

Dear Sir or Madame, dear AI enthusiasts,

Artificial Intelligence (AI) is neither a new concept nor a completely new technology. Nevertheless, it has been the talk of the town for some time now for it promises to herald a new era of technological change. Innovations such as artificial neural networks, increasingly faster supercomputers and increasingly larger volumes of data facilitate the application of this technology and raise great expectations. This impending turning point is even being compared to the process of industrialization; self-learning systems with the invention of the steam engine. AI will lift digitalization to a new level. Changes in the economy, the science community and society will be groundbreaking. Our everyday lives, i.e. life and cohabitation as well as work and collaboration will radically change.

Many things are already a reality today and the majority of people are not even aware that they are already using artificial intelligence in their day to day lives; for instance when they use search engines or talk to the digital assistant on their smartphones.

Some link AI to optimistic scenarios for the future, in which machines take over all unpleasant routine work and in doing so allow us to spend more time on creativity, social relationships and leisure. However, others link this topic to the fear of losing their job or even dystopias of machine domination. Neither of these will become a reality in Schleswig-Holstein.



Over the past few years China, France, Finland, the Federal Republic of Germany and many other countries have published national strategies regarding artificial intelligence. However, the German states are also required to evaluate their strengths and weaknesses in connection with AI, to be able to use the opportunities of this technology and handle the risks. Therefore, the Schleswig-Holstein state government has developed and determined these strategic objectives and areas of activity in an interdepartmental process.

I hope you enjoy reading and I look forward to the exchange and discussion on the topic.

A handwritten signature in blue ink, which appears to read 'Dirk Schrödter'. The signature is fluid and cursive.

Dirk Schrödter
Head of the State Chancellery

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AI - Opportunities for our state

Currently, we are experiencing a development that is at least as radical as the Industrial Revolution 200 years ago. In the process, artificial intelligence (AI) is becoming the steam engine of digitalization. Artificial intelligence has developed into one of the most significant technologies of the 21st century with the ever-expanding performance of computers, the continually improving availability of data and progress in the programming of algorithms. Using AI it is possible to specifically analyze huge volumes of data to be able to offer efficient solutions in the fields of science, business and administration.

Just like all topics regarding digitalization, artificial intelligence is not an end in itself but contributes to successfully reaching political, economic and social goals.

This includes securing prosperity, the competitive capacity of Schleswig-Holstein's economy, citizen-friendly politics and administrative services as well as the sustainable development of the state.

The federal state government recognized the significance of the matter of "AI" early on and held the first AI conference in May of 2018. With its digitalization program, the federal state government decided to define the scope of action for the application of AI in June of 2018. A strategy meeting in February 2019 connected all universities and research facilities with respect to AI.

At a second interdisciplinary conference in March 2019¹, more than 250 people from a variety of fields including business, science, administration, and civil society discussed the application of AI in Schleswig-Holstein. This inter-departmentally compiled strategy paper integrates key findings from these conferences.

The federal government and the European Commission have announced various funding programs. Schleswig-Holstein will exhaust all possibilities so that the state can benefit from these funds. You can find an overview of several of the programs in the appendix.

► Artificial Intelligence

We see **artificial intelligence** as **sophisticated software systems** which are adaptive and trainable in order to be able to master complex tasks.

The areas of application include image, speech and optical character recognition as well as robotics.

¹ Conference proceedings published at https://schleswig-holstein.de/tagungsband_ki

Initial situation in Schleswig-Holstein

Already today, a number of small and medium-sized companies are using AI. However, the lack of interlinkage between companies results in insufficient exchange about the application possibilities of AI. Large-scale companies with their own research and development departments are rare in Schleswig-Holstein.

All universities and universities of applied sciences in Schleswig-Holstein conduct research on AI or using AI ; many AI working groups are in the world's research top tier. The universities of applied sciences contribute to the transfer of knowledge between businesses and the scientific community. Here, the SME Competency Center 4.0 at the University of Applied Sciences in Kiel as well as the Joint Innovation Lab in Lübeck play an important role.

In comparison to other states, Schleswig-Holstein has a great number of places for studying computer science. Therefore, this state is well prepared for the development of AI knowledge. Furthermore, a bustling digitalization network already exists, which for instance meets at events such as BarCamps or the Waterkant Festival². Start-ups can get support and assistance through numerous advisory services, among others in line with Startup.sh³. Several digital hubs⁴, the Cluster Digital Economy Schleswig-Holstein (DiWiSH), FabLabs in Lübeck⁵, Kiel⁶ and Flensburg⁷ as well as various co-working spaces⁸ provide good networking opportunities and points of contact for an AI ecosystem.

Key aspects of AI

The scientific key aspects of AI research include the areas of **medicine/ healthcare** as well as other promising approaches in **oceanography** (e.g. in underwater robotics), in **autonomous marine navigation** and in the area of **Smart Cities**.

² <https://waterkant.sh/>

³ <https://www.startupsh.de/>

⁴ https://umap.openstreetmap.fr/de/map/digitale-knotenpunkte-in-schleswig-holstein_293372#9/53.9650/10.4979

⁵ <https://www.fablab-luebeck.de/de>

⁶ <https://fablab.sh/>

⁷ <https://startup-flensburg.de/startups/fablab-ideenreich/>

⁸ <https://coworking-spaces.info/coworking-spaces/schleswig-holstein>

Strategic objectives for Schleswig-Holstein

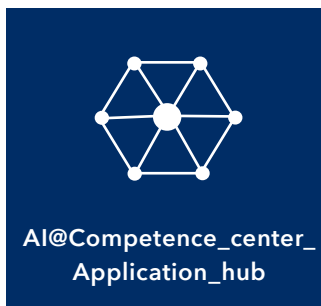
The aforementioned particularities of being a small territorial state in between the metropolitan city of Hamburg and neighboring country Denmark as well as an economy mainly shaped by small and medium-sized enterprises characterize the state. The value system of the German constitution and the mutual European values will play a significant role in the development of the application of AI, so that Schleswig-Holstein will be pursuing different paths in the development of AI than for instance the USA or China.

“**AI made in Schleswig-Holstein**” stands for innovation and application orientation in line with sustainable growth taking into account data privacy and protection as well as a fair, participative approach in compliance with humanistic values. Its objective is to have a gender-equitable and diverse effect in all social groups. The stakeholders in the fields of science, business and civil society will continue to be closely involved in the AI policy in the future. At the same time, the federal state government pursues the following strategic orientation:

- ▶ The federal state government boosts the **competitive capability of small and medium-sized companies** through support in applying AI. Schleswig-Holstein is to belong to the most active federal states using AI.
- ▶ Acceptance among the population will be increased by **promoting knowledge** of artificial intelligence and the percentage of women in the sector.
- ▶ Schleswig-Holstein will have **protected data platforms** for practice and research purposes.
- ▶ Schleswig-Holstein is to become more appealing as a **location for skilled workers and company start-ups**, in particular for AI.
- ▶ In selected fields of research for artificial intelligence and in the linking of AI with learning, digital learning and human-machine interactions Schleswig-Holstein’s universities are to be visible worldwide and this competence is to be translated into added value together with companies.
- ▶ For even more **efficient and citizen-friendly administrative services**, the federal state government is to become a nationwide pioneer for the application of AI and the improved use of data with the data protection standards and requirements established on a European level.
- ▶ **Climate protection and energy** revolution as key challenges in the coming years are to quickly and effectively contribute to the sustainable development of Schleswig-Holstein with the application of AI.
- ▶ Schleswig-Holstein stands for the benefit of **placing people in the center of the application** of AI. The priority of human behavior and human supervision, technical robustness and safety, the consideration of personal privacy and data quality management, transparency, diversity, non-discrimination and fairness as well as regard to social and ecological well-being and accountability are important guiding principles for the federal state government.

AI areas of activity

The following pages outline the following eight areas of activity derived from the strategic objectives:





AI@Competence_center_ Application_hub

We also want to support cutting-edge research on specific topics when using and applying AI and continue to develop our strengths.

One example is the field of medicine/healthcare where Schleswig-Holstein stakeholders are currently applying for the funding of a North German AI competency group from the federal government together with Bremen and Hamburg (see appendix page 28 for the initiative “AI space for intelligent healthcare systems”, KI-SIGS).

Application hubs are also to be understood as research focal points as defined by the AI strategy of the federal government, in which particular concentration is on areas with the ability to transfer and the integration of companies. Application hubs are also to be increasingly the object of funding on the part of the federal government and the EU in the coming years.



KI@Teaching_Research

We will continue to enhance top-tier research and make its AI findings systematically usable for our universities and non-university research facilities.

Interdisciplinary knowledge of AI shall be transmitted to students at our universities. Non-technical branches of study are as well to be provided with easy-access AI technologies. For this purpose, a new quality and intensity of interdisciplinary cooperation on campus and transfer into society must be achieved.

We encourage the universities to pool competencies and working groups and in doing so make increase their visibility to the outside. We want to discuss and continue to develop digital transformation with a focus on AI with the universities in a strategy process.



KI@BEducation

AI as a basic innovation will have a decisive effect on human learning. At the same time, more and more professional fields will be working with AI. Therefore, we advocate that all basic knowledge of data analysis, data use and data application is conveyed to pupils as well as university students in Schleswig-Holstein.

It is our goal to train more female students to join the critical and constructive discussion on AI and to win over female students for the active development of AI. Furthermore, the areas of expertise and skills (among others critical thinking) are being adapted to the requirements of an AI-oriented world of learning and working. This requires that the education of teachers also continue to evolve in all phases accordingly.

An essential prerequisite for the acceptance of AI is the citizens' broad knowledge and understanding. We are checking which paths and means are suitable to transmit knowledge of AI, pilot AI applications and deal with AI in everyday life in a confident and knowledgeable manner. In addition to producing big data, AI in the area of education and in particular learning analytics will also require ethical discussions.



KI@Economy_Transfer

Schleswig-Holstein is not only to become the federal state which best accommodates small and medium-sized enterprises but also to earn a top position in the application of AI in small and medium-sized enterprises.

The universities of applied sciences, the economic clusters and the SME Competency Center 4.0, which we support in becoming advisory and advanced training relays for our companies, play a crucial role in satisfying the need for skilled workers and establishing consultation services. In particular, we are planning to set up and facilitate an AI hub as the structure for the development of a nationwide ecosystem for AI, to transform research results into products, processes and services more quickly. The financing instruments of the state business program are available for projects for technology transfer and business start-up from the science sector in the area of digitalization/AI, in particular for joint and collaborative projects between scientific institutes and companies.



KI@Network

Today, there are already numerous people, ideas, and projects all revolving around AI in Schleswig-Holstein's business sector, science community, and civil society. We will continue to support networking and thereby also advance social dialog on the application of AI.

At the same time, we are looking to collaborate with other federal states, the Baltic Sea region, with our partners in San Francisco and the other partner regions of the country to achieve more together.



KI@Administration

We will improve tapping into internal and external data and making it usable for decision making processes.

The public administration executes its tasks based on rules. Intelligent systems can thus support and expand the capabilities of the public administration in organization, planning and decision-making.

Thus, with modern administration, the federal state government relies more and more on the possibilities of data-based political decisions, the so-called data driven governance. This is to be used to increase the effectivity and efficiency of administrative actions. Here, we are reviewing which processes are suitable for automation in the medium term. Among the applications of AI in public administration are chatbots and digital language assistants, the classification of text data, image data and audio data and the analysis of Internet of Things/IoT (sensor) data.

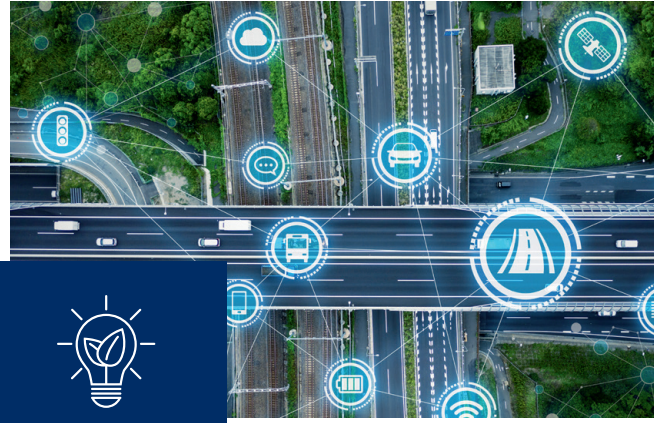


KI@Society

We want to define necessary changes to the legal framework and ethical guidelines for the application of AI.

The more decisions are prepared or automated actions are initiated by AI systems, which can have an effect on individual people or the entire society, the more these need to be traceable, verifiable, explainable and assessable in the consequences. Together with experts, we will find answers for important social issues such as changes in the working world and the consequences for social security, participation and of course the safety and protection of critical infrastructure dependent on data and data systems.

An essential prerequisite for the public acceptance of AI is the citizens' broad knowledge and understanding. The use of AI in public services presents good opportunities to bring citizens in touch with AI and demonstrate its advantages to them, e.g. chatbots that recognize required forms, make them available and help you fill them out. We are reviewing suitable formats to convey knowledge on AI and its value added, to discuss its usage, to try out applications of AI and to acquire confidence and clarity in dealing with AI in everyday life.



KI@Climate_Energy

The decarbonization in the areas power generation, heat and mobility is one of the greatest challenges of our time. Artificial intelligence can contribute to achieving these goals.

Intelligent power grids (smart grids) support the service security and resilience of the power grids. Smart mobility concepts increase efficiency in the transport sector. The state will support the municipalities in this area by ensuring that all traffic data, both on the supply side and the anonymous usage data, is made available in the state's open data portal and that this is taken into account in future licensing to transport companies.

Measures

The following defines measures to achieve the aforementioned strategic objectives within each of the central areas of activity; business, research, teaching, education, application, transfer, network, administration, climate, and energy as well as society. These measures are not conclusive but are geared to the importance for the achievement of the objectives as well as their feasibility. At the same time, this means that the process is open for new strategic measures to be initiated by the federal state government or third parties in the area of AI at a later point in time.

For the duration of the still ongoing funding period of the European Regional Development Fund (EFRE), the federal state government will use the funds still available to place emphasis on digital technologies and in particular AI. In addition, it will pay particular attention to digital technologies, in particular with a focus on AI, in the forthcoming update of the Regional Innovation Strategy (RIS.SH). The state government is thus taking up one of the most important issues of the future and launching developments, the results of which will only be visible and generate added value in the state in the coming years and decades.

Data basis



Data is the crucial basis of all AI applications. The federal state government has already done significant groundwork with establishing an **open data portal**. It went online in June 2019 and is intended to provide a growing volume of data regarding Schleswig-Holstein to the public.

The open data portal forms a growing, solid data basis for the development and training of AI applications.

Citizens, companies, associations, and research facilities can not only view data sets on a multitude of topics in the future, but also provide their own data and in doing so contribute to the growth of the platform.

In addition to the open data portal, a data platform (“**trusted data center**”, “**data hub**”) is to be established, which – equipped with relevant mechanisms for authentication and authorization – also contains non-public data from administrative services, businesses as well as “data donations” from individuals (e. g. medical data & vital data).

▶ open data/open data portal

In accordance with the “Open Data Manifest” of the industry association Bitkom, **open data is “unfiltered, machine-readable electronic data which is made available to anybody without purpose and obligation.”**

The open data portal Schleswig-Holstein is distinguished not only by containing data from public administration, but also data from companies and associations. In the medium term, the open data portal is to be upgraded in a manner, which enables sensor data (e.g. traffic counts) to be processed and provided in close to real time.

<https://schleswig-holstein.de/opendata>

AI application in administrative services



Together with the North German IT service provider Dataport and the Joint Innovation Lab in Lübeck, we are developing pilot applications for the application of AI in administrative services. At the moment, the following applications are being developed: Speech recognition in the context of mobile work with the state police, the intelligent analysis of data from the open data platform and the presorting of entries in a mail reception center. A chatbot is also being set up in the Integration Office by the end of 2019 as a pilot application.

An important principle is the protection of data privacy: Citizens’ data cannot be transmitted to service providers who do not comply with the European standards for data protection. Processing within the Dataport computer center is therefore the preferred option. This should include the option for hybrid solutions and cannot be limited to server solutions. Dataport also opens its server architecture for technical solutions from qualified third-party providers in order to benefit from technical know-how outside its own area of competence.

Therefore, the general plan is to upgrade the Dataport computer center with standard infrastructures as well as innovative and experimental infrastructures, so that it is “AI compatible”. This, for example, enables the establishment of infrastructures for chatbots in the first step; speech recognition systems are planned to follow.

In the medium run, the federal state government sees possible AI application scenarios in school and day-care center development planning, in converting texts into simpler language and in accessible formats, for text recognition and classification, e.g. for public participation, for fraud prevention e.g. in tax issues, for forecasts e.g. for social transfer payments and tax estimates, for the taxation of infrastructure and the further use of chatbots for contact with citizens.

AI in school



We are developing an AI concept for the application of AI in schools in Schleswig-Holstein. This concept is being compiled in cooperation with the universities and business partners and outlines the strategic ideas for the implementation of AI in schools in Schleswig-Holstein. Some approaches that will be integrated into the AI at school strategy can already be described:

1 We are organizing a **Blended Learning competence center** at the UAS Lübeck in collaboration with the Institute for Education of the Free and Hanseatic City of Hamburg, to, on the one hand, exchange already existing modules for virtual teacher training (e.g. for inclusion, for German as a second language) and on the other hand, to develop and collectively use joint modules. This is also intended to make compiling materials for teacher training possible. This undertaking is being implemented in line with the transnational projects of the digital package and will be open for cooperation with additional states.

2 In cooperation with IQSH and the Baden-Württemberg and Hamburg teacher training institutes as well as with the Mercator Institute for Literacy and Language Education Cologne and the Cornelsen publishing company, we are developing a **tool for adaptive learning for pupils in secondary school**. In the process, the findings from the accompanying concept "Leave no one behind" as well as the findings from the joint orthography project are being used. With this, the learners are to be automatically assigned adequate exercises according to their levels. In the future, the concept is also to be used for applications in the area of mathematics.

3 For the **evaluation and analysis of data** at schools we are reviewing the application of AI in order to provide tools to the teachers not only in the areas of orthography and mathematics (for additional applications in the subjects but also for projects in the area of initial learning capabilities and diagnostics)

Public acceptance of AI



Inspired by the Finnish AI strategy and its objective of reaching one percent of the population with an AI online course⁹, Schleswig-Holstein will develop an online course for the general population. This shall vary according to target audience (e.g. small and medium-sized enterprises, administrative staff, "for all"), with reference to Schleswig-Holstein and with recognised final certificates. In line with this, a collaboration with existing training and further training modules such as KI#CK¹⁰ of the Life Science Cluster Nord and those still in the development phase are being looked into.

Furthermore, actual locations such as future labs, makerspaces and digital hubs shall be equipped to give interested parties an insight into the possibilities of AI technology.

The success of both state AI conferences shows that there is significant interest in this topic. We will create further formats to intensify the social dialog on AI.

⁹ <https://www.elementsofai.com/>

¹⁰ <https://www.lifesciencenord.de/kick/>

Autonomous driving as an application field of artificial intelligence



In line with the state Business program 2014-2020, the “**Network autonomous driving in rural areas**” is being funded by the state. In addition to its basic funding by the state, the network has already successfully brought a series of research and development funding from the

federal government to Schleswig-Holstein. With its mandate, the network is an important partner in the development of applications for artificial intelligence in the area of mobility.

KI#CK - Artificial intelligence: Recognizing opportunities and developing expertise



The multitude of possible applications holds significant economic potential for small and medium-sized enterprises (SMEs) in the cluster, however, there is often still a lack of sufficient knowledge and expertise required to not only be able to continue to keep up internationally in the future but also to be able to take the lead.

For this reason, the KI#CK project aims to enable employees to independently develop innovative ideas for future-oriented business concepts by imparting conceptual and methodological skills in addition to the introduction to the topic.

Experts in various fields will be working together closely to create a versatile further training offer which will be co-developed, tested and ultimately further developed by the companies in the sector. This project will be funded with approximately half a million Euros by the Schleswig-Holstein state employment program through state funds and the European Social Fund.

KI#CK

The project „**KI#CK - Artificial Intelligence: Recognizing opportunities, developing competences**” of the Life Science Cluster Nord, the Technical University Lübeck and the oncampus GmbH has the objective of creating a **taylor-made qualification offer for employees of the Life Science Cluster in Schleswig-Holstein** in order to provide an entry into the highly relevant future topic of AI and its possible applications.

Digital Learning Center



Together with the universities, we are developing a concept for one or possibly several Digital Learning Centers, in which the research and development of AI as a learning software system is closely linked to the research and application of digital learning, machine learning, learning technologies such as augmented reality (AR), virtual reality (VR) and avatar development as well as to man-machine interactions in the context; in particular for 4.0 processes. These AI-relevant future-oriented fields are to be strategically researched, tested, taught, learned and combined with one another in the application.

Therefore, a Digital Learning Center would be a contact point and a service provider for interdisciplinary teaching and research but at the same time, also laboratory, research center and transfer hub for teachers and students at the universities as well as for business partners and partners in civil society.

Teaching and learning platform



As part of the strategy process we are developing a **cross-university and cross-locational teaching-learning platform for digital transformation** with a focus on AI that offers e-learning and blended learning with face-to-face teaching on the topic of AI and its fundamentals targeted at specific audiences. The promotion and teaching of AI is to be embedded in a digital cur-

riculum along with general technologies and trends of digital transformation that are fundamental for a basic understanding, exploration and development of AI. At the same time, digital, technological and social competencies must take center stage, which e.g. the Association for the Promotion of "Future Skills"¹¹ defines and summarizes in its draft paper.

AI Ecosystem/ AI Hub Schleswig-Holstein



There are already functioning networks for AI experts in Schleswig-Holstein. The organizational condensation points are the CCI Lübeck, the specialist AI team of the Cluster Digital Economy Schleswig-Holstein (DiWiSH) and the "Kiel.AI" Meetup. A main task will be to make the scientific expertise available in Schleswig-Holstein in the area of artificial intelligence accessible to the businesses in the state. There are a number of suggestions from several stakeholders.

In particular, we are planning to set up and facilitate an AI hub as the structure for organizing a nationwide ecosystem for AI in connection with existing facilities and networks in the state.

Businesses, startups, research facilities, universities are to be linked there and competencies in the area of AI are to be expanded. Furthermore, research results shall quickly be transformed into products, processes and services. Technology transfer to the businesses in the state and support for spin-offs in the area of artificial intelligence applications are central tasks.

We will continue to support these networks and, in doing so, promote exchange with the community.

¹¹ <https://www.stifterverband.org/future-skills>

Expert board for the social effects of AI



We will routinely discuss the social effects of AI with experts. These experts are to advise the federal state government on the application of artificial intelligence in Schleswig-Holstein in accordance with public welfare. This requires taking the EU formulated core competencies of transparency, accountability, non-discrimination, data quality management, technical robustness, ecological well-being and the priority of human behavior into account.

We aim for the advisory committee to develop a target image for the socially beneficial and harmless use of AI in Schleswig-Holstein.

Furthermore, policy documents are to be compiled for the application of AI in specific fields of application such as medicine, for example. Mission statement and policy documents are to serve as orientation for “AI made in Schleswig Holstein” and, as such, are to radiate beyond the state’s borders.

Strategic process for university development in the digital transformation with focus on AI



Along with a new strategy process with the universities in Schleswig-Holstein, the federal state government supports and broaches the topic of the development of the curricula and the reinforcement of the “**digital literacy**” of university students. I.e. the **promotion of digital competencies** as the basis for dealing with AI as well as the discussion of AI-relevant interdisciplinary

topics such as a new learning approach for more multi-disciplinary, curiosity-driven, self-driven learning at universities, the reinforcement of MINT skills including in subjects which are not related to MINT. A healthy learn-life-balance in the digital age and the requirement for new digital ethics in handling big data and AI also belong in this category.

Development of sensor technology as the basis for the processing of data



The availability of large volumes of data is the basis for applications in artificial intelligence. At the same time, sensors of all types of data collected play a central role. The “**Center for Networked Sensor Systems**” (ZEVS) at the technical faculty of the Christian-Albrechts University, which was funded with 25 million Euros in line with the state business program, has the potential of becoming a central interface for research, development and tech-

nology transfer. The outstanding international research work in the area of sensor system technology, sensor information technology and sensor system modeling at the CAU is to be consolidated in the ZEVS. Addressed fields of application are in particular medicine and life sciences, maritime applications, energy networks and environmental sensor systems.

Appendix

AI examples of use in the area of science and research

Artificial intelligence as an assistant for parcel logistics

The same problem arises again and again at parcel distribution centers: With thousands of parcels a day, lost consignments have to be tediously tracked down in the distribution center. In collaboration with the computer sciences department at CAU, the medium-sized DIVIS (Deutsche Industrie Video System GmbH) based in Bordesholm developed methods of artificial intelligence to organize the **sorting of parcels in distributions centers more reliably**. For this purpose, camera images

are analyzed with neural networks, parcels are found and identified automatically. Funding by the Federal Ministry for Economic Affairs and Energy within the framework of the ZIM (Central Innovation Program for small and medium-sized enterprises) program was essential for the cooperation between the university and DIVIS as one of the leading enterprises for video surveillance systems in logistics.

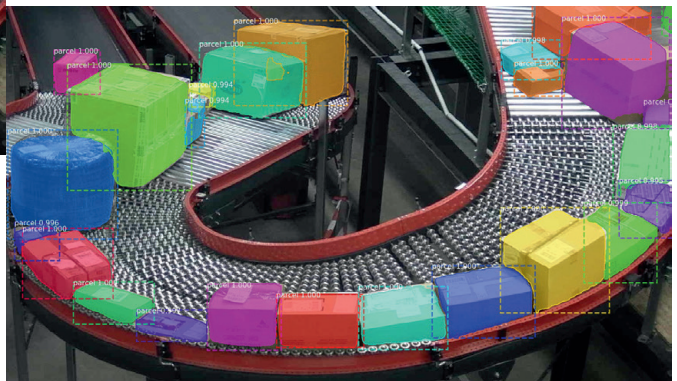
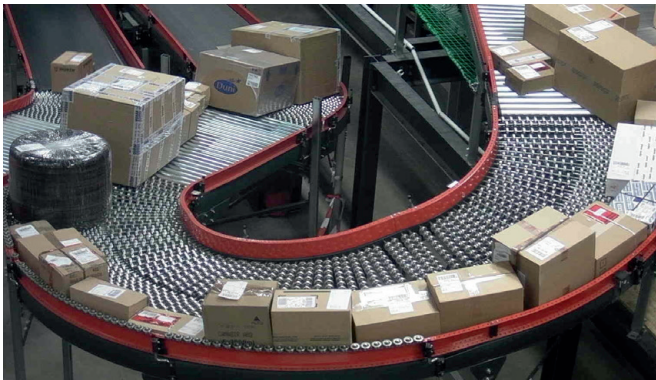


Fig. 1:
With the help of AI, parcels are recorded and processed.
Photo: DIVIS

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AI helps in the early detection of asthma in children

In the project “**KILL-Asthma**” the Lübeck research team of Dr. Daniel Rapoport at the Fraunhofer Research Institution for Marine Biotechnology and Cell Technology explores the **AI-supported analysis of immune cells** for the diagnosis of asthma. The idea is to observe immune cells from a drop of blood for approx. 90 minutes with a microscope specifically developed at the Fraunhofer EMB and based on the patterns of movement to assess whether or a case of asthma can be diagnosed. It is particularly important to detect asthma early on in children to enable

quick intervention and alleviate the symptoms. In the process, AI plays a crucial role: It is supposed to recognize characteristic patterns in the complex movement patterns of thousands of cells. This method can also be extended to the diagnosis of other diseases, provided that these are accompanied by patterns of movement in the immune cells. The highlight is that it is not even necessary to know these patterns of movement beforehand; the AI can simply learn them based on examples from the respective patient’s blood.

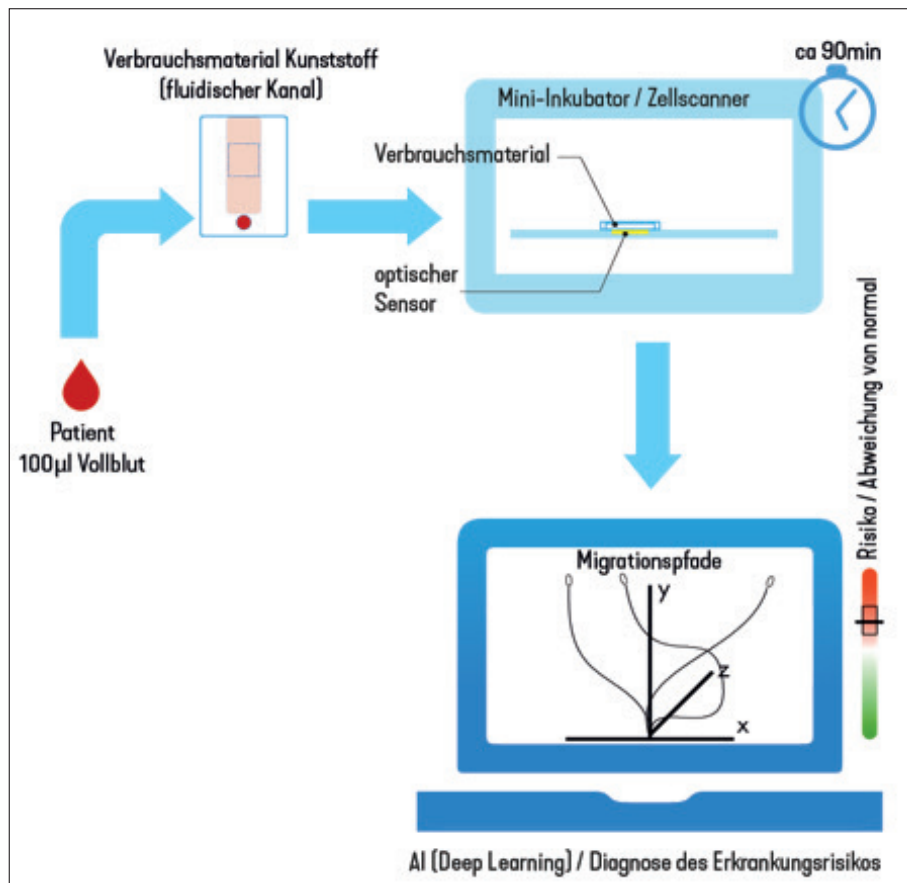


Fig. 2: Diagram of the AI-supported method to diagnose asthma from a drop of blood

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Adaptive battery systems

Adaptive battery systems impress with an innovative concept which enables the realization of **reliable diagnostic systems for high-quality batteries** using measuring systems designed by engineers and machine learning methods. The battery management system from the Kiel University of Applied Sciences generates characteristic records for each cell of the battery system during operation. By collecting the frequency-dependent

impedance, the temperature and other statistical values based on current flow, the state of charge and the state of health are estimated with a high degree of accuracy by means of a corroborative learning method. Knowing both values in operation is essential when it comes to, for example, providing high-capacity battery systems, which are used e.g. as a permanently operated current buffer for the energy revolution.

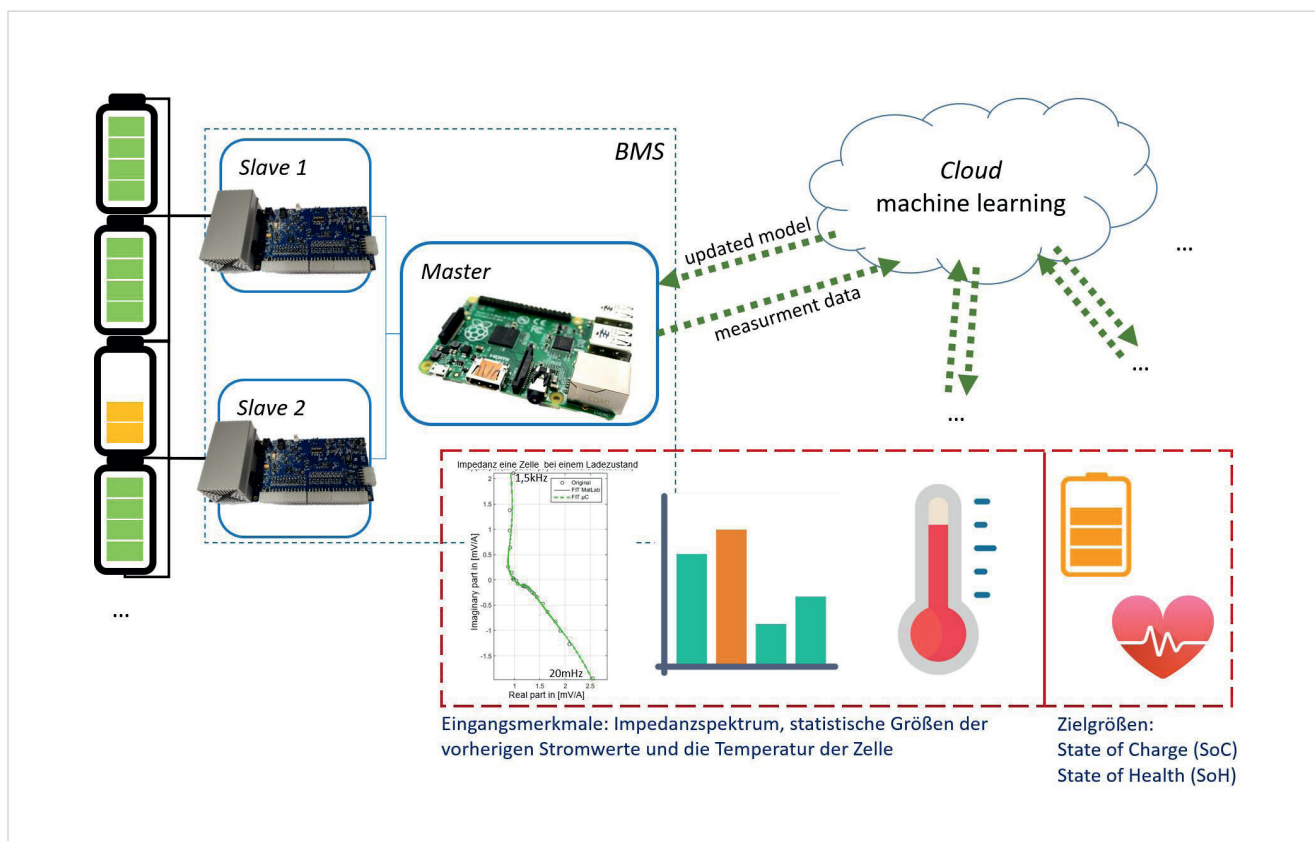


Fig. 3: Cloud-based adaptive battery management system from the UAS Kiel. Diagram: UAS Kiel

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Understanding the worldwide coasts and the climate with artificial intelligence

How can climate developments be shown in more detail in climate models? In the course of an 11.4 million Euro project of the Helmholtz Association, the Helmholtz-Zentrum Geesthacht (HZG) (Centre for Materials and Coastal Research), is developing new methods for the **processing of large volumes of data with the objective of improved climate modelling** in collaboration with the German Climate Computing Center using artificial intelligence. The results improve the fundamental understanding of climate and coastline and by

doing so, support the economy and public authorities, for instance in predicting currents and wave heights. At the same time, concrete scenarios enable concrete decisions: How do climate change and rise in sea level affect the coastal regions? And how can we prepare ourselves for it? The Helmholtz-Zentrum Geesthacht (HZG) (Centre for Materials and Coastal Research) is one of six research units of the nationwide and internationally operating Helmholtz Association.



Fig. 4: The HZG is a partner in the German Climate Computing Center. Photo: HZG/Christian Schmid

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AI for the detection of movement behavior of piglets

To improve the well-being of animals when breeding piglets, the **movement profile of the animals shall be observed** in order to **predict the animals' social behavior** towards one another. At the Computer Science Institute at CAU Kiel AI-supported procedures for the detection and tracking of animals in the pen are being studied. This work is being conducted in close collaboration with the agricultural faculty at CAU Kiel and the Department for Animal Sciences at the Georg-August University of Göttingen. In the process, neural networks help locate the precise position of the piglets, even under the most difficult visibility conditions.

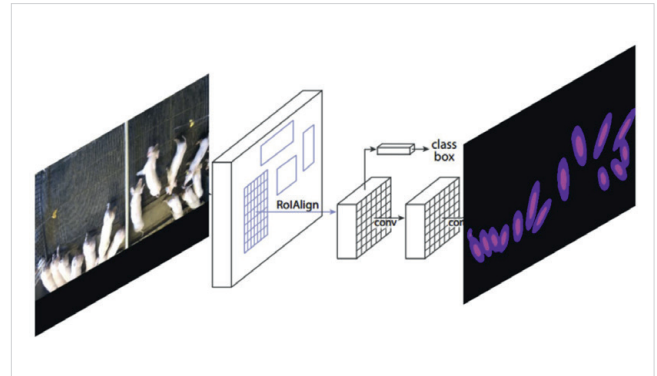


Fig. 5: Neural network for the positioning of the pigs

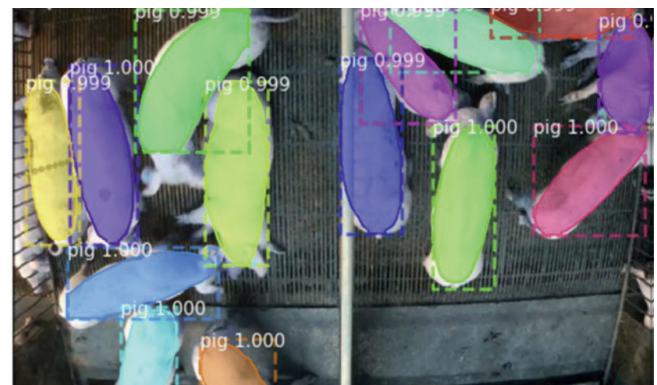


Fig. 6: Precise localization of the animals in the pen

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Artificial intelligence as an X-ray assistant

Approx. 150 million X-rays are taken every year in Germany alone. The AI developed at the University of Lübeck not only supports diagnoses but can also improve the image quality. To do so the physical location of the patient is recorded using a 3D time-of-flight camera mounted on the X-ray machine. With methods of AI it is predicted whether an X ray in a certain

position meets the required criteria and is suitable for a diagnosis. If so, the green light is given. If not, it is indicated how the position and location should be adjusted. The **optimized images with such an AI X-ray assistant** not only increase **diagnostic quality** but **also reduce the radiation dose** and unnecessary additional X-rays are avoided.

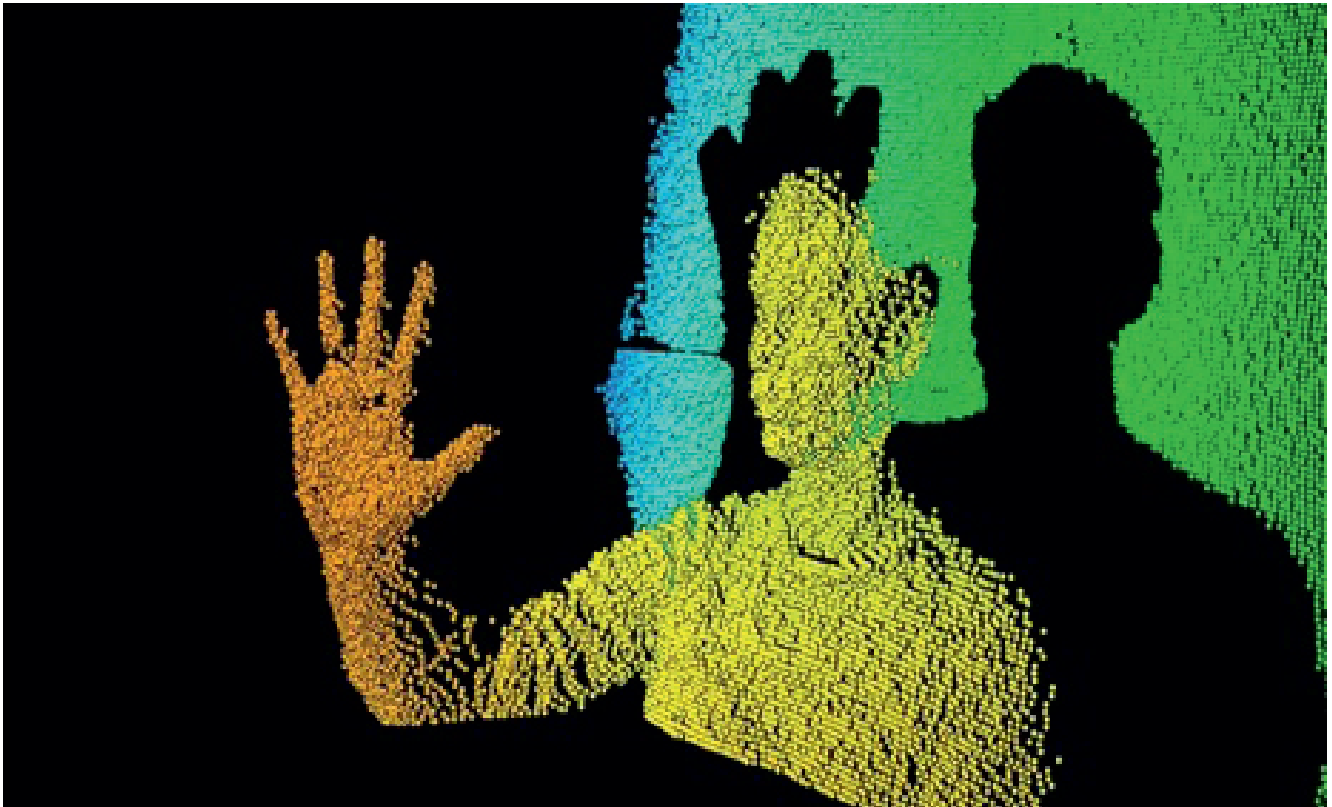


Fig. 7: Body scanning with 3D time-of-flight camera. Photo: University of Lübeck

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Appendix

AI examples of use in the area of business

Using AI to keep and serve customers

Many businesses are dependent on keeping acquired customers' loyalty. That requires staying on top of things. What customer contacts are there? Is it possible to detect if a customer might terminate the relationship soon?

The **clarifydata GmbH** brings artificial intelligence to small and medium-sized enterprises and aims to become the most well-known expert on this topic in Northern Germany. The current development project is a platform for the application of AI in small and medium-sized enterprises. Day-to-day business has a lot to do with replicating successful sales personnel based on data analysis and machine learning.

The DataDrivenAction software predicts which customers will be terminating the relationship in the near future and how to avoid this. Furthermore, clarifydata is developing products revolving around open data as well as for the optimization of master data. The AI building blocks from clarifydata are continuously being increased through new projects.

clarifydata was founded in 2017 by Dr. Johannes Raabe and Michael Hartke. Michael Hartke comes out of eCommerce and it was here that he found his passion

for data-based optimization in various areas. Johannes Raabe is rooted in the science community and research and is specialized in statistics, specifically in the analysis and projection of behavior in choice making.

The latest development project at clarifydata is the AI platform "clarify.ai". The platform pursues the objective of making artificial intelligence easy to use and tangible for small and medium-sized enterprises. The platform is intended to enable businesses to **understand AI, train it themselves and also, to use it in business in a meaningful manner.**

Optimizing appointment scheduling and route planning with AI

All businesses with field representatives have to plan their appointments and routes and, in doing so, achieve the highest possible level of efficiency - i.e. planning routes in a manner that avoids unnecessary travel.

The **FLS GmbH** in Heikendorf develops and sells software with which utility companies, industrial enterprises, financial service providers as well as commercial enterprises and real estate companies can **plan and optimize appointment scheduling and route planning for their field representatives and delivery vehicles.**

At the core of the products is an algorithm which works on the basis of real-time data and, with this, can solve scheduling/planning tasks by taking a multitude of influencing factors into account.

Such requirements are particularly prevalent in companies that want to efficiently deploy a large number of employees at the same time in a rapidly changing environment. The increasing expectations in order and delivery processes as well as dynamic and rarely predictable traffic conditions form the background for the business activities of the company.

The market for optimization software in such application settings is growing with considerable two-digit rates, ultimately also driven by the increasing number of



Fig. 8: trucks on the motorway.
Photo: M. Staudt | grafikfoto.de

eCommerce. FLS sets itself apart through a range of services tailored to meet the mentioned customers' needs. These benefit from the competitive advantages of maximum resource utilization, cost savings as well as a significantly improved service quality.

FLS was founded 25 years ago and is based in Heikendorf and also has another branch in Cologne. With sales locations in Great Britain and in the Netherlands, the company is advancing its international expansion.

Creating sales forecasts with meteorological data and AI

It is not news that the amount of goods sold by a bakery changes depending on the weather conditions. But how exactly can that be predicted?

The **meteolytix GmbH** was formed in April 2009 as a joint venture between the WetterWelt GmbH, a highly specialized weather service provider and the analytix GmbH, a provider of predictive analytics. Based on a request from a baker, meteolytix developed a model that provides a precise sales forecast for the individual stores based on more than 400 influencing factors.

In the course of the next ten years, the services offered were expanded and continuously improved. Today, in addition to sales forecasts, meteolytix also supports its customers in production management and purchase planning. As of lately, the company also offers personnel planning with which the bakeries can conduct their resource planning in the stores by the hour.

Today, the meteolytix GmbH is a leading software company in the field of predictive analytics and primarily supports businesses in food retail to plan their orders

and resources. Founded as a start-up ten years ago, the company has meanwhile made a name for itself and employs 15 staff.

The objective is to enable the contracting company to achieve good availability of goods with a lower cost of sales and thus an increased yield on the basis of data analyses.

The German Association of Chambers of Commerce and Industry (DIHK) also acknowledged that the company is on the right track when they presented meteolytix GmbH with the “WE DO DIGITAL” award in the area of digital commerce last year.

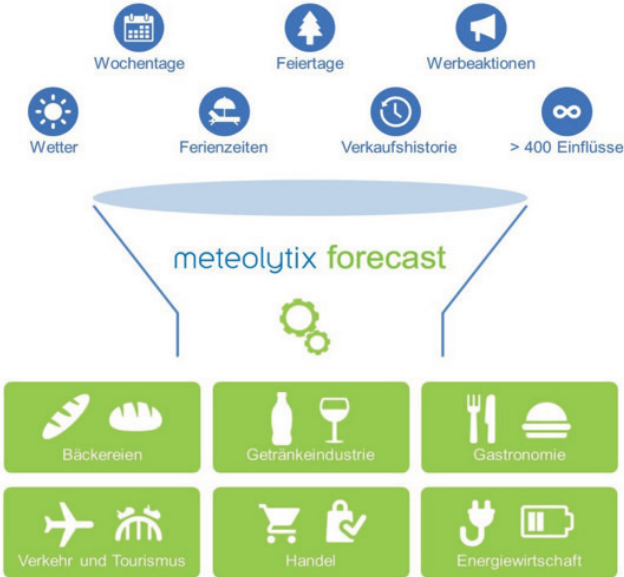


Fig. 9: Self-learning algorithm from meteolytix forecast. Diagram: meteolytix GmbH, Kiel

AI space for intelligent healthcare systems (KI-SIGS)

What?

The project objective is the establishment of an “AI space for intelligent healthcare systems” (KI-SIGS) in collaboration with designated AI institutes in Bremen, Hamburg and Schleswig-Holstein (Lübeck/Kiel) with the companies in the healthcare sector and medical partners of the university medical centers in the North. Intelligent healthcare systems include adaptive medical systems as well as adaptive robotic assistance systems and smart living home assistants. The AI competencies of the science partners in the field of deep learning,

machine learning and cognitive systems are displayed in the diverse AI-relevant product innovation potentials of the business partners, supported by overall competencies such as security, reliability or ethical considerations and using AI development and platform projects, applied in cooperative application and evaluation scenarios for the systematic establishment of a diverse AI ecosystem. An adaptive socio-technical AI platform will be developed and established as basis for cooperation on a dynamic value-generating network.

Executive Summary

KI-SIGS-Konsortium

Contact: info@ki-sigs.de

Why?

The increasing digitalization in medicine and medical technology causes the quantity of large, heterogeneous, complex, and partially unstructured data sets in life sciences to increase rapidly. This data holds great potential for intelligent healthcare systems and the adaptive self-learning AI technologies. A more comprehensive data exchange and the consolidation of health data from scattered data sources from care and re-

search open diverse possibilities for increasing interoperability of medical devices, learning algorithms and adaptive AI systems. Intelligent assisting health technologies, robotic systems with assisting components and everything through to humanoid robots and mobile healthcare treatments also open new fields of application in caregiving and rehabilitation.

Who?

Eight partners are involved in the development of the concept, with further partners joining for the implementation phase. The following belong to the initial consortium:

- ▶ Consortium leader UniTransferKlinik Lübeck
- ▶ Christian-Albrechts University of Kiel
- ▶ DFKI Bremen
- ▶ Fraunhofer MEVIS
- ▶ University of Bremen
- ▶ University of Hamburg
- ▶ University Medical Center Schleswig-Holstein
- ▶ University of Lübeck

▶ Dates

- ▶ **March 1, 2019:** submission of the preliminary application
- ▶ **March 15, 2019:** positive decision for the preliminary application; amount of funding approx. €700,000
- ▶ **April 15, 2019:** start of the competitive phase
- ▶ **August 16, 2019:** submission of the entire application
- ▶ **August:** notification of the decision
- ▶ **January 1, 2020:** if decision is positive, implementation commencement

Glossary

Source: Platform learning systems¹²

Algorithm

An algorithm is a precise calculation program for one or more computers to solve a problem. Learning algorithms are a special type of algorithms: These are machine learning methods that abstract a model from example data (learning data or training data) that can be applied to new example data.

Autonomous systems

Machines, robots and software systems are classified as autonomous if they independently achieve a specified goal and adapt to the situation without human control and detailed programming. Autonomous systems have the ability to adapt to the environment, to learn and, if applicable, to cooperate with other systems or humans.

Big data

Amounts of data distinguished by their volume, the diversity of the data types and sources (variety), the speed with which accumulate (velocity) as well as the uncertainty regarding the quality of the data (veracity). It is often mostly a matter of unstructured data which, for instance, may come from social networks or mobile devices. Another aspect of big data involves the solutions and systems which help in handling these quantities of data, for example to be able to recognize new patterns and correlations.

Chat Bot

Virtual dialog systems, which are used more and more in customer service and for user interfaces in general. You communicate in natural language with the human via text input and text output masks (e.g. a dialog window on a website). Using machine learning methods, chatbots can continuously learn more and more from entries in order to, for example, interpret the person's mood or give personalized answers.

Data Mining

Application of statistical or machine learning methods for detecting new correlations and patterns in a data volume. For instance, with the objective of providing recommendations for decisions or to make predictions. Cluster analyses, decision trees but also artificial neural networks are used for this, for example.

Deep Learning

Method of machine learning in artificial neural networks. These include several layers - typically an input and output layer as well as more than one "hidden" intermediate layer. The individual layers consist of multitude of artificial neurons which are connected to one another and react to the inputs of neurons from the respectively previous layer. For instance, a pattern is detected in the first layer, a pattern of patterns in the second layer and so on. The more complex the network (as measured by the number of neuron layers, the connections between neurons as well as the neurons per layer), the higher the possible degree of abstraction and the more complex issues can be processed. Deep learning is used for image, speech and object recognition as well as for reinforced learning.

Explainable AI

Black-box models, such as deep artificial neural networks in particular, are not comprehensible to humans. Explainable AI looks for possibilities to make the hidden logic or the individual outputs more understandable or explainable.

Internet of Things (IoT)

The increasing networking of tools, devices, sensors, vehicles, etc. through installed computer systems as well as the assignment of distinct digital identifiers (IP address). With the help of their sensors, the networked devices

¹² <https://www.plattform-lernende-systeme.de/glossar.html>

collect data which they can exchange and make available among one another as well as via the Internet. This results in extremely large data volumes (big data), which in turn can represent the basis for learning systems.

Artificial neuronal network

Models of machine learning which were motivated by the aspects of the human brain. They consist of layers of nodes realized in software, which are called artificial neurons. The individual connections between the neurons have a numerical weighting which is adapted during the training process so that the results improve continuously. At the same time, more and more abstract representations of the input develop from layer to layer, so that in the event of a very high number of layers (deep learning), very complex patterns can be mapped and detected.

Machine Learning

Machine learning is a basic method of artificial intelligence (AI). It aims to ensure that machines automatically deliver meaningful results without explicit programming of a concrete solution. Special algorithms learn from the existing sample data models, which can then be applied to new data which has previously not yet been seen.

Robotics

The term “robot” is derived from the Czech word for forced labor, “robota”. A robot is a system that relieves humans of work. However, only machines which do physical work are called robots. More and more frequently, learning systems must be used to control robots. Robotics is a research field of AI with the objective of developing robots which interact with the physical world autonomously by means of algorithms.

Weak AI

Systems which operate in a specific, narrowly defined context and can even exceed human abilities. Examples of specific applications are strategy games such as chess and Go or product recommendations as well as medical diagnoses. All artificial intelligence available today is defined as weak AI. The opposing model is the strong AI.

Strong AI

Hypothetical AI systems that have at least human-like intelligence in all areas and not only in narrowly defined fields of application (weak AI). An artificial super intelligence would be far superior to than the most intelligent human.

Turing Test

A test developed by the British mathematician Alan Turing in order to determine whether a machine can be deemed intelligent. In the process, a human evaluator communicates with a human dialog partner and a machine using a keyboard. If, at the end of the communication, the evaluator cannot say which dialog partner is the machine, it is deemed intelligent.

Additional materials

AI@Participation

Under the umbrella of the WECHANGE community, the federal state government created an “Artificial Intelligence” closed group. Here, there is room for discussions, collaborative work on documents and event information. This platform is kept going by your participation – just take a moment to register, join and you’re ready to go!

<https://wechange.de/project/kunstliche-intelligenz/>

You can find an “AI map” on the Learning Systems platform of the Federal Ministry of Education and Research. Are you researching the topic of AI? Are you developing AI project or products in your company? Then check and see if you can add to the Schleswig-Holstein AI map with an entry:

www.plattform-lernende-systeme.de

The Federal Ministry of Education and Research is also organizing the Science Year 2019, which is dedicated to Artificial Intelligence this year. Stakeholders from the scientific community in particular can participate here:

<https://www.wissenschaftsjahr.de/2019>

AI@Network

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DiWiSH Specialist Team Artificial Intelligence
<https://www.diwish.de/ki-kuenstliche-intelligenz.html>

Machine Learning Camp Sankt Peter-Ording (8./9.11.19)
<http://www.mlcsपो.de>

MeetUp Kiel-AI
<https://www.meetup.com/de-DE/kiel-ai/>

AI@Funding

“SME innovative: Electronics and autonomous driving”:

<https://www.bmbf.de/foerderungen/bekanntmachung-2154.html>

Funding of research and development in the field “Human-technology interaction for digital sovereignty”:

<https://www.technik-zum-menschen-bringen.de/foerderung/bekanntmachungen/digisou>

Funding of the pilot innovation competition “Energy-efficient AI System”:

<https://www.bmbf.de/foerderungen/bekanntmachung-2371.html>

Funding of international future labs in Germany for Artificial Intelligence:

<https://www.bmbf.de/foerderungen/bekanntmachung-2377.html>

Funding of projects pertaining to “Explainability and Transparency of Machine Learning and Artificial Intelligence“:

<https://www.bmbf.de/foerderungen/bekanntmachung-2392.html>

Funding of projects pertaining to “Application of Artificial Intelligence Methods in Practice”:

<https://www.bmbf.de/foerderungen/bekanntmachung-2395.html>

Funding of research and development in the area “Adaptive Technologies for Society – Intelligent Interaction between Man and Artificial Intelligence”:

<https://www.bmbf.de/foerderungen/bekanntmachung-2416.html>

Funding of research projects for “Future-oriented Special Processors and Development Platforms (ZuSE):

<https://www.bmbf.de/foerderungen/bekanntmachung-2422.html>

EFRE funding program:

https://www.schleswig-holstein.de/DE/Fachinhalte/F/foerderprogramme/MWAVT/EFRE/efre_inSH_2014_2020.html

Funding opportunities for Artificial Intelligence in line with the state Business program 2014-2020 (LPW)

To fund projects in the area of artificial intelligence one can turn to the established and approved financing instruments in the LPW for research, development and innovations. The following can generally be considered for AI projects:

- ▶ Guideline for the approval of grants for the funding of application-oriented research, innovations, future-oriented technologies and technology and knowledge transfer (FIT Guideline)

- ▶ Guideline for the approval of grants for the promotion of company research, development and innovation (BFEI Guideline)
- ▶ Guideline for the approval of grants for the funding of corporate process and organizational innovations (POI Guideline)
- ▶ Guideline for the approval of grants to employ graduates from universities of applied sciences and universities of science in small enterprises in Schleswig-Holstein (IA Guideline)

Projects that facilitate original university assignments cannot be funded from the LPW.

AI@Links

Performance Measurement of AI Strategies

Stiftung neue Verantwortung

https://www.stiftung-nv.de/sites/default/files/erfolgs-messung_von_ki-strategien.pdf

Comparison of National Strategies for the Funding of Artificial Intelligence (Part 1 + 2),

Konrad-Adenauer-Stiftung

<https://www.kas.de/kuenstliche-intelligenz-und-robotik>

Assessment of the German AI Strategy (Part 3),

Konrad-Adenauer-Stiftung

<https://www.kas.de/einzeltitel/-/content/bewertung-der-deutschen-ki-strategie>

Ethical principles for AI application

Microsoft

<https://news.microsoft.com/de-de/ethik-prinzipien-kuenstliche-intelligenz/>

Fundamental values for Artificial Intelligence

D64 Thesis Paper

<https://d-64.org/wp-content/uploads/2018/02/D64-KI-Grundwerte-Februar2018.pdf>

New Thoughts on Digital Ethics

Initiative D21

<https://initiated21.de/publikationen/denkimpulse-zur-digitalen-ethik/>

Four Future Scenarios for Artificial Intelligence in Public Administration

ÖFIT

<https://www.oeffentliche-it.de/publikationen?doc=84404&title=Exekutive+KI+2030+-+Vier+Zukunftsszenarien+für+Künstliche+Intelligenz+in+der+öffentlichen+Verwaltung>

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