$\dfrac{42}{32}$

DATA SHAPES THE FUTURE

Prescriptive Analytics

42
32

Analogue through digitisation

Prescriptive Analytics is an interdisciplinary topic in an interdisciplinary field, or put another way it is a synergistic hybridisation of various methods and algorithms from statistics, computer science, artificial intelligence, mathematics and operations research. Its aim is to provide optimized recommendations for action in various application areas. In this way, knowledge gained in the digital world is brought back to the real world, providing better and more efficient procedures, designs and processes.

Our economy – with its numerous world market leaders and hidden champions, in the automotive, steel and plant construction sectors in particular – can maintain and build upon its position with custom solutions from the modular system that Prescriptive Analytics offers.

If you don't want to surrender the scientific depth in the interaction between the contributing sub-disciplines, then the breadth of content within Prescriptive Analytics can only be proficiently expanded in an environment as complex and yet focused as Softwarepark Hagenberg.

Comprehensive solutions can be developed in the already established interaction between university and non-university research institutions. The software companies on-site ensure that the prototypes developed through research are suitable for everyday use and that they can be maintained in the long term. The diverse range of courses in the Hagenberg study programmes supply the most important raw material: human competence and intelligence. ▷

Photo: Sara Aschauer

Prof. Dr. Michael Affenzeller
Scientific Head of
Softwarepark Hagenberg

Know the present – shape the future

Photo: Sara Aschauer

Dr. Sonja Mündl
Manager of Softwarepark Hagenberg

What comes after data analysis? The answer's easy: Prescriptive Analytics. Prescriptive Analytics focuses on using the available data to find the best approach in a given scenario.

Only those who know the past and the present can shape the future!

Softwarepark Hagenberg has stood for visionary future design since it was founded, which is why I'm all the more pleased that we've now turned our attention to the topic of Prescriptive Analytics.

Our experts use Prescriptive Analytics to investigate how different approaches affect a result. This provides companies with recommendations for action and the opportunity to automate the decision-making process. In our events series we want to find out how machines can help us make intelligent decisions.

Between all the data and analyses, one thing is certain: the future will be exciting – we're excited about shaping it together now. ▷

contact ◢

Softwarepark Hagenberg Management
Softwarepark 32 | 4232 Hagenberg
Tel: +43-7236-3343 0
office@softwarepark-hagenberg.com
www.softwarepark-hagenberg.com

Photo: Land OÖ

"Predictive analytics, machine learning and deep learning help us to recognise trends and act with foresight. With its research facilities, Softwarepark Hagenberg creates an important foundation for making decisions which give that edge in knowledge required to be economically competitive.

Markus Achleitner *Minister of Economy, State of Upper Austria*

Highlights from Softwarepark

Happy Birthday, Softwarepark Hagenberg! On 30 October 2019 Softwarepark Hagenberg celebrated its 30th anniversary together with partners and associates.

Left to right: Dr. Michael Affenzeller, Scientific Head of SWPH, Business and Research-Provincial Government Markus Achleitner, State Governor Mag. Thomas Stelzer, Prof. Dr. Bruno Buchberger, Initiator of SWPH. Photo: Land OÖ / Maximilian Mayrhofer

A hive of building activity – cranes fill the Softwarepark Hagenberg skyline. Business Campus One was opened in autumn 2019. The second phase of Business Campus One and the new COUNT IT Group & ventopay gmbh building is currently under construction, while the Business Park Hotel is being planned.

COUNT IT Group & ventopay gmbh building Photo: COUNT IT Group

Softwarepark Hagenberg becomes a leading centre for IT-Security & Prescriptive Analytics

Left to right: FH-Prof. PD DI Dr. Michael Affenzeller, Scientific Head of Softwarepark Hagenberg, Provincial State Governor Mag. Thomas Stelzer, Business and Research-Provincial Government Markus Achleitner and Gerhard Eschelbeck, Professor of Vision and former vice president of IT-Security at Google. Photo: Land OÖ / Heinz Kraml

Business Campus One - Second construction phase Photo: Softwarepark Hagenberg:

Report by Prof. Dr. Michael Affenzeller,
Scientific Head of Softwarepark Hagenberg

Prescriptive Analytics at Softwarepark Hagenberg

RESEARCH

BUSINESS

EDUCATION
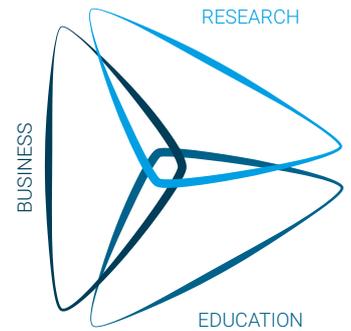
Prescriptive Analytics is the driver for digitised companies

Prescriptive Analytics is the fourth stage of business analytics, which focuses on decision-making. The view of the past and present, which is represented e.g. by predictive models of predictive analytics, must be directed into the future. Building on the first three stages (descriptive, diagnostic, predictive), the fourth stage – Prescriptive Analytics – uses models and procedures for decision-making and providing industry with recommendations. New key elements include:
(1) Considering mutually influencing effects
(2) Responding to changes
(3) Identifying good/optimized decisions

For this fourth stage, the theory and methodology already established in the field of analytics is enriched by modelling and optimization. Modelling, through simulation for instance, digitalises processes and procedures, while machine learning in the predictive phase helps to map past and present facts recorded in data into the future.

Optimization attempts to make the best possible decisions for the future under the given conditions or to make the best possible and adaptable assumptions.

Prescriptive Analytics is established at Softwarepark Hagenberg

Softwarepark Hagenberg (SWPH) is ideally positioned for Prescriptive Analytics; it has been conducting research in individual scientific disciplines for many years, which are all brought together in the field of Prescriptive Analytics. The institutes of the Johannes Kepler University represented in the SWPH, such as RISC, FLLL and FAW, as well as the University of Applied Sciences, SCCH and RISC Software GmbH are strong research units that expand their knowledge in individual and joint projects and apply this knowledge together with industrial partners. The combination of these research and development facilities is unique. Collaboration within Softwarepark Hagenberg often takes place within the framework of larger research projects such as FFG COMET projects/centres, Josef Ressel Centres or Christian Doppler laboratories. Together with companies, medium-term research topics are also defined and applied in other programmes:

- FFG production, mobility and ICT of the future
- FFG Basic Programme and FFG Bridge Projects
- Cluster Projects
- Other funding programmes with the participation of the Upper Austrian government

A special element of these grant systems is the transfer within the companies, while Softwarepark Hagenberg, as a technology supplier, does not provide essential stimuli for Upper Austria alone.

A serious and comprehensive treatment of Prescriptive Analytics is only possible if it builds on the descriptive, diagnostic and predictive phases. It's only thanks to the interplay between the wealth of methodological skills of the Hagenberg institutions that makes it possible

DESCRIPTIVE ANALYTICS
What happened?

DIAGNOSTIC ANALYTICS
Why did it happen?

PREDICTIVE ANALYTICS
What will happen?

PRESCRIPTIVE ANALYTICS
What should I do?

PRESCRIPTIVE ANALYTICS AT SOFTWAREPARK HAGENBERG
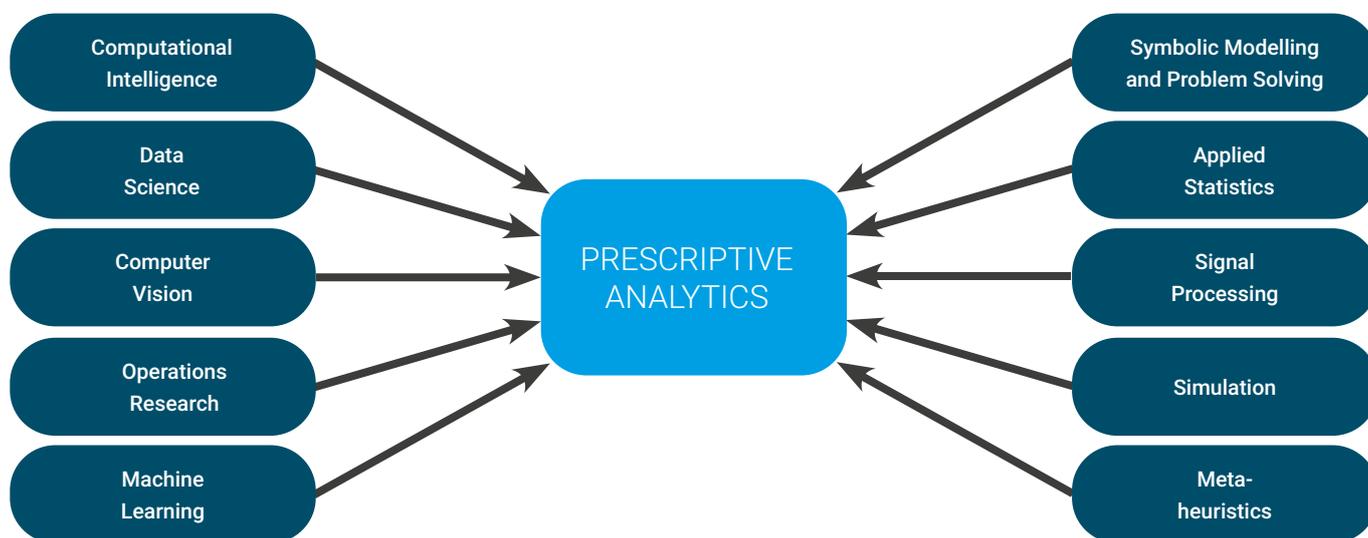
to work on Prescriptive Analytics to the necessary breadth and depth. Softwarepark Hagenberg is the go-to partner for the economy:

- **Machine Learning**: FH Research groups and study programmes, SCCH, RISC Software, Dynatrace
- **Operations Research**: RISC Software, FH Research group HEAL
- **Computer Vision**: FH Research groups and study programmes, SCCH
- **Data Science**: SCCH, FAW, FLLL, FH Research groups and study programmes
- **Computational Intelligence**: FH Research groups and study programmes, FLLL, SCCH
- **Symbolic Modelling and Problem Solving**: RISC Institute, FH Research groups HEAL
- **Applied Statistics**: FH Research groups and study programmes, across all research institutions
- **Signal Processing**: FH Research groups and study programmes
- **Simulation**: RISC Software, FH Research groups
- **Metaheuristics**: FH Research group HEAL, RISC Software, FLLL

The following potentials and possibilities result from the expertise distributed throughout the Softwarepark Hagenberg institutions:

- The combination and integration of artificial intelligence (AI) and machine learning (ML) technologies with modelling, simulation and optimization in the context of Prescriptive Analytics provide **solutions that are essential for the Upper Austrian economic region with its strong production and plant manufacturing companies** in order to maintain core strengths and to develop and build competitive advantages.

- The **established expertise of the university and external R&D facilities and educational institutions** cover the most important areas of the topics which contribute to business and Prescriptive Analytics very well. By combining the expertise available at Softwarepark Hagenberg, it is possible to present the wide range of content of the interdisciplinary theme that Prescriptive Analytics comprises without having to forego depth of content.
- Much competence in the field of industrial and practical AI and operations research in the sense of Prescriptive Analytics has been already established at SWPH, often in cooperation with large and leading Austrian companies such as voestalpine, Miba, Primetals, Rosenbauer and AVL.
- Due to the interlocking nature of research, education and business at SWPH and the close cooperation with resident research partners, established software companies **are able to grow the prototypes developed in research projects** into mature products and ensure their subsequent maintenance. While large companies tend to perform these tasks in their own IT departments, in terms of sustainable use, **this aspect is particularly important for SMEs.**

contact ◢

FH-Prof. Priv.-Doz. DI Dr. Michael Affenzeller
Scientific Head
Softwarepark Hagenberg
www.softwarepark-hagenberg.com
office@softwarepark-hagenberg.com

Expert interview with Univ.-Prof. Dr. Karl Dörner, University of Vienna

Prescriptive Analytics – optimization meets data science

What exactly is meant by "Prescriptive Analytics"?

In (business) analytics we distinguish more or less between three different levels: descriptive, predictive and Prescriptive Analytics. Sometimes there's an additional level of diagnostic analytics between descriptive and predictive analytics.

Regardless of how Prescriptive Analytics is defined, I cannot recall ever having such intense discussions about the terminology and content of various disciplines, as have been triggered by the availability of such large amounts of data. Strategy meetings and retreats are held to define the terms data science, analytics, machine learning through to artificial intelligence – demarcations are made and then thrown back over the edge. A superb article by Mortenson et al., 2016 tries to create a better understanding of the different definitions here (https://doi.org/10.1016/j.ejor.2014.08.029).

In 2007, Davenport and Harris defined analytics as follows: The intensive use of data by statistical analysis and forecasting models and fact-based bases to make decisions. The results of analytics then form the basis for human decisions or completely autonomous decisions. Bartlett (2013) defined analytics as part of Business Intelligence = Analytics + Information Technology.

Can you illustrate this in more detail by way of an example?

I spend most of my time dealing with distribution logistics. An essential aspect of analytics is combining data with decision models. In parcel logistics, that would mean factoring in past and real-time information about travel times, and possibly even when the recipient is available or whether they are at home or not. Prescriptive Analytics even goes so far as to consider not only current and past traffic situations but also what effects the plans have on the future traffic situation. The reasoning behind this is that if all navigation systems let drivers take a different route because of traffic jams, then there will soon be a traffic jam on the alternative route. And it's exactly this interaction of data and decision models which is crucial in Prescriptive Analytics.

From descriptive to diagnostic, from predictive to prescriptive. Can you explain this process in more detail?

At this point, this question reminds me of the industrial revolution's stages of development up to the fourth industrial revolution. Everyone knew the pictures from the first assembly line in the Cincinnati slaughterhouses for the 2nd industrial revolution. It's the same with lectures on analytics – everyone knows the slide with the four phases. This is also the case in the first article in the first issue of the Journal of Business Analytics. Descriptive analytics is essentially the analysis of the existing (what happened?), then the next step could be the analysis (why did it happen?), this step is very often called diagnostic analytics. If you want to draw conclusions about the future on the basis of all this historical information, you talk about predictive analytics. All these stages are limited to the information and analysis of existing data. However, if a decision model is also used for the solution on the basis of the prediction – then nowadays you talk about Prescriptive Analytics. Supporting decisions using real data to the point where considering decisions based on future data is called Prescriptive Analytics.

What methodology does Prescriptive Analytics use and in which areas can it be applied?

The toolbox of methods is versatile. For decision support systems this comprises various optimization techniques, exact, heuristic, metaheuristic, simulation, simulation-based optimization. For data analysis, the well-known data mining and machine learning procedures and methods, but also classical statistical procedures.

What are the challenges before Prescriptive Analytics methods can be used effectively?

How do we find new interesting information in the newly collected large amounts of data (Big Data), how can the new amounts of data be processed sensibly? This may also require new hardware or special parallel architectures. How can a massive amount of data be analysed sensibly? Can we apply the traditional statistical approach to this data, formulate hypotheses and then test them? What are meaningful levels of significance? There is also a lot of unstructured data. How can we integrate this heterogeneous data, for instance by analysing text messages and integrating them into numerical data?

To make all the dynamic problems manageable in real time, we equally need efficient hardware and software to process this dynamically available data in real time.

Data visualisation is also a buzzword in the analytics age, possibly to develop a better understanding and thus better understand the solutions.

How well do individual scientific disciplines work together?

That's actually always quite difficult. Even if you take two very related disciplines such as computer science and operations research/management science, which both have a quantitative foundation. These disciplines have their own vocabulary, use similar things, but describe them differently. The disciplines in themselves also have different traditions in terms of publishing strategy. Computer science also publishes inter-

esting and new ideas in conference papers, on the other hand in operations research/ management science you can assume that good and novel concepts are only published in journals. Therefore it's more difficult to find out the current status in these interdisciplinary topics.

What are you currently researching in Prescriptive Analytics? Are there any current projects that you could briefly outline?

We're applying the topic in several areas – one of them is Industry 4.0 and the use of collaborative robots (Cobots) in production. Can failures be predicted on the basis of log data or machine data? Can quality problems or deviations from the production process be detected early? We are developing solution methods for this purpose which integrate these predictions into the stage when production is still being planned.

Another focus is the various route planning problems that are interlinked with inventory management. In Smart Cities we assume that the stock levels of dealers but also of households are continuously recorded and that there are automatic replenishment actions, the same applies to waste disposal and snow removal and service logistics – street cleaning. How can demand be predicted, how can customer behaviour be predicted? When does one household need a supply of baby nappies or another household need a drinks delivery?

Why is Prescriptive Analytics so interesting for entrepreneurs and researchers?

Decision support has always been very valuable for decision makers. The decision-making situations are becoming increasingly complex. That's why decision support systems that can handle these complex data are becoming more and more important. For science, the interaction between data science and optimization is still

an area that has not yet been sufficiently researched.

How can Prescriptive Analytics help us not only to predict the future more accurately, but to actively shape it too?

This point is already included in Prescriptive Analytics, it is included in the orientation for the future. What is increasingly becoming our problem, however, is that the methods are so complex that it's no longer possible to say exactly why, what decision has been taken. If we can no longer make progress with the theoretical knowledge or with the theoretical foundation, we should at least make sure that we understand the solutions. The buzzword "explainable" is flying around at the moment and that is dominating the discussion about future development. It is also important to understand why the methods have arrived at these decisions. If you reach the limits of theory, you try to find an explanation with visualisation techniques.

How does IT have to evolve in order to realise the full potential of Prescriptive Analytics?

In my opinion, high performance computing and the parallel processing of data in real time is the big challenge. What's more, the procedures and algorithms must be parallelised. Mining mass data or providing decision support for highly complex problems is challenging. Making real-time information available without delay – and providing an analysis of the real information.

What is the potential of Prescriptive Analytics? What developments can we expect in the field of Prescriptive Analytics in the future?

Of course you have to be careful in this regard too. I don't want to predict this for the whole industry, but the control of autonomous vehicles in the city may become more

efficient, the concepts of sales-oriented inventory management, service logistics – rubbish collection will not use streets where there are frequently traffic jams, some areas will become safer with less traffic.

But you also have to be careful not to get carried away. Just because we collect data everywhere nowadays, we won't be able to read everything from this data. The entrepreneurial skill to make the right decisions at the right time will continue to dominate in companies. However, it is expected that current advancements will provide a sound basis for decision-making.

Univ.-Prof. Dr. Karl Dörner
Karl Dörner is Professor of Business Administration at the University of Vienna. His research focuses on the development of decision support systems for complex problems in production, logistics and supply chain management.

bda.univie.ac.at

Study to capture the future now

At Softwarepark Hagenberg, FH Upper Austria researchers have developed expertise in the groundbreaking technique called "Prescriptive Analytics". Their know-how is also enhancing a range of courses on offer for students.

Hagenberg researchers combine the possibilities of artificial intelligence with simulation and optimization to look into the future. And they can derive recommended courses of action for the real world. This not only benefits science and business but also the students at the Hagenberg campus of the University of Applied Sciences Upper Austria.

Such praxis-oriented knowledge is also among the range of specialist areas campus researchers are imparting to students and is firmly anchored in the curriculum of the Software Engineering, Data Science and Engineering, Information Engineering and Management, and Human-Centered Computing Master's programmes.

They explore everything from simulating the soft landing for Neil Armstrong aboard the lunar landing module to modelling an action plan to tackle a global pandemic. These are among the real-world applications worked on in the study programmes at the Faculty of Computer Science, Communications and Media.

FH-Prof. DI Dr. Gabriel Kronberger contributes his expertise in machine learning and data mining. Photo: FH OÖ

Modelling A-Z : from the moon landing to the spread of disease

Dr. Stephan Winkler, head of the bioinformatics research group, says: "We model fundamental dynamic processes in technology, economics, biology etc., mathematically." In practical exercises, his students also follow in the footsteps of Neil Armstrong, the first man on the moon. They use artificial intelligence to simulate the landing of a space shuttle on the moon and automatically optimize the braking parameters with an evolutionary algorithm so that the impact is as gentle as possible.

The importance of simulation for biology is also being currently demonstrated by the corona pandemic. "We model and simulate the spread of pathogens such as the corona virus mathematically," says Dr. Winkler. "We calculate critical vaccination rates and how many will become infected in the long term if not enough people are vaccinated. From this we can derive recommendations for action, and support the health authorities with important data and tools."

Machine learning and data mining: carving out success in business

Dr. Gabriel Kronberger, a key FH researcher, also shares his expertise with young IT professionals. As head of the Josef Ressel Centre for Symbolic Regression, Dr. Kronberger is involved in the development of Prescriptive Analytics algorithms that can be used to make drive trains more efficient and environmentally friendly, and in the wider field of practical applications, to optimize, for example, plastics recycling plants. He imparts his expertise in data warehousing, data mining, business intelligence and

FH Professor PD DI Dr. Stephan Winkler and his students model the spread of pathogens such as the corona virus. Photo: FH OÖ

methods of machine learning to students of the part-time Master's degree in Information Engineering and Management (IEM). "Students learn how to determine recognisable correlations in the data through mathematical models," says Dr. Kronberger.

The principles of artificial neural networks and evolutionary algorithms are also on the agenda on the IEM programme. Students get hands-on experience through exercises in the lab, where they work on practical tasks from the field of Prescriptive Analytics using various software tools. Research and praxis-oriented teaching and learning is clearly not only a basic principle of academic training, but a practice deeply imbued in the didactic culture of Hagenberg.

contact ◢

FH OÖ Campus Hagenberg
www.fh-ooe.at/campus-hagenberg

Josef Ressel Centre for Adaptive Optimization in Dynamic Environments

Smart optimization in production and logistics

At the Josef Ressel Centre for Adaptive Optimization in Dynamic Environments (adaptOp) run by the HEAL research group, optimization algorithms to control dynamic production and logistics processes – for example in the manufacture of steel or flat glass – are being researched that can continuously learn, adapt to changes and act with foresight.

Optimization problems in the areas of storage, production and intralogistics arise, for example, in controlling cranes, transport vehicles or production lines. In view of the advancing digitalisation in production and internal logistics, the use of computer-aided and simulation-based optimization models for process control is an important research area that belongs to the domain of Prescriptive Analytics.

When controlling production and logistics processes, dynamic events within the planning horizon must be continuously taken into account. To this end, the Josef Ressel Centre adaptOp is researching proactive and adaptive optimization methods that are able to continuously monitor and react to change events as well as predict future events and adapt over time. By combining heuristic algorithms and machine learning, optimization procedures can be developed which optimally assist process owners with customised and comprehensible recommendations for action.

Besides developing a software environment for adaptive optimization procedures, other key milestones include forming new dynamic problem models and defining suitable benchmarks. Furthermore, machine learning methods are used as an integral part of solution processes to predict future events, develop potential future scenarios and automatically select and parameterise appropriate optimization algorithms. The performance of the developed methods is ultimately examined through simulation experiments and is evaluated under realistic conditions with partner companies.

Collaborators of the Josef Ressel Centre adaptOp – which is located on the Hagenberg campus of the University of Applied Sciences Upper Austria – include the University of Applied Sciences Upper Austria, the University of Vienna and the companies voestalpine Stahl GmbH, LogServ GmbH, Industrie-Logistik-Linz GmbH and LiSEC Austria GmbH. The Josef Ressel Centre adaptOp is financially supported by the Federal Ministry for Digital and Economic Affairs and the National Foundation for Research, Technology and Development.

contact ◢

Josef Ressel Centre adaptOp
www.adaptop.at
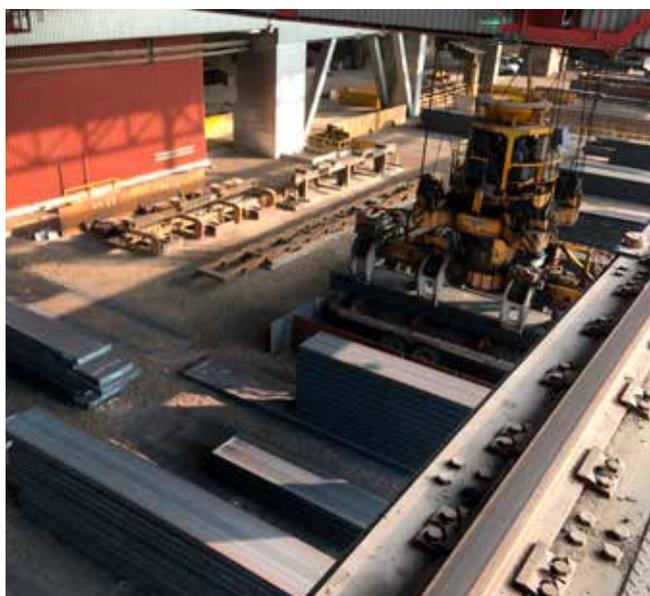
The Josef Ressel Centre adaptOp team at FH OÖ Campus Hagenberg.
Photo: Petra Wiesinger

Adaptive optimization methods improve the efficiency of cranes in the production of steel slabs.
Photo: Flößholzer/voestalpine Stahl GmbH

Dr. Bernhard Freudenthaler: "We make production smarter." Photo: SCCH

Smart transformer production

"At the Software Competence Center Hagenberg (SCCH) we deal with deep learning, forecasting models, machine learning, predictive maintenance and also Prescriptive Analytics in the data science field," explains Dr. Bernhard Freudenthaler, who heads the data science area. A research project regarding Prescriptive Analytics was been carried out in collaboration with SIEMENS TRANSFORMERS Austria. "Transformers consist of many superimposed metal sheets which are cut from coils and this poses a challenge. Additionally, the properties of the input material influence the transformers' characteristics, such as power loss and noise. Choosing the right sheet metal is therefore crucial. Last but not least, SIEMENS TRANSFORMERS AUSTRIA wants to produce little waste and buy the metal sheets as cheaply as possible," says Freudenthaler. The SCCH researchers solved the task by combining production optimization and automated software documentation.

Making hidden knowledge visible

The calculation of transformers is complex and often based on C++ or FORTRAN. This software contains the core domain-specific expertise of the engineers. With the tool developed by SCCH, the expert knowledge available in the software will be transferred into a technical documentation. This documentation contains the mathematical formulas for calculating the transformers and is therefore used to verify the correct calculation. However, the formulas are also used for the next step, the optimization of the production.

AI gives recommendations for production

The AI analyses the measurement data of the produced transformers and compares them with the pre-calculated data. As knowledge grows with production experience, the prediction of transformer properties and the parameterization of the calculation model – which includes material usage, cutting plan optimization and selection of sheet metal qualities – is improved. In this way, key figures such as power loss,

Smart production processes in transformer manufacturing. Photo: UAR/Kirchner

noise development and machine set-up times can be optimized. An additional plus point is that the transformer calculation's acceptance documentation is automatically generated. The H2020 project COGNIPLANT, in which an innovative approach to digitalization and intelligent management in the process industry will be developed, is also pointing the way forward.

About the Software Competence Center Hagenberg

Software Competence Center Hagenberg (SCCH) is a non-university research center that has been driving excellence in applied research in the fields of data science and software science for over 20 years. This focus enables optimal implementation of projects in the fields of digitalization, industry 4.0 (the smart factory) and artificial intelligence. SCCH serves as an interface between international research and domestic industry. The COMET (Competence Centers for Excellent Technologies) K1-Center is funded by the ministries BMDW (Federal Ministry for Digital and Economic Affairs) and BMK (Federal Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology) and by the province of Upper Austria. COMET is managed by FFG (Austrian Research Promotion Agency).

contact ◣

Software Competence Center Hagenberg GmbH (SCCH)
www.scch.at

Machines that automatically optimize themselves

Shaping the future with data

As in all fields, artificial intelligence will also significantly influence production in the future. The foundation for this will be fully automated analysis procedures that use machine data to predict future events and immediately link them to the necessary measures. Several research teams at STIWA Group are working on this last phase of data analysis: Prescriptive Analytics.

An interview with Martin Schwarzenberger, Head of Advanced Analytics at STIWA in Hagenberg.

What does the Advanced Analytics division at STIWA Group represent?
We see ourselves as a competence centre for machine analysis, we bundle the existing analysis expertise of the STIWA Group, continuously improve our methods and offer these services to our existing and new customers.

Can you provide a more in-depth explanation?
STIWA started recording machine data back in the early 90s. As a result we now have very detailed data records. We utilise procedures such as machine learning, correlations, bottleneck or data science methods to filter out weak points and abnormalities and to show optimization potential for our customers' machines and plants. One of our major advantages is the combination of machine manufacturer, machine operator, software producer and system integrator in one company. This enables us to directly link analysis data with expert insights from data science and machine operation, allowing us to make predictions for the future. Our aim is to further automate these methods and to pour our expertise into our software and tools so that they can be used across the board for all plants.

We're thus advancing towards fully automated analysis procedures. What are the future challenges as regards implementing Prescriptive Analytics in production?
Challenges exist at several levels. Consequently, we're working on storing this extensive material of raw data even more efficiently, which would enable us to get even more out of this data. Further development efforts are also required to convert expert knowledge or intuitive experience into software and to standardise it to the point where it can be used for STIWA machines worldwide. We have the best conditions here at STIWA and our research teams are dedicated to working on this. At the same time, we also rely on cooperation with universities in the artificial intelligence field to keep our finger on the pulse of new technologies and processes, which are currently developing at a rapid pace. However, the factor of cost plays an essential role in advancing what is possible: Affordable solutions are needed so that fully automated processes can be used across the board.

DI (FH) Martin Schwarzenberger, Head of Advanced Analytics at STIWA Automation GmbH. Photo: STIWA Group

contact ◣

STIWA Group
www.stiwa.com

**Development is moving towards fully automated analysis procedures (Prescriptive Analytics).** Photos: STIWA Group

JKU institutes at Softwarepark Hagenberg
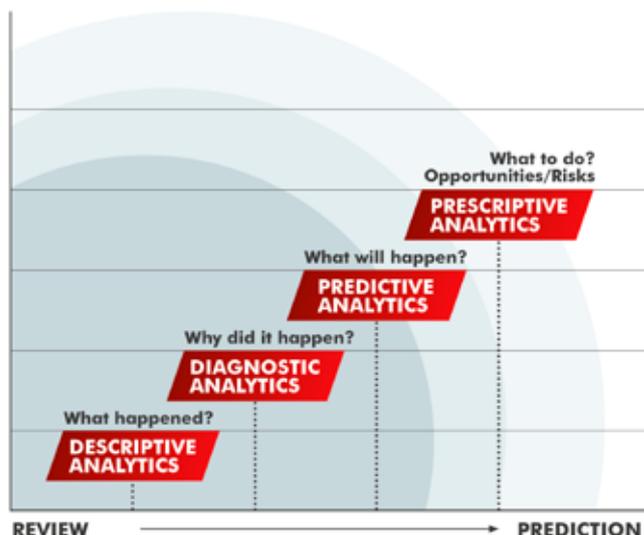
Photo: Sara Aschauer

The Research Institute for Symbolic Computation (RISC) conducts fundamental research in the algorithmisation of mathematics. Activities that were previously thought to be reserved for mathematicians will be made accessible to computer processing. Examples of this include mathematical modelling and automated proving of mathematical theorems.

We see various connections to Prescriptive Analytics. For instance, computer-powered symbolic calculation methods can be utilised to assist formula manipulations, which are required in Prescriptive Analytics to derive calculation and description models. Another example is logical reasoning, where reasoning chains can be "continued into the future" based on a current status in order to gain insights into future events. Automatic proof methods with human-readable output, such as those developed at RISC, can thus not only depict future scenarios, but also explain how and why this happens.

Data, information, knowledge and, more recently, machine learning are major topics at the **Institute for Application-oriented Knowledge Processing (FAW).** These are all essential ingredients for developing efficient and Prescriptive Analytics.

More specifically, the institute scientifically investigates quality issues and quality improvements at all levels. Other ongoing research topics include graph-based approaches for storing and managing information and knowledge. Moreover, a recent change in leadership has further sharpened the expertise in computational data analytics, machine learning and data mining.

Last but not least, security and privacy aspects must not be neglected either. FAW is active here as well, on the one hand in the area of access control, on the other hand in the area of data and knowledge anonymization.

At the **Institute of Knowledge-Based Mathematical Systems (FLLL)** research into techniques and methods for realizing predictive and prescriptive maintenance in industrial processes is being conducted. An emphasis is placed on the early detection of anomalies indicating actual errors or (later) machine or system failures, the prediction of different quality measures monitoring processes, as well as reactions to a detected undesired or problematic system status. For realizing these steps models serving as error-free references or providing predictive forecasts are essential. Such models are built on the basis of measurement data and time series signals of the respective process by involving machine learning methods, in particular (evolving) fuzzy systems. Ongoing model adaption ensures that intended (regular) system changes are integrated and reflected in the current model. The application of multi-criteria optimization procedures aims at deriving proposals for further developments and response measures.

contact ◢

Research Institute for Symbolic Computation (JKU)
www.risc.jku.at

contact ◢

Institute for Application-oriented Knowledge Processing (JKU)
www.faw.jku.at

contact ◢

Department of Knowledge-Based Mathematical Systems (JKU)
www.flll.jku.at

Decision support at the push of a button?

How solutions for the future can be created from analyses of the past and knowledge of the present

When using artificial intelligence (AI) to generate added value in industrial applications, important points must be taken into account as early as the drafting stage. Purely data-based AI systems lack an understanding of the underlying physical and technological processes and require vast amounts of training data, which must consist of classified examples. This training data must cover all critical situations and problems, though such data is often not available because it is still unknown. Owing to their practical experience and logical conclusions, human experts don't need this informa-

tion. A similar approach is also applied to AI systems: The system learns during operation with the involvement of the technical experts. Methods of machine learning are combined with knowledge-based systems for this purpose. Independent decision making is achieved through a model-based approach, which is controlled by the experts.

RISC Software GmbH has already implemented this approach in numerous projects from research and practice: Umändern auf: The virtual production assistant AnnaLyze (www.risc-software.

at/annalyze) assists experts by bringing together all the knowledge gained from production, processes, configuration, orders and tools of all machines. New knowledge is then generated using data and visual analytics to derive cause-and-effect relationships. This leads to reductions in downtime, or increases productivity.

contact ◢

RISC Software GmbH
www.risc-software.at

InfoSec Conference made in Hagenberg

The aim of the Hagenberger Kreis is to promote public awareness about information security, through events like the Security Forum. Experts can share their know-how, exchange information and network. The event is especially designed for an audience who wants to learn more about information security. The main features of information security are the three protection goals: integrity, confidentiality and availability.

- **Integrity** – no unnoticed modification of your data
- **Confidentiality** – only authorised persons may view or modify your data
- **Availability** – your data should be accessible at any time

The media reports frequently on "Artificial Intelligence" and "Big Data" as well as cyber attacks on large companies. To counter these attacks, "Prescriptive Analytics" at-

tempts to find out how different approaches affect a result. As this is a dynamic approach, it generates a lot of data. These data sets usually become so large that human analysis is often no longer possible or there simply is not sufficient time to do so. In terms of incident handling, a combination of "Prescriptive Analytics" and artificial intelligence could open new doors to find the most promising approach. Put another way, conclusions about current or future situations are drawn from past scenarios so that a timely approach to cope with them can be found.

The Security Forum also holds lectures on artificial intelligence. Gain an edge in your knowledge of current events and developments in the security sector. The Hagenberger Kreis looks forward to seeing you at the upcoming Security Forum at the University of Applied Sciences Upper Austria in October 2021. On both days of the event, national and international representatives from industry, research and public administration will hold technical and management talks.

Details about the event can be found at www.securityforum.at.

contact ◢

Hagenberger Kreis for the promotion of digital security - Security Forum
E-Mail: info@securityforum.at

25 years of computer security

From Upper Austria to Silicon Valley

Successful Upper Austrians abroad. A report by Gerhard Eschelbeck, Professor of Vision and former Vice-President of IT-Security at Google

Photo: Eschelbeck

My years at the local university were marked by the introduction of the first personal computers, no computer security was non-existent. Only when viruses paralysed computers did I have to deal with them, and I think computer security found me that way. Secure computers were not seen as important or necessary 25 years ago and back then I was one of the few. Today I am one of the many. My work in information security is as exciting and interesting now as it was on the first day. Back then, computer security was a mission, today it is an absolute necessity. We use smartphones, we have GPS in our cars, we pay using apps. Our technology covers many areas of modern life and these systems must function reliably and be protected.

Computer security was not only a new area of research and work but was also my springboard into the international business world. As an assistant I founded a start-up together with students in Linz, long before the word start-up existed. Our savings were our venture capital and the foundation of the first company was a vision on a student budget. We were a good team with a good idea, but no experience. Albert Einstein's words couldn't be more fitting: "Anyone who has never made a mistake has never tried anything new." The start-up was later taken over by the US anti-virus manufacturer McAfee, and McAfee then brought me to Silicon Valley in California.

Life in Silicon Valley is pretty straightforward, the workdays are long though. Although my family and I miss Austria and Austrian food, what was planned to be 6 months have now become more than 20 years and Silicon Valley has become our second home. We have many American, Austrian and international

friends, and with more than 300 days of sunshine a year when I do have a little free time there is plenty to do. The sea is 30 minutes away, the mountains can be reached in three hours. The valley is a melting pot of different cultures and the best minds in the world – including many Austrians – and with top universities such as Stanford and Berkeley, it's an incubator of ideas too. The demands, expectations and the competition are very high and are well rewarded.

Over the last 25 years I have been able to build companies from scratch as well as lead security teams of 1000 employees in the world's largest companies such as Google. No single person can solve computer security alone. I've always worked with great teams and top experts, and today the task is to protect the data in the world's largest data centres, coordinate security for billions of users worldwide and create environments where teams can be successful and motivated.

My next personal goal is to mentor start-up founders, especially start-ups from Austria or start-ups of former employees. I'd also like to encourage people to choose careers in information technology, as IT represents a great opportunity for the future. I am always pleased to meet Upper Austrians who have the courage to help shape these new and future-oriented areas on an international level.
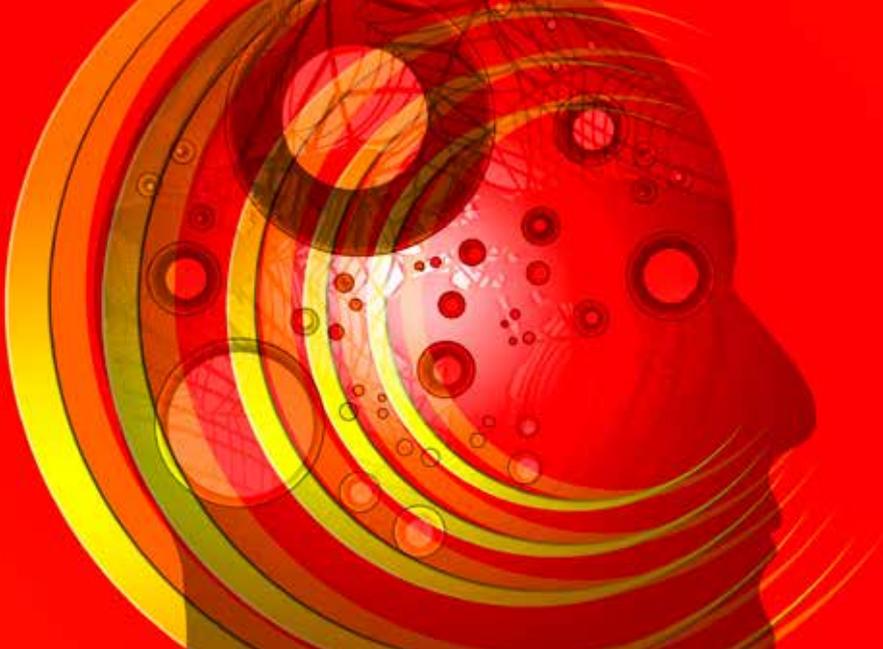
Getting an edge in information security through e-learning

IT security training in the workplace

Information security lives through training and awareness

Information security forms the basis for competitiveness for every company and is essential to long-term success. The constant threats posed by malware, blackmail trojans, banking fraud, social engineering attacks etc. are not the only driving forces behind information security; for companies compliance also plays an essential role. Almost daily media report on hacker attacks, data theft or unauthorized publication of secret company information. Many of the prominent media cases of this kind relate to large, international companies, but in reality hundreds of information security incidents occur every day, regardless of size or business area - mostly undetected and hidden, sometimes unintentionally within the company's own ranks. Many companies have implemented technical and organisational information security measures (TOMs) since the GDPR was put into effect. However, in order for these measures to be understood and followed by the employees, it is necessary to keep employees up-to-date through regular training and steps to raise awareness. At the same time, for the company management itself, knowing that employees are learning is an important component of risk minimisation.

Training costs time, and time is money

Working around regular training sessions is a real challenge for many companies: there's the time lost on travelling to and from the course, the interruptions to the workday, and the often part-time/working hours of traditional training schedules with seminars and lectures. Written tests to ensure that the knowledge is sinking in also create additional administrative work and, in the case of small refresher courses on individual topics, classical training formats are unsuitable because they are inefficient. This has a knock-on effect on the onboarding process in many companies; new employees are simply given an information security guide or are informed of the IT rules and no further action is taken. It is rare to find subsequent updates on the company intranet, which are sent out by e-mail but which are often ignored by the employees.

Modern forms of information security training

A crucial factor for effectively disseminating knowledge and constantly raising awareness of IT security is to minimise the time the company and its staff lose when attending training courses. To this end, the content must be conveyed in compact units with a clear thematic focus so that it is possible to take courses away from typical working hours or even on mobile devices. It should also be possible to share new content at any time and verify whether the training is successful. Modern e-learning-based systems with modular content structure and electronic knowledge checks are ideally suited for this purpose and can be accessed at any time, updated quickly and used cost-effectively regardless of company size. Through modern implementation methods ("flash free", HTML5), e-learning content can also be used across technologies, e.g. on smart displays in waiting areas.

Competent implementation of IT security e-learning

UNINET offers a selection of standardised IT Security/Information Security/GDPR trainings, where customer-specific adaptations are simple and cost-effective. E-learning-based IT security training requires professional content preparation and delivery. The UNINET team includes several full-time and part-time lecturers who teach IT security/information security at the FH OÖ Campus Hagenberg, and who have many years of teaching experience using e-learning platforms and a broad spectrum experience gained from ICT/IT security/information security projects. The UNINET team is made up of professionals trained in their fields who ensure that the e-learning modules are properly delivered. The course modules come with a flexible licensing model for operation at the customer's location. Alternatively, customers can also use the e-learning platform operated by UNINET in Austria/EU which features a full-service help desk.

contact ◢

UNINET it-consulting GmbH
www.uninet.at

Women in technology

Woman power at Softwarepark

Female technicians in the spotlight at Softwarepark Hagenberg! We're strengthening and networking women in technology through the "Successful Women" campaign. We introduce strong women, their careers and current projects in "4232", the Softwarepark Hagenberg magazine.

Photo: Sara Aschauer

How did your career lead to your current position in IT and technology? Have these areas always excited you?

I have always been fascinated by IT and business administration, and the inevitable connection between these two worlds. After graduating from high school with an emphasis on these two fields, I worked in the IT department of a corporation. I then studied business sciences at JKU Linz, including a major in production and logistics management. The course contents not only provided us with a qualitative management approach to this field. We were also shown how practical problems can be solved using intelligent, computer-assisted algorithms - how they can be explored in the associated field of operations research (OR) and implemented sensibly as a manager. After graduating, I was head of logistics and administration of an Upper Austrian production company. However, the interest in research and a doctoral thesis in this field never left me. It became increasingly clear to me that my thirst for academic knowledge was far from being satisfied. As part of the research group HEAL, I can do both. I investigate new OR solution methods and received excellent support during my doctoral studies.

What exciting projects are you currently working on?

I am currently working on online optimization problems as part of Prescriptive Analytics, i.e. solving real-time problems and providing the industry with appropriate recommendations for action. If, for example, an intermediate storage facility suddenly breaks down during the production process, a new solution has to be proposed within the shortest possible time. This solution has to provide a different storage location for the produced goods, taking into account the product quality and the duration of the relocation. In addition, I teach operations re-

search and work on my favorite topic - integrated logistics optimization. This summer, I also completed my dissertation in this exciting field of research.

What advice would you give to young women who are interested in IT?

Be more self-confident and courageous – trust in yourself because you are definitely good enough. In my experience, we women often have far too little confidence in ourselves; for example, when it comes to undergoing a technical education or accepting a challenging job offer. Mostly, because we think we are not good enough. The socialization in our society assigns this role to us, especially with regard to technical understanding. I am convinced that this is not true, but that we learn to believe in it from an early age. Several independent studies show that this problem affects (almost) exclusively women – men are for the most part much more self-confident and rightly believe in themselves. We must learn from this self-confidence.

contact ▲

Mag.ᵃ Dr.ⁱⁿ Viktoria Hauder
Heuristic and Evolutionary Algorithms Laboratory (HEAL)
FH OÖ Forschungs- & Entwicklungs GmbH, Hagenberg
heal.heuristiclab.com
viktoria.hauder@fh-hagenberg.at

YOUR 360° SERVICE PROVIDER
FOR ELECTRONIC MODULES

FROM THE IDEA TO SERIES PRODUCTION

We offer our customers a comprehensive service portfolio – from development to design, production, testing and the assembly of electronic modules. Talk to us about your project! Contact us at: **www.technosert.com**

technosert electronic GmbH Angererweg 7 | 4224 Wartberg/Aist, Austria | T: +43(0)7236-20900-0 | info@technosert.com | www.technosert.com

www.grz.at

1500 applications, spread over 10 000 TB of storage, hundreds of server systems and 16 000 end user systems. Sounds cool? Is cool!

Our IT infrastructure provides the basis for the stable payment transactions of the involved banks. We make it possible for more than 1.5 million Austrians to securely do their banking businesses.

event highlights 2021

Give your knowledge the edge!

All events at Softwarepark Hagenberg can be found at
www.softwarepark-hagenberg.com/veranstaltungen

ISM 2021

International Conference on Industry 4.0 and Smart Manufacturing

17- 19 November 2021

www.msc-les.org/ism2021/