As we grow, we're fostering a dynamic ecosystem around AI entrepreneurship, poised for further expansion in 2024.

We offer targeted support for those embarking on their entrepreneurial journey, providing feedback, best practices, and guidance on AI entrepreneurship's key aspects. Our consulting sessions, highly rated at 5/5 with an NPS of 100, are instrumental for our students and researchers.

To nurture entrepreneurial careers, we've established clear pathways and robust support mechanisms, notably through the

Talent Kick program and collaborations with key partners in the entrepreneurship ecosystem, both locally, nationally and internationally.

Talent Kick, a selective, cross-university initiative, has seen ETH AI Center as a key supporter from its inception. It aids students in forming interdisciplinary co-founder teams and merging their academic and entrepreneurial paths. Annually, it supports around 20 Swiss teams, with the top 10 receiving CHF 5,000 each. In 2024, we're doubling our efforts, offering course credits and expanding the program to both Spring and Autumn semesters. Notably, Talent Kick alumnus ethon.AI, now an affiliated startup, has secured over 8 million USD in funding and boasts a team exceeding 25 members. Startups like Aircloud, Faive robotics, Manukai, and Uthereal, also began their journeys with Talent Kick.

Collaborating with Venturelab, we've brought exciting events and successful founders to our community. A notable event featured ▶

The DeepJudge-Team at AI+X Summit

© Wayne Zeng

The founding team of LatticeFlow AI, a startup spun out of ETH in 2020 and amongst the first affiliated startups of ETH AI Center. From left to right: Prof. Andreas Krause, Petar Tsankov, Pavol Bielik, Prof. Martin Vechev

Markus Pflitsch, CEO of Terra Quantum, who shared insights into his entrepreneurial journey.

Our partnership with Cyber Valley led to hosting the AI Incubator, a six-week program aimed at fostering the next wave of AI startups. Sessions covered entrepreneurship basics, team building, product development, and MVP creation, with contributions from our affiliates and startup founders.

A second iteration of the hosting included a new program we offered, the "one-day AI Startup", a hands-on workshop and competition with the goal for its participants to go online the same day with a rudimentary AI business offering, ready to test with real customers.

The ETH AI Center's Entrepreneur in Residence (EIR) program could successfully continued with a new joining entrepreneur: Dr. Stefan Tuchschmid. More than 10 years ago he turned his ETH PhD thesis into VirtaMed, a global leader in surgical training with now 130+ employees. He now mentors aspiring student entrepreneurs, start-up / scale up companies and supports strategic research of the ETH AI

Center within surgery, medtech and health-related activities.

To facilitate co-founder matchmaking among students, we hosted a tech entrepreneurship bootcamp by Entrepreneur First and Talent Kick. This bootcamp provided a unique methodology for startup idea validation and co-founder relationship testing.

In 2021, we launched the Dandelion Awards to honor professors contributing to entrepreneurship at ETH Zurich. With nominations from all departments in 2023, we awarded a professor from each, highlighting the growing engagement within our community. To date, 47 professors have been recognized, underscoring the awards' significance in our entrepreneurship initiatives.

Lastly, our Alpreneur community, now comprising about 35 students and researchers, focuses on navigating the entrepreneurial landscape in AI. Through Alpreneurs events and a growing knowledge base, we offer insights into business ideation, validation, and market engagement, supporting our budding entrepreneurs on their journey. ∎

Affiliated Startups
as of December 31, 2023

Communication & Outreach

The ETH AI Center's events and outreach activities in 2023 continued to build on the momentum established since the center's inauguration, with a strong focus on our flagship event, the AI+X Summit. Held in October at the StageOne Convention Hall in Zurich Oerlikon, the summit has already become the largest AI ecosystem event in the german-speaking part of Switzerland, bringing together researchers, practitioners, entrepreneurs, students, and investors.

Our audience has grown significantly across social media channels and through our newsletter, a growing network across disciplines and sectors. By leveraging events organized by other institutions, we have efficiently reached broad audiences, capitalizing on the widespread interest in AI – an approach that has allowed us to achieve remarkable progress in just 12 months.

Reach across our channels

Our communication channels have seen significant growth. More specifically, our LinkedIn follower base surged from 7.5k to 20k. Our Instagram channel, launched in 2022 to connect with young students, grew from 350 to 1,000 followers, indicating increasing interest from the next generation of AI enthusiasts. Additionally, our presence on Twitter/X doubled from 1.5k to nearly 3k followers.

Our monthly newsletter now reaches 3,600 subscribers, providing regular updates on our activities and advancements. Our webpage traffic averages 600 – 800 visits per week, peaking at over 1,000 visits per week in October and November due to the AI+X Summit and the call for fellowship applications.

Office opening: 8. May

After moving to our dedicated offices on the 19th floor of Andreasturm, a modern high-rise next to Oerlikon train station, in spring 2023, we held an inauguration event on May 8th. We welcomed nearly 200 guests to an evening filled with demos, presentations, and a ribbon-cutting ceremony officiated by Christian Wolfrum, ETH's Vice President for Research and Prof. Andreas Krause (plus food and drinks, obviously).

The AI Center fellows set up demo stations showcasing their research, organized into groups such as Reinforcement Learning, Representation Learning, Health AI, NLP, ML Theory, and Robotics, complementing the introductory talks by Alex Ilic and Christian Wolfrum. ▶

Video:

LinkedIn Followers of ETH AI Center compared to insitutions of similar rank, as of October 27, 2023

ETH AI Center	CSCS	Swiss Data Science Center	Wyss Zurich	EPFL CIS	UZH Digital Society Initiative
14,900	10,748	6,563	6,500	2,837	2,258

Latsis Hackathon

In conjunction with the Latsis Symposium 2023, which was organized by Professor Domink Hangartner's group, the AI Center hosted a hackathon focused on creating safer and more inclusive online spaces. Social media and comment forums on news platforms have become crucial parts of today's civic public sphere, but they often fall short of their democratic potential due to destructive discussions, viral fake news, and persistent hate speech. The Latsis Symposium connected civil society actors, online news platforms, and scientists to explore innovative solutions for these issues.

The AI Center's hackathon invited students skilled in Natural Language Processing to develop a hate speech detection algorithm. Participants, working in small teams, had access to a unique dataset of annotated reader comments from leading Swiss online newspapers. Held on September 6th at ETH's Student Project House, the event attracted 40 participants and was supported by donations from the City of Zurich, as well as industry members Unique and Coop Rechtsschutz.

AI+X Summit

The AI+X Summit was held for the third time in 2023, co-located once again with the ETH Entrepreneur Club's Launch Event. It attracted over 2,000 attendees from diverse backgrounds, including students (mostly master level and up), academic researchers, industry representatives, startup founders, and governance professionals.

Starting in 2023, we began a new collaboration with the ZHAW School of Engineering, welcoming them as a presenting academic partner. This collaboration is set to continue and expand in 2024. Additionally, 2023 marked our first media partnership with Swissinfo.

The demo zone buzzed with more than 50 exhibits, showcasing both software and hardware innovations such as exoskeletons, drones, robots, and VR goggles. The main stage program included a keynote by faculty member Davide Scaramuzza on "How we made AI beat the best drone pilot," a panel on "AI made in Europe" featuring Raphael von Thiessen (Canton of Zurich), Thilo Stadelmann (ZHAW), Frauke Goll (Applied AI Institute Heilbronn), and Martin Pejsa (CreativeDock), moderated by Rebecca Reisch (CyberValley). Another panel, "AI and the Media," was moderated by Veronica de Vore (Swissinfo) and included Sahar el Khoury (Thomson Reuters), Florian Notter (SRF), and Titus Plattner (Tamedia). The summit concluded with the panel "Gen AI changes everything - or does it?" featuring Gaetan de Rassenfosse (EPFL), Karl Ruloff (EY), Menna El-Assady (ETH Zurich), and Torsten Hoefler (CSCS), moderated by Cerstin Mahlow (ZHAW).

Together with ZHAW, the ETH AI Center held 20 workshops covering a wide spectrum of AI topics, including AI in financial services (hosted by Peter Schwendner, ZHAW), legal topics in AI (Elliott Ash), secure and trustworthy AI (Martin Vechev), AI in education (Mrinmaya Sachan), accelerated discovery (Kjell Jorner), medical AI (Dirk Wilhelm, ZHAW), AI policy (Ayisha Piotti), and reinforcement learning in real-world applications (Giorgia Ramponi).

Overall, the AI+X Summit 2023 was a resounding success. Over its first three editions, the Summit has established itself as a central hub for exchange, networking, and collaboration across the entire AI ecosystem, spanning Switzerland and southern Germany.

Summit Video:

Media relations

In 2023, the ETH AI Center significantly enhanced its visibility among top journalists in IT, engineering, and related fields, hosting two delegations from Germany. In May, the German Association of Science Journalists (WPK) visited us, exploring AI applications for sustainability through the work of Professors Konrad Schindler, Jan Dirk Wegner, Catherine De Wolf, and Elliott Ash. An evening session at Cabaret Voltaire offered a deep dive into combating online hate speech with Sophie Achermann (Public Discourse Foundation) and Professor Dominik Hangartner.

November saw a visit from science and tech journalists on a study trip organized by the Berlin-based "Journalists Network". They explored the OR-X infrastructure at the University Clinic Balgrist (Prof. Philipp Fürnstahl) and engaged in a workshop on co-creating with Generative AI, led by curator Adrian Notz.

Our researchers and faculty continued to attract media attention. Swiss Radio and Television (SRF) featured the work of Elvis Nava from the Soft Robotics Lab in a kid's news segment. Professor Andreas Krause discussed AI's potential risks on "10 vor 10," and Alexander Ilic participated in a live debate at "Bilanz Standpunkte". Davide Scaramuzza and his work were featured in an episode of "NZZ Format" on drones.

Early in the year, discussions on the existential threats of AI, highlighted by figures like Geoffrey Hinton and Sam Altman, dominated media inquiries. However, there was ample space for good news, too. The Swiss AI Competition for Teenagers drew significant attention, covered by SRF and Neue Zürcher Zeitung (NZZ), among others. In April, NZZ's Sunday edition ran ▶
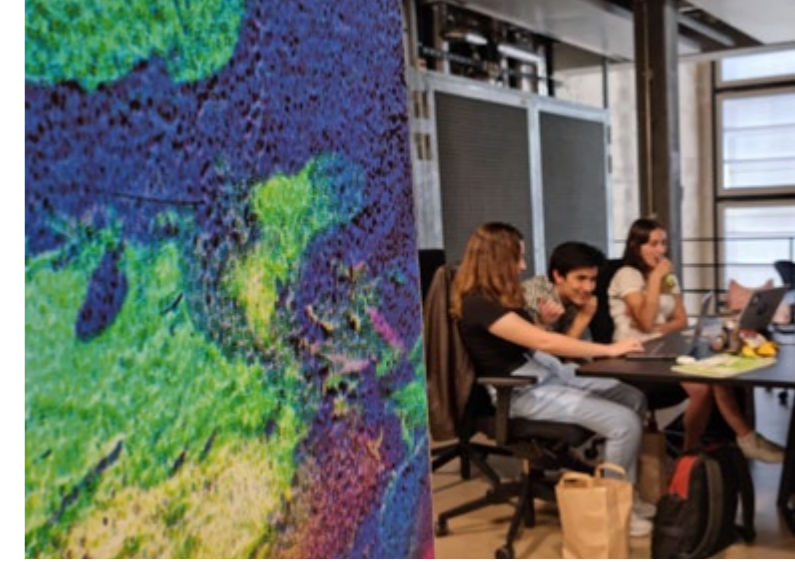
© ETHZ / Andreas Eggenberger // Travis Purrington

a comprehensive story on the standing of Swiss AI research, tech transfer, and industry in Europe and beyond, featuring the ETH AI Center prominently. Opinion pieces by Ayisha Piotti, Director for AI Policy at Elliott Ash's lab, and Professor Peter Kirchschläger, initially published in ETH's Zukunftsblog, were picked up by a number of print outlets. The year concluded with the Swiss AI Initiative catching the media's eye, particularly with the planned upgrade of the Swiss Supercomputer Alps with Nvidia Grace Hopper units for early 2024, showcasing our ongoing impact and reach in the AI domain.

Outreach

In 2023, the ETH AI Center made its mark across numerous events, engaging a diverse array of audiences. Our year kicked off with the AI Workshop at Davos, held at the sidelines of the World Economic Forum. The session "AI, Future, Europe", hosted in partnership with Merantix and Tübingen AI Center, centered on nurturing a pan-European AI ecosystem and the legal nuances of generative AI. Our panelists included Prof. Björn Ommer (LMU Munich), Jonas Andrulis (Founder and CEO Aleph Alpha) and Vanessa Cann (Managing Director Bundesverband KI, Germany), alongside our faculty members professors Elliott Ash, Valentina Boeva, Inge-Kathrin Hermann, Andreas Krause, and Melanie Zeilinger.

In light of pressing issues and a quickly evolving AI landscape, WEF 2023 became the breeding ground for the AI House Davos – a dedicated platform for AI queries set to debut at the 2024 World Economic Forum.

We mainly reach out to the general public through events organized by other entities, such as the canton of Zurich and ETH, which facilitates access and minimizes organizational costs. Highlights in 2023 include the event series "KI im Dialog", which continued with editions in Kloten and Uster, and engaging panels on AI's ethical and societal dimensions at Ortsmuseum Meilen, the Grossmünster Zürich (the city's main cathedral), and Paulus Academy (a forum run by the catholic church).

For the Informatiktage in early April, we set up an "AI Lounge" at the Department of Computer Sciences, featuring demos by the Soft Robotics Lab (Prof. Robert Katzschmann) and VU Engineering, an affiliated startup that offers AI-enhanced quality control for precision mechanics parts. In parallel to the exhibition, the Department of Computer Sciences organized a series of open lectures, to which AI Center contributed a presentation by Prof. Melanie Zeilinger, and the award ceremony of the Swiss AI competition for teenagers.

For the biannual science festival "Scientifica", a collaboration between ETH, UZH and the University Hospitals, we contributed a booth, a startup demo, and the interactive game Morphtales.

Treffpunkt Science City, ETH Zurich's public science programme for all ages held in German, focused entirely on artificial intelligence in their autumn 2023 programme, titled "Der Siegeszug der Künstlichen Intelligenz" ("The Triumph of Artificial Intelligence"). Amongst the speakers for that programme were a host of ETH AI Center's esteemed faculty members, including Benjamin Grewe, Andreas Krause, Elgar Fleisch, Roland Siegwart, Thomas Hofmann, Melanie Zeilinger, Markus Gross, Gunnar Rätsch, Benjamin Dillenburger, Robert Katzschmann, Dirk Helbing, Konrad Schindler, and Stefan Bechtold.

Our affiliated startup, Aegis Rider, presented their AR-enhanced motorbike helmet in the demo zone of Treffpunkt Science City. Additionally, the labs of Robert Katzschmann and Melanie Zeilinger provided captivating demos of bio-inspired robotics and autonomous driving. Fellows Rene Zurbrügg and Karin Yu led an engaging youth lab on "Deepfakes and ChatGPT – what's behind it?", adding a comprehensive showcase of cutting-edge AI technology and research for teenagers.

All the public lectures of Treffpunkt Science City are available on YouTube: www.youtube.com/channel/ UCMUnBSAU6KeD3PtDx662xlw

Morph Tales

Morph Tales is an engaging game designed to introduce the diverse applications of AI to a broad audience. It was developed by ETH's Corporate Communications in collaboration with the Game Technology Center and ETH AI Center from 2021 to 2023.

Combining virtual reality with a real-world experience on ETH Zurich's campus, Morph Tales educates kids, families, and adults about AI in a fun and interactive way. Players use tablets and augmented reality (AR) at real game stations to help their customized Morphs overcome challenges. Each of the four mini-games takes around 20 to 30 minutes to complete.

After debuting at events such as Olma St. Gallen and the Informatiktage, Morph Tales became available to ETH visitors in June 2023, situated in the main building and attracting more than 1000 visitors over the months. This innovative game offers an accessible entry point to learning about AI's potential and its collaborative possibilities with humans. ■

Video:
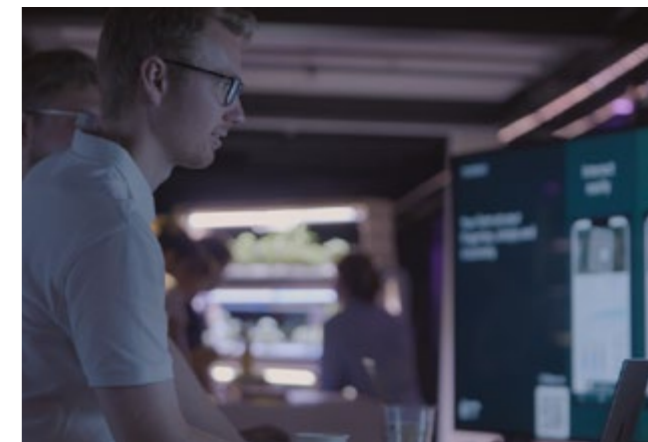
Events

WEF 2023: AI Breakfast
Davos, ETH Pavillion

Informatiktage 2023
ETH CAB

Panel Discussion "Künstliche Intelligenz und Ethik"
Ortsmuseum Meilen

Learn & Talk at ETH Library "Macht KI Informationskompetenz überflüssig?"
ETH Library

From Hype to Reality: Artificial Intelligence in the Study of Art and Culture Digital Society Initiative
University of Zurich

**Faculty Workshops:
– AI + Digital Health
– AI for Scientific Discovery**
ETH AI Center

Soirée "Künstlich Intelligent?"
SRF Live Stage, Zurich

The AI Incubator 2023 - Cyber Valley
ETH AI Center

**Art Basel Conversations:
(Co)-creating with AI – the artist's view**
Art Basel

Google Austria Delegation Visit
ETH AI Center

STIU Fachtagung zu Informatik im Unterricht
ETH Zürich

**Faculty Workshop:
– Augmented Reality**
ETH AI Center

Visit Students HLW Steyr
ETH AI Center, Game Technology Center, Design++

Swiss AI initiative Kick-off
ETH AI Center

Workshop II "Trust & Transparency in AI"
ETH AI Center

Visit of the Board of Directors and Executive Directors of Coop Group
Science Gateway at Cern, Geneva

"Der neue Hype um Künstliche Intelligenz – Gottgleich oder grottenschlecht?"
Paulus Akademie, Zurich

Workshop III "Trust & Transparency in AI"
Science Gateway at Cern, Geneva

AI + X Summit 2023
StageOne, Zurich

ETH Entrepreneurship & UBS Event
ETH AI Center

KI im Dialog
Stadtbibliothek Uster

Visit IT-Prüfungskommission of the Canton of Zürich
ETH AI Center

The AI Incubator 2023 – Cyber Valley
ETH AI Center

JANUARY   MARCH   APRIL   MAY   JUNE   JULY   AUGUST   SEPTEMBER   OCTOBER   NOVEMBER

BA-Seminar "AI, Entrepreneurship, Art & Ethics"
University of Lucerne

KI im Dialog
Zurich Airport Kloten

KI-Workshop für KMU im Zürcher Oberland
Amt für Wirtschaft Zürcher Oberland, online

**Faculty Workshops:
– AI + Intellectual Property
– AI + Complexity**
ETH AI Center

ETH AI Center Opening Ceremony
ETH AI Center

Visit of German Science Journalists (WPK)
ETH AI Center

Exhibition "Travel Across Boundaries"
*Swiss-Korean Innovation Week
Seoul, South Korea*

Exhibition "My Rhino is Not A Myth – Art"
Art Encounters Biennial, Timisoara, Romania

**"Wozu Menschen?" –
Panel on AI within the series
"500 Jahre Zürcher Disputationen"**
Grossmünster, Zürich

ELLIS kickoff workshop
ETH AI Center

The one-day AI Startup
ETH AI Center

Workshop I "Trust & Transparency in AI"
ETH AI Center

Scientifica 2023
ETH AI Center

Latsis Hackathon on tackling online Hatespeech
ETH Student Project House

ETH Industry Day & Morning Program "Bridging AI in Industry & Innovation"
ETH Zürich, Campus Hönggerberg

Visit Ideas, Piotr Sankowski (AI Center from Warsaw)
ETH AI Center

Media Visit (journalists's network, Germany) for OR-X and AI Art
*ETH AI Center
OR-X Universitätsklinik Balgrist*

AI + Environment Summit
ETH AI Center

Industry Workshop with Roche & Genentech
ETH AI Center

Legend:

● Events aimed at the broader public

● Events made to connect the innovation ecosystem

● Events related to the AI+Art project

● Research-focused events

●●● Events organized under the leadership of the ETH AI Center

AI Competition for Teenagers

The Schweizer KI-Wettbewerb is a project aimed at introducing teenagers aged 13 to 19 to the concepts and applications of AI. Launched in 2019 by the AI Center Tübingen, Germany, the Swiss edition commenced its journey in October 2022 with a pilot phase in the German-speaking part of Switzerland.

Central to the competition is the collaborative effort of teenagers working in teams on their own projects. Through a complimentary online course, participants learn the fundamentals of artificial intelligence (AI), explore how AI can enhance their ideas, and ultimately develop their own AI solutions. The initiative thus not only hones the participants' programming skills but also aims to empower them by teaching overarching project management, team-building, and problem-solving skills.

During a ceremony at the "Informatiktage 2023" in early April, two teams from the pilot round were recognized for their achievements. One team devised an AI that recommends outfits based on current weather conditions, earning them the award in the "creative coding" category. Another team created an AI

to assist individuals in determining the need for medical attention for respiratory symptoms, securing the prize in the "AI for good" category. Remarkably, these teenagers embarked on this journey with minimal prior programming experience, receiving support from ETH AI Center Fellows.

Building on the success of the pilot edition, the KI-Wettbewerb Schweiz will host a second iteration. The application period remains open until Easter 2024, with teams given approximately four months post-application to implement their ideas, supported by a PhD mentor. The winning teams' projects will be showcased at the AI+X Summit in October 2024. The second edition will primarily focus on the German-speaking regions of Switzerland, with aspirations to expand its reach nationwide. ∎

The winning teams of the first round of the AI competition for teenagers received their awards at the Informatics Days in early 2023.
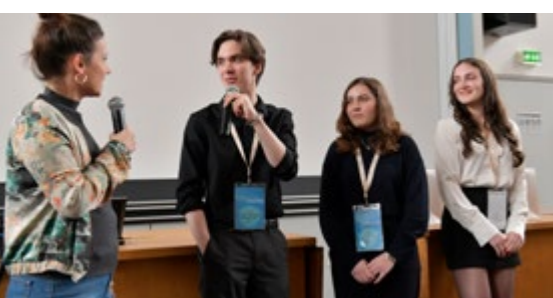
Talent Kick

Talent Kick, initiated by the ETH AI Center as the lead partner in early 2021, has experienced rapid growth, expanding its presence nationally and integrating deeply into the Swiss startup ecosystem.

For more information, explore the comprehensive 2023 annual report of Talent Kick. Scan the QR code to directly access it! ∎

AI + Art

A Cinderella Moment represents a transformative juncture where shifts in our perceptions influence how we see the world. The AI+Art initiative actively pursues this transformative moment, in that a shift in perception in an artist's or a scientist's mind can change how we gather data. [1]

Curated by Adrian Notz, this dynamic initiative serves as a catalyst for fostering dialogues between artists and scientists. These interactions lead to fruitful collaborations, inspiring encounters, and the creation of artworks that challenge the predominantly business-oriented development of artificial intelligence (AI) applications and technologies. Moreover, they effectively communicate scientific ideas and findings to a broader audience, bridging the gap from science to society.

AI+Art strives to promote critical thinking and ethics, diversify knowledge and intelligence, pose new questions, offer alternative perspectives, and provide inspiration. It aims to create visions and fictions for the future, contributing to a more holistic understanding of AI's impact on society.

The AI+Art program encompasses two main areas of activity: Conversations and Projects, each featuring four distinct formats. This structure establishes an ecosystem where art and science converge within the realm of AI research. Conversations foster dialogue and interaction between artists and scientists, while Projects focus on collaborative efforts to realize works and products.

Co-Creating with AI, Suzanne Treister, Marguerite Humeau, Roger Wattenhofer, 17.06.2023
© Photo Art Basel

Conversations

To bridge the gap between ETH AI Center researchers and the world of art, we host monthly AI+Art Tours. These tours expose fellows to artworks created with AI tools or linked to scientific concepts. Previous visits have included venues like Kunsthalle Zürich, Haus Konstruktiv, and Kunsthaus Zürich.

To delve deeper into the work of our 122 ETH AI Center faculties and laboratories, we arrange monthly Lab Visits for artists and curators. These visits facilitate collaboration opportunities and mutual interest exploration, shedding light on faculties' interest in AI+Art. In 2023, notable artists and curators such as Sarah Friend, Anna Kählin, and Catherine Hug visited scientists and researchers including Prof. Bob Sumner, Prof. Siyu Tang, and Prof. Andreas Krause.

Through collaborative block seminars with ZHdK (Zurich University of the Arts) and the University of Lucerne, we brought together students from computer science, fine arts, and ethics at both Bachelor's and Master's levels. Led by media artist Nora Al-Badri, AI+Art curator Adrian Notz, and ZHdK Professor of Fine Arts Felix Stalder, the ZHdK seminar featured guest lecturers such as computer scientist Dr. Eva Cetinić and data scientist Dr. Alexandre Puttnick. The University of Lucerne seminar, led by

AI+Art Pipeline, by Adrian Notz, 2023

ethics and theology Prof. Peter Kirchschläger and Adrian Notz, hosted entrepreneur Kevin Satori and Talent Kick director Viviana Groppengiesser as guests.

In 2023, we furthered our public AI+Art Conversations, hosting dialogues at notable events. During the Zurich Art Weekend, discussions featured Israeli artist Liat Segal, astrobiologist Dr. Jennifer Wadsworth, Indian artist Rohini Devasher, and science and technology historian Dr. Omar Nasim. Additionally, at Art Basel, Prof. Roger Wattenhofer engaged in conversations with artists Marguerite Humeau and Suzanne Treister.

Projects

"Science as Art" introduces an innovative approach to showcasing research, moving beyond traditional formats like posters and papers. After issuing an open call to the entire ETH AI Center community, we meticulously selected and curated eight exceptional "works of art" for this year's edition at the AI+X Summit. Contributors included Prof. Inge Herrmann, Alexander Jessernig, Lucas Dosnon, Oscar Cipolato, Dr. Cyril Matthey-Doret, Dr. Stefan Milosavljevic, Carlos Vivar Rios, Elvis Nava, Ayça Takmaz, Jonas Schult, Irem Kaftan, Mertcan Akçay, Prof. Bastian Leibe, Prof. Robert Sumner, Dr. Francis Engelmann, Prof. Siyu Tang, Prof. Konrad Schindler, Prof. Roger Wattenhofer, Florian Grötschla, and special guest Google Senior Director Yariv Adan.

A report can be found here:

In 2023, we curated three "Art and Science Exhibitions": "Travel Across Boundaries" in Seoul, "My Rhino Is Not A Myth - art science fictions" in Timișoara, and "Data Alchemy - Observing Patterns from Galileo to AI" in Zurich.

"Travel Across Boundaries" was part of the Korean Innovation Week from May 12 to June 11, 2023, showcasing research from the "Hybrid Reality Research Group" by Adam Kiryk and Adi Grüniger with the installation "Meta-Tourism in Hybrid Reality".

"My Rhino Is Not A Myth - art science fictions" was the 5th edition of the Art Encounters Biennale in Timișoara, the European Capital of Culture 2023 in Romania, featuring works by 61 international artists across eight venues. Co-curated with artist Liat Grayver, the exhibition "Data Alchemy - Observing Patterns from Galileo to AI" was held from June 8 to June 25, 2023, at the Collegium Helveticum, based on the history of the Semper Observatory and supported by the Mobiliar Jubilee Foundation.

The collaborative artwork "Blue Transmutations" debuted at the exhibitions in Timișoara and Zurich, created by painter and media

artist Liat Grayver, media artist Marcus Nebbe, and nanoparticle researcher Dr. Robert Nissler.

Continuing the collaborative artwork "The Post-Truth Museum," Nora Al-Badri worked with Dr. Sergey Prokudin, Alberto Pennino, and Irem Kaftan from Prof. Siyu Tang's lab. The resulting video was showcased in the exhibition "Poetics of Encryption" at the KW Institute for Contemporary Art in Berlin.

My Rhino Is Not A Myth, Art Encounters Biennial 2023 Timisoara
© Art Encounters Foundation 2023

Our first positive experience in collaborative research came with the "Synesthetic Strokes" project by Liat Grayver. Carried out at the Collegium Helveticum, the transdisciplinary project involved researcher Lioba Schürmann from the Institute for Neuroinformatics, mentored by ETH AI Center Faculty Members Prof. Benjamin Grewe and Prof. Giacomo Indiveri, with support from the Gramazio Kohler Research Group. "Synesthetic Strokes" aims to create an autonomous and collaborative robotic system that blurs the boundaries between artists and machines. ■

Synesthetic Strokes, Liat Grayver 2023
© Marcus Nebbe, 2023

[1] cf. Krebs Cycle of Creativity, Neri Oxman, 2016

Artificial Augmented Creativity:
A New Era of Art?

Artificial intelligence is transforming the way in which art is created and experienced. Are we at the beginning of a new artistic revolution? Or at the end of creativity as we know it? Adrian Christopher Notz puts things in perspective.

› Adrian Christopher Notz, published in ETH's Zukunftsblog on 12.04.2024

© Jasmin Frei

Artists working with code, hacking and new media have been around for as long as there has been code. And yet the veritable Cambrian explosion of generative AI that we have experienced in the last two years has cut just as deep a swathe through the art world as it has in many other areas of our lives. Ever since applications such as Dall-E, Midjourney and Stable Diffusion have been available to virtually everyone, artists and designers have been experimenting with them and using AI to search for new subjects and visual languages. The results have been more or less directly incorporated into artistic works: generated visuals have been painted by hand on canvas or embedded into videos, artificial reality and virtual reality works.

These creations, often referred to as AI art, are increasingly raising the question of whether these machines can be creative in and of themselves. And whether they could replace artists, designers and other creatives in the foreseeable future. In certain areas of applied art, such as illustration and photography, the extent of the upheaval is already foreseeable: processes are being streamlined, with artificial intelligence scaling up individual work steps or taking them over completely – for example, when subjects of a photograph are to be mounted in front of a different background.

But what about the visual arts? One clue could be the historical role of photography: it once freed painting from the need to depict reality, paving the way for new art movements – starting with Impressionism and Cubism. Without photography, neither Van Gogh nor Picasso would have taught us to see the world in new ways. In this sense, we can also trust generative AI to revolutionise the art world and usher in completely new art forms. What could the first steps in this development look like in concrete terms? Three possible answers are emerging:

1. A return to the artisanal aspects of creating art

In a world in which artists define themselves first and foremost through innovative ideas, generative AI tools could draw attention back to the craftsmanship of painting, sculpting and modeling. However, this prospect, although fascinating, seems unlikely. In the near future, advanced AI will also be able to handle brushes, paper and canvas independently. Artists are already experimenting with painting robots that handle traditional materials. The more successful this becomes, the more the importance of artistic craftsmanship will be called into question again.

From an art historical perspective, this would not be as new as it might seem at first glance. Constructive Art, Concrete Art and Minimal Art were also looking for ways to get rid of the human element and paint pictures and produce objects that were "industrially manufactured". And more than a century ago, the followers of the avant-garde wanted to abolish the creative genius. If we can achieve this with the new, generative applications, it would be entirely in the spirit of art history. However, it is more likely that the exact opposite will be the case – that the artist as an author will become even more important.

2. Redefining creativity

From the Romantic era, when we invented the "singular creative genius", until today, when our society operates within the framework of a creativity dispositive, the concept of creativity has been constantly changing. After talking about the "creative economy" and "creative thinking" not long ago, we are now referring to "artificial creativity". In its essence, however, it remains – just like art – an unsolved mystery. Both creativity and art are constantly being negotiated in discourse and cannot be conclusively described by means of definitions and axioms.

Here, too, generative AI is proving to be astonishingly connected to the history of artistic practice , with essential moments lying in the unknown. We do not know in detail and we can never know conclusively what happens in the many layers of artificial neural networks. The moment a diffusion model starts detecting an image in the noise of latent space – i.e. in all higher-dimensional possibilities – can be compared with the moment in which a painter stands in front of an empty canvas and projects their imagination onto the empty surface to give it form with paint and brush.

Minimal art artist Robert Ryman, who only painted white pictures, called the white surface "total sensitivity". In his spirit, the latent space of AI could be described as the "total sensitivity" of the machine. Training an AI with images from the past would thus correspond to an artist's art-historical education, experience and recollected impressions.

3. Écriture automatique as an artistic strategy

A century ago, the surrealists put an artistic strategy called écriture automatique, spirit writing or psychography into practice. The idea was to create text and image from the unconscious, without intellectual control. This approach has a modern equivalent in the use of generative AI for art production. (The fact that one of the best-known text-to-image programs, DALL-E, is named not only after the lonely robot WALL-E but also after the most famous surrealist painter Salvador Dalí would appear to be no coincidence). Dalí saw himself as a medium, shifting the authorship of his art to his unconscious and his dreams. This did not diminish his influence as an artist. Ever since, avant-garde has no longer been the craftsmanship and personal expression of an artist but rather the idea and inspiration that is seen as the essence of an artwork.

A similar approach is to be found with the Dadaists: at around the same time, they wanted to get rid of the creative gesture and the authorship of the artist. The means to that end was the "composition selon les lois du hasard", i.e. compositions according to the laws of chance. A handful of cut-out shapes were thrown on the floor, and a decision was made as to whether it was an interesting composition – if not, the artist stepped in. Who wouldn't recognise an analogue counterpart of today's prompt engineering in this creative process? When we feed our AIs with commands and eagerly wait to see what comes out as a result, we are also composing according to the laws of chance. If we don't like the result, we can change the input to achieve a better one. We correct chance, just like the Dadaists did.

These considerations show that generative AI technologies not only take up and revitalise various currents in art history but may also lead us to the threshold of a new era of art – an era in which generative AI tools act not only as aids but as partners in the creative process and assist with the birth of previously unimaginable forms of creativity.

Today, AI is helping us to recognise patterns in almost all areas of knowledge and to extract meaning from them. In the future, this could also apply to the fine arts. We should therefore speak in terms of "artificial augmented creativity" – extended creativity that gives rise to new, contemporary avant-gardes. Just like photography did around two centuries ago. ∎

ANNEX

Members as of 31.12.2023

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- Prof. Lothar Thiele – D-ITET
- Prof. Peter Bühlmann – D-MATH
- Prof. Roland Siegwart – D-MAVT

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- Letizia Turri, Director's Associate
- Natalia Marciniak, Operations Manager (on maternity leave)
- Flori Olteanu, Financial Administrative Assistant
- Patrizia Napoli, HR
- Dr. Jennifer Wadsworth, Research Coordinator
- Trinh Ngo, Office & Community Manager
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- Andrej Kulikov, Partnership Manager
- Mateja Kramar, Customer Success Manager
- Dr. Helga Rietz, Science Communications Manager
- Valeria Bella, Event Manager
- Hanna Brahme, Curator AI House Davos
- Fiona Könz, Project Manager Swiss AI Competition (ad interim)
- Lisa Wagner, Project Manager Swiss AI Competition
- Adrian Notz, Curator AI + Art
- Dr. Gerd Kortemeyer, AI for Education

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- Prof. Andrea Burden – D-CHAB
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- Prof. April Wang – D-INFK
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- Prof. Benjamin Dillenburger – D-ARCH
- Prof. Bernd Stadlinger – UZH
- Prof. Bernd Wollscheid – D-HEST
- Prof. Bernd Bickel – D-ARCH
- Prof. Bjoern Menze – UZH and USZ
- Prof. Bruno Sudret – D-BAUG
- Prof. Cara Magnabosco – D-ERDW
- Prof. Carlo Menon – D-HEST
- Prof. Catherine De Wolf – D-BAUG
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- Prof. Domenico Giardini – D-ERDW
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- Prof. Laura De Lorenzis – D-MAVT
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- Prof. Luca Benini – D-ITET
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- Prof. Markus Püschel – D-INFK
- Prof. Markus Gross – D-INFK
- Prof. Mehmet Fatih Yanik – D-ITET
- Prof. Michael Krauthammer – UZH and USZ
- Prof. Mirko Meboldt – D-MAVT
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- Prof. Nicola Zamboni – D-BIOL
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- Alice Bizeul (Prof. Vogt, D-INFK, Prof. Schölkopf, D-INFK)
- Alizée Pace (Prof. Rätsch, D-INFK, Prof. Schölkopf, D-INFK)
- Anej Svete (Prof. Cotterell, D-INFK, Prof. Boeva, D-INFK)
- Anh Duong Vo (Prof. Grewe, D-ITET, Prof. Van Gool, D-ITET)
- Barna Pasztor (Prof. Krause, D-INFK, Prof. Seuken, UZH)
- Bogdan Raonic (Prof. Mishra, D-MATH, Prof. Vermant, D-MATL)
- Boqi Chen (Prof. Rätsch, D-INFK, Prof. Konukoglu, D-ITET)
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- Dr. Carl Allen (Prof. Cotterell, D-INFK, Prof. Sachan, D-INFK)

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- Dr. Xiaoyu Zhang (Prof. Sachan, D-INFK, Prof. Netland, D-MTEC)

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- Dr. Alexander Marx (Prof. Vogt, D-INFK, Prof. Bühlmann, D-MATH, Prof. Rätsch, D-INFK)
- Dr. Amartya Sanyal (Prof. Yang, D-INFK, Prof. Schölkopf, D-INFK, Prof. Alaifari, D-MATH)
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- Dr. Nikola Konstantinov (Prof. Vechev, D-INFK, Prof. Yang, D-INFK)
- Dr. Xinwei Shen (Prof. Bühlmann, D-MATH, Prof. Meinshausen, D-MATH)

Publications and Invited Talks

Our ETH AI Center PhD and Post-Doc Fellows had 50 accepted publications in 2023, which are listed in detail in the ETH Research Collection repository (tagged AI Center OU 02219). Several publications are with co-authors from different research groups and often different departments, supporting the success of the highly interdisciplinary setup.

Invited Research Talks at the Center
(excluding AI Center faculty members)

Sustainability Faculty Workshop:
- Dr Yanan Xin, MIE Lab ETH
- Dr Reik Leiterer, ExoLabs / UZH
- Matteo Turchetta, ETH
- Noel Gorelick, Google
- Dr Iro Armeni, ETH/Stanford University

AI & Complexity Faculty Workshop:
- Dr. Christian Heimgartner (Lumisera)
- Dr. Lukas Ambuehl (Transcality)

AI & Digital Health Faculty Workshop:
- Dr Giulia Da Poian (SMS Lab, ETH)
- Dr Diego Paez (SCAI Lab, ETH/SPZ)
- Dr Florian Haufe (Akina AG)
- Dr Marianne Schmid Daners (Zeilinger lab, ETH)

AI for Scientific Discovery Faculty Workshop:
- Ankit Gupta (D-BSSE, ETH)
- Jan-Hendrik Bastek (D-MAVT, ETH)
- Javad Komijani (D-PHYS, ETH)
- Grzegorz Kłopotek (D-BAUG, ETH)
- Dana Grund (D-USYS, ETH)

AI for Augmented Reality Faculty Workshop:
- Fabio Zünd, Game Technology Center
- Bob Sumner, Disney
- Ionut Zoiti, Meta
- David Ferstl, Magic Leap
- Mahdi Rad, Microsoft

AI & IP Faculty Workshop:
- Amanda Metzger, Artist and Software Developer
- Margaritha Windisch, Center for Law & Economics, ETH

Other invited speakers:
- Prof. Behcet Acikmese
- Vincent Fortuin (Helmholz AI)
- Razvan Pascanu (Deepmind)
- Prof. Mehmet Dogar
- Prescient Design team (Genentech/Roche)

Visiting Delegations / Institutes

- Innovate UK delegates
- German BMBF delegates & Swiss SBFI delegates
- Sweden WASP PhD Fellows & directors
- ELLIS Warsaw Unit director & team

Awards and Recognitions

- Prof. Siddharta Mishra: **Rössler Prize** 2023
- Prof. Andreas Krause: appointment to **UN advisory board on Artificial Intelligence**
- Prof. Torsten Hoefler: appointment to **Chief Architect for Machine Learning** at the Swiss National Supercomputing Centre (CSCS)
- Prof. Mennatallah El-Assady: **EuroVis Early Career Award**
- Jakub Macina: **"Forbes 30 Under 30"** in the category Science & Education.
- Profs. Manu Kapur (D-GESS), Marc Pollefeys (D-INFK), Luca Benini (D-ITET), Nicolai Meinshausen (D-MATH), Jan Vermant (D-MATL), Daniel Ahmed (D-MAVT), and Daniela Domeisen (D-USYS), all associated faculty members of ETH AI Center: **Dandelion Award** for Entrepreneurship in 2023.
- Alexander Ilic: listed amongst the **"Digital Shapers 2023"** by the economics magazine "Bilanz", along with several founders of ETH AI Center affiliated startups: Paulina Grnarova (DeepJudge), Simon Heckler (Aegis Rider), and Lucas Vandroux (VU Engineering).

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