Research news
2020 - 2021

A?
Aalto University

**Department of
Computer Science**

Contents

Research News

Humans of Computer Science

Computer Science News

Research News

What prevents us from making the most of the IoT? Aalto researchers developed ways to make IoT truly ubiquitous

For his doctoral dissertation, Óscar Novo Díaz researched the technical challenges that prevent us from using the full potential of the Internet of Things

Research & Studies, published: 27.5.2020

In recent years, the Internet of Things (IoT) has become a reality in our society. It has helped automatize our homes, healthcare, and industrial manufacturing, to mention just a few application areas. In the home environment, this can mean that your energy supplier reads your energy meter automatically, or that you have a security system in your home, which allows you to monitor and manage your property, simply by using a mobile app.

Óscar Novo Díaz, Doctor of Science (in Technology) who recently graduated from Aalto University, says that IoT can be seen as an extension of the Internet, and one of its most essential aspects resides in its ubiquitous nature. IoT devices are broadly available and fully connected to each other and the Internet.

However, one of IoT's main challenges, too, lies in its ubiquitous nature; currently some technical challenges prevent us from making the most of IoT's potential. Óscar Novo recently defended his doctoral dissertation on this topic, and he focused on four specific categories; ubiquitous communication, access control, concurrency control, and ubiquitous semantics.

'Right now, we have protocols for the Internet of Things, but we have to ensure that all those protocols – in terms of security, accessibility, and so on – are totally invisible and work very smoothly, without spending too many resources of the constrained IoT devices,' he explains. By the term constrained, he means that inexpensive devices, such as small sensors, run on batteries and have a relatively low computation power.

The decentralization of IoT, its heterogeneity in terms of protocols, technologies and standards, has created several interoperability questions from the perspective of connectivity, management, and data processing. Many of those challenges are scattered across the various layers of the Internet protocol stack, making it difficult to identify the crucial mechanisms contributing to the cause.

As an important part of his doctoral research work, Óscar Novo and his colleagues developed several solutions that address these problems. Particularly, the researchers implemented an IP-agnostic mechanism that enables

"Right now, we have protocols for the Internet of Things, but we have to ensure that all those protocols – in terms of security, accessibility, and so on – are totally invisible and work very smoothly"

the connectivity and communication of IoT devices behind Network Address Translations. Moreover, they designed and implemented a resource concurrency framework to manage the concurrent access of shared resources in IoT environments.

To improve the current access control situation, they also designed a decentralized access control management system that relies on blockchain technology to control the authorization policy of the IoT devices. Finally, they addressed the problem of semantic interoperability, proposing and implementing a system designed to enable interoperability across heterogeneous semantic IoT domains.

Due to the COVID-19 pandemic, Óscar Novo's public defence took place online. He was physically together in the same lecture hall with the kustos, Professor **Antti Ylä-Jääski**, and the opponent, Professor **Sasu Tarkoma**, but everyone else followed the conference over Zoom. Novo thinks that everything went well and having the conference online had its benefits. 'Normally, public defences are quite heavy and some people may be more interested in the presentation, while others want to hear the discussion with the opponent. Now, people could just join and leave the conference whenever they wanted.'

Professor Ylä-Jääski kept track of the number of participants during the event and he told Novo that, at some point, around 20–30 people were following it online. 'That felt really nice.'

Óscar Novo has been working on the IoT field for years, for which reason it felt natural to select it as his dissertation topic, too. Currently, he is working as a researcher at a private company. 'I would like to move towards another research topic but still stay connected to IoT and use my IoT knowledge. For example, artificial intelligence is a very promising and interesting area of research.'

Óscar Novo Díaz defended his dissertation on 24 April 2020. The title of his dissertation is 'Improving the Ubiquitous Capabilities of the Internet of Things'.

By Anu Haapala

Finns' use of data is growing rapidly and increasing electricity consumption in the entire ICT sector

The use of mobile data is growing fast in Finland, compared to other countries, reveals a recent report.

Research, published: 8.6.2020

IP traffic and data use by the industry and consumers have increased significantly in the last fifteen years. In Finland, the use of fixed data grew seven-fold and the use of mobile data 25-fold during 2011–2017. In the last few years, the growth has slowed down, but researchers believe that the use of fixed and mobile data will keep on growing in the coming years.

The information is revealed by a recent report by Aalto University and ETLA Economic Research (Etla), which was released on Monday, 8 June. In their report, researchers at Aalto and Etla address how the energy and electricity consumption in the ICT sector increased during 2011–2017.

In the last decade, the information sector and software-based applications acquired an increasing role in the everyday lives of humans and organisations. Digital services, mobile applications and software are increasingly utilised in everyday communication as well as companies' operations.

In Finland, the use of mobile data alone increased on average 72 per cent each year in 2011-2017. The share of total data use in Finland is currently at approximately 29 per cent. Its share in relation to fixed network data is growing more rapidly than in the countries under comparison. The phenomenon is explained by two factors: the availability of fixed-price subscriptions with limitless data as well as Finland's strong role as a developer of mobile technologies.

The increasing use of mobile data among consumers has not, however, resulted in growing household electricity consumption but as increased energy consumption in the entire ICT sector. Watching videos on the phone, in other words, does not increase the electricity consumption of just a single consumer but the entire ICT industry. Consumers' use of data services, streaming services in particular, is a factor that has increased IP traffic most significantly.

As states, companies and different types of organisations seek a shift towards a low-carbon economy, the role of the ICT sector is divided. On the one hand, it has been proposed that the ICT sector would seek more efficient energy consumption and form a basis for a greener economy. On the other hand, the growth in the ICT sector's energy use and massive use of rare metals in usable devices has been perceived as a threat to sustainable development.

"In Finland, electricity consumption represents as much as 68.7 per cent of the energy consumption in the entire ICT sector"

In Finland, electricity consumption represents as much as 68.7 per cent of the energy consumption in the entire ICT sector. In 2011-2017, electricity consumption of the ICT sector increased a total of 2.2 per cent annually. Within the ICT sector, the growth has been particularly strong in data processing where the electricity consumption increased by 130.9 per cent. Data processing services include for example data centres, the number of which keeps on increasing in Finland. In 2017, the share of the ICT sector in Finland's entire electricity consumption totalled one per cent.

'The energy and electricity consumption in the ICT sector will form an increasingly significant part of Finland's electricity consumption. While electricity in Finland is a relatively pure form of energy, other energy sources in the ICT industry should also be set on a sustainable basis. During a power cut, for example, reserve power comes from heat and fuels based on fossil fuels that strain the environment,' notes **Timo Seppälä**, Chief Research Scientist at Etla and Professor of Practice at Aalto University.

'Research shows that despite the strong growth of IP traffic and the amount of data the electricity consumption has not increased at an equivalent rate. Instead the relative share of the ICT sector's electricity consumption of the total electricity consumption in European countries seems to be strongly linked to the number of data centers. In other words, in the light of the information that was gathered, the growth in electricity consumption in the ICT sector is strongly focused on data centers, not so much on telecommunications networks,' says **Kari Hiekkanen**, Research Fellow at Aalto University.

The researchers were able to form a good overview of the energy and electricity consumption in the ICT sector using open data from Statistics Finland and Eurostat. Since open statistical data was available in great extent in Finland as well as elsewhere in Europe, they were also able to compare European countries.

The report has been written as part of the Finnish Innovation Fund Sitra's theme of carbon-neutral circular economy and the Digital Disruption of Industry research project, which is funded by the Academy of Finland.

By Anu Haapala

Artificial intelligence produces data synthetically to help treat diseases like COVID-19

The ability to produce data synthetically makes studying of the COVID-19 disease significantly easier.

Data driven technologies and 'big data' are revolutionizing many industries. However, in many areas of research – including health and drug development – there is too little data available due to its sensitive nature and the strict protection of individuals. When data are scarce, the conclusions and predictions made by researchers remain uncertain, and the coronavirus outbreak is one of these situations.

'When a person gets sick, of course, they want to get the best possible care. Then it would be important to have the best possible methods of personalized healthcare available,' says **Samuel Kaski**, Academy Professor and the Director of the Finnish Center for Artificial Intelligence FCAI.

However, developing such methods of personalized healthcare requires a lot of data, which is difficult to obtain because of ethical and privacy issues surrounding the large-scale gathering of personal data. 'For example, I myself would not like to give insurance companies my own genomic information, unless I can decide very precisely what the insurance company will do with the information,' says Professor Kaski.

To solve this issue, researchers at FCAI have developed a new machine learning-based method that can produce research data synthetically. The method can be useful in helping develop better treatments and to understand the COVID-19 disease, as well as in other applications. The researchers recently released an application based on the method that allows academics and companies to share data with each other without compromising the privacy of the individuals involved in the study.

Many industries want to protect their own data so that they do not reveal trade secrets and inventions to their competitors. This is especially true in drug development, which requires lots of financial risk. If pharmaceutical companies could share their data with other companies and researchers without disclosing their own inventions, everyone would benefit.

The ability to produce data synthet-

"I myself would not like to give insurance companies my own genomic information"

ically solves these problems. In their previous study, which is currently being peer-reviewed, FCAI researchers found that synthetic data can be used to draw as reliable statistical conclusions as the original data. It allows researchers to conduct an indefinite number of analyses while keeping the privacy of the individuals involved in the original experiment secure.

The application that was published at the end of June works like this: The researcher enters the original data set into the application, from which the application builds the synthetic dataset. They can then share their data to other researchers and companies in a secure way.

The application was released on the fastest possible schedule so that researchers investigating the Coronavirus pandemic would have access to it as early as possible. Researchers are further improving the application, to make it easier to use and add oth-

er functionality. 'There are still many things we don't know about the new coronavirus: for example, we do not know well enough what the virus causes in the body and what the actual risk factors are. When researchers have synthetic data, we start understanding these things better,' says Kaski.

FCAI researchers are now working on a project in which they use synthetic data to construct a model that, based on certain biomarkers, predicts whether a test subject's coronavirus test is positive or negative. Biomarkers can be for example certain types of molecules, cells, or hormones that indicate a disease.

'The original data set with which we do this has been publicly available.

"To solve this issue, researchers at FCAI have developed a new machine learning-based method that can produce research data synthetically"

Now we are trying to reproduce the results of the original research with the help of synthetic data and build a predictive model from the synthetic data that was achieved in the original research,' explains Joonas Jälkö, doctoral researcher at Aalto University.

By Anu Haapala

6

Sleep apnea is a threat for public health - students developed an application that recognizes its signs at home

The app is currently being tested, and its usability and reliability will be improved based on test users' feedback.

Research, published: 2.7.2020

Sleep apnea is a very common sleep disorder characterised by breathing pauses and periodic snoring. According to some studies, as much as ten percent of the population suffer from it, but up to nine out of ten cases remain undiagnosed because symptoms are sometimes mild and there are a lack of resources in diagnostics. As untreated apnea can cause severe health issues, having simple and inexpensive ways to monitor and screen the disease would be important.

To solve this issue, Finnish computer science students designed an Android application, which helps to identify the signs of sleep apnea at home. Joni Gardemeister, Jonatan von Martens and Sowrov Doha, who study artificial intelligence, machine learning and data science at Aalto University, developed the app in collaboration with Dr. Tapani Salmi, a medical doctor, PhD, and specialist in Clinical Neurophysiology and Sleep Medicine.

The SnoreTracker application, developed by the team, monitors the us-er's snoring through a microphone and the sleeping position using the sensors of a smartphone or smartwatch. The most common clinical form of mild and moderate sleep apnea is position-dependent; the apneas occur mainly when sleeping on the back. If

"Nine out of ten cases remain undiagnosed because symptoms are sometimes mild and there are a lack of resources in diagnostics"

breathing pauses occur while the user is sleeping on their back, the application detects the situation and alerts the sleeper to change position.

'Sensors on smart devices are sensitive and reliable. However, when per-forming a home recording, it is not possible to control that the user performs the measurement under optimal conditions. The accuracy of the apnea alerts has not been yet studied. Fortunately, the application makes it easy to make repeated measurements, which compensates for the situation and increases the reliability of the results,' says Joni Gardemeister, one of the developers.

In the morning, the app forms an overall result of the night's events, giving an idea of the amount of snoring and the number of breathing pauses in different positions. The results are saved in the application, making it easy to track them over a longer period.

SnoreTracker is based entirely on the features of an Android smart device; hence, the user does not need any additional devices. The app is suitable for anyone who suspects they may be suffering from the symptoms of sleep apnea, or who simply wants to follow their sleep. 'It allows you to examine your own snoring, pauses in breathing

and sleeping at home on a low threshold – even if you have no opportunity for actual medical sleep study,' Gardemeister adds.

Diagnosing sleep apnea requires a polysomnography, usually performed only during one night, either at home or in a hospital sleep laboratory. Measuring is laborious and expensive, and in some countries, there are hardly any resources for making such measurements. For these reasons, the app can be of significant help, as it makes it possible to monitor the sleep easily at home.

If someone suspects they have sleep apnea, they should however always contact health care as well. Untreated sleep apnea can cause daytime somnolence, make the person more susceptible to accidents but also cause serious health risks. It increases the risk of health problems such as hypertension, cardiac and neurological diseases.

Sleep apnea is most common in people middle aged and over, and obesity is the major risk factor. As populations age and levels of obesity increase in countries with poor resources for sleep medicine, there is a risk of a sleep apnea epidemic, says Dr. Tapani Salmi.

The application is based on years of research work aimed at identifying breathing disorders and developing algorithms and led by Dr. Salmi. The accuracy of the methods has been studied at Helsinki University Central Hospital and the results have been published in the United States in the Journal of Clinical Sleep Medicine, Salmi says. 'I suppose SnoreTracker is the first project that helps monitor and treat a disease this common with the use of a mobile device,' he notes.

The developers emphasize that SnoreTracker is not a medical device but an application that promotes health, sleep and well-being. However, with the help of feedback collected from users, its usability and reliability can be improved and developed. People interested in the app can presently download the beta version for free from Google Play app store.

By Anu Haapala,
Illustration Matti Ahlgren

How vaping companies exploit Instagram for youth-oriented marketing?
Researchers use artificial intelligence to analyse hundreds of thousands of Instagram posts about vaping

Research, published: 13.7.2020

E-cigarettes are highly addictive nicotine products with unclear health impacts, particularly on youth. Instagram is a visual social media platform which is wildly popular among adolescents. Researchers interested in public health at Aalto University in Finland studied how vaping is represented on the platform. By using artificial intelligence, they were able to analyse hundreds of thousands of posts from a 6-month period last year, and found that a large portion of posts are promoting controversial flavoured e-liquids to young audiences.

The research analyzed Instagram posts shared between June to November 2019 with a caption "#vaping". 'We knew this would be predominantly promotional material,' said Dr. **Aqdas Malik** from the Department of Computer Science who studies social media and user behaviors with a specific interest in online discourse about public health 'but we were interested in what types of images these would be, and who was posting them.' In the end, the research team generated a database of over half a million pictures, which were sorted using a neural network, and subsequently grouped the images into categories representing similar features.

What the neural network showed was that over 40% of the images – the largest proportion out of the 6 categories – were of e-liquids or e-juices. These were predominantly posted by Instagram profiles listed as business accounts. The prominence of posts about e-liquids is interesting from a public health perspective because, although many

> **"By using artificial intelligence, they were able to analyse hundreds of thousands of posts from a 6-month period last year, and found that a large portion of posts are promoting controversial flavoured e-liquids to young audiences."**

e-cigarette brands market themselves as "smoking cessation" devices, it has been shown by other studies that flavoured liquids are strongly linked to adolescent users taking up vaping in the first place. The USA banned the sale of flavoured liquids at the beginning of this year specifically to help tackle the huge growth of teenage vaping, and other countries are looking to do the same.

'While print and broadcast media has clear rules and regulations about what can and cannot be advertised, and what constitutes advertising, we don't see this on social media,' said Dr. Malik. 'I believe we need stricter laws to regulate the visibility of various substances - including vaping products on these networks. Any 12-year-old with a phone can easily create a social media account and bypass the age-rules for seeing what's posted there, and the potential health implications are significant.' 60% of all the posts using the hashtag #vaping were from business accounts. Over 70% of Instagram users are under 35, and over 35% of its users are under 24 years old. 'It's a huge grey area in terms of advertising regulations, especially regarding promotion towards younger audiences' Dr. Malik said.

The research has been published in the International Journal of Medical Informatics, and is available to read online.

By Anu Haapala

Practices identified at Terveyskylä for facilitating the adoption of online health care services

It is important to involve professionals in the fields of information technology and health care as well as patients in the development of services

Research, published: 19.8.2020

The adoption of online health care services has been found very difficult globally: an estimated 45 per cent of services fail on account of resistance from health care professionals. In a study by Aalto University and Terveyskylä that has just been published, numerous factors for facilitating the adoption of the services have been discovered. The information will help in launching new online health care services in the future.

The study focused on the Terveyskylä.fi online service used within specialised Finnish private health care to offers health care related information and support for citizens, along with tools for health care professionals. In addition to virtual houses focusing on different health issues, accessible to everyone, Terveyskylä includes digital care paths for certain patient groups. 'Since there are new digital care paths on the way, we wanted to gather lessons from the first care paths to benefit the later ones,' says Research Fellow and the first writer of the article **Sari Kujala**.

The researchers interviewed employees of the university hospitals of Helsinki, Turku, Oulu, Tampere and Kuopio, inquiring after their experiences regarding the adoption of services. The interviewees were mainly nurses responsible for the adoption of the digital care paths in their place of work. They were selected among different care paths and different hospitals for the purpose of gathering lessons from a range of environments.

Based on the results they gathered, the researchers conclude that when new digital services are introduced in health care, it is essential to include professionals of health care and information technology as well as experts on usability in the design process. Involving patients, which is often considered a difficult feat, is also important.

'If we can involve even the smallest group for testing, for example, the feedback will help us to improve the usability of services. It would also useful to include professionals of user-centered design or service design. They can identify hidden needs that the users are unable to report as well as combine the needs of the different

"It is necessary to recognise that adopting services takes time and resources"

parties into solutions. Patients can be included as part of the treatment on a continuous basis on a small scale, but also in collaboration with patient organisations, thesis workers and researchers,' Kujala says.

The study also states that services and changes related to them must be communicated continuously. Adequate training must be provided to professionals, along with guidance on how to use the services, and any concerns they raise must be taken seriously. User feedback should also be collected and the services tested at all stages in order to enable continuous improvement of the services and to ensure that everyone can understand the services. It is necessary to recognise that adopting services takes time and resources. This is why the adoption should be planned well and not the re-

sponsibility of just one person within an organisation.

'Professionals are motivated by services that make it easier to work – for example, having to enter data only once – as well as help patients. According to the interviewees, interest has been shown towards a digital care path that helps to identify a serious skin symptom from home with the help of the patient sending a photograph,' Kujala says.

Researchers have known for a long time that motivating health care professionals as well as patients to use new online health care services is difficult. 'The introduction of new digital services causes stress in a hectic care work environment, and professionals have not always received enough support in the change.'

Yet digital services do, when functioning properly, help to offer better services and support for professionals in their work. Services also cost Finland a great deal. Therefore, it is important to get professionals as well as patients to use them. Doctors and nurses do not always remember to communicate about the services to their patients. According to Kujala, this would be important: according to research, having a professional recommend services to their patients has a huge impact on the use of the services.

The study is a part of the DigiIN project, which seeks to get all people involved in a digital society by renewing the service culture. The study is funded by the Strategic Research Council (SRC). The research article was recently published in the Journal of Medical Internet Research.

By Anu Haapala

University collaboration brings a scope of new possibilities for Planmeca's business

Comparison of the model segmentation and the ground truth, from the secondary test data annotations, for a CBCT scan. For further explanation, see the research article in Nature Scientific Reports.

Research, published: 2.11.2020

Collaboration between the Finnish Center for Artificial Intelligence FCAI, dental equipment manufacturer Planmeca and Tampere University Hospital (TAYS) will soon make the work of radiologists, mouth and jaw surgeons and dentists easier, in addition to making the treatment of mouth illnesses even safer.

Together with experts from Planmeca and TAYS, researchers at FCAI have developed a method to help locate the nerve canal of the lower jaw, i.e. mandibular canal. This facilitates the placement of teeth implants, for example. A dentist placing a tooth implant must know the exact location of the mandibular canal in order to plan the size and position of the implant and the entire procedure.

Specialised dentist **Jorma Järnstedt** from Tampere University Hospital specialises in radiology and dental, oral and maxillofacial diseases. He reveals that for a hospital radiologist, locating the nerve canal is a routine procedure that must be done for each patient.

Normally the task is very time-consuming, and automating it reliably with the help of artificial intelligence makes the work of healthcare professionals faster and easier, in addition to making the treatment safer. 'An algorithm that is medically proven to be reliable makes the patient's treatment safe while reducing unpleasant, although very rare, surgical injuries,' Järnstedt says.

The benefit of artificial intelligence is that it does the work accurately every time. The new method will be a tool for healthcare professionals, not their replacement. 'The goal of the research work is not to replace radiologists but to create a tool to assist them and make their work faster and more efficient, allowing them to focus on more challenging cases,' says Professor **Kimmo Kaski** from Aalto University.

Planmeca is one of the world's leading companies when it comes to manufacturing dental equipment. For Planmeca, the collaboration means new and significant business opportunities. The company plans to include a new feature in its existing software to ensure that the method will be used by healthcare professionals.

Vesa Mattila, Senior Advisor of

"The new method will be a tool for healthcare professionals, not their replacement"

Medical Imaging at Planmeca Group, has also followed the project with interest. He highlights that the entire collaboration began with the needs of professionals of clinical work. 'At the time, the project had a great chance of succeeding, not just technically and operationally, but also commercially.'

"The industry needs tools such as this one"

Artificial intelligence methods have taken significant leaps in the last years. As for Planmeca, the company has for long been developing technology that is important for the company, 3D X-ray imaging. '3D imaging is the pillar of our business, and we want to utilise it and commercialise the products that have been created using it,' says **Vesa Varjonen**, Vice President of Research and Technology at Planmeca.

The new deep learning method is based on the training of deep neural networks with a dataset consisting of 3D cone beam CT (CBCT) scans. The research results were published in the prestigious Nature Scientific Reports publication in spring 2020.

Based on the results, the model can effectively identify designated structures in images. The method located mandibular canals on a detailed level and was able to beat statistical shape models, which have previously been determined as the best automated method of locating mandibular canals.

It was important for Planmeca that the collaboration involved FCAI, Aalto University and Tampere University Hospital. Scientific publications are almost indispensable to verify the functionality of the method and gain research status. This and the collaboration with Tampere University Hospital helped to gain patient data for research purposes, which is essential in this type of study.

Vesa Mattila points out that because the field of dental care has moved into 3D imaging, the amount of data has jumped significantly. At the same time, there is a need for more radiologists. 'Thus the industry needs tools such as this one.'

All parties are grateful for their collaboration partners. Although collaboration with instances from different fields is always challenging at first, initial problems were quickly overcome. 'In the initial stage, it felt like we weren't speaking the same language, but we are now. This is very important for the project,' Mattila says.

By Anu Haapala

Scientists develop a sound device to allow monkeys living in a Finnish zoo to play sounds and music

The use of sounds is a promising way to improve the life and wellbeing of animals living in captivity

Research, published: 7.10.2020

Sound is a promising way to stimulate zoo animals and increase their welfare, as shown by a study from Aalto University collaborating with Helsinki's Korkeasaari Zoo. Researchers built a device that plays different sounds for a group of white-faced saki monkeys to listen to in their enclosure. They were interested in the saki monkey's behaviour: did they want to use the device, when would they use it, and what would they choose to listen to?

Little is known so far about the sound preferences of primates, so the researchers wanted to choose as varied a soundtrack as possible. The researchers chose to play four different soundtracks, avoiding sounds of animals that prey on sakis, or sudden and loud noises.

The Animal-Computer Interaction research team at Aalto University's Department of Computer Science designed and built a tunnel-shaped sound device of wood and plastic for small monkeys, which was placed in their own residential area in the Amazon House of Korkeasaari Zoo. The monkeys were able to turn the device on themselves and therefore decide to listen to sounds or remain in silence.

'We didn't measure welfare factors, but from a welfare perspective, it was essential to give animals decision-making power and independence. These issues have been linked to well-being in other studies. Instead of just playing music and other sounds in their living environment and seeing how it works, we gave them a system that they could approach and use themselves,' says **Roosa Piitulainen**, the first author of the research paper and doctoral candidate at Aalto University.

The researchers followed how the monkeys used the tunnel for several months. They found that the sakis used the sound system regularly throughout the study and, after the first few days, also began to sleep, groom, and socialize with other monkeys inside the sound device.

Kirsi Pynnönen-Oudman, research coordinator at Korkeasaari Zoo, says that food is often used to enrich the lives of animals in zoos. However, non-food stimuli must also be provided, especially for small animals that are prone to gain weight. 'Sounds are really important to many

> **"Sounds are really important to many animals in their communication with each other. The rainforest is full of different sounds and little monkeys are supposed to be sensitive to different sounds"**

animals in their communication with each other. The rainforest is full of different sounds and little monkeys are supposed to be sensitive to different sounds.'

The fact that animals are so interested in sounds is also reflected in the results of the study. The sakis were allowed to choose how much either calm music, fast-paced electronic music, sounds of rain, silence, or traffic noises they prefer to listen. The sakis preferred the sounds of traffic over all other sounds.

Ilyena Hirskyj-Douglas, postdoctoral researcher at Aalto University, says that the result was both unexpected and expected. 'I've been working with animals for a long time and learned to keep an open mind. However, given that the sound of traffic is so unfamiliar to the sakis and not related to their normal daily life -- unlike, for example, the sound of rain -- it came as a surprise that they were interested in those sounds.'

According to Dr. Hirskyj-Douglas, the result suggests that scientists need to think carefully about what technologies work for animals, keeping an open mind and leaving the human perception at the door.

In addition to influencing what sounds they want to listen to, the white-faced sakis were able to influence the final form of the device. The researchers initially tested two prototypes and built the final sound device from the option that the monkeys used significantly more.

The tunnel-like box with a plywood floor and a transparent acrylic roof was the sakis' favourite. Both materials were already familiar to white-faced sakis, and thanks to the shape and materials of the box, the tunnel acoustics were good without having to completely close the space. The shape and material were suitable for their habitat and to support the species-specific behaviour of the animals.

Dr. Pynnönen-Oudman from Korkeasaari Zoo says that sound stimuli have been used in zoos to some extent, but so far quite little has been tailored to particular species. 'This could very well be the way of the future to stimulate the life of zoo animals.'

By Anu Haapala

New epidemic modelling facilitates assessment of corona strategies

Carried out as a joint project involving Finnish, Swedish and Norwegian researchers, the model also takes into account network structures and human mobility.

Research, published: 13.11.2020

The NordicMathCovid project aims to model corona and future epidemics more extensively than has been previously attempted. It also builds towards long-term cooperation in mathematical modelling and extensive collection of health data.

'One of the purposes of the project is

"Mathematical modelling allows to explore and try to understand the spread of the epidemic and also the question of who should be vaccinated first"

to compare different corona models and scenarios in different countries. For example, we can apply Swedish figures to conditions in Finland and Norway or see what would have happened if Sweden had acted differently,' says Professor Lasse Leskelä from Aalto University.

Traditional epidemic modelling does not take into account the network structure, geographical location or human mobility. Modern network theory provides computational methods for modelling population contact structures, which is needed in order to assess, for example, the contribution of school closures towards slowing down the epidemic.

'We are studying large populations. We do not assume that individuals are associated to each other on an entirely random basis; instead, we apply knowledge about how social networks are usually shaped: some people, such as superspreaders, have more contacts than others. In addition, social networks are clustered, which means that the connections are interlaced,' explains Professor **Mikko Kivelä**.

The large variations in contacts, mobility and social activity in different population groups have a significant impact on the spread of the epidemic and the formation of immunity. In order to understand these phenomena, the project will develop new stochastic models.

Data from different sources

The researchers are utilising an as diverse as possible range of realistic and real-time medical, physical and social data. At the general level, Statistics Finland is providing data related to people's mobility, with telecommunications operators providing more detailed data. Vehicle data can be obtained from road traffic. Local authorities can provide structural data on schools, which provides information on which areas the pupils of different schools are drawn from.

'The data is always stored on the secure servers that belong to its owner or to the CSC IT Center for Science', Le-

skelä explains.

In addition to examining the spread of communicable diseases, the data and models may also be used to compare diverse vaccination strategies.

'Mathematical modelling allows to explore and try to understand the spread of the epidemic and also the question of who should be vaccinated first,' says Professor **Tapio Ala-Nissilä**.

The research can also be used to examine the structure of the infectious disease situation.

'Our research can tell us, for example, how working remotely affects the spread of the disease,' Kivelä explains.

The project is led by Professor **Tom Britton** from the University of Stockholm and includes researchers from Aalto University and the University of Oslo as well as the countries' national health institutes: the Finnish Institute for Health and Welfare (THL), the Public Health Agency of Sweden and the Norwegian Institute of Public Health (NIPH). In addition to the stochastics research group led by Lasse Leskelä, the project also includes Mikko Kivelä's network science research group and Tapio Ala-Nissilä's computational physics research group.

The budget for the two-year project comes in at just under EUR 1 million. The project is funded by NordForsk.

The name of the project is 'Data streams and mathematical modelling pipelines to support preparedness and decision making for COVID-19 and future pandemics'. An objective for the future is to extend the cooperation in mathematical modelling to also include Denmark, Iceland and the Baltic countries.

By Tiina Aulanko-Jokirinne

Towards trustworthy AI and an autonomous Europe

Professor Michela Milano is the Deputy President of EurAI and one the keynote speakers at AI Day 2020

Europe needs to be autonomous in terms of artificial intelligence (AI) and create its own AI technology that respects citizens' privacy, says **Michela Milano**, Professor at the University of Bologna and one of the leading AI researchers in Europe.

The European Commission wants European experts to build AI that people can trust, and according to EU's ethical guidelines, trustful AI is lawful, ethical, and robust. As the Deputy President of European Association for Artificial Intelligence (EurAI), Professor Milano has a central role in this work and she supports the commission in shaping its AI strategies. She leads also the interdepartmental research institute for human-centred artificial intelligence, Alma AI, in Bologna, and in November, she will speak about the European AI strategies at AI Day 2020.

Europe needs to be able to compete against large economies, such as the US and China, in terms of AI. According to Milano, its advantages include the strong university system, the long history in conducting research of top quality, and an industrial ecosystem that includes start-ups, big corporations, and everything in between.

'We have all the components that are needed to create a significant strategy and to really create an autonomous Europe. But there are problems, too: investments and the fact that start-ups can start here but as soon as they become successful, they are bought by Google, Facebook, or another big American player,' Milano notes.

Another significant problem for Europe is brain drain. 'Talents are leaving Europe because they can find better salaries and better conditions outside of Europe. We really need to retain talent. If we have a strategy with an ecosystem that is favourable for them, and for creating start-ups and keeping the start-ups in Europe after they become successful, I believe Europe will have a very important and competitive advantage with respect to other big players.'

Taking privacy issues seriously is crucial. "For example in China, privacy is not considered important at all and personal data are shared and used without any consideration. Europe should keep on taking these values and aspects very carefully into account to make something really different."

Building trustworthy AI is more com-

> **"Europe wants to shape a strategy that differentiates from other economies, like the US and China that have made huge investments on AI"**

plex than what it may sound. Milano points out that many AI systems "simply work", while we do not complete understand why they work. To create trustworthy AI systems, researchers need to develop AI that is understandable and explainable to humans.

'We also need to have more collaboration between AI systems and experts, which is very difficult. That requires encapsulating the collaboration and interaction with an expert. The system needs to learn from humans how they solve problems, and that knowledge needs to be injected in the AI systems.'

When we are developing such systems, we also face the issue of causality; while calculating correlations is straightforward, showing causal relations – that outcome Y happens because of the factor X and these events do not simply co-occur – is much more demanding.

'There are many, many aspects that are considered important from the European point of view. Europe wants to shape a strategy that differentiates from other economies, like the US and China that have made huge investments on AI. Europe is lagging behind a bit, but I think that the strategy that is going to build trustworthy AI in response to ethical principles is a good path.'

Professor Milano has been an AI researcher for much longer than AI has been the hot topic it is these days. She remembers the time when people commonly thought that AI methods were useless and researchers even avoided using the term to avoid scaring funders away. 'But now of course everyone understands that it's useful and can bring really important results and impacts in all aspects of our life.'

Milano researches decision-support systems and especially systems that support – rather than replace – human experts. What Milano thinks is particularly fascinating in AI is that researchers can embed human knowledge in AI models. 'You can really use these systems to put together knowledge from different experts, different domains, and glue it all together with data-driven models.'

One aspect that fascinates her is the interdisciplinary nature of AI and, for example, ethical aspects that call for multidisciplinary approach. 'When you are in a driverless car, you need to consider aspects that are not just algorithmic or technological. You really have to understand that there are difficult decisions to make.'

When e.g., lives are in question, modelling a system is particularly difficult

and ethical and moral principles should come into place – and at the same time, there are many situations in which people from different parts of the world do not follow any global moral guidelines. While East Asians may think that it is most important to protect the elderly, Europeans put children's safety first.

How to code these types of decisions will be one of the key challenges in AI research in the near future. On a positive note, a machine can be more rational than human decision makers can, as it can process information so quickly that it can genuinely base its decisions on reasoning, while humans use their instinct.

In the last few years, artificial intelligence systems have developed at an extremely fast pace. Professor Milano is eager to see what types of results will be achieved in the next ten years; she hopes to witness a European AI field that is truly strong and competitive.

Another thing she wishes to see is that researchers start using AI systems more to solve problems that help make the Earth a better place for everyone; technology can help us reduce pollution and emissions and hit the zero emission and carbon neutrality targets.

'It is time for us to use technology for the good and help the environment and improve our citizens' quality of life. Technological solutions really help us to go towards a better planet for us, our children, and the next generations to come.'

AI Day 2020 took place online on 26 November 2020.

By Anu Haapala

Pekka Marttinen: It is very important to take good care of health and social services data

The DataLit project develops understandable and reliable practices for using health and social services data

Research, published: 16.11.2020

Assistant Professor **Pekka Marttinen** is part of the new DataLit research consortium headed by Professor **Petri Ylikoski** of the University of Helsinki. The project aims to develop comprehensible and reliable practices for using Finnish data on health and social services.

'My task is to develop machine learning methods and models for health and social services data. With the help of these methods and models it is possible to examine societal questions related to health care', Pekka Marttinen says.

The DataLit project brings together skilled people from many different fields. 'In addition to the methods, it is important to examine what the models are used for and who use them, talk about them, and make decisions on how they are used. As it is often said, the decisions must not be left to the engineers alone', Marttinen says.

The project analyses key ethical concepts – such as privacy – in a range of technical, societal, and legal contexts, while examining how officials can use the data in a socially sustainable manner. DataLit also produces tools for the responsible and reliable use of register data, for example forecast models to support decision-making, and methods for anonymising data.

'It is especially important to take good care of data. This means data security, consideration of ethical questions, the implementation of data analysis in a protected environment – in general, the secure use of data. The use must be transparent and acceptable', Marttinen says.

The first phase of the project will take three years and its total budget is € 3.9 million. In addition to the University of Helsinki and Aalto University, the University of Eastern Finland and several other cooperative partners are involved in the project: The Finnish Institute for Health and Welfare (THL), The Social Insurance Institution (Kela), the Joint municipal authority for North Karelia social and health services (Siun sote), the Cancer Society of Finland, the Ministry of Finance, Statistics Finland, the Digital and Population Data services Agency, and the Helsinki Institute for Social Sciences and Humanities (HSSH). The project is implemented in close cooperation with the Finnish Center for Artificial Intelligence (FCAI).

ect they have tested the new solution with several collaborators. One of those collaborators is Elisa, a Finnish company offering telecommunications services, which announced a demo application developed during the collaboration.

One aim of the Aalto computer scientists is to try to find the customers who will gain most benefit from the solution. 'Our goal is to start a company that brings the solution to the market.' says **Olavi Mertanen**.

The CloudXR project in question is a TUTLI (From Research to Business) project funded by Business Finland and Aalto University that ended at the end of March 2020. The team has focused on exploring potential commercialization paths for XR applications' remote rendering and developing the technology further.

By Anu Haapala

AI predicts which drug combinations kill cancer cells

A machine learning model can help us treat cancer more effectively

Research, published: 1.12.2020

When healthcare professionals treat patients suffering from advanced cancers, they usually need to use a combination of different therapies. In addition to cancer surgery, the patients are often treated with radiation therapy, medication, or both.

Medication can be combined, with different drugs acting on different cancer cells. Combinatorial drug therapies often improve the effectiveness of the treatment and can reduce the harmful side-effects if the dosage of individual drugs can be reduced. However, experimental screening of drug combinations is very slow and expensive, and therefore, often fails to discover the full benefits of combination therapy. With the help of a new machine learning method, one could identify best combinations to selectively kill cancer cells with specific genetic or functional makeup.

Researchers at Aalto University, University of Helsinki and the University of Turku in Finland developed a machine learning model that ac-curately predicts how combinations of different cancer drugs kill various types of cancer cells. The new AI model was trained with a large set of data obtained from previous studies, which had investigated the association between drugs and cancer cells. 'The model learned by the machine is actually a polynomial function familiar from school mathematics, but a very complex one,' says Professor **Juho Rousu** from Aalto University.

The research results were published in the prestigious journal Nature Communications, demonstrating that the model found associations between drugs and cancer cells that were not observed previously. 'The model gives very accurate results. For example, the values of the so-called correlation coefficient were more than 0.9 in our experiments, which points to excellent reliability,' says Professor Rousu. In experimental measurements, a correlation coefficient of 0.8-0.9 is considered reliable.

The model accurately predicts how a drug combination selectively inhibits particular cancer cells when the effect of the drug combination on that type of cancer has not been previously tested. 'This will help cancer researchers to prioritize which drug combinations to choose from thousands of options for further research,' says research-er **Tero Aittokallio** from the Institute for Molecular Medicine Finland (FIMM) at the University of Helsinki.

The same machine learning approach could be used for non-cancerous diseases. In this case, the model would have to be re-taught with data related to that disease. For example, the model could be used to study how different combinations of antibiotics affect bacterial infections or how effectively different combinations of drugs kill cells that have been infected by the SARS-Cov-2 coronavirus.

By Anu Haapala,
Illustration Matti Ahlgren

Video games evoke emotions that even music and cinema fail to reach

A recent doctoral dissertation shows players appreciate evoked emotional experiences, even when some are far from positive

Research, published: 2.12.2020

Traditionally, video games have not been thought to evoke strong and deep emotions. However, a recent doctoral dissertation by **Julia Ayumi Bopp** from Aalto University, showed that video games evoke a wide range of emotions in players - even ones that have not been commonly associated with other media, such as music and films.

The reason for this lies in the interactive nature of video games. Because the player can influence the storyline and the actions of the character they control, they experience strong emotions such as remorse, and sense of responsibility. The interactive nature of games has an impact on emotional experiences, especially if the player needs to make difficult decisions, or their decision power is taken away from them.

Moreover, players enjoy the emotional experiences evoked by games and they appreciate them even though they are sometimes far from positive.

Playing also makes the player reflect on themselves, their lives and socio-cultural problems, for example. 'In that sense, the emotions evoked by games seem to be similar to the emotions evoked by more traditional media, at least to a certain point,' says Julia Ayumi Bopp.

Excitement and worry

Bopp's research also found that players become attached to characters in many different ways, and the characters evoke a wide range of emotions, for example, a strong character can arouse enthusiasm, while a vulnerable one can evoke worry. Bopp was awarded an honorable mention for her research on emotional attachment at the prestigious CHI Play 2019 Conference.

Traditionally, many researchers and non-professionals have thought that games evoke only rather superficial emotions. The findings of this dissertation however support the everyday experience of many video game players: video games evoke all kinds of emotions and in that sense they are comparable to other forms of art. Bopp has noticed that players also eagerly discuss their feelings about gaming on online discussion boards, for example. Moreover, when she was conducting her research, many participants explicitly told her that they enjoyed sharing their emotional experiences regarding video games.

The results will certainly be of interest to game developers as well, although Bopp doesn't want to directly advise them. 'However, I believe the results give direction and food for thought. For example, if a game developer wants a certain character to evoke concern in the player, it is worth making the character vulnerable but still useful from the player's point of view.'

Bopp will defend her dissertation at Aalto University on December 4, 2020.

By Anu Haapala,
Illustration Matti Ahlgren

Artificial intelligence for dementia prevention

AI-Mind is a 5-year project funded by Horizon 2020, with the goal of facilitating a paradigm shift in clinical practice of mild cognitive impairment. A team of Aalto University and HUS Helsinki University Hospital researchers are involved in the project

Published: 12.2.2021

AI-Mind will create intelligent digital tools for screening of brain connectivity and dementia risk estimation in people affected by mild cognitive impairment. During the project's 5-year lifecycle, two new artificial intelligence-based digital tools will be developed. The AI-Mind Connector will identify dysfunctional brain networks, and the AI-Mind Predictor will assess individual dementia risk using data from the Connector, advanced cognitive tests, and genetic biomarkers. These two tools aim at creating personalized patient reports for further intervention recommendations.

Aalto university and HUS have well-established experience with both magnetoencephalography (MEG) brain imaging, and using Artificial Intelligence to analyse imaging data. 'We have incorporated computational models and machine learning methods in our neuroimaging research, to help us understand neural mechanisms and representations of cognition, as well as individual variation in neural function and behaviour.' explains **Riitta Salmelin**, professor in the department of Neuroscience and Biomedical Engineering (NBE) at Aalto University. 'Together with professors **Samuel Kaski** and **Hanna Renvall**, we have succeeded in identifying simple spectral features of MEG signals that differentiate between individuals, and appear stable within an individual. We anticipate that this tool may serve as an easy-to-use, robust probe of brain networks and their breakdown in neurological diseases, thus linking directly with the goals of AI Mind.'

Dementia affects tens of million worldwide

Currently, there are over 50 million people living with dementia across the globe. By 2030 we can expect that number to reach 82 million. Besides time-consuming patient investigations with low discriminative power for dementia risk, current treatment options focus on late symptom management. This has numerous implications in terms of familial, medical, and care costs.

'Our research has revealed individually highly distinctive features, "brain fingerprints", in healthy subjects, and we believe such approaches to have also wide clinical potential.' says Hanna Renvall, who holds a joint professorship at both HUS and Aalto University NBE, 'I have also worked for years as a clinical neurologist, and thus I recognize the huge challenges related to the increasing burden of memory disorders both at the individual and societal level.' AI Mind provides an intriguing possibility to bring together both the research and clinical neurological work that I have been involved with.'

AI-Mind enables earlier preventative therapies

For people with mild cognitive impairment (MCI), the dementia risk is almost 30% higher than unaffected individuals. With the current clinical approaches, many patients developing into dementia receive their diagnosis only rather late in the course of disease. The risk of dementia could, however, be reduced by adopting healthy lifestyle habits and managing treatable conditions such as diabetes and high blood pressure. Thanks to the AI-Mind tools, the time needed to estimate the risk of developing clinical dementia could be potentially reduced down to only one week. This would give doctors and patients opportunities for preventive interventions, therapies, and rehabilitation measures early in the course of the disease.

'Machine learning can provide us with great insights into complex data.' says Samuel Kaski, professor at Aalto University Department of Computer Science and director of the Finnish Center for Artificial Intelligence (FCAI), 'Our slogan at FCAI is that we create 'Real AI for Real People in the Real World' and our work with AI Mind is an example of this. We're bringing together engineers and scientists with expertise and experience across a number of fields to develop viable solutions for the next generation of medicine.'

The doctor's new best friend: AI

What is now complex, labour-intensive, costly, and poorly predictive screening in mild cognitive impairment (MCI) shall be replaced by automated diagnostic screening tools. These are driven by artificial intelligence to address the urgent need for early accurate prediction of disease risk.

'AI-Mind is an excellent chance to bring together highly relevant questions with top-level clinical, neuroscience, and computational expertise at the European level, ' Professor Renvall continues, 'I believe that the data collected and analysed within this consortium will inform us about the most informative ways to approach other clinical neurological questions, and pave the way for more future studies and new lines of research.'

By Matthew Allinson

How did Runeberg's career progress? AcademySampo helps find the answer from a huge amount of data

With the help of the new AcademySampo portal, one can easily find information about people who registered to study at the university in Finland between the 1640s and 1890s

On Runeberg Day, Friday 5 February, a new AcademySampo portal will be published, which will gather a huge amount of information about people who enrolled to study at the university in Finland, in 1640-1899. The service has been developed by researchers from Aalto University and the University of Helsinki's Center for Digital Humanities HELDIG.

The most important material of the AcademySampo are the student registers ('ylioppilasmatrikkelit' in Finnish) of the Royal Academy of Turku and the University of Helsinki, which contain information about all persons enrolled at the university during that period. At the time, the Academy of Turku - which became the University of Helsinki in 1919 - was the only university in Finland. The researchers have supplemented the database with information on the later stages of students' lives, such as relationships, careers, and professions.

The AcademySampo includes a "home page" for all the 28,000 people listed in the student registers. In addition, up to about 50,000 other people have been recognized from the texts.

The home page gathers together biographical information about a certain person, and all the crumbs of information related to them have been linked together. The data has also been linked to external databases, such as the BiographySampo and the collections of the Finnish Literature Society, as well as WikiData.

The AcademySampo provides comprehensive information on several important figures in Finnish history, such as the national poet Johan Ludvig Runeberg, the composer Jean Sibelius, President **Carl Gustaf Emil Mannerheim**, Professor **Henrik Ga-**

briel Porthan who has been called the father of Finnish history, and **Tekla Hultin** who was the first Finnish woman to receive a Ph.D. degree and who had a successful career as a journalist, editor-in-chief, and political influencer. In total, the AcademySampo lists 521 women who enrolled to study at the university, including Maria Tschetschulin - the first female high school graduate in the Nordics - and **Emma Irene Åström** - Finland's first female university graduate.

Technologies of the semantic web are the technical innovation behind the AcademySampo. The semantic web is a data network created within the internet to answer the needs of computers. In it, the information is

linked to each other. The idea is that the computer understands the semantic web – while the human user, in turn, understands and uses the web pages created by the machine using the semantic web. The same technology was also behind the previously published Sampo portals, such as WarSampo and BiographySampo.

According to **Eero Hyvönen**, Professor at Aalto University and Director of HELDIG 'Technically, what is new in the Academy Sampo, are the use of learning artificial intelligence in investigating relationships between different people, and new types of network analyzes, among other things.'

The service includes intelligent search and browsing functions, which are combined with data analytical tools and data visualizations in the form of networks, statistics, graphs, and maps. Thus, users can easily utilize and visualize data without having to learn to program complex data analytics tools.

A collaborative effort between humanists and computer scientists

The AcademySampo is based on years of effort by humanists and computer scientists. The digitization, transliteration, and completion of handwritten student registers was largely a handicraft contract of about ten person years, drawn by **Yrjö Kotivuori** from the National Archives of Finland and **Veli-Matti Autio** from the archives of the University of Helsinki's Archives and Registry.

After that, computer scientists created a semantic network, published the network as an open linked data service for everyone to use, and implemented the intelligent online service Akatemiasampo.fi using the service's interfaces.

The AcademySampo can be used by both researchers and citizens interested in history. The launch event, which will be open for everyone interested in the topic, will showcase how AcademySampo helps historians and genealogists, among other people.

AcademySampo has been implemented at Aalto University in co-operation with the University of Helsinki's Center for Digital Humanities HELDIG and the archives of the University of Helsinki's Archives and Registry. It is part of the digital anthropology linked open data infrastructure in Finland (LODI4DH), which is part of the Academy of Finland's roadmap.

By Anu Haapala

Alumna Juulia Suvilehto is studying how coronavirus is affecting social behaviour and touching

The research targets Nordic countries, and it is still possible to participate in the study. On International Women's Day Suvilehto wants to thank inspiring female role models and to draw attention to the fact that women tend to be the ones who take care of community well-being.

Published: 8.3.2021

Aalto University alumna **Juulia Suvilehto**, a postdoctoral researcher at Linköping University, is investigating the impact that coronavirus is having on behaviour involving social touching, and how touches are interpreted. The pan-Nordic study involves researchers from Finland, Sweden, Denmark, and Norway.

'Coronavirus restrictions set by governments can affect how people make decisions about their social behaviours. On the other hand, social touching probably will not change in the closest relationships.'

Social touching is a natural and instinctual form of communication. Touch is thought to have phylogenetic and ontogenetic primacy and it is still relevant in the lives of modern adults.

'Shaking hands, meanwhile, is a cultural norm which is not a particularly beloved form of communication. People prefer hugs to handshakes. Personally, I would not mind if handshakes were replaced by something else, such as elbow bumps.' says Dr Suvilehto.

The fate of shaking hands and touching depends on how long the coronavirus epidemic and the restrictions last.

On hugging and social isolation

On a more general level, Suvilehto is also interested in why different people experience social touching differently.

'I want to find out if the experience of being touched is linked with things like personality, physiological characteristics, or personal history. Some people are very touchy-feely, while others do not find being touched to be pleasant at all.'

In another new project, Suvilehto is investigating how loneliness among young adults might be better understood. Studies have shown that people under the age of 25 are at their loneliest, or are approximately as lonely as those over 70.

'When a student starts at university, this often involves relocating and moving away from home for the first time. They also may lose contact with their old classmates. Freshmen often experience a reorganisation in their social networks. This leads elevated levels of loneliness in some while others find the transition easier.'

Suvilehto wants to learn what kinds of factors affect a young adults' risk of ending up lonely, and if this can be influenced from outside. This project uses the skills and knowledge of the group of researchers headed by Aalto University Professor **Jari Saramäki** who are studying how data collected by mobile telephone could be used to describe and understand social behaviour in the real world.

Stamina and role models

Suvilehto graduated from the Bioinformation Technology Bachelor's and Master's programme at Aalto University in 2014. She wrote her doctoral dissertation on social touching at the Department of Neuroscience and Biomedical Engineering. During her studies Suvilehto held several positions of trust in Inkubio, the guild for students of bioinformation technology. The experience taught her how to take responsibility for things.

On International Women's Day Suvilehto wants to thank inspiring female role models, such as Academician **Riitta Hari** and University of Zürich Professor **Anna-Liisa Laine**.

> **"Coronavirus restrictions set by governments can affect how people make decisions about their social behaviours. On the other hand, social touching probably will not change in the closest relationships"**

'We are all just researchers, not female, or male researchers. However, the pandemic has made it clear that women in academia have, on average, more caregiving responsibilities and should have more institutional support. Women also put in more effort to being good departmental citizens while men focus more on their individual scholarship. Currently the academic incentive structure is designed to only reward individual achievements. I think it would be important to notice all the work women do in supporting the well-being and smooth operation of their work environments.'

By Tiina Aulanko-Jokirinne

Artificial intelligence model developed by Finnish researchers predicts which key of the immune system opens the locks of coronavirus

With an artificial intelligence (AI) method developed by researchers at Aalto University and University of Helsinki, researchers can now link immune cells to their targets and for example uncouple which white blood cells recognize SARS-CoV-2. The developed tool has broad applications in understanding the function of immune system in infections, autoimmune disorders, and cancer.

Published: 22.4.2021

The human immune defense is based on the ability of white blood cells to accurately identify disease-causing pathogens and to initiate a defense reaction against them. The immune defense is able to recall the pathogens it has encountered previously, on which, for example, the effectiveness of vaccines is based. Thus, the immune defense the most accurate patient record system that carries a history of all pathogens an individual has faced. This information however has previously been difficult to obtain from patient samples.

The learning immune system can be roughly divided into two parts, of which B cells are responsible for producing antibodies against pathogens, while T cells are responsible for destroying their targets. The measurement of antibodies by traditional laboratory methods is relatively simple, which is why antibodies already have several uses in healthcare.

'Although it is known that the role of T cells in the defense response against for example viruses and cancer is essential, identifying the targets of T cells has been difficult despite extensive research,' says Satu Mustjoki, Professor of Translational Hematology from the University of Helsinki.

AI helps to identify new key-lock pairs

T cells identify their targets in a key and a lock principle, where the key is the T cell receptor on the surface of the T cell and the key is the protein presented on the surface of an infected cell. An individual is estimated to carry more different T cell keys than there are stars in the Milky Way, making the mapping of T cell targets with laboratory techniques cumbersome.

Researchers at Aalto University and the University of Helsinki have therefore studied previously profiled key-lock pairs and were able to create an AI model that can predict targets for previously unmapped T cells.

'The AI model we created is flexible and is applicable to every possible pathogen - as long as we have enough experimentally produced key-lock pairs. For example, we were quickly

> **"The AI model we created is flexible and is applicable to every possible pathogen - as long as we have enough experimentally produced key-lock pairs"**

able to apply our model to coronavirus SARS-CoV-2 when a sufficient number of such pairs were available,' explains Emmi Jokinen, a Ph.D. student at Aalto University.

The results of the study help us to understand how a T cell applies different parts of its key to identify its locks. The researchers studied which T cells recognize common viruses such as influenza-, HI-, and hepatitis B -virus. The researchers also used their tool to analyze the role of T-cells recognizing hepatitis B, which had lost their killing ability after the progression of hepatitis to hepatic cell cancer.

The study has been published in the scientific journal PLOS Computational Biology.

A new life for published data with novel AI models

Tools generated by AI are cost-effective research topics.

'With the help of these tools, we are able to make better use of the already published vast patient cohorts and gain additional understanding of them,' points out **Harri Lähdesmäki**, Professor of Computational Biology and Machine Learning at Aalto University.

Using the artificial intelligence tool, the researchers have figured out, among other things, how the intensity of the defense reaction relates to its target in different disease states, which would not have been possible without this study.

'For example, in addition to COVID19 infection, we have investigated the role of the defense system in the development of various autoimmune disorders and explained why some cancer patients benefit from new drugs and some do not,' reveals M.D. **Jani Huuhtanen**, a Ph.D. student at the University of Helsinki, about the upcoming work with the new model.

Will AI make us better humans? Why we must be cautious

What does the ancient greek word Ethos have in common with Artificial Intelligence? It's not news that digitalisation and AI are transforming how we live, work, consume and behave. Ethical concerns often emerge when technologies affect society, and AI is no exception.

Published: 27.4.2021

Artificial Intelligence has the potential to take us further into space, improve how we understand climate change and help develop vaccines for new epidemics, but without careful development, it can also cause havoc in society. Today, different aspects of AI and machine learning algorithms are used in everything from job recruitment to self-driving cars, and the other use cases in nearly every facet of society are emerging at breakneck speed. However, it is evident that the world we live in is not yet ready to give up humanity in favour of technology entirely.

Professor of Practice **Nitin Sawhney**, Department of Computer Science at Aalto University examines the intersection of Artificial Intelligence and human-centred design and is one of the lecturers at Digital Business Master Class (DBMC) offered by Aalto University Summer School. The course includes topics such as digital strategies, design, platform development and AI and machine learning.

'Systems based on AI often embody and amplify the biases and unfair assumptions embedded in their models by the very people developing them, and the large-scale but incomplete datasets that they often learn from. Just like any technology we regulate in society, from the cars we drive to the drugs we take for treatments, understanding the implications of using AI requires critical public awareness, oversight, trust and accountability.', says Nitin Sawhney.

The Digital Business Master Class students are all working on digital strategies for real business cases from partnering companies. During the course, the students gained insights into applying their knowledge about AI to their own business projects.

Svitlana Chaplinska is an Erasmus exchange student from Ukraine and is currently studying at the Master's Programme in Security and Cloud Computing at Aalto University. She finished the Digital Business Master Class at Aalto University Summer School this spring and felt incredibly inspired by the lecture about ethics and AI.

'I was so intrigued by the lecture that I could not keep my mind off the topic for several days afterwards! We all know that AI's ethical aspects are a

> **"Understanding the implications of using AI requires critical public awareness, oversight, trust and accountability."**

real issue that very much exists. To acknowledge this, it is important to stay informed and educate ourselves about how the effects of AI will change our lives in some ways or another.', says Svitlana Chaplinska.

Several problematic cases show that AI generally lacks both inclusivity and cultural diversity when collecting and evaluating data. Stereotypical beauty filters on Instagram, face recognition software that doesn't recognize dark-skinned people and recruitment algorithms that automatically filter out women. The list goes on. At the same time, reports tell us that half of all cur-

rent jobs will be replaced by machine learning or AI within a decade. That number may be realistic or not – but we should all be aware of a true industrial crisis that we may be facing regarding the future of our jobs.

AI systems are already being developed to learn from and exceed human capabilities in many realms, but is this something we should strive for? Humanity is an inevitable element in avoiding the harm that these systems' unethical use can cause as they lack both emotions and empathy – all the things that make us human and something that hopefully will never be replaced by an algorithm or computer.

'How do we design algorithmic systems and data-centric technologies that align with human values, but also societal and environmental concerns? Part of the answer lies in democratizing AI through open education, improving diversity and inclusion in the field, ensuring trustworthy policies and governance while engaging both ethical business practices and wider aspirations of civil society. We must strive for futures that center human and ecological well-being, as we re-imagine the role of Artificial Intelligence in society.', explains Nitin Sawhney.

By Johanna Fagerström

What archaeological objects have been found in different parts of Finland? Researchers have developed FindSampo to bring together the discoveries made by citizens

FindSampo portal prototype, opened for public use on May 17th, 2021, contains information on thousands of discoveries made by citizens and the Finnish Heritage Agency in the archaeological catalogue application after 2015

Published: 17.5.2021

Aalto University, the University of Helsinki and the Finnish Heritage Agency have been collaborating on a research project to develop the new FindSampo online service that is open to all and collects information on archaeological discoveries made by citizens, especially metal detector users, in Finland.

'At the beginning of the project, in 2017, the greatest hope of metal detector users was to have a tool for reporting discoveries directly at the site of the discovery. In the project, we tested the mobile reporting service of FindSampo and received good feedback from metal detector users,' says researcher **Anna Wessman** who has interviewed metal detector users and is now a professor at the University of Bergen in Norway.

Originally, archaeological discoveries were reported to the Finnish Heritage Agency using paper forms. In 2019, the Finnish Heritage Agency opened an electronic notification service, Ilppari.

'Our goal is that in the future, information about discoveries reported to Ilppari could be available also in Find-Sampo. Until now, the discoveries reported have often remained within the walls of the Finnish Heritage Agency, but FindSampo allows us to open more doors and share information more easily. Everyone has a right to cultural heritage,' **Ville Rohiola**, Curator in the Archaeological Collections in the Finnish Heritage Agency.

Now in it's test phase, FindSampo contains information on thousands of discoveries made by citizens, and discoveries stored by the Finnish Heritage Agency in the archaeological catalogue application after 2015. Data analysis has been included in the service, for example, it is possible to visualise the data using maps. The location of a discovery is shown in FindSampo with an accuracy of a few metres, and the locations can be visualised on heat maps.

'Map visualisations make it possible to see what kind of objects have been discovered e.g. around your own cottage,' says Professor at Aalto University and Director of the Helsinki Centre for Digital Humanities (HELDIG) at the University of Helsinki **Eero Hyvönen**.

Abundance of discoveries made

FindSampo contains only part of the national discoveries of archaeological collections, as not all discoveries from recent years have yet been catalogued.

'The cataloguing queue is based on the great popularity of the metal searching hobby and the continuous increase in the total number of discoveries,' says Rohiola.

The material of FindSampo contains items such as money, weapons and dishes.

'Money is interesting because it makes good digital research material. It is possible to pinpoint fairly accurately the era it is from, unlike with objects like stone axes. Money is also international, like the dirhem from the Viking era,' says Hyvönen.

'The most interesting part is how the discoveries all form a picture of history. For example, they can enrich the picture we have of the Vikings and Crusades,' says Rohiola.

Finders keepers or property of the State?

Since 1963, there has been a law in force in Finland that states that relics over 100 years old belong to the State and must be reported and delivered to the Finnish Heritage Agency. The Agency decides whether or not to take an object into its collections.

'For example, if there is a lot of money from the 19th century already in the collections, the Finnish Heritage Agency will only be interested in the location of the discovery, and the person who found the money may keep it. But if the Finnish Heritage Agency takes an object into its collections, the discoverer may request a compensation for redemption based on the object's informational value. An object discovered can also be donated to collections,' says Rohiola.

The Antiquities Act, on the other hand, defines sites of historical and archaeological interest and areas that are protected. The exclusion areas around them are also shown in map visualisations.

'People should not go to the same places of discovery, as a place may be protected after just one discovery,' says Rohiola.

Most of the findings in archaeological collections originate from archaeological field studies, such as digs at areas containing relics. The aim is to be able to publish discoveries from both archaeological sites and civilians on FindSampo through digitalisation.

By Tiina Aulanko-Jokirinne

AI predicts if storms will cause blackouts many days in advance

A collaboration between Aalto University and Finnish Meteorological Institute improves prediction tools for energy companies

Published: 24.2.2021

In Finland, stormy weather can happen at any time of year. This is an issue because Finland is heavily forested, and falling trees can knock out power lines and disable transformers, causing power blackouts for hundreds of thousands of people a year. Researchers at Aalto University and the Finnish Meteorological Institute (FMI) are using artificial intelligence and machine learning to try and predict when these weather-inflicted blackouts happen. Their new method can now predict these storms days in advance, allowing electricity companies to prepare their repair crews before the storm has even happened.

'Our previous model looked at highly local thunderstorms with short lifespans. We've now made a new mode that looks at large low-pressure storms, which uses weather prediction data up to 10 days ahead,' said **Roope Tervo**, PhD candidate at Aalto University and software architect at FMI.

The model categorises storms into 3 categories : No damage; low damage (1 - 140 damaged transformers); and high damage (over 140 damaged transformers). It can predict the location of the storm to within 15 km, and the time of the storm to within 3 hours. Based on the test data, the model has a recall of approximately 0.6, which means that it has a 60% chance of correctly predicting which category a storm will be in. It also has an accuracy of approximately 0.8, which means that 80% of the storms the model predicts will do damage then go on to cause the predicted damage.

'The geospatial and temporal resolution become more accurate as the weather models evolve. In 2024 the weather prediction geospatial and temporal resolution will be 5 kilometres and 1 hour, correspondingly.' says Tervo, 'The outage prediction accuracy can still be improved a bit. For example adding ground frost data and information about tree leaves would most probably improve the results. The prediction will, however, never be perfect. It is also good to remember that, when employing weather prediction data, errors are coming from both weather prediction and the outage prediction models.'

The thunderstorm prediction tool previously developed by the team at Aalto and FMI has been used by the power grid operators Järvi-Suomen Energia, Loiste Sähköverkko, and Imatran Seudun Sähkönsiirto. 'Our new prediction is provided to them via the same user interface, and they are experimenting using the tool' says Tervo.

The full research article "Predicting power outages caused by extratropical storms" is published in the journal Natural Hazards and Earth System Sciences.

By Matthew Allinson

Following e-cigarette conversations on Twitter using artificial intelligence

Machine learning methods help researchers follow social media promotions of addictive products to teenagers and young people.

Published: 4.6.2021

The advertising of nicotine products is highly restricted, but social media allows a way for these products to be marketed to young people. What's more, e-cigarette flavourings make them particularly appealing to teenagers and young adults. A team of researchers have developed machine learning methods to track the conversations on social media about flavoured products by one of the most popular e-cigarette brands, JUUL.

'An increasing amount of discussions on e-cigarettes is taking place online, in particular in popular social media such as Twitter, Instagram,

> **"The team hopes that the AI tools that they have developed, which are built upon the open-source BERT platform by Google, could be used by regulators"**

and Facebook. As the content related to e-cigarettes is often targeted at youth — who are also very active on many social media platforms — it is important to explore these conversations' says Dr **Aqdas Malik**, Postdoctoral Researcher in the Department of Computer Science at Aalto University.

Previous research has shown that young people find the flavouring of e-cigarettes appealing, and Malik himself has used AI to study how vaping companies are using Instagram to promote their products to young people. In their new work, the team developed machine learning methods to study key themes and sentiment revolving around the Twitter conversations about JUUL flavors.

The team analysed over 30,000 tweets, and found many positive tweets about the different flavours. 'Popular flavors, such as mango, mint, and cucumber are highly appealing but also addictive for young people, and must be further regulated,' said Malik. 'There is also a need to cap the promotional activities by e-cigarettes retailers such as giveaways, announcing new stock arrivals, discounts, and "buy more, save more" campaigns.'

Overall, the tweets were overwhelmingly positive in tone, though some arguments were made against the product and the addictiveness of its flavours. Another core theme among negative conversations was proposed legislation, mostly from anti-tobacco campaigners and news outlets.

The team hopes that the AI tools that they have developed, which are built upon the open-source BERT platform by Google, could be used by regulators to help monitor how e-cigarette products are promoted to youngsters. Trained on web-based data, Google BERT is a relatively new machine learning technique for natural language processing and has been previously shown to excel at predicting sentiment -- allowing the team to label individual tweets as positive or negative.

While this work has focused on Twitter messaging, the tools used can be easily applied to textual data on other social media platforms, too. For the next stage of their work, Malik's team will apply their machine learning methods to understand trends in how people talk about e-cigarettes and other substances on TikTok, Reddit, and YouTube.

By Matthew Allinson

How is Instagram used by the leading health agencies to engage with the public during the COVID-19 crisis?

Most of the images shared by major health agencies (NHS, CDC, WHO, IFRC) relate to preventive measures, health advisories, gratitude and resilience of front-line workers. Social media messaging depicting well known personalities, influencers, and celebrities received greater engagement. Furthermore, posts with inquisitive messaging, infographics, or dispelling myths/fake news/misinformation also receive more attention.

Published: 17.6.2021

Pictures can speak a thousand words! Given the significance of images for online information sharing, a team of researchers attempted to understand how pictures on social media can be used to communicate and engage the public with health messaging during a crisis. More specifically, the research focuses on the kind of messaging that has been portrayed by the leading public health agencies through Instagram during the COVID-19 pandemic. Moreover, Instagram user engagement was assessed through likes and comments indices.

Aqdas Malik, a researcher in the Department of Computer Science collaborated with researchers from USA (M. **Laeeq Khan**, Ohio University) and Canada (**Anabel Quan-Haase**, Western University) to study social media posts by the World Health Organisation (WHO), the United States Centers for Disease Control and Prevention (CDC), the International Federation of Red Cross and Red Crescent Societies (IFRC), and the National Health Service (NHS), UK. The team found that posts that performed very well in terms of likes and comments were those with pictures of celebrities, posts alerting/dispelling myths, fake news, or misinformation, infographics and data visualization.

"As most of the online users barely confirm the reliability of social media content before sharing with their network, huge responsibility lies on the shoulders of social media companies." said Dr. Malik; "This is critical as the majority of the public around the globe get COVID related information through social media and most of the misinformation, disinformation, and conspiracies about the pandemic has been spread through these platforms."

The team analyzed the Instagram presence of four major health agencies (NHS, CDC, WHO, IFRC) and found how the posts varied in their content theme, gender depiction, person portrayal, and image type. They compared how the different content of these posts resulted in different levels of engagement on Instagram. They found that effective strategies for public health organizations to use on Instagram include inquisitive messaging and infographics, as these performed well on the platform. This entails an effective data analytics and visualization strategy that should be employed by organizations especially for crisis and emergency risk communication.

"Instagram can be a highly engaging tool for reaching youth during crises and emergencies, in scenarios where younger demographics may not be effectively targeted by mainstream media" concludes Dr. Malik. The paper "Public health agencies outreach through Instagram during the COVID-19 pandemic: Crisis and Emergency Risk Communication perspective" is available to read online.

By Matthew Allinson

Christian Guckelsberger, researcher in FCAI and Department of Computer Science,

Photo: Matti Ahlgren

HUMANS OF
COMPUTER
SCIENCE

Computer Science at Aalto University is more than just coding. Here are stories from our researchers.

From her own little world to the other side of the globe

Her studies and her parents used to be her whole world, but now Dr. Avleen Malhi lives on the other side of the world, designs an Airbnb for car drivers, and encourages women to pursue their goals

Published: 4.8.2020

Postdoctoral researcher **Avleen Malhi** has achieved a lot at a young age. In 2016, she graduated with a doctoral degree in information security at Thapar University in India and immediately received an Assistant Professor position at her alma mater.

A few years later, she moved from India to the other side of the world, to Finland, and now she works as a project leader in a research project that recently received a significant Business Finland funding and aims to develop an Airbnb-like platform for car drivers.

Already as a child, Dr. Malhi got used to working hard towards her goals. 'My father is a surgeon and we always had these educational and career-related talks at home. Career and the fact that you always need to excel at everything were always on my mind,' she tells now.

Her father hoped that she would pursue a career in medicine, but Malhi was more interested in technology. 'During the tenth grade, I scored 100% in mathematics, which helped me to convince him that I want to go to technology,' Malhi says laughing.

Her parents always encouraged her to study and supported her, but while she focused solely on school, she did not see the world outside her own small bubble that included only her parents and her studies. She did not have time for hobbies or friends because she focused on being the best student in her class. After moving out of her childhood home however, she started travelling and interacting more with other people. 'I have evolved a lot and now I am very open to various things.'

eParkly is about creating an Airbnb for parking spaces

Dr. Malhi had wanted to work and live abroad for a long time, and after gaining experience as an Assistant Professor in India for a couple of years, she started looking for postdoctoral positions around the world. She soon got a job interview with an Aalto University's Adaptive Systems of Intelligent Agents (ASIA) research group, which worked on similar topics she researched in India: autonomous vehicles and the Internet of Things.

The interview went well, she got the position, and things happened quickly. 'Immediately after I got the interview results, I applied for a visa and handled all the official things. I was in Finland within two months.'

Now, Malhi works as a project leader in the eParkly project that aims to offer better parking experience to car drivers. In their previous bIoTope project, researchers in Professor **Kary Främling**'s group developed a mobile application that helps finding and booking an available parking space or charging place for an electric car. The application was piloted in 2018.

Now, the group wants to improve this technology and provide a dynamic, demand-based pricing system for parking spaces. 'If there is more demand, the prices will change accordingly. In short, we are trying to create an Airbnb for parking spaces,' Malhi explains.

The goal is to solve problems that car drivers encounter on a daily basis: they drive around randomly and spend an excessive amount of time trying to search for parking. Malhi points out: 'A recent study showed that drivers in the US spend 17 hours per year search-

ing for parking, which is quite a huge amount of time.'

Therefore, an application that shows the parking space availability and location in real time and reliably, and allows booking the parking space in advance, has potential to save an enormous amount of car drivers' time and make their lives more stress-free. 'The technology we are using is an IoT messaging framework, which is an open source platform that was already built in the previous bIoTope project.'

The researchers will collaborate with various parking operators and private parking owners. 'We allow private citizens who own parking spaces to rent those spaces if they wish to do so. Therefore, we are proving an open ecosystem for parking spaces, so that everyone can use them as efficiently as possible.'

Persistence has paid off

In May 2020, Malhi and her colleagues received a Business Finland Research to Business funding of 861,000 euros for their project. It will help to commercialize the innovation, but receiving it was not a walkover.

The first application submitted in September 2019 was rejected and henceforth Malhi's colleagues forgot the project later. 'But I am always persistent in what I do, and I was very motivated to try again and give it another opportunity. Rejections are a part and parcel of life.'

Malhi took responsibility for improving the original application. She and her colleagues closed loopholes that they had noticed after receiving the initial feedback and Malhi met Juha Siivola, innovation advisor at Aalto School of Science, several times. Siivola gave her feedback and shared her materials that the research group might find useful. 'Then we applied again and this time we got it accepted without any further changes.'

Encouraging women to be more ambitious can change the world

Malhi has now lived in Finland for 1.5 years, and thus far, she enjoys her life here. She enjoys her peaceful living environment and spends a lot of time in forests or at the beach. 'I go often to the Otaniemi beach. It is a very nice place to grab a drink or read a book in the sun.'

She has also positive experiences of the Finnish work life. 'People here are very nice, cooperative, and supportive. They listen to you and they won't ignore your ideas even if you were talking from a totally different perspective.'

As a postdoctoral researcher, Malhi writes research articles and project proposals, guides doctoral researchers, works as a teaching assistant, and manages other team activities. 'I always try to involve myself in learning new skills. For example, last year I went to a Digital Cities Summer School in Italy to learn about business perspectives of smart cities, which has helped with the eParkly project.' People around her can see her hunger of knowledge also when she is off-duty; when she turns on the TV, she likes to watch informative shows, such as documentaries and news broadcasts.

One major goals in Malhi's life is to encourage women to study, build their careers, and pursue their professional dreams. These days, an increasing number of women continue working even if they get children, but many mothers still sacrifice their progression or give up promotions because they take more responsibility for taking care of their home and children.

In many countries, girls still have fewer possibilities to educate themselves than boys do, and even many educated women are not using their full potential. This means that resources are wasted, and the society, companies, and the academic world are losing a remarkable amount of talent. 'There is no limit to what we as women can achieve. If we encourage women to be a little more ambitious, I think the world can change.'

By Anu Haapala,
Photo Matti Ahlgren

Avleen Malhi, Postdoctoral Researcher

Education: PhD in Security of Vehicular Networks from Thapar University

Comes from Patiala City, Punjab, India

Lives in Otaniemi

The greatest professional accomplishment: Getting a postdoctoral position and receiving the Business Finland funding. 'I got the job without any reference, only with my own hard work. Another thing was getting our project proposal accepted for 861,000 euros. That is a once-in-a-lifetime opportunity and I had a leading role in proposal writing.'

Is also

A traveler. 'Travelling is what makes me me, and I want to travel to each corner of the world – to Antarctica, for example. The most exciting place I have visited was North Lapland. I was in Tromsø for four days and it was the best thing I have ever done. I could have never imagined that nature can be so beautiful. As a kid, you watch all these fairytale movies and I felt like I was in that fairytale, with all the snow-covered streets and trees and the wild.'

A good listener. 'Whenever it comes to meeting people or getting opinions of people, I always give a chance for other people to speak about themselves and I always listen to their opinions.'

An independent and friendly person. 'I have learned to navigate foreign countries on my own by developing valuable communications and international collaborations. I try to learn about different cultures and personalities by my interactions and experiences.'

Anna Cichonska uses data science to develop better healthcare

Dr. Cichonska has received two awards for her dissertation and now she helps develop preventive medicine using data science.

Published: 25.8.2020

Dr. **Anna Cichonska**, alumna of Aalto University and Senior Data Scientist, knows how data science can help us develop better healthcare and drug therapy. During her doctoral studies at Aalto, Cichonska and her colleagues developed novel machine learning-based methods that make predicting patient responses to drug therapies easier and help identify the contribution of the variation in a DNA sequence of individuals to their risk of developing diseases. In her current job, Cichonska helps to develop preventive medicine.

These days, researchers conduct a lot of genetic research and they have access to enormous amounts of data from all over the world. However, most studies investigating the impact of genetic variants on different diseases seek to detect a link only between a single genetic variant and a single disease trait at a time. Often, sample sizes in these studies are modest and researchers have no access to the original data from other studies for the joint analysis. Therefore, individual studies explain only a small proportion of why diseases manifest themselves in different ways in different people. If more genetic variants and traits were studied together, more discoveries could be made, but this type of research is slow and laborious to do with the use of traditional methods.

The model developed by Cichonska and her colleagues helps to identify novel insights from published standard research results. In practice, if a single study has found, for example, an association between a particular genetic variant and type 2 diabetes, the model can test other genetic variants from several studies simultaneously and identify whether they are also related to the disease.

The new model does this quickly and using little data. Therefore, it can make a significant contribution to the development of new and more individualized drug therapies. 'Machine learning methods can really help us to gain valuable information about the biology of the disease,' Dr. Cichonska sums up.

In 2019, she received a dissertation award from the Aalto University School of Science for her work. In May 2020, the Finnish Society for Bioinformatics awarded her dissertation as the best dissertation done in 2018–2019 in the field in Finland. According to the society, it awarded the prize to Cichonska because her work had such a major impact on systems pharmacology. 'When I heard about the award, I couldn't believe it. I was so happy and surprised at the same time. They only chose one dissertation from the whole Finland, so it was a great honor.'

Two good reasons to move to Finland

Cichonska originally comes from Poland but she moved to Finland almost eight years ago. As a child, she liked school but also many other things. 'I

liked sports and different activities. I played volleyball and table tennis and enjoyed being outdoors with my friends.'

Math was her favorite subject. 'Doing math homework didn't feel like doing homework. It was really fun. That is why I later decided to study bioinformatics, where I can apply mathematics to solve important problems in biology and medicine.'

Cichonska became more interested in research at the end of her bachelor's studies. For her bachelor's thesis, she studied genes that manifest in different ways in colon cancer. The project included not only laboratory work but also conducting computational analyzes, which seemed interesting. 'My instructor suggested that we present my work at a large scientific conference that happened to be held in Poland that year, where I got to meet a lot of researchers from all around the world. At this point, I wasn't yet thinking about pursuing doctoral studies, but I found it all very interesting.'

Cichonska went to Italy as an exchange student where she met her current boyfriend who is from Finland. After finishing her master's degree, she received an interesting job offer from Poland and at first did not consider moving abroad – until she heard about Aalto and FIMM's joint doctoral position, which seemed intriguing. She applied for the competed position, and to her surprise, got the job. 'Then I had two reasons to move to Finland – my boyfriend and the job – so I did.'

But what made her do such groundbreaking and successful work during her doctoral studies? According to her, one important reason was the interdisciplinary nature of the work combined with the stimulating research environment at Aalto and FIMM. 'I worked with several people from different backgrounds, at two institutions, and in different research groups. It was very diverse – computer science combined with genetics and drug development. Of course, it also required a lot of work, but it wouldn't have been possible without the people who supported me,' Cichonska says.

Doctoral studies last for years, so she thinks it is important for doctoral researchers to make sure that they can maintain interest in the topic and stay optimistic. 'There are failures along the way. They are part of academic research. It is important not to give up.' The dissertation is not your whole life, she recalls. She found balance between work and leisure through yoga and exercise; hobbies brought new perspective and helped recharge batteries.

Work for preventive healthcare

Cichonska's first winter in Finland was a bit of a shock, as it was a very long, cold and snowy one. She said to her boyfriend repeatedly that she would not want to stay permanently in Finland. After completing her dissertation, however, she got a job at Nightingale Health – and that was just what she wanted to do. 'Things change – I still don't like winter, but also my home and friends are here now.'

Nightingale aims to build a new 'health-creation' system that is designed to abolish chronic diseases by predicting, preventing and averting them. Nightingale developed an innovative blood test that measures over 250 metabolic biomarkers from a single blood sample, and provides a comprehensive view of an individual's overall health. 'Nightingale's metabolic biomarkers can e.g. identify individuals at high risk of developing diseases or health problems, such as heart attacks. At the moment, our healthcare system treats sick people, so we want to help it by focusing on preventing diseases.'

Nightingale collaborates with two Japanese companies to take their model of preventive healthcare to Japan, a country that has the largest proportion of elderly people in the whole world. The Japanese people are also very cautious about health, says Cichonska who was supposed to move to Japan for some time in spring 2020. The Covid-19 pandemic postponed her relocation, however.

Cichonska seems to be very excited about different projects Nightingale is involved in and she enjoys working in an environment where she can apply the scientific methods coming from the academic world. She hopes to work towards advancing medicine and healthcare also in the future and continue working with different kinds of people with different types of expertise. Cichonska believes that, at least in her case, doctoral studies helped her get to the point where she is now. 'Doctoral studies are useful because they give you more substance knowledge and you learn different techniques really in depth. From my point of view, it has all been very useful.'

By Anu Haapala,
Photo Matti Ahlgren

Anna Cichonska, Senior Data Scientist

Education: PhD in Security of Vehicular Networks from Thapar University

Hails from Bytom, Poland

Lives in Helsinki

The greatest professional accomplishment: 'My dissertation. Cooperation with smart and driven people and years of hard work took me here and led to the fact that my thesis has been awarded.'

Has also

Missed airports during the Covid-19 pandemic. 'I love to travel, and to me, being at the airport often means traveling to conferences and meeting my family.'

Lived in Greece and learned to speak Greek. 'As a student, I had a summer job in Greece and worked as a barmaid at a hotel on the island of Evia.'

By studying software and service engineering, you will learn truly useful skills

Nikolai Denissov jumped out of his comfort zone, moved to Finland to study software engineering, and now he wants to stay for good.

Published: 8.9.2020

When **Nikolai Denissov** finished high school in his home country Estonia, he was sure about two things: He would not study information technology nor anything related to physics. In school, Denissov liked mathematics and chemistry and overall his grades were so good that he was free to select what he would study at the university.

'When I was very small and I played with Legos, I always told my parents that I will become a construction engineer – which I would nowadays call a mechanical engineer or something like that – but when I finished school, I disliked physics so much that I went to economics.'

Denissov completed a Master's degree in Business Administration, but after working at an IT consulting company in Russia for some time, he noticed that in addition to comprehending the business world, he would like to understand more of the technical side of IT.

He decided to return to student life and this time he would study technology. Also his fiancée wanted to study more and they decided to move to Finland. 'Sometimes people say that you should go out of your comfort zone. I actually know what that means and what challenges you will face on that path,' says Nikolai who has now lived in three countries and studied at four different universities.

Important skills and great teaching

Denissov studies computer science at Aalto University, majoring in Software and Service Engineering. After moving to Finland, he completed his second Bachelor's degree in Software Engineering at Metropolia University of Applied Sciences, after which he decided to apply to a Master's program at Aalto. 'I am happy I found this program. It teaches you things that are very important and are on a demanding level.'

The aim of the Software and Service Engineering major is to equip students with skills that are valued in modern organizations. Students learn to design, develop, and manage digital products and services. They also learn to tackle complex, real-world problems taking into account human, societal and organizational factors. 'The program is very well structured. You learn basically all the necessary stuff and the teachers are very good,' Denissov adds.

He points out that many jobs in technology call for also other skills than just coding. For example, one needs to know how to talk to customers to understand what they really want. His current studies allow him to combine his background in economics and business with a deep understanding of technology. 'I'm a bit of a chatty guy, so I am into agile methods and scrum mastership. I did scrum mastership as part of one of my jobs before joining Aalto, so joining this program was a very natural move to me.'

In Finland, the combination of studying, working and starting a family is possible

Denissov grew up in a small town in northeastern Estonia. He always did well in school and regularly participated in the STEM Olympiads, for example. In his hometown, the choice of hobbies was relatively small but he played the clarinet and the saxophone, which took a great deal of his time.

Soon after moving to Finland, Denissov and his fiancée who had now become his wife decided that they would stay for good. Finland is close to their native Estonia both physically, culturally and in terms of language, but according to Denissov there are some important differences, too. 'Finland is the calmest of the three countries I have lived in. Every place has its own challenges, but it is safe in here – so safe that we even decided to have a kid here.'

Even the combination of studies, family life and a full-time job is doable in Finland, he says. 'It's a bit challenging, but in all my jobs, the employers have been very understanding and the whole system with parental leaves and kindergartens is just great. This allowed me to spend plenty of joyful time with my kid.'

Denissov hopes to graduate with a Master's degree in Technology by the end of 2020 and find a job that

combines technology with education. 'Taking into account the recent developments, coronavirus situation and paradigm shift in education, more emphasis will be put on online education. I see a very bright future for this field.'

How did your own studies go when the Covid-19 situation closed schools and universities? 'The courses I took did not change that much. Because many of our courses include group assignments, we would have probably been a bit more efficient as a team if we were to sit together in the same place, but overall it don't think it effected the studies that much.'

By Anu Haapala,
Photo Matti Ahlgren

Nikolai Denissov, Master's student

Education: Master of Business Administration (University of Tartu), Bachelor's degree in Software Engineering (Metropolia University of Applied Sciences)

Comes from Kohtla-Järve, Estonia

Lives in Espoo

The greatest study-related accomplishment: 'I completed my Bachelor's degree within the four-year target time even though I had a full-time job and my wife was pregnant at the end of my studies. When I presented my thesis, my son was two-weeks old. Luckily he slept through the presentation!'

Is also

A person who likes seals. 'I consider seals to be my totem animals. They are nice animals that are not that bad to others but can be sometimes quite fierce – and they are really cute, especially the pups.'

Someone who made a shift from business to software engineering. 'If you ever think how it is to step out of your comfort zone and how that feels in practice, ask me. I have some stories to tell!'

Patiently waiting for his child to grow older. Then I can buy him – or actually myself – a programmable Lego set to play with.'

Maarit Käpylä turned her childhood hobbies into a living

As a child, Maarit Käpylä was interested in the stars and coding, and now she researches the activity of the sun, which could not be done without computer science.

Published: 22.9.2020

Maarit Käpylä researches a field few are familiar with. In other words, she is an astroinformatics specialist. When you google 'astroinformatics specialist' or 'astroinformatics' in Finnish, hardly any search results come up.

'An astroinformatics specialist is a researcher who uses data processing methods in order to understand an astrophysical research subject. My own, current research topic is related primarily to the sun and its activity,' says Käpylä, who started working as an associate professor at Aalto University's Department of Computer Science at the start of the year.

Käpylä studies magnetised plasma, i.e. matter that has become ionised for some reason. These matters are interesting, as the magnetic field makes objects behave differently than they would without one.

'All activity of the sun derives from the magnetic field. Similarly in galaxies, the magnetic field plays a major part in the birth of stars and pretty much everywhere. It involves major research questions: what is the role of the magnetic field and why does it make the sun burst, sometimes more and sometimes less?' Käpylä says.

As a student, Käpylä studied astronomy, physics as well as mathematics. Methods of computer science help in processing the vast observation data of both astronomy and space physics. 'If we don't harness computer science methodology in our research, we are trumped by the amount and complexity of data.'

From shy and nervous to a highly-featured researcher

Käpylä says that she has always treaded a path of her own. As a child, she found coding more interesting than social engagements. 'I was a very shy and withdrawn geek girl. I spent more time with Commodore 64 than with other people – or I would go out and watch the stars in the evening.'

Already at an early age, Käpylä learnt the different constellations from Tähtitaivaan opas ('Guide to the starry sky'). 'It was actually the first book I read.' On sunny days, she would wait for the evening, when she could observe the starry sky from her sleeping bag. Her parents would sometimes join her, and Käpylä was often accompanied by her dog.

At school, her classmates would keep their distance. The older Käpylä grew, the more others considered her to be uptight. During upper secondary school, she would spend her evenings with the hardest math problems, because solving them was fun. 'I didn't think I wanted to be the best in the class or make it on top. That type of thinking has always been really uncharacteristic of me.'

A researcher must be on display, and that is a skill which Käpylä has taken a long time to learn. She is grateful to her parents that they encouraged her to also pursue, for example, piano. This forced her to practice performing at a young age.

'I got nervous easily and was terrified of performing. Yet somehow you learn that being a researcher includes going to places and explaining your own work to your colleagues. It also comes very naturally, when you're enthusiastic about a solution you've discovered.'

Modelling galaxies sparked her enthusiasm

Nearing the end of her university studies, when all that was left for her to do was her master's thesis, Käpylä was provided with an opportunity to carry out a project on astrophysics. She jumped at the chance immediately.

'It involved modelling galaxies on the computer. I was able to do research that was clearly new and unusual and to develop methods that help obtain new information on modelling galaxies. It was terribly rewarding, and that is the path I stayed on.'

Käpylä's dissertation was in 1999, and she became an Academy Research Fellow only six years later. 'I had been a postdoc for just a few years when I was already placed in charge of a research group. It was a place of growth: it made me think I wasn't alone any longer now that there was also a postgraduate student I didn't want to abandon.'

Käpylä is in charge of an astroinformatics research group with members from a variety of different backgrounds. Multidisciplinary phenomena would be impossible to study if the group consisted only of computer scientists or astrophysicists. Leading a cross-disciplinary group is 'challenging but highly rewarding'. 'It nearly always calls for inventing something new. The work requires new visions, and therein lies the reward. The challenge is that old methods usually have to be discarded.'

Discussion on quota for women

When working as a postdoctoral researcher, Käpylä noticed that female- and male-dominated fields and quotas for women became an increasingly covered in discussions in Finland. She considered it a good thing that matters of equality and research by women were highlighted, but:

'Not many people think about what quotas caused for women and how it influenced e.g. applying for jobs. Colleagues could say that you're in this interview because of this quota for women thing.'

A bit over ten years ago, Käpylä was interviewed for a series of articles presenting research of women working in male-dominated fields. She did not think anyone would have something bad to say about it. 'Then the first comment from a well-known senior researcher was "oh, so you've become a mannequin."'

Unpleasant experiences have left a mental scar. But Käpylä is not a big fan of certain events only featuring women either, of taking photographs of only female participants or denying entry from men. She considers it discrimination to leave a part of the group on the outside on the basis of any gender. 'I have seen both extremes, and I don't like either of them. This is why I want to discuss the subject.' Käpylä will speak about this topic at the Mentoring & Diversity event organized by the Department of Computer Science on 25 September, 2020.

'I appreciate the way Aalto is run'

Käpylä recently moved back to the Helsinki metropolitan area from Germany, where she worked for the Max Planck Institute. Her big family followed her in the summer. Käpylä is happy to be back in Finland and at Aalto where she has worked as a coordinator, leading the Dynamo team of the Academy of Finland's ReSoLVE centre of excellence at the same time.

'Aalto has a very low hierarchy, but the community can still be managed and with good results. I've returned to Aalto with very warm thoughts and I now appreciate the way research is conducted and the university is run here, even more so than before.' She may miss the amount of light in Germany and the earlier arrival of spring. Yet one does get used to Finland's climate quickly, she believes. 'Finland's spring and summer are but short sprees, but you learn to enjoy them in a new way.'

By Anu Haapala,
Photo Matti Ahlgren

Maarit Käpylä, Associate Professor

Education: Doctor of Philosophy (astronomy) from the University of Oulu

Has spent most of her life in Sievi, Finland

Lives in Helsinki

The greatest professional accomplishment: 'For me, the most rewarding achievement is the fact that we were the first group in the world to produce, on some level, the sun's cycle based on a direct computer simulation.'

Is also

Having hobbies 'similar to exercising' 'My hobbies resemble running, cycling and swimming. I bike and run to work as well.'

A mother of a large family. 'I have six children, the oldest of them already an adult. Running our household calls for compromises from the children as well as adults. We have agreed, for example, on the times for doing homework and eating. Everything happens on a schedule and you can look at the shared family calendar to see where everyone is at any given time.'

Used to optimise everything. 'I always consider ways to do something the fastest and with the least effort, starting from the little things. I always buy black or brown clothes, for example, as they don't show dirt easily. I do things side by side. If I get stuck thinking about a formula or work issue, I cook, do the laundry or clean while I wait. Once I figure it out, I leave everything else or put my idea into writing.'

Besides coders, computer science needs professionals interested in humans

Master student of Software and Service Engineering, Emmi Kranz wants to approach technology from a human perspective.

Published: 6.10.2020

Emmi Kranz, who studies Software and Service Engineering as her major subject, was faced with a small crisis as a bachelor student of computer science. The field of computer science – a natural choice for someone who grew up amid technology and games – was no longer something she embraced. 'I was originally interested in computer science, because I thought cyber security was my thing. Then I noticed that it was too wide and technical,' Kranz says.

She even tried to switch her major subject from computer science to information networks. When this failed, she picked up her courage and decided to find her place among students of computer science. 'I noticed that there aren't that many people like myself in computer science, which I assumed meant that I was needed and that there must also be jobs available for me.'

Now Kranz is a second-year master student and warmly recommends her master's programme. The major programme of Software and Service Engineering provides the opportunity to choose and find a focus area that matches one's interests. The goal of the major subject is to teach students skills that are required in modern organisations. They teach design as well as developing and managing digital products and services. Master's studies also improve the ability to solve complex problems impacted by human, social and organisational factors alike.

Kranz considers the major subject to be suitable for those who consider other areas of computer science too technical. The field of computer science does not need coders alone. 'In computer science, the human aspect often only comes as an afterthought: a fancy user interface is developed, and then you realise: no one knows how to use this.'

Kranz wants to approach technology and other things from a human perspective. She is also interested in, for example, how group spirit between humans is created and how people form groups. This has resulted in her becoming a tutor for exchange students and to head the Martha club of Tietokilta, the guild for computer science students.

Martha club is intended for students who seek communal activities but not necessarily wild parties. 'The idea is for us to be together, talk and do things with our hands, such as crochet or bake buns.'

Dreaming of a job that combines technology and working with people

According to Kranz, she used to be a quiet young geek girl, who loved to play, read fantasy books and dance. At home, computer science was strongly present, as Kranz's father also played a lot of computer games and knew much about computers.

As an art enthusiast, Kranz considered studying humanities – such as history, mother tongue or English – after high school. Eventually, she decided against turning her writing and history hobbies into a job. It turned out to be the right decision. 'Now they are my ways out: if math or coding starts to get on my nerves, I'll escape them into history, fantasy or whichever area.'

Kranz has managed to carry out several kinds of jobs alongside her studies. She has worked as the community manager of a small gaming company, a flight attendant and now as a freelancer in quality testing. 'I like to experiment with all kinds of things new and different. I get bored easily by doing just one thing.'

Kranz does not yet have exact career plans, but she hopes that after graduation she can work with project management, among other things. A certain master-level course dealt with technology company Ericsson's transition into agile methodologies. This refers to a method that focuses on people and end result in a way that considers the changing world. 'Studying it interests me, and Ericsson as a company also seems interesting.'

What matters is that she can combine her technical know-how and working with people. Kranz is very happy with her decision to continue her studies in computer science, even if it did not always seem like her thing. She also encourages other students to keep going, even through the hard times. 'Now in master-level studies, it feels like I'm doing really well and it was worth pushing through.'

By Anu Haapala,
Photo Matti Ahlgren

Emmi Kranz

Education: Bachelor of Science (Technology) in computer science

Is from Helsinki

Lives in Espoo

The greatest study-related accomplishment: 'I was the scrum master of bachelor-level students of a Software Project course last semester. My team earned a quality award, which I am very proud of.'

Has also

A great enthusiasm for history. 'I write historical fiction for fun and study history for this. I like to read about people and events and consider what historical figures would be like if they lived now.'

Worked as a flight attendant for a year. 'A year ago I did not get a summer job and I noticed that Finnair was hiring. Working as a flight attendant interested me already after high school. Back then, I was too short to apply, but the height limit had been lowered since then. As a flight attendant, I could fly around the world. I was most eager to fly to China, where I meant to go study in spring 2021. I am drawn to the culture and country of China. I plan to do courses related to architecture and the history of architecture.'

Developed a green thumb since corona spring. 'I got excited about plants, and it got slightly out of hand. Now our place is filled with house plants. They also die continuously, but I've learnt from mistakes. My tips for taking care of house plants is to be persistent. Recently there were aphids in my plants, and I've removed them with a powder brush. Now they're fine again.'ways buy black or brown clothes, for example, as they don't show dirt easily. I do things side by side. If I get stuck thinking about a formula or work issue, I cook, do the laundry or clean while I wait. Once I figure it out, I leave everything else or put my idea into writing.'

Everyday choices: Nitin Sawhney, how do we cooperate in times of crisis?

Professor of Practice Sawhney examines the role of technology and cooperation in crisis using transdisciplinary human-centered design practices.

Published: 20.10.2020
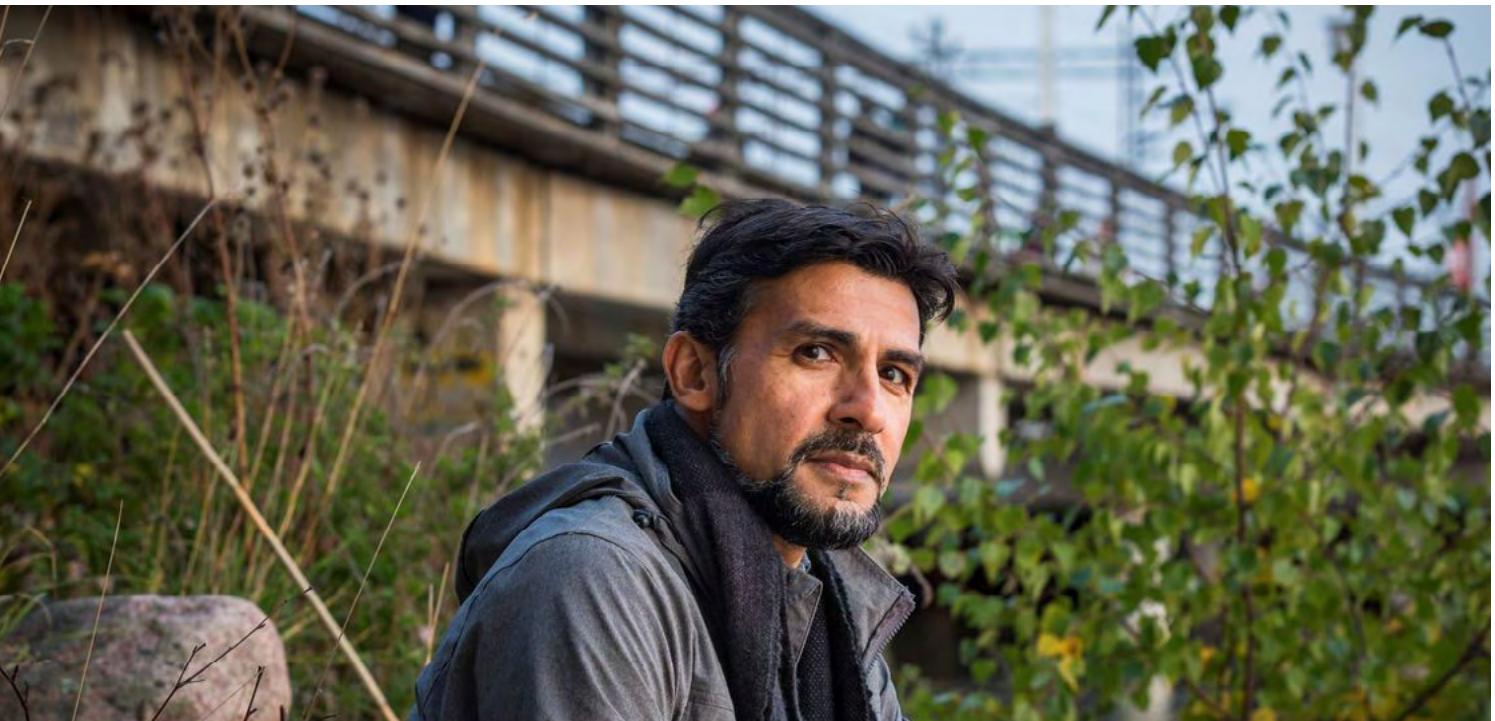
Your field of research is Human-Computer Interaction (HCI). Tell me what you find most fascinating about it!

I tend to think of Human-Computer Interaction in parallel with Human-Centred Design. These increasingly affect almost every facet of our lives – and of society.

Human-centred design practices are embedded in most of the everyday digital appliances and services we use today. Various health and wellness applications, devices and services offering heart-rate, sleep and activity tracking, like the Apple Watch and Oura ring, as well as emerging contact-tracing applications, such as Koronavilkku, released by the Finnish Institute for Health and Welfare (THL), are all developed using thoughtful HCI and human-centred design research. It's inescapable that we need to make new

technologies and services more evocative, engaging and better suited to our lives.

The field is highly trans-disciplinary and continues to evolve: it has sociologists, anthropologists, cognitive psychologists, product designers, computational data-scientists, and AI researchers among others. This is what excites me most: collaborating with people from so many different domains, who deeply care about understanding and enhancing human experience.

You have engaged in cooperation with artists, activists and social scientists. Which aspects of their thinking would you like to introduce to the field of technology?

I find myself constantly working with artists and activists on projects, and it's rather liberating, because it chang-

es how we critically engage with society outside the academic ivory tower. Artists can take a visceral or emotional approach to something, but they challenge our logical assumptions while channelling their sensibilities to create very unexpected outcomes.

I always tell my students that if we don't find something unexpected then what are we really trying to do in our research? Science should always be examining the uncertainties in our lives, and that is something artists are confronting all the time.

The role of activists is also very crucial. When there is so much injustice in the world, activists take many risks to expose these fractures in society, offering an important reality check for scientists, helping us recognise that we cannot take a neutral position. I've come to believe that creating technology and engaging in design is always political.

Starting from your childhood, crises have often had an impact on your life. You have, for example, had to emigrate because of social upheavals. Has this taught you to be prepared for surprises?

When I was a child, we moved from New Delhi to Tehran, and of course, a revolution spurred in Iran in the seventies, so we had to uproot ourselves and relocate again. While living in the Middle East, I started to realise that crises are just a fact of life. There are many moments that we simply find ways to confront and build a kind of resilience, but we also have to recognise what we can learn something from every crisis.

A crisis often brings out the best in humanity and helps reimagine how it can transform us. It offers an opportunity to recalibrate society; an opportunity to devise more inclusive and integrative solutions, rather than just addressing only one aspect. For example, during this global pandemic we've begun to pay attention to the health and economic disparities around the world, and our relationship to wildlife, ecology and the climate; all of these unfolding crises are inter-related.

Do you have a personal toolkit for crisis management? What does it include?

It varies from place to place and each context needs adapting. In any crisis situation a lot of the work is in the planning and preparation. But generally, when you are in the middle of a crisis, you have to rely on good cooperation with others.

While living in New York City, I witnessed many crises from storms and hurricanes to social and economic protests; what's extraordinary is how people who hardly know each other would quickly self-organise to take action in neighbourhoods. When there was no power in parts of the city due to flooding, grassroots communities were the first to provide relief on the ground, well before the city could effectively deploy emergency resources.

So, in addition to technological tools and infrastructures we need to nur-ture such resilient human systems to emerge and thrive. The challenge is designing platforms and practices to support such distributed and self-organized networks, rather than top-down institutions and hierarchical systems. This is something we experimented with through initiatives like Occupy-DataNYC in New York City and Mikro-Acts in Moscow.

We need to research how various micro-networks consisting of societal human response systems can be effective. I've learned to trust neighbourhood initiatives and cooperative action, but they can also collapse and are not easily scaled without the right support structures. I've examined the role of distributed co-production of knowledge and participatory design practices in such contexts.

In August, the world was shocked by the massive explosion in Beirut and the subsequent humanitarian catastrophe. What's your prognosis regarding the rebuilding of the city? Could technology help in this effort?

To me, this is really a crisis of trust and politics, and we should not shy away from discussing that. If we only deal with the humanitarian aspects, the systemic concerns and factors enabling the crisis remain unchanged.

We have to critically examine the situation in Beirut from a historical perspective. Lebanon has been through many wars and overlapping crises that have nearly devastated its infrastructure, economy and governance over the years. Lebanon was already confronting, before the pandemic and this unfortunate catastrophe, mass public protests around economic inequity and corruption. This explosion amplified all of that, while exposing the deeper fractures in society and how dysfunctional the government had been.

This vibrant city will rebuild, for sure. There are certainly many potential technologies that can be leveraged, from using drones for 3D mapping and reconstruction to devising resilient architectures and smart urban infrastructures. But we should also consider how to improve collabora-tive governance: technologies of civic engagement to rebuild the democratic institutions.

Developing new platforms where people can engage more effectively in both dialogue and dissent, offer alternative visions of the city, while participating in transformation and shared governance, is crucial. In that sense, technology is only one of the many layers affecting such crises; we need to grapple with the larger cultural and socio-political complexities in society.

Every crisis offers an opportunity for radical shifts in technology, design and social practices, as we've already seen emerging with this global pandemic.

This summer, you organised the highly topical course Human-Centred Research and Design in Crisis. How did it succeed?

It was offered as an online course with a trans-disciplinary approach; we invited disaster management experts from the Finnish Red Cross as well as design researchers and data scientists. We also had graduate students from computer science, arts and design, and all of them were engaged in thinking about the ways we can find intersections across fields in dealing with crises. Just having them in conversation with each other, reflecting on how to make sense of recent crises like the pandemic, wildfires and social protests from very different perspectives, was extraordinary.

We discussed the wider ecology of actors and stakeholders, as well as the values, ethics and power structures embedded in technology and design. This kind of political and social criticality was embraced by the students who took on more holistic, speculative and integrative design thinking. All of the course content is available to the public, and we hope others are inspired to draw on this work.

Meet the data agent: Richard Darst

Data agent Richard Darst calls for sense of proportion in expectations related to research data management. Instead of expecting everything to be perfect, he hopes everyone does things a little better in their next project. In this article series Aalto University data agents, researchers and experts experienced in research data management are introduced.

Published: 9.12.2020

Richard Darst is a staff scientist at the School of Science, Aalto Scientific Computing (Science-IT). He has worked as a data agent in addition to his other duties since 2017.

How did you become a data agent?

When I started my current job in Science-IT, I joined the Data Management Working Group. Eventually, one of our ideas was "Data Agents", where we would support a network of people close to researchers, within departments. I became one of the agents.

What do you do in practice to help researchers with research data management?

Our tools need to be designed for good data management by default, so that good data management is easier. Of course, I am here to answer questions, and based on those questions I try to make sure that our infrastructure is designed so that people don't need to ask questions.

What are your specialties in research data management?

I specialize in computational data, simulation data, software, and generally data connected to large-scale computing. I especially want to help make software reusable, open, and valued.

Why do you think research data management is important?

Of course, it's important to society, but it is equally important to every researcher and research group. I've seen so many cases where bad data management causes major problems internally: you can't quickly handle paper revisions. Your new student can't find or use the thing your previous student did. It's easier to reprocess data from scratch, than figure out how to use existing data. Bad research data manage-

ment really hurts us.

If you had a magic wand, what would you change in research data management at Aalto University?

This is not really Aalto but the world: Perfection is the enemy of getting it done. Instead of expecting everything to be perfect (which ends up being postponed, and essentially ignored) and overloading people with instructions, can we hope everyone does things a little bit better in their next project, and the final result is proportional to the value we get out of the data? As long as data is released somehow, and has a license, and minimal documentation, someone can come later and improve the data a little bit more.

What is the new Research Software Engineer program?

Science-IT has always tried to provide hands-on support to computing and data, but we can't scale as much as we need. Now, we have people dedicated to this task as part of our Aalto Research Software Engineer program.

Like us, they can provide a short-term basic service for free to the departments that join the program. Unlike us, they can also formally join and be paid by the project for a short period. This way, a group can get international-quality expertise for a short period, without needing to do their own recruitment. Services provided can range from writing and improving software, to data management, to helping with open science tasks. Right now only School of Science sponsors this program, but it will soon expand to other schools.

Your greetings to Aalto University researchers about research data management?

What do you know now about doing research, that you wish someone had told you when you first started as a researcher? Teach that to others.

By Eeva Savolainen
Photo Matti Ahlgren

Meet the data agent: Enrico Glerean

Enrico Glerean has a mission: make personal data in research as open as possible, while respecting the law and ethical principles. He teaches "good enough" practices in data management and scientific computing: "good enough" is the first step towards the "best" practices. In this article series Aalto University data agents, researchers and experts experienced in research data management are introduced.

Published: 21.12.2020

Enrico Glerean is a staff scientist at the School of Science (SCI), supporting the Department of Neuroscience and Biomedical Engineering as well as other departments in SCI and other schools at Aalto. He started as a data agent from the beginning of the initiative. Enrico is also one of the core team members of Aalto Scientific Computing / Science-IT.

How did you become a data agent?

I was a data agent before I knew it was called like that. I have always tried to convince colleagues on the importance of proper data management as well as good practices in coding to make sure the whole workflow (from data collection, to publication) is reproducible. I joined the Aalto data agent network at its very beginning.

What do you do in practice to help researchers with research data management?

As my research background is in medical imaging, I decided to focus on research ethics and personal data in research. I help researchers with issues related to the technical aspects of fulfilling GDPR/ethical requirements. It often goes beyond data management, covering aspects of scientific computing (version control, reproducibility and reusability of code). I also help researchers write data management plans and grant applications that involve personal/sensitive data as well as data storage/analysis for personal/sensitive data.

What are your specialties in research data management?

Data management for health/medical data, registry data, confidential data. Data anonymisation. Solutions for opening/sharing confidential data ethically and legally. Beyond data management and more about open science in general: Research ethics, research misconduct, questionable research practices (e.g. p-hacking, harking, researcher's bias) and possible solutions (e.g. pre-registration, blind analysis, multiverse analysis). Reproducible data analysis workflows (reproducibility, replicability, robustness, generalisability).

Why do you think research data management is important?

Sloppy data management is one of the roots of irreproducible science. Irreproducible science is not science. You win a lottery tomorrow and you disappear to a desert island and nobody can contact you anymore. If you were good with data management, your close colleague knows exactly where the data are (and the code!), which data should be used, which should be discarded, how it was collected, how you were analysing them, etc. Or maybe you won't win the lottery, but you just move to another job and have no time to go back to your old research project. Good data management makes sure that the data and the science are not dependent on a single individual: Everything is documented and "lottery winning" scenarios are not going to stop science. Good data management is also a relief for the individual researcher: once you know that everything is documented and well organised, you don't need to remember the obscure folder path with the latest version of the data, or the exact file name of the final script that analyses the data. You can then use your brain memory to remember what is more important in life such as friends and family and nice moments with them.

If you had a magic wand, what would you change in research data management at Aalto University? Good enough practices take time and researchers have barely time to do what they are expected to do. Every department should have a dedicated data agent/data steward/data manager to hands-on help researchers with their data. Each department should also have a dedicated research software engineer to help researchers with their analysis code development, code sharing, etc.

Your greetings to Aalto University researchers about research data management? Come talk with us. A few minutes chat is always beneficial. We learn from you and you hopefully learn from us. You can find me (almost) daily at the "Aalto Scientific Computing garage".

By Eeva Savolainen

Tuomas Sandholm applies game theory in his companies and encourages everyone to study AI

Sandholm, the Alumnus of the Year at Aalto University School of Science 2019, was recently named among the 100 Most Intriguing Entrepreneurs of the year in the United States.

Published: 15.12.2020

Alumnus of the Year 2019 at Aalto University School of Science, **Tuomas Sandholm**, was honoured in a very distinguished way this autumn. US investment bank Goldman Sachs named him one of the 100 Most Intriguing Entrepreneurs of 2020.

In addition to his work as a Professor of Computer Science and researcher of artificial intelligence, Sandholm is a long-term serial entrepreneur. The tribute from Goldman Sachs was awarded for his work on a company called Strategy Robot. The startup founded in 2018 uses applied game theory, artificial intelligence (AI) and optimization, for example, to assist the United States Department of Defense.

In 2017, several US media wrote about the Libratus poker bot developed by Sandholm and his colleagues that managed to beat four professional poker players at a two-player game of Texas Hold 'Em. The group of researchers led by Sandholm developed the bot in order to test automated decision-making based on a game theory. In 2019, his bot Pluribus won the best professional players in Texas Hold 'Em with several players. According to Sandhold, it was the first AI-based system that performed better than humans in a game that wasn't a zero-sum game between two players.

Sandholm founded Strategy Robot to apply similar technology for the use of the U.S. Department of Defense in planning and war games, for example. Media such as US magazine Wired have since written about the company.

Sandholm believes that the honorary mention by Goldman Sachs is due to the fact that the list includes entrepreneurs and companies working with something new and revolutionary. 'It's nice to have a leading instance like Goldman Sachs note us already at this stage,' he says.

At the beginning of December, it was announced that Sandholm wins also the 2021 Robert S. Engelmore Memorial Lecture Award from the Association for the Advancement of Artificial Intelligence (AAAI) for his AI research and service to the AI community. He will receive the award at AAAI's Innovative Applications of Artificial Intelligence conference in February 2021.

'I have always found it important to make real-life applications as well'

Selecting Sandholm as the Alumnus of the Year 2019 at Aalto University School of Science was based on the fact that he has successfully commercialized his research and translated it into innovations and business in his academic career.

'I have always found it important that academic work has an impact in the real world and the world becomes a better place through this work. I have carried out artificial intelligence research since 1989, and I have always found it important to make real-life applications as well instead of just theory, although my research group does both.'

Even before founding Strategy Robot, Sandholm had worked as an entrepreneur for two decades.

He developed online trading centers based on optimization as early as the late 1980s and founded his first company CombiNet in 1997. It managed to arrange over 800 combinatorial multi-attribute auctions where the buyer acquired combinations of items instead of single ones, with over $60 billion in total spend and over $6 billion in generated savings, before the company was sold in 2010.

The next company was Optimized Market. It sells software for companies in the advertising industry to help with the timing, pricing and distribution of advertising campaigns. The objective is to improve the advertising chain and make advertisements visible to the people actually interested in them.

There is yet another company utilizing game theory in the making. The company, still in its early stage, is called Strategic Machine and aims to help private companies instead of operators in the public sector.

'Business strategies today certainly don't optimize strategies in a game-theoretical way but are based on heuristics. Industries, where for example pricing and product portfolio are optimized, do not consider the answers of competitors. This means that there is quite a lot of work in terms of making things better and in a completely new way,' Sandholm says.

Industrial engineering and artificial intelligence

Sandholm studied industrial engineering in the 1980s at the Helsinki University of Technology, which later became part of the current Aalto University. He liked being in Otaniemi and made friendships that have even lasted until this day.

Already back then, Sandholm had an interest in combining business economics with computer science. In his studies, he delved into corporate strategy, international marketing, system analysis and operational research as well as artificial intelligence.

The technicality of applied mathematics courses appealed to him. 'Later, at the end of the 1990s when the study of artificial research became inter-

> **"I see it as a pyramid of knowledge. If you do high-level research at the top, you need a strong foundation – the pyramid won't hold without a broad and strong base"**

nationally more mathematical, it was good that I had taken applied mathematics seriously.'

Sandholm graduated as a Master of Science in Engineering in 1991 and set off for doctoral studies in the United States immediately after that. Currently, he works as a Professor of Computer Science at the Carnegie Mellon University in Pittsburgh, Pennsylvania and publishes in the fields of artificial intelligence and applied mathematics.

Everyone benefits from studying artificial technology and applied mathematics

For current students, Sandholm's advice is that whatever you do study, the basics need to be in order. 'I see it as a pyramid of knowledge. If you do high-level research at the top, you need a strong foundation – the pyramid won't hold without a broad and strong base.'

Sandholm recommends for all adolescents to get to know artificial intelligence and applied mathematics, at least on some level. 'After ten years, there will probably not be many industries where you can carry out research without understanding artificial intelligence to some extent.'

Those interested in a doctoral thesis should focus on things that are new and relevant and boldly apply for research groups carrying out the best research in their field. 'For students of industrial engineering and business, I would say that it's helpful to have expertise in a certain field, not just management. A career can be more satisfying once you truly understand the field you work in.'

In terms of his own career, Sandholm hopes that he will get to witness the game theory being incorporated widely into applications and products, through Strategy Robot and Strategic Machine, for instance. He also hopes that the theory he has developed could somehow be used in the fight against climate change. 'I've commissioned a couple of market studies on how our technologies could help prevent climate crisis. Yet we still haven't found a so-called killer application.'

By Anu Haapala,
Photo Tuomas Sandholm

Tuomas Sandholm, professor and alumnus

Work: Professor of Computer Science at the Carnegie Mellon University (Angel Jordan University Professor of Computer Science, Co-Director of CMU AI, Founder and Director of the Electronic Marketplaces Laboratory), an entrepreneur at Strategy Robot, Optimized Markets, and Strategic Machine

Education: Ph.D. (computer science) from the University of Massachusetts, Amherst, Master of Science in Engineering (industrial engineering) from Helsinki University of Technology (current Aalto University)

Is from Helsinki

Lives in Pittsburgh (Pennsylvania) in the United States

The greatest professional accomplishment: 'If you look at science, I would say, solving games of incomplete information. Looking at the bigger picture, I'd say, having been able to carry out artificial intelligence research from basic research to software solutions that have a significant real-life impact.'

Has also

Been in the Finnish national windsurf team' 'In 1987, I was a Finnish champion, fifth on the European level and twelfth in the world. Windsurfing was a really big deal at that point in the 80s. I still windsurf, though I no longer compete.'

Travelled around the world together with his fellow engineering students. 'On that trip, I got to see the world and different cultures. I still have very good friends from that trip and period of time.

Managed to embarrass himself with his enthusiasm for engineering. 'I received the title of honorary doctorate from the University of Zurich, and the university arranged an event that was attended by the President of the Confederation and ministers of Switzerland. The president had an educational background in engineering, and I admired this during our discussion. In the US, presidents are nearly always lawyers. The president agreed, which encouraged me, and I continued the same discussion with the next person, saying that it's great to have others besides lawyers manage things here. By the time I spoke to the third person, things did not go so well: the person ended up pointing out that they are the minister for education in Switzerland, and a lawyer.'

Former Nokia executive Tero Ojanperä believes intelligent platforms could be next success story for Finland

New professor of practice wants to apply his AI expertise and make sure usable innovations are brought from research papers into practical use.

Published: 3.2.2021

Finland has a history of creating successful businesses from new technology. The competition is hard, though, and ever-intensifying – how are we keeping up?

There are signs in both directions. On the one hand, there are stagnating numbers in productivity and digitalization, growth lagging behind neighbouring countries for a decade already. On the other hand, there is entrepreneurial spirit, promising startups, bigger and bigger venture rounds. There is tech company Wolt and its hundreds of millions of growth financing.

Tero Ojanperä, a newly appointed part-time professor of practice at Aalto University and one of the founders of Silo AI, the largest artificial intelligence lab in the Nordics, has an in-depth perspective on the development. Ojanperä has previously worked for years as an executive in Nokia, and subsequently moved onto the world of startups and AI. He believes that platform economy and AI are now key elements in technological development, and for him, they are intricately connected.

"If you take any significant global company, you see how platform economy and AI interweave. Because of this, I like to use the term "intelligent platforms"".

Intelligent platforms are also central to Ojanperä's new role as professor of practice, a position that is split between the departments of industrial engineering and management and computer science, and is also tightly connected to the Finnish Center for Artificial Intelligence FCAI.

Ojanperä elaborates on his role by first explaining the what he means by intelligent platforms:

Platform economy has to do with a business model in which the network effect has a key role. When new users join a platform, earlier users ben-

efit. One example would be Facebook where a friend joining in is a benefit for me, too.

AI, then, helps in making use of these networks as efficiently as possible, and especially of the data produced in them. Every single Tesla driver provides all Teslas data that teaches them to behave more smartly on the road. Learning with the help of AI is much quicker than without.

When the amount of data gathered by companies grows, also more traditional industry can make use of such elements of platform economy. For instance, a manufacturer of machinery can gather data from all of its machines and use it to further improve its products.

As the platform capabilities from the current business can often be applied elsewhere, platform companies have considerable potential for expanding into new fields. Ojanperä calls these "strategic leaps". For instance, Wolt was able to use the logistics expertise it had gathered from food deliveries and expand quickly to other deliveries.

"New Nokias are already here"

So what does the future look like? Ojanperä is cautiously optimistic.

"If you take a look at AI, the past three years have seen major leaps in the right direction in Finland, he says.

According to Ojanperä, the possibilities of AI have gradually been understood in large corporations. In addition, the Finnish startup field gives reason for optimism. Ojanperä praises the "Slush-generation" which in the past few years has founded several promising firms and has also reinvested the money from exits into new startups.

A positive attitude towards entrepreneurship should also not be underestimated. Aalto, Ojanperä notes, has played a key role in encouraging this.

"This entrepreneurial spirit didn't always use to be there. It has arisen in the 2010s."

One of the major breakthroughs of the Slush-generation is the gaming giant Supercell, which has not only succeeded in occupying a leading position in the global gaming industry, but has also managed to keep up the good work. Other high-flyers follow: Ojanperä mentions again the delivery company Wolt, the satellite company Iceye, the ad company Smartly – just as examples. All have roots in Aalto.

"There used to be a lot of talk about where to find the new Nokia. These are the new Nokias", Ojanperä says.

Courage as bottleneck

A sigh of relief might nevertheless be premature. According to Ojanperä, especially small and middle-sized firms could understand the potential of applying AI a lot better than they currently do. Also bigger players still lack courage to take on challenges.

Overall, Ojanperä says that there is great need for education regarding new technology. In addition, useful innovations currently sometimes remain in research papers with no one

to take advantage of their economic potential.

Such challenges relate to Ojanperä's work in Aalto. He'd like to bring together people from different fields, from the university, and from business. If needed, he says he could also function as an interpreter when know-how from the academia is translated into the language of business. He would also like to develop new funding models for cooperation projects, as well as help utilize the existing ones more efficiently.

For FCAI, Ojanperä is prepared to offer his insights on what kind of AI research is especially sought after in the world of business, and on how research results can be brought into practice.

This spring, Ojanperä and the professor of strategic management Timo Vuori are starting a project together with the international business school Insead, the aim of which is to map factors that hinder, and speed up, the implementation of AI in companies.

Also students will get their share of Ojanperä. The new professor of practice says that he considers the possibility to take part in teaching "super exciting".

"Here, I can really have an impact on what kinds of students graduate from the university."

The head of the department of industrial engineering and management Risto Rajala thinks it great that the researchers and students of Aalto will be able to benefit from Ojanperä's extensive experience at the crossroads of research and industry.

"Lately, the technical know-how regarding AI has developed positively in Finland. However, in addition to courage, know-how in application is needed. This is an exciting challenge not only for companies but also for students."

By Minna Tiainen
Photo Juho Vainio, Silo AI

'The atmosphere at Aalto is comfortable and you can do things at your own pace'

Thong Tran, the first graduate with a major in Data Science, shares his experiences on studying at Aalto University.

Published: 8.12.2020

Thong Tran is the first student who has graduated from Aalto Bachelor's Programme in Science and Technology - Data Science. Thong, who originally comes from Vietnam, became interested in data science during his engineering studies in Singapore, but during his first studies, he did not have a chance to invest much time on learning more about data science.

Data science is a multidisciplinary field that focuses on the study of scientific methods used to extract knowledge from data and build models that cope with complex problems. It employs techniques and theories drawn from the broad areas of mathematics, statistics, information sciences, and computer science.

Thong says, 'It was an easy choice for me to move to Finland to study data science because my girlfriend lived here. I had also heard that Finland has a high quality of life and it is a peaceful country, which fits me well.'

Thong has been happy with his choice ever since. He appreciates especially the fact that, at Aalto University, students get a great amount of freedom to choose courses they like, also from other study programmes, and that there is not much comparing and competition.

When Thong went to secondary school, his favourite subject was physics, but he was a bit intimidated by mathematics. 'There were so many good students in Vietnam, and we were also very competitive. Here, I think the atmosphere is more comfortable and you can do things at your own pace.'

Dreaming of combining data science and finance

In addition to studying, Thong has found some time to do tutoring on programming courses, for example, during which he got to meet several new people. To balance work and leisure, he likes to play videogames and take walks.

For his bachelor's thesis, Thong completed a study on approximate Bayesian computation. This work also helped him get an internship position in an Aalto University research group in which he continues working.

During their bachelor's studies, the Aalto data science students obtain important skills that help them solve real-world problems using algorithm design, machine learning, artificial intelligence, statistical inference, operations research, and optimization. After completing the bachelor's degree, many students continue their studies in the Master's Programme in CCIS - Machine Learning, Data Science and Artificial Intelligence.

That was Thong's choice as well, and he started his master's studies this autumn.

'I guess the next one and half years will be quite important because I will need choose whether I want to be more involved academically and do a PhD or whether I want to work in the industry right after completing my Master's.'

Right now, his dream job would be working at some interesting tech company or at a bank. In fact, in addition to being interested in data science, Thong is keen on learning more about finance. 'I did a minor in financial engineering here at Aalto. That minor opened just last year, so I was very lucky.'

By Anu Haapala,
Photo Matti Ahlgren

If you study computer science, you may end up developing better cancer treatments by applying AI

Heli Julkunen developed a machine learning method that predicts how different drug combinations kill cancer cells, and now she helps advance preventive healthcare as a data scientist

Published: 16.2.2021

Heli Julkunen, Master of Science (Technology), saw a great culmination point for her years at Aalto University in autumn 2020.

Towards the end of her studies, Julkunen took on a central role in a research project of Aalto, the Institute for Molecular Medicine Finland (FIMM), and the University of Turku that combined artificial intelligence and medical research. The project involved researchers developing a machine learning method which accurately predicts how different cancer drug combinations kill cancer cells. Julkunen's master's thesis on the subject was considered excellent and it received the Master's Programme in Life Sciences Technologies award in the summer of 2019.

Julkunen graduated as a Master of Science in Technology in 2019 but continued her work on the subject and finalised an article on the project for publication, first alongside her day job and later as a project researcher for Aalto. In late 2020, the article was accepted for publication in the esteemed Nature Communications scientific journal. This was covered in news in Finland as well as abroad.

Combining different drugs in cancer treatments often improves the treatment's effectiveness while also reducing its harmful side effects if the dosage of a single drug can be reduced. However, the experimental screening of drug combinations is slow and expensive, which increases the importance of utilising artificial intelligence (AI) methods.

Researchers trained the machine learning method with a large set of data from previous studies focused on investigating the associations between drugs and cancer cells. The results of the study revealed that the complex model discovered connections be-

tween drugs and cancer cells that were not observed with simpler models.

'The method is based on a similar principle as recommendation systems behind applications such as Netflix and Spotify. Instead of recommending certain songs or films based on what other similar users like, the method can be used to predict how similar drug substances work together with other drug substances and different types of cancer cells' says Julkunen.

This is precisely what fascinates her about data science and artificial intelligence: similar methods can be applied for very different use purposes and in different fields. 'It's really amazing, all the things you can do with data.'

Drawn to the possibilities of mathematics and physics

Julkunen was fond of school as a child and adolescent and liked several

subjects. She spent her free time with friends and on the move. Her hobbies included horseback riding, swimming, and playing the Western concert flute.

Pursuing studies in the field of science after upper secondary school was not a given: Julkunen was also enthusiastic about literature and history, among other things. Medical studies interested her as well. 'Instead of working as a medical doctor, however, I was more interested in the possibilities of technology in the healthcare sector.'

Julkunen was admitted into Aalto University to study bioinformation technology, and as her minor, she studied computer science. At first, she did not quite understand all that comput-

> **'This is precisely what fascinates her about data science and artificial intelligence: similar methods can be applied for very different use purposes and in different fields. 'It's really amazing, all the things you can do with data.'**

er science and data science include and can be used to do. 'Yet the coding courses included in my basic studies and the studies in computer and data science made me realise how interesting all this is.'

Her interest in research was sparked during the second year of studies. Julkunen began to look into the different research groups at Aalto and sending emails to the people heading those groups. Professor **Juho Rousu** responded to her email and gave Julkunen a position as a summer intern.

Working as a research intern, she was able to put methods introduced in her studies to practice. At first, Julkunen began studying the interaction between drugs and proteins and the ways they could be predicted with the help of machine learning. After a couple of years, she was introduced to the study

on cancer drug combinations.

During her master's studies, Julkunen opted for the Master's Programme in Life Science Technologies and chose Complex Systems as her major subject. She focused on data science, artificial intelligence, machine learning and bioinformatics, in particular. For the summer of 2017, she received a coveted scholarship to study at Stanford University in the United States.

'The place was very much disposed towards entrepreneurship and the students were highly motivated. I completed a course on entrepreneurship that took me slightly out of my comfort zone. Studying at a top university abroad was a very encouraging and meaningful experience at that point in my studies.'

Placing interest and enthusiasm first

According to Julkunen, she has always been interested in applying artificial intelligence to the field of healthcare. It is a way to apply theory to 'problems of the real world' and do something meaningful for people's

health.

Upon graduation, Julkunen began working as a data scientist for Nightingale Health. The company seeks to develop preventive healthcare through data science; the goal is to reduce chronic illnesses by preventing and fighting them more effectively.

'Based on blood analysis, we predict the development of chronic diseases, and that way, we aim to prevent them so that people could change their lifestyle and the direction of their health,' Julkunen explains.

She considered beginning a doctoral thesis after graduation, but the projects at Nightingale piqued her interest. Even though Julkunen is happy working in the corporate sector, she has not ruled out postgraduate studies if she finds a topic that is interesting enough. 'I've always wanted to carry out projects that are interesting and inspiring, instead of trying to take a certain pre-defined path.'

By Anu Haapala
Photo Matti Ahlgren

Heli Julkunen, data scientist and alumna

Education: Master of Science (Technology) from Aalto University

From Hyvinkää

Lives in Espoo

Greatest academic or career achievement: : A scholarship to Stanford University and getting published in Nature Communications journal'

Has also

Salsa dance as a hobby' 'Dancing makes work stuff disappear; you can have fun, enjoy the music and let go.'

Done sky diving during her time at Stanford. 'I did it despite my terrible fear of heights. I was brave enough to do it because I was following my friends' example and I wanted to challenge myself. It was scary but fun!'

A high interest in learning new things. 'I enjoy learning and trying new things also in my spare time, whether it's investing in stocks or trying a new form of exercise.'

Teaching creativity to computers - Christian Guckelsberger wants to equip AI with the motivation to discover the unexpected

Research on computational intrinsic motivation could answer some fundamental questions about the nature of creativity, but also improve household robotics or even self-driving cars

Published: 18.5.2021

Since the 1950s, computers have served artists as tools to unleash and augment their creativity – and right from the start, AI researchers have wondered whether the machines themselves could be creative.

Today, computers produce art that people collect and even mistake for man-made. **Christian Guckelsberger** believes that something fundamental is still missing, though.

Guckelsberger is a postdoctoral researcher at Aalto University and the Finnish Center for Artificial Intelligence FCAI. He stands at the crossroads of some very different fields: computer science, art history, philosophy, and cognitive science. Armed with insights from all of these, he wants to get to the essence of what makes us creative, and help computers get the hang of it, too.

To do this, Guckelsberger believes we need to equip AI with intrinsic motivation – the thing that drives us people when we persistently do something while not aiming for any specific goal or benefit. While psychologists consider intrinsic motivation – of which curiosity is perhaps the most famous type – a cornerstone of human creativity, its role has received little attention by AI researchers.

Guckelsberger wants to fill this gap, and to do this he has chosen an environment where the imagination can roam free: video games.

'Video games have become arguably the most prominent AI testing ground in recent years', he explains. 'And creativity can flourish particularly well where we are allowed to playfully experiment'.

Where philosophical questions meet video game characters

Guckelsberger's work is part of FCAI's research on interactive AI. His insights support and enhance the interaction between AI and people, and could, for instance, lead to more robust and adaptive video game characters that require less cost- and time-intense fine-tuning by developers.

The possibilities of more creative AI are of course not confined to video games. Many real-world applications, from self-driving cars to household robotics, could benefit from this research.

'Our work provides the foundation for a whole family of new AI algorithms to drive more open-ended and robust human-AI interaction in other domains', Guckelsberger says.

Guckelsberger has also made several theoretical contributions that address fundamental questions about the future role of AI in creative activity: What does it take for a machine to be accepted by us as a creative partner? Could it truly be the author of its own ideas? And could we ever build an AI that intentionally exhibits human-like creativity?

'I would like to use an AI toolbox to complement what philosophers and psychologists can do, and also feed insights back into those disciplines'.

From a covid hotspot to the socially distant Helsinki

Guckelsberger's journey into research begun with German university degrees in art history and computer science. An exchange year in Glasgow got him hooked on AI and the question whether computers could be autonomously creative.

'This shaped my future career'

Guckelsberger eventually wrote his PhD at Goldsmiths College and Queen Mary, University of London, supervised by Professor **Simon Colton** who is a pioneer in computational creativity research. His demonstrations in video games caught the attention of Aalto University professors Perttu Hämäläinen and Antti Oulasvirta. Over a period of two years, they convinced Guckelsberger to choose Finland and Aalto University as his next destination.

Guckelsberger arrived in Helsinki last May, at a time when London was a European corona hotspot. He says he has not regretted the move once, and not just because of covid.

'Having spent six years in London, with all its rush and noise and pollution and stress, I felt like Helsinki was just the thing I needed to ground and inspire me again', he says.

The covid restrictions have made his start in Finland rough, though. Guckelsberger was lucky to get involved in a project at the Institute for Molecular Medicine Finland (FIMM) driving covid-19 research with AI, the results of which we will probably hear about soon. This required work on-site.

'Collaboration with FIMM saved me to a certain extent', he says.

By Minna Tiainen
Photo Matti Ahlgren

Alexandru Paler: Creating software for quantum computers

The newest professor to join the department of computer science tells us about how, when you cut through all the hype, quantum computing is full of interesting challenges that unites diverse fields.

Published: 17.6.2021

Alexandru Paler has joined the department of computer science as an assistant professor. Paler was previously a researcher at Johannes Keppler University, Linz in Austria and did his PhD slightly further upstream on the Danube at the University of Passau in Germany. We spoke to him about his work on developing software for quantum computing.

What do you research?

My work is like a triangle, with three sides that support each other. First is the design and implementation of quantum software, the second is quantum error correction software, and the third, newest side, is quantum circuit simulation.

I did my PhD in circuit design, which including quantum circuit design. After this, my research focused on quantum software, which is the software required for operating a quantum computer. It's such a wide area and there are many people working in different corners, so the work covers a lot of bases. I spent two of my postdoc years writing code, but realized that a lot of it was useless. I'd made state of the art tools, but they did not produce state of the art results because there wasn't the possibility to actively incorporate error-correction methods. So, I started exploring which software parameters need to be optimized in order to improve the detection of errors.

With quantum computers, errors can arise from imperfections in the hardware and noise from the environment, and these are problems that physicists are trying to solve. But even with a perfect system you would still get errors from the environment, so I am interested in software that can recognize and correct these errors. These tools are called quantum decoders.

The third part of my research is related to quantum circuit simulation. We started looking into simulation software because testing the decoders and analyzing the circuits needs a quantum computer, and we don't have quantum computers quite yet. Simulating quantum computers is a difficult problem, so we are focusing only on specific simulation requirements.

These three strands make up the triangle of my work, hopefully they will come together and result in something nice.

What interested you about the field?

To be honest I didn't really have a clue at the time what I was getting myself into. In retrospect, I was drawn to this field because it's a challenging problem. I didn't care too much for my employability, I was interested in the research challenges.

So where do you see the field going next?

I'm into the field of quantum computing because it's so interdisciplinary in the truest sense, it's quite difficult to stay afloat of everything that's happening. Even if you cut out all of the hype— of which there is a lot— people are generating very interesting results about computing and engineering in general. We're learning things that are valuable for fields outside of quantum computing. One example is that I did my Master's thesis on digital image processing, which had nothing to do with quantum computing. Now, people are talking about quantum machine learning, with applications in things like image classification. It is possible to connect broad research areas of computer science, physics and engineering together with quantum computing research. Even if quantum computing turned out to be a great big disappointment and didn't work at all, then there would be value from all the sharing of knowledge from across all these different fields!

By Matthew Allinson
Photo Matti Ahlgren

Computer Science News

Ten new Academy projects awarded to the School of Science

The projects will investigate questions from nuclear fusion, solar energy, bio inspired materials, and many more

Studies, published: 17.6.2020
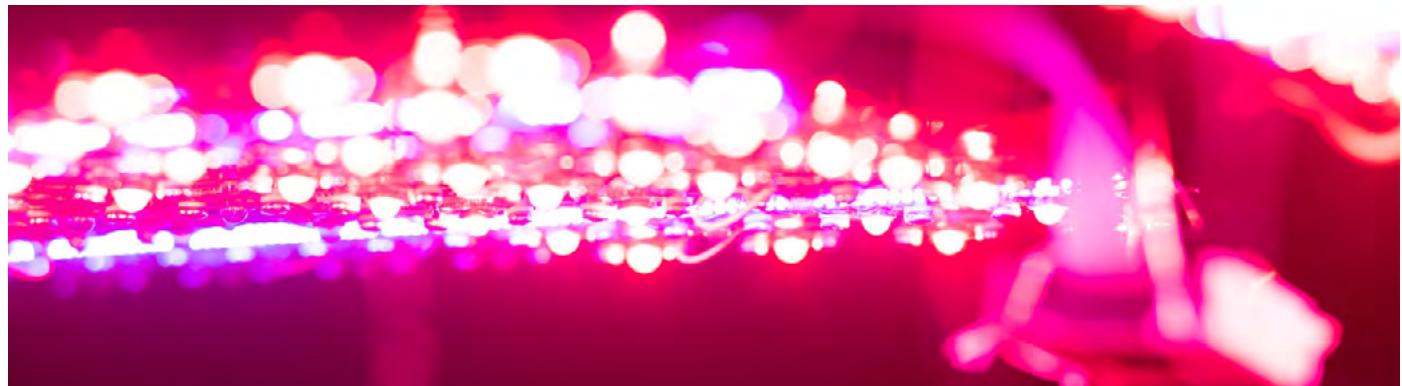
Dr **Vladimir Eltsov** investigates topological matter experimentally at ultra-low temperatures. In the future, such materials promise to change everyday life by making quantum devices available even at room temperatures, but currently there are still a lot of questions to answer, like resistance to the noise from the environment.

Professor **Mario Di Francesco**'s project aims to overcome the limited resources of mobile devices for cross-reality - virtual, augmented, and mixed reality. It does so by moving heavy processing to remote servers, while guaranteeing high quality and low latency for a truly immersive user experience.

Professor **Mathias Groth** aims to elucidate the role of molecules and photons in achieving highly radiative edge plasmas in nuclear fusion reactors. The project will be carried out at Aalto University in collaboration with scientists from Germany, the UK and the USA.

Professor **Olli Ikkala** investigates soft materials consisting of polymers, liquid crystals, proteins, surfactants, colloids, and biological matter, thus involving a wide range of functional properties, from adhesion, stretchability, and absorption properties to even "life-like" properties.

Assistant Professor **Alex Jung** and his colleagues develop modern AI-based methods for condition monitoring of powertrains. The results of the project are expected to produce new knowledge on how to optimally leverage AI algorithms for energy conversion systems.

Professor **Fabricio Oliveira**'s project will further develop the decision programming framework as a methodology for modelling and solving multi-stage decision problems under uncertainty. The outputs of this project offers researchers and practitioners a general modelling approach for addressing challenging decision problems, including those encountered in diagnostic testing in healthcare, selection of risk mitigation actions for safety-critical systems and cost-benefit analyses for climate change mitigation strategies.

Professor **Vanni Noferini** and collaborators have discovered a completely new class of functions called "centrality measures" that have the potential to overcome certain disadvantages that more classical measures are known to have. "Who is the most influential person among those you follow on Twitter?" or "Which reindeer should be isolated from the herd to avoid the spread of a deadly disease?" are examples of the questions that network theory can answer via centrality measures. This project will advance the study of these novel measures, and to apply them to problems in biology, economics, and finance.

Professor **Patrick Rinke** targets low cost, high efficiency solar cells. In the LearnSolar project, he will develop and apply a machine-learning based materials design approach to find more stable and environmentally friendly perovskites, a new and promising class of solar cell materials.

Assistant Professor **Jukka Suomela**'s research group studies which computational tasks can be solved rapidly with distributed algorithms, and which computational tasks are such that solving them with any distributed algorithm will necessarily take a long time. A theory of such systems will help us to understand not only man-made communication networks but also systems taking place in nature.

Assistant Professor **Jara Uitto**'s group studies frameworks that are designed to process big data. Their goal is to understand what can be computed by the aforementioned frameworks. This allows the researchers to show how to solve fundamental problems efficiently and identify provably hard problems. Ideally, this allows us to understand how the practical frameworks need to be adjusted to provide more efficient data processing, researchers explain in their project description.

Aalto students help develop digital services for women's charities and family support groups

Student projects included a website for advice on long-distance relationships for Väestöliitto and an Instagram campaign aimed at recruiting members for the Women's Line.

Studies, published: 17.6.2020

Students from two Aalto University courses have collaborated with a group of organisations to help develop their digital services. The students came from the Digital Service Design course and the Growth Hacking course, both part of the Information Networks programme, which is led by Professor **Risto Sarvas**.

'The courses bring together students, companies, alumni and third sector organisations, resulting in meaningful and socially important collaboration. Many students and graduates reflect on the importance and contribution of their own work to society. It is therefore important that the students have an opportunity to cooperate with the third sector as well as companies. This way they get to experience how their own skills and expertise can improve the world,' Professor Sarvas said.

The organisations participating in the courses were Väestöliitto, the Women's Line and the Association of Domestic Science Teachers. In the service design course, students designed a website about long-distance relationships. The website combines strategy, services and marketing.

'Some of the relationship services already existed, but after the cooperation with Aalto a remote relationship component was added. A large number of young adults living in a long-distance relationship need information, support and peer support, as well as services to strengthen their relationship. The course cooperation was a great success,' said **Heli Vaaranen**, Psychotherapist from Väestöliitto.

The collaboration with Väestöliitto began with students planning and implementing a nationwide online survey and interviews, which provided a lot of additional information about long-distance relationships.

'Long-distance relationships have pitfalls and that is why couples can benefit from additional services. For example, moving together as a couple after a long-distance relationship can bring about a crisis. After all, this is where two people who have lived independently and in two different worlds come together. Based on the survey, couples would particularly like peer support and information about the

> **'The rapid experiments changed the way we operate and boosted our social media communication. We will continue with these small-budget, quick-response campaigns. Years of pre-planning isn't always needed'**

successes and failures of other couples in long-distance relationships,' Heli Vaaranen added.

The cooperation with the Women's Line was aimed at developing membership acquisitions - increasing the number of both main and support members.

'Together with the students we conducted three short social media campaign experiments. Instagram stories one and two were implemented in January-March and the third campaign in March used content that worked well on Valentine's Day and on Women's Day,' said **Ada Kairavuori**, Communications Coordinator at Women's Line.

The number of membership applications increased after each experiment, and in addition to these, the Women's Line also received new voluntary applications and dozens of new followers on Instagram.

'The rapid experiments changed the way we operate and boosted our social media communication. We will continue with these small-budget, quick-response campaigns. Years of pre-planning isn't always needed,' Ada Kairavuori said.

All of the campaign content was designed by the Aalto students, in close collaboration with the Women's Line.

'The students immediately understood what kind of visual catalogue we wanted to use. We are dealing with difficult issues, but we want to support recovery. The students understood this from the start and thus were given freedom with the campaign implementation,' Ada Kairavuori added.

During the course, the students visited the organisations' offices, and representatives from the organisations in turn attended lectures and the final seminar.

'Services for long-distance relationships and violence against women emerged as important themes during the coronavirus crisis. The work done by the students was even more meaningful and topical than we expected at the beginning of the year,' Risto Sarvas said.

By Tiina Aulanko-Jokirinne

Flexibility and enthusiastic teaching make the SECCLO programme a great option

The first graduates of the SECCLO programme share their study experiences

Studies, published: 18.6.2020
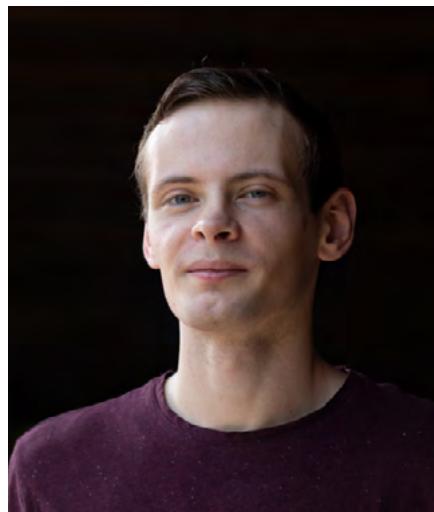
Eric Cornelissen

Shiting Long

The first students from the Master's Programme in Security and Cloud Computing (SECCLO) have graduated. **Eric Cornelissen** and **Shiting Long** presented their Master's theses and completed their studies at the end of May 2020.

SECCLO is an Erasmus Mundus Joint Master Degree programme in the field of computer science, and it combines practical engineering skills with a strongly research-based curriculum. The SECCLO programme was established in 2018 and it drew both Mr Cornelissen and Ms Long to study and live in Finland.

After completing his Bachelor's Degree in Engineering at Delft University of Technology, in the Netherlands, Mr Cornelissen knew that he wanted to continue his studies in a security-related programme. 'First of all, security seemed interesting from a mathematical point of view. Secondly, I was interested in how you make systems secure and why you should make them secure,' he explains.

Ms Long – originally from China – came to Europe as an exchange student, and she also completed her bachelor's thesis project at Leiden University, in the Netherlands. 'I enjoyed living and studying in Europe, so I decided to apply to some European master's programmes,' she explains.

Her bachelor's degree at the Beijing Institute of Technology had focused on computer science and software engineering on a general level but she had completed some elective courses that focused on security and realized she would like to learn more.

The SECCLO consortium consists of six universities which are renowned research and educational institutions in Europe, and among the top-ranking universities of technology in the Nordic countries: Aalto University, KTH Royal Institute of Technology, The Norwegian University of Science and Technology (NTNU), The Technical University of Denmark (DTU), University of Tartu (UT) and EURECOM (France).

The students complete the first year of the Master's programme at Aalto University and spend the second study year abroad. Both Mr Cornelissen and Ms Long studied at the University of Tartu, in Estonia, in addition to Aalto and they say that they enjoyed their time at both universities and in both countries.

Flexibility is one of the aspects they enjoy most about studying in Finland. 'The general study atmosphere is very free, which is something I find very enjoyable. You do not need to follow many rules and you can study while enjoying the process. That is really nice because every student is different and has their own way of studying,' says Ms Long.

She thinks that it is important that students do not need to decide what they want to focus on right at the beginning of their studies. 'You can find out what you are interested in along the way.'

Mr Cornelissen says that he enjoys Finnish nature and living in Helsinki, which is a big city and a cosy place at the same time. 'Also, the staff at Aalto is very good. The teachers do not just teach because they have to do so – most of them really enjoy teaching and that shows. That was the case also in Tartu.'

The SECCLO programme prepares its students for many types of careers. Ms Long is interested in research and has now applied for both PhD positions and researcher jobs in industry. 'I did my master's thesis with Professor **Pekka Orponen**. The project was very interesting and, if possible, I would like to continue my previous research.'

Mr Cornelissen would like to work as a security specialist or security consultant. However, before starting to look for jobs, he will first finish writing a research paper together with his thesis supervisor **Chris Brzuska**.

Both graduates warmly recommend the SECCLO programme for students who are interested in security. 'Of course, you have to be interested in living in two countries, so you also need to be a bit adventurous,' Mr Cornelissen adds.

By Anu Haapala
Photos Matti Ahlgren

The coronavirus pandemic encouraged hundreds of experienced professionals to study change leadership

The Facilitating Change online course saw as many as 500 registrations, with the majority of participants already within working life

Studies, published: 26.6.2020

Aalto University's Department of Computer Science and the Department of Industrial Engineering and Management arranged an open online course called Facilitating Change, which became a huge success. The free course, which was directed at those interested in change leadership, organisational transformation and organisation design, fit up to 500 students.

Up to three quarters of the participants enrolled to the class from outside the university. The other host of the course, Professor of Practice **Risto Sarvas** believes that this proved the appreciation for facilitating leadership and the interest towards it. The course also included many experienced 'change agents,' who now got the opportunity to meet one another. 'Change agents are often quite on their own within an organization but during the course found out that they are not alone and that it is an actual job description that requires concrete skills and tools,' Sarvas states.

The coronavirus pandemic made the course particularly timely: the central theme was new leadership in the time of uncertainty. The pandemic forced small as well as larger companies to face change, even a crisis, and made all types of organisations rearrange their operations. 'I believe that, already in March, many could see the change which organisations and businesses would face. In this sense, the course was surely a good investment during a time of crisis.'

The course provided new tools to get started with

Due to the coronavirus situation, the course was arranged entirely online. Some students carried out the course and received credits for it, but the course could also be completed as a 'tourist': lectures could be followed freely, but there was no pressure to complete course assignments.

The fact that the course took place online was fortunate for **Fransje Schoenmaker** who lives in Berlin, and is developing e.g. data-conscious culture and ways of working at software company Futurice. In addition to her work, she is kept busy with family life, and travelling to Helsinki for the course would not have been possible. 'I was lucky with the course taking place fully online, since it was the only way for me to participate.'

Schoenmaker was already familiar with Sarvas through work. This was one of the reasons for taking part in the class, but above all, she was drawn to the theme of carrying out change. 'All my work assignments are related to change, so understanding all the related aspects and bringing these together in a single course is very inspiring,' Schoenmaker says.

She considers that changing complex systems is often so difficult that she does not know where to even start. The course taught new tools for finding the starting point and which will help to understand the context and define goals.

Schoenmaker is not the only participant who believes that the lessons will prove beneficial in the future: the course feedback revealed that nine out of ten participants had the same experience. Many participants said that they received an abundance of good tips and ideas for working as the work place's change agent and practical tools to apply to working life.

'The feedback already shows that the different ways of participating were welcomed warmly. It became evident last year, when we did not arrange the course online, that mixing students with working professionals was a very fresh experience for both parties,' Sarvas says.

The most important lesson for Schoenmaker was related to the idea that one's own personality is a part of the entire arsenal: not everyone manages change situations with the same methods, and each has to find their own style. 'I can't wait to be able to share this new knowledge with my colleagues.'

The university has an important role as a convener of thoughts and people

Sarvas managed the course together with University Lecturer **Jari Ylitalo**. Both are experienced teachers and instructors. During the course, it became evident that there is a lot of competence in facilitation and organisational transformation in working life, but professionals rarely sit down to ponder which theories and principles this is based upon.

Sarvas reveals that the course made him understand the important role of the university as a convener of thoughts and people: the university has theoretical and holistic competence, which completes the practical aspect of working life.

According to Sarvas, the coronavirus crisis has resulted in a great deal of positive movement around change that has long been smouldering in organisations. 'When forced to do so, companies as well as other operators must really push changes and think of ways to establish them. Change can signify moving a business online, or the entire business coming to a stop on account of the restrictions, among other things.'

The change leadership course is a reminder of how change can and should be implemented. 'Especially if the future is still uncertain – which it is for almost everyone.'

By Anu Haapala

Nitin Sawhney receives an Academy of Finland grant for analyzing and reconstructing crisis narratives

Professor Sawhney hopes that his collaborative research will offer insights into how crisis narratives emerge in society during the global pandemic

Funding News, published: 26.11.2020

The Academy of Finland has granted special funding for research projects studying crisis preparedness and security of supply. One of the projects funded is by Professor of Practice Nitin Sawhney from the Department of Computer Science. He receives a three-year grant for his research focusing on analyzing and reconstructing crisis narratives.

Sawhney is conducting this research in collaboration with Jonas Sivelä from the Finnish Institute for Health and Welfare (THL). They will use qualitative research methods and computational data analytics of crisis discourses in news and social media for this project.

One aim of Sawhney and Sivelä is to design a platform that represents and visualizes information to engage decision-makers, front-line responders, stakeholders, and the general public in making sense of crises and perceptions of risk and trust.

Professor Sawhney says 'We hope this collaborative research with THL will offer us insights into how crisis narratives emerge in society to influence public anxieties and behaviors in the midst of a global pandemic, but also how we can improve risk communication strategies and cooperative models for crisis preparedness and response.'

According to Tua Huomo, the chair of the call's subcommittee, the funded projects effectively represent both research related to system-level activities and the perspective of ordinary citizens. The projects implement interdisciplinary approaches in a particularly innovative way.

Huomo added: 'As we all know, our society can be affected by a number of surprising crises. The high-level projects funded under this call convince us that, with the help of science, we can find ways to solve even difficult issues.'

By Anu Haapala

Digital humanities information infrastructures receive the Academy of Finland's roadmap status

Aalto's contribution to infrastructure is related to language technology and the information infrastructure of linked data in digital humanities

Published: 17.12.2020

The national digital humanities information infrastructure proposal Common Language Resources and Technology Infrastructure (FIN-CLARIAH), prepared under the auspices of the Center for Digital Humanities (HELDIG), has received the Academy of Finland's roadmap status.

A total of 29 high-quality research infrastructures were selected to the new roadmap. The roadmap for national research infrastructures is a list of strategically significant research infrastructure services needed over the next 10–15 years in the Finnish research, development and innovation system. Research infrastructures refer to tools, equipment, computer networks, databases and materials, as well as services that enable research, promote research collaboration and strengthen research and innovation capacity and expertise.

The FIN-CLARIAH co-operation involves the University of Helsinki, Aalto University, CSC - Center for Science Information Technology Ltd, University of Eastern Finland, University of Jyväskylä, National Archives, Center for Finnish Languages, University of Tampere, University of Turku and University of Vaasa.

Aalto's share in the infrastructure is related to language technology and the Linked Open Data Infrastructure for Digital Humanities in Finland (LODI4DH) developed by the Semantic Computing Research Group (SeCo) of the Department of Computer Science. It includes ontology and data services published on CSC's servers, tools, and semantic Sampo portals developed for use by researchers and the general public, which have had millions of users online to date. The work has been done together with the HELDIG Center of the University of Helsinki, and it is part of the infrastructure program of the Aalto University School of Science.

'FIN-CLARIAH provides a long-term framework for developing co-operation between researchers in the humanities and social sciences and computer scientists at Aalto,' says **Eero Hyvönen**, Professor at Aalto University and Director of the HELDIG Center at the University of Helsinki.

The goal of the FIN-CLARIAH project is to become a full member of the EU-level (ERIC) DARIAH infrastructure program in the future. Finland is already participating in the European Union's CLARIN program. Access to the roadmap offers new opportunities for domestic and international cooperation and long-term financing for the maintenance and development of infrastructures. Now DARIAH includes Aalto University and the University of Helsinki / HELDIG from Finland, but only with cooperating partner status.

By Anu Haapala

ELLIS inaugurates 30 research units at leading institutions across Europe

The European Laboratory for Learning and Intelligent Systems presented the broad scope of research its units will cover in the field of modern AI.

Cooperation, published: 23.9.2020

The European Laboratory for Learning and Intelligent Systems (ELLIS) today inaugurated 30 research units at a virtual ceremony. Spanning 14 European countries, the ELLIS network includes several world-class institutions. The ELLIS units will make a decisive contribution to securing Europe's sovereignty and leadership in the research field of modern AI.

"Today, we celebrate the momentum that the ELLIS initiative has gained since it was founded just two years ago," said **Bernhard Schölkopf**, co-founder of ELLIS and Director of the Max Planck Institute for Intelligent Systems in Tübingen, Germany, which will also be home to an ELLIS unit. "Since the first 17 units were announced at the end of 2019, we've added 13 more to the network. With their combined strengths, the units will contribute to enabling Europe to compete with the world's AI hotspots, particularly the US and China. Together, the units are creating new opportunities for collaboration with scientists across Europe, and a strong foundation for developing AI that is in line with the values of open European societies."

"We're excited to bring our expertise to this table," said Professor **Samuel Kaski**, Professor of computer science at Aalto University and Director of the Finnish Center for Artificial Intelligence FCAI and ELLIS Unit Helsinki. "With our focus on research excellence, training promising young researchers, and promoting technology transfer, our goals are aligned with ELLIS and the broader objectives of the European AI policy. FCAI is looking forward to expanding our contribution to driving European AI forward."

Professor **Petri Myllymäki**, the Vice director of FCAI and Professor at Helsinki University, sees this as an excellent opportunity to boost basic AI research, which is the basis of all AI-related applications and impact. "Finland is very strong in AI research, and this new status is one indication of that."

ELLIS is a pan-European effort initiated in 2018. Its central goal is to foster European research excellence in machine learning and related fields by offering scientists outstanding opportunities to carry out their research in Europe, and to train the next generation of young European researchers in this field of strategic importance. It focuses particularly on tackling fundamental research challenges in the field of AI that promote positive economic and societal impacts. At present, research topics within the ELLIS network include fundamental machine learning, computer vision, natural language processing, robotics, human-centric and trustworthy AI, and areas of application such as environmental modeling, autonomous systems design, biology, and health.

The ELLIS units were selected on the basis of scientific excellence by a committee of leading scientists from several different countries. In total, they have committed funding of some 300 million euros for an initial period of five years. Twenty percent of this sum will go toward ELLIS network activities such as student and faculty exchanges and the organization of joint ELLIS research programs and workshops.

By Tiina Aulanko-Jokirinne

European Commission grants €4M funding for SECCLO – Master's Programme in Security and Cloud Computing

Aalto University has received continuing funding for a joint European master's programme on security and cloud computing. The programme is coordinated by Aalto and operated jointly by six European universities.

Funding News, published: 9.9.2020

SECCLO started in 2018, supported by the European Commission funding. The initial grant was for three annual intakes. Now, the recent award 4 million EUR covers four more annual intakes, with the last students to graduate in 2026. The new Erasmus Mundus funding includes 84 scholarships for outstanding European and non-European students for two-year studies in the programme. The European Commission selected 40 such programmes from 100 submitted proposals. SECCLO is a continuation to the very successful NordSecMob – Master's Programme in Security and Mobile Computing, which ran for 10 years (2006–2015) with more than 200 graduates.

SECCLO focuses on two specific aspects of modern computing systems. The first is cloud computing: meaning highly distributed and scalable computation and data-storage in data centres as well as in physically accessible devices. The second area is information security: meaning the protection of computation, communication and data from unauthorized access and other threats caused by potentially malicious actors. Studies in the Security and Cloud Computing programme give the students a broad understanding of the latest and future technologies for secure cloud computing systems. Students gain both practical and theoretical knowledge into secure-systems engineering, distributed application development, network and service architectures, and cloud and mobile platforms. They can specialize

in communications systems design, information security, reliable distributed systems, cryptography, or big data security.

"We believe in combining theoretical knowledge and security expertise with product development skills" says Professor **Tuomas Aura**, Director of SECCLO, "Our graduates have been very successful in finding employment in European companies and, in many cases, continue into doctoral programmes. This is a major effort to attract and educate bright young people, often with previous industry work experience, whose expertise is in high demand in Finland and the partner countries."

The first year of the SECCLO programme is offered by Aalto University Department of Computer Science. The second year is completed at one of the consortium partner universities: KTH Royal Institute of Technology, Sweden; The Norwegian University of Science and Technology; Technical University of Denmark; University of Tartu, Estonia; or EURECOM, France. Upon completion of the programme, the student receives a double degree.

In addition to university partners, the SEC-CLO consortium is strengthened with Associate Members including companies and research centers from several countries: F-Secure Corporation (Finland), Ericsson Oyj (Finland), KONE Oyj (Finland), VTT Technical Research Centre of Finland, Intel Labs Europe (Germany), Nokia Bell Labs (France/Finland), Cybernetica AS, (Estonia), GuardTime (Estonia), RISE – Research Institutes of Sweden, Security Lab, Intopalo Digital (Finland), SAP Labs (France), IKER-LAN (Spain), Eficode Oyj (Finland), SINTEF (Norway), BMW Group (Germany).

"We are interested in enlarging the Associate Member network of industry and research collaborators to widen the employability opportunities for SECCLO students, and to get feedback from industry and research organizations to support the further development of the programme. SECCLO Associate Members and other companies are invited to offer internship and thesis positions to the students. We welcome also smaller companies and start-ups to join our network" says **Eija Kujanpää**, Coordinator of the SEC-CLO programme.

By Tiina Aulanko-Jokirinne

CodeRefinery went online and attracted over a hundred participants from all over the Nordics

'When we went online, we wondered how can we help as many people as possible and make it open for everyone,' says Richard Darst from Aalto Science-IT

Events & Conferences, published: 19.10.2020

When the Covid-19 pandemic forced universities across the world to close their facilities and cease at least some of their teaching activities in March 2020, Aalto Science-IT decided to make the most of the exceptional situation. Science-IT is a part of the CodeRefinery project, a Nordic e-Infrastructure Collaboration-funded project. Both have a long history of offering workshops for researchers who are not software developers but need software development skills to do their job better, and instead of postponing the workshops, they went online for the first time and opened their courses for each and every one who might find them beneficial.

The CodeRefinery workshop has been organized biannually for several years and it helps professionals from fields other than computer science become familiar with tools and best practices in modern research software development. Its first online edition took place in May 2020, and in only a few days of time, over a hundred people registered for the online workshop – which the organizers had started calling Mega-CodeRefinery.

Normally, when CodeRefinery is hosted on the Aalto University campus, participants come from different departments of the School of Science, as well as plenty other Aalto schools, too. 'This time we had people from all over the Nordics. Many organizations started offering online teaching, but we really made the effort to think of what possibilities were opened by being online, and took advantage of them to accept as many people as possible and make it open for everyone' says **Richard Darst**, Staff Scientist from Aalto Science-IT, who is behind the idea of organizing workshops online. In addition to about one-hundred people in the actual online course, anyone in the world could follow via a Twitch stream.

CodeRefinery focuses on using a software called Git for efficiently writing and maintaining research software. Participants won't learn to code, but they will learn to use tools one needs to use to program well. The workshop is informal and interactive with type-along type of presentations, live coding, and demos. Short tutorials alternate with practical exercises.

The next CodeRefinery will take place at the end of October 2020, and the registration for it is now open. The CodeRefinery project is funded by the Nordic e-Infrastructure Collaboration from 2016-2021 and contains staff from across the Nordics. Each CodeRefinery workshop is taught by instructors from across the program. Aalto University is a hub of CodeRefinery and one of its leading university partners.

By Anu Haapala

Mario Di Francesco elected Computer Science teacher of the year 2020

The teacher of the year was announced at the CS department's online holiday party on Thursday 17 December 2020.

Awards & Nominations, published: 18.12.2020

Professor **Mario Di Francesco** was elected as the Computer Science teacher of the year 2020. In recent years, Mario Di Francesco has actively developed teaching in CS at both bachelor and master level, through continuous renewal of course content and teaching methods. He has created a new set of courses that are up-to-date and relevant for modern industry. As a teacher, he encourages questions and discussions, and is always prompt in replying to any queries. He always tries to help and guide students to their best potential.

Picks from the course feedback of CS-E4100 Mobile Cloud Computing:

"Excellent course. One of the best courses that I have attended with the right amount of workload. The course is well planned. The lab/practical exercises are perfect. Well done."

"Overall, the course was well organized, and the staff was excellent."

"Excellent teaching staff, always ready to help and give additional material."

"Based on the little experience I've managed to attain in the industry, the contents of the course were highly relevant. - - - This experience can surely be put into use in the job market."

The teacher award has been granted since 2007. This year, a total of 26 proposals were received and 18 teachers nominated for the award. The final decision on the winner was made by a board including the following members Professor **Tuomas Aura** (BSc in computer science), Professor **Petri Vuorimaa** (Master's programme in CCIS), Lecturer **Sanna Suoranta** and Planning Officer **Elsa Kivi-Koskinen** (Learning Services). The teacher of the year receives a certificate of honour and a reward of 1000 euros.

By Anu Haapala

SCI Awards 2020 celebrate our successes in a challenging year

Members of our community who've helped us carry on during Coronavirus situation are recognised in annual awards

Awards & Nominations, published: 18.12.2020

Alumnus of the Year

Kyunghyun Cho, Department of Computer Science

Kyunghyun Cho is an associate professor of computer science and data science at New York University. Cho obtained his Bachelor's degree from the Korea Advanced Institute of Science and Technology in 2009, and both his Master's degree and PhD from Aalto University. He graduated from the Master's Programme in Machine Learning and Data Mining, MACADAMIA, with distinction in 2011. Cho continued his research in the group of Professors **Juha Karhunen** and **Tapani Raiko**, and defended his PhD in 2014.

Kyunghyun Cho is one of the pioneers of neural machine translation, the inventor of the gated recurrent unit (GRU) and well known for his works on neural attention mechanisms. He is one of the most cited researchers in the field of deep learning and natural language processing. Cho is an inspiring example of a talented student who started his research career in Aalto and leaped to a successful international career.

Teaching Assistant of the Year

Shamsiiat Abdurakhmanova, Department of Computer Science

"Oustanding work on preparing course material as well as the student support for FiTech flagship courses Machine Learning with Python and Deep Learning with Python."

"Shamsi makes math understandable! She has made very clear teaching material and always understands what we are trying to ask even though our questions may be a bit vague due to us not understanding something. And she always answers fast and to every question. Also she asks for student input during course so she can adjust her teaching accordingly."

Jaakko Harjuhahto, Department of Computer Science

"Jaakko is a good role model, especially for the students and younger assistants. He has been an inspiring teacher for several years with deep commitment and sincere attitude. He has been able to utilize his strong industrial engineering knowledge and connections in his work. But despite of the long industrial experience, he has been able to keep an academic heart and a curious mindset with him throughout all the different course implementations and other educational tasks he has had."

By Matthew Allinson

Doctoral thesis: Technology that's better at detecting hate speech may also increase security risks

Advances in language technology don't only facilitate moderation but also censorship, says Tommi Gröndahl, who is defending his dissertation on language technology methods.

Studies. published: 23.8.2021

Doctoral candidate **Tommi Gröndahl** will defend his doctoral dissertation on language technologies at Aalto University on 23 August. Language technology is one of the most common forms of artificial intelligence, and Gröndahl tested its methods for detecting lies and hate speech.

"Artificial intelligence is needed when massive amounts of data need to be processed and the targeted material is screened out. However, language technologies have been a black-box, which means that they have been utilised without actually understanding how they process language," Gröndahl says.

Gröndahl was particularly interested in the consequences of the methods from the perspective of information security and privacy protection.

"If language technology methods are developed, it improves the possibilities of both content moderation and censoring. The techniques are the same, regardless of the consequences the classification of the text has for the author," says Gröndahl.

In the study, Gröndahl compared deep learning neural networks with more traditional rule-based methods. In the rule-based methods, a person creates a rule in the system, which is then utilised in automation. Major differences were found between the methods.

"Complex neural network models have a vast amount of numbers, which makes it difficult to know which feature of the text each number represents, and what happens to the text when one of the numbers is changed. When a text needs detailed structuring, the most commonly used neural network models are not always reliable. For example, a neural network model cannot distinguish between a sentence and its negative equivalent," explains Gröndahl.

Then again, rule-based methods are not ideal for screening vast amounts of data. It is therefore essential to combine the best of the two methods.
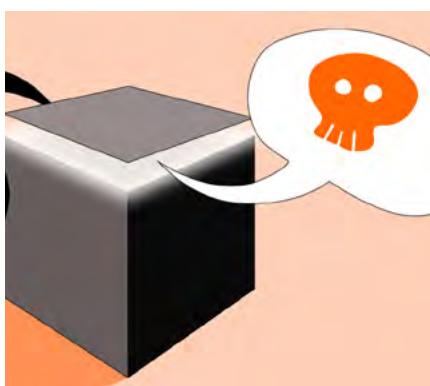
Methods easily deceived

The classification of text is typically based on fairly simple features, such as specific words. For example, in the case of lie detection, the methods do not actually detect lies, but simple features in the data. Complex machine learning models catch such features similarly to simpler models. This makes models vulnerable to attacks; for instance, hate speech detectors are easily fooled by people, when spaces are removed from the text or the word 'love' is added to the text.

Gröndahl found that the assigned task and training data affect how well an AI-based classifier succeeds in the task.

"As machine learning models are massive, it is important that the classifier receives enough training data. It can also easily be caught out by undesirable features if the training data is distorted, i.e. in some way unrepresentative. Complex machine learning models do not know when to take into account a word or a character and when not, but they act on the basis of the training data provided," says Gröndahl.

In addition to hate speech and lie detection, Gröndahl also studied the possibilities of language technology for automatic alteration of writing style and automatic text editing. The objective may be, for instance, to modify the text so that the author cannot be identified.

For example, when the writing style was automatically altered, the neural network produced a conversion similar to a machine translation that could result in repeating the same text or changing the meaning of the text content. In rule-based methods, it is possible to control in more detail, for example, the effect of a certain word, such as a synonym or a contradiction, on the conversion of a sentence.

Unusual path

Becoming a doctoral student in security and privacy usually requires prior studies in the topic, typically as part of undergraduate studies in computer science. Gröndahl's journey was untypical: as a cognitive scientist at the University of Helsinki, his previous studies focused on language research. He ended up in Professor N. Asokan's research group after a summer internship to help run user studies.

"Tommi Gröndahl had no background in security and privacy when he started, and yet he has had a very impressive record, publishing in excellent security and privacy venues, and getting very good media coverage for one of his papers" Asokan says.

Gröndahl has continued with his previous discipline as well, doing another PhD in the cognitive science of translation at the University of Helsinki.

By Tiina Aulanko-Jokirinne,
Illustration Matti Ahlgren

'I'm happy I didn't go anywhere else' – HAIC scholars very satisfied with their studies at Aalto

As top applicants, Rina Shmeleva and Parinaz Avaznejad received scholarships for their master's studies and now they share their study experiences

Studies, published: 20.10.2020

Rina Shmeleva and **Parinaz Avaznejad** are students in the Master's Programme in Computer, Communication and Information Sciences at Aalto University, majoring in security and cloud computing. Ms Shmeleva will soon graduate with a master's degree, while Ms Avaznejad recently started the second year of her studies.

When starting their studies at Aalto, both of them received the Helsinki-Aalto Institute for Cybersecurity's (HAIC)scholarships which HAIC admits to top applicants who choose to specialize in information security at either Aalto University or the University of Helsinki. The scholarships, supported currently by F-Secure and Huawei and both universities, cover students' life expenses and tuition fees.

Before starting her Master's, Ms Shmeleva worked in software development in her hometown Moscow,

> ## 'I find it nice to work with other students and not just by myself.'

Russia, while Ms Avaznejad had a job in which she focused on the security of mobile applications in her native Iran. Both are very satisfied with their decission to select Aalto for their Master's studies.

'I got interested in security through my work experience because at work I came across with security issues and realized I didn't completely understand how they work,' explains Ms Shmeleva. She wanted to learn more and applied to universities in Finland and Norway, finally choosing Aalto. The scholarship played an important role in her decision, as thanks to it, she could focus fully on studying.

A practical and flexible master's programme

Ms Shmeleva enjoyed especially the hands-on projects that were often did in groups. 'I find it nice to work with other students and not just by myself.' The projects forced her to look at security issues from different perspectives and the flexibility of the programme allowed trying different courses even from outside her major.

Ms Avaznejad is also pleased with the practical approach of her programme, which actually made Aalto her first choice from the very beginning. Before applying, she looked up for information about many international master's programmes and thought that her current programme was complete, concrete, and practical. 'I thought that this is what I want; to learn about security practically.'

The programme has met her expectations. 'I really recommend the programme! When you work on projects, assignments and do practical hands-on work in addition to theory, you will learn more,' she says. According to Avaznejad, the researchers and professors at Aalto are willing to help students and the university shows that it cares about its students. 'If you do not know how to find an internship, for example, Aalto helps with student fairs and job fairs.'

At the beginning of her studies, she was astonished by the seemingly fast pace of studies. 'I wondered how I can complete 120 ECTS in just two years. This concept of five periods was fully new to me because in Iran we have only two semesters. But then I noticed I can complete two or three courses in a period, and now I think the system is really good.'

Aalto master's students plan their own timetables, which can sometimes feel challenging. Ms Shmeleva: 'I remember one time in my first year when I stayed with my fellow students at the Computer Science building until 2 a.m. because we had an assignment deadline early in the next morning. That was quite difficult time because I had wanted to take as many courses as possible in my first year.'

Finnish nature and seasons are beautiful

Both students seem to enjoy living in Finland. 'For example, commuting here is just amazing. I like living close to the university and nature in Finland because it is so green. It is really easy to go out for a walk and get away from the studies,' Ms Shmeleva says.

She points out that in some countries, students may need to share a room with their peers. 'Here you can have a shared apartment but you always have your own room and own space. That is also beneficial for your studies because you have a place to isolate and focus on what you need to do.'

Getting used to the Finnish winter weather was a bit difficult for Ms Avaznejad who comes from a hot country, but she thinks that all the Finnish seasons are beautiful, too. 'In the summer, it is green everywhere, and the autumns are so colourful.'

Towards work in industry

Rina Shmeleva will soon graduate with a Master of Science in Technology and she wants to stay in Finland after graduation. Currently, she is finalizing her Master's thesis while working in mobile development – an area that she was interested in already when she applied to Aalto a couple of years ago. She thinks that it is amazing how common summer jobs are in Finland. 'So many companies are ready to hire students for just three months.'

Parinaz Avaznejad does not yet know what kind of a career she would like to pursue after graduation, but she is currently interested in working in industry. She is now doing an internship

> **'When you work on projects, assignments and do practical hands-on work in addition to theory, you will learn more,'**

at Nokia, a position that she found through Aalto's International Talent Programme. 'The programme helped me a lot. We had five sessions with experts of Nokia who told us about the work environment in Finland and helped us with our resumes and motivation letters.'

Ms Shmeleva has a message for those who are considering moving to Finland and studying at Aalto: 'I'd say do it because it's an amazing experience and you will meet so many international students. In Finland, everyone speaks English, which makes moving here from abroad relatively straightforward. I'm happy I made this choice and didn't go anywhere else.'

About HAIC

Helsinki-Aalto Institute for Cybersecurity (HAIC) is a strategic initiative set up by Aalto University and the University of Helsinki in June 2016 to ensure excellence in cybersecurity research and education.

HAIC focusses on offering scholarships for talented master's students choosing to specialize in cybersecurity. HAIC scholars are funded by donations from HAIC donors and supporters as well as financial aid from the universities.

By Anu Haapala
Photos Matti Ahlgren

Forbes AI Award to research on image-creating GAN models

The magazine pays tribute to the development of a model that starkly reduces the amount of data needed for generating new, artificial images

Awards & Nominations, published: 22.1.2021

GAN generated images created with a limited amount of training data. Source: Karras et al. (2020): Training Generative Adversarial Networks with Limited Data.

The American business magazine Forbes hails research relating to Aalto University and the Finnish Center for Artificial Intelligence FCAI on its AI Awards 2020 listing. On a list of altogether six award recipients, Forbes has chosen for "Most disruptive innovator" the FCAI partner company Nvidia.

Specifically, Forbes praises 'a series of breakthroughs' reducing the amount of data which is needed in generative adversarial networks (GAN). This research has been conducted by a group of researchers at Nvidia, one of whom is Aalto University Associate Professor and FCAI member **Jaakko Lehtinen**.

GAN models, Lehtinen explains, learn from pre-existing data sets in order to create new data with similar properties. In Lehtinen and his colleagues' work, the data in question are pictures. Lehtinen exemplifies with cats:

'If you're shown pictures of cats, you can, although you've never seen them before, recognize that they portray cats. This is because there are particular similarities – cats tend to look a particular way, be in particular places, particular positions, and so on', he explains.

The aim of a GAN model, then, is to find such regularities in the original set, and to produce new data – for instance artificial cat photos – that follow the guidelines identified. The problem is that high-quality results typically require tens or even hundreds of thousands of pictures for the algorithm to learn from. Often, these are not available.

Lehtinen and his colleagues, however, have succeeded in reducing the number of pictures to up to one tenth of what has previously been needed. This has been made possible by changes in the process by which the algorithm learns from the original data.

'This is achieved by, so to speak, equipping the algorithm with glasses that are broken in very particular ways as it studies the set of example pictures. This has an exciting combined effect that helps the algorithm produce better pictures', Lehtinen says.

In practice, the results of such research are increasingly utilized, for instance, in the field of medical research, where research data tends to be sensitive and therefore difficult to acquire. As hospitals are understandably protective of their patients' picture data, a model which generates new data sets that are based on a limited number of original picture examples, and which no longer entail sensitive personal information, can be of great value.

The model that Lehtinen and his colleagues have developed and now improved belongs to the StyleGAN model family. In the context of FCAI, this research closely relates to the research programmes concerned with simulator-based inference (R2) as well as data-efficient deep learning (R3).

By Minna Tiainen,
Picture from publication

School of Science announced 2021 equality implementation plan, and funds new diversity and inclusivity projects

The three community led projects will facilitate discussions about inclusivity, and increase representation of a more diverse range of people in science teaching and research.

School diversity and inclusivity fund

Three new projects have been funded by the School of Science diversity and inclusivity fund.

1. Creating experience-based podcast series on artscience – **Janne Halme** and **Bart Vandeput** will produce podcasts, videos and textual content to encourage collaboration between the arts and science.
2. Increasing minority representation through video exercise solutions – led by **Jami Kinnunen**, **Milli Keskinen** and **Olli Winberg** will produce instructional videos with female assistants solving exercises for online courses.
3. Color of Science: Engaging Critical Perspectives from Scientists of Color and the Indigenous – led by **Nitin Sawhney**, **Talayeh Aledawood**, **Caterina Soldano**, **Andrea Botero Cabrera** and **Karin Fröhlich**, lectures, panel discussions and film screenings to initiate dialogue and workshop changes.

School Equality implementation plan

The School of Science has also unveiled it's 2021 implementation strategy for the EQU plan.

Our shared goal is to have a good atmosphere for study and work at the university. Aalto University wants to offer a working environment in which employees and students of different genders, tasks and backgrounds are treated equally. The obligation to promote equality and equal treatment applies to all members of the university community.

The 2021 plan includes, communicating equal operating models (Aalto recruitment handbook, Aalto Code of Conduct) and increasing the inclusiveness of the work and study environment, such as diverse role models on campus art and unisex toilets in all buildings.

By Matthew Allison

From Mars to machine learning

Aalto PhD student Tuomas Kynkäänniemi did summer- and part-time work at the Finnish Meteorological Institute (FMI) calibrating sensor of a Mars rover, but his research is now worlds away

A project that Aalto University PhD Student **Tuomas Kynkäänniemi** was working with at the summer 2017 has reached worldwide attention, as part of the Perseverance rover that just landed on Mars on Thursday night.

In 2016 as an undergraduate student at Aalto university studying engineering physics, Kynkäänniemi got a summer research job at the Finnish Meteorological Institute, working in what is now the Planetary Research and Space Technology Group at FMI. Kynkäänniemi's job was to help with the calibration of the temperature and pressure sensors that make up MEDA a Martian weather station that takes a wide range of atmospheric measurements that FMI helped develop. 'The sensors give an electrical signal, and my job was to take that electrical signal and turn it into a 'real world' unit, like degrees celsius'

Kynkäänniemi's work now is "on another planet" as he puts it, from his engineering work from his student internship days. He now works in the Computer Science research group of **Jaakko Lehtinen**, developing machine learning methods called generative models for generating highly realistic images. 'When I finished my job with FMI, the field of machine learning, and generative models were very exciting and interesting to me. I got an internship at Nvidia Finland and started working in this area instead, so when it came to choosing what to focus on for my Master's project, I swapped from engineering physics to computer science.' Professor Lehtinen also worked at Nvidia as a principal research scientist, and Kynkäänniemi did his master's project with him developing a method for evaluating the performance of AI that generates images.

'A model that generates images needs to meet two criteria,' explain Kynkäänniemi, 'they need to be realistic looking, but they also need to be highly variable. It's no good if your model can only turn out one realistic looking image and they all look the same. It needs to make a wide range of realistic looking pictures.' Kynkäänniemi's master's thesis was given the MSc Thesis Award of 2018-2019 by the Finnish Society for Computer Science, and was also published as a paper for the NeurIPS 2019 conference.

Kynkäänniemi describes his research path from undergraduate to now as a bit of a 'random walk' but he hopes it inspires other students, and people thinking about studying technology at university. 'I hope my example shows that if you are open-minded and curious, you can get the opportunity to work on lots of very different and fascinating projects'

By Matthew Allison

'For many people, it's always been a crisis' – a new Aalto collective engages intersecting dimensions of crises

The transdisciplinary Crisis Interrogatives collective critically discusses topics at the intersection of design, technology and socially engaged practices.

Published: 7.4.2021

In September 2020, when people all over the globe had been struggling with the COVID-19 pandemic for months, a group of Aalto University researchers and students from different schools decided to start gathering for virtual coffee chats and organizing participatory online workshops together, unpacking interrelated aspects of crises.

Now the new collective called Crisis Interrogatives comes together regularly to discuss important, crisis-related topics from a critical perspective, and re-imagine them in new ways, as core members **Natalia Villaman**, **Floris van der Marel**, **Henriette Friis**, and **Sid Rao** explain in this interview.

While the collective was established during the pandemic, the COVID-19 crisis was not the only reason for the initiative. Even though the crisis caused by pandemic touches people all over the world, 'for many people, there's always been a crisis,' as Floris van der Marel, doctoral candidate at Aalto and Swinburne University of Technology in Australia who studies imbalances in participatory design reminds. 'This is just the crisis that we all are seeing and acknowledging,' he adds. Examples of workshops conducted by the collective include Empathy in Crisis, Resilience in Crisis, Disarming Data for Activism, and Deviating Perspectives in Participatory Design.

In every culture and educational context, things go unquestioned. A designer, for example, learns a certain way to deal with an issue, which at some point, becomes a subconscious way of doing, easily overlooking its potential harmful implications and connotations. In this regard, Natalia Villaman,

who is a design researcher and cultural mediator at Aalto, says that she finds the initiative crucial because the collective touches upon narratives that are not usually discussed as critically as they should.

'We have different backgrounds academically, coming from all over the world and having different experiences. By joining forces, we can turn all our knowledge into action,' adds Henriette Friis, student in Aalto University's Master's Programme in Creative Sustainability.

Floris van der Marel adds that everybody is in some ways shaping society: 'We feel it's important to become aware of what subconsciously guides us, what those norms are and how we can detect and challenge them. That's always important - but it's more important in times of crisis, because crises make power imbalances more real and explicit.'

Critical views on technology and policies around it

Many of the active members of Crisis Interrogatives met for the first time in 2020 at the Department of Computer Science summer course Human-Centred Research and Design in Crisis. The course was organized by Professor of Practice **Nitin Sawhney** whose life and career have been intertwined with crises.

Despite having started up just a few months ago with informal coffee chats and workshops online, the collective has already created several larger-scale initiatives.

Nitin Sawhney is leading an Academy of Finland-funded research project, Reconstructing Crisis Narratives for Trustworthy Communication and Cooperative Agency, which is conducted in collaboration with the Finnish Institute for Health and Welfare (THL). The researchers hope that the project will offer insights into how crisis narratives emerge in society to influence public anxieties and behaviours during the pandemic, but also how to improve risk communication strategies and cooperative models for crisis preparedness and response.

The collective was also a source of inspiration for the Department of Computer Science's new course, Critical AI and Data Justice in Society, which too is instructed by Professor Sawhney. Henriette Friis and doctoral candidate Sid Rao from the Department of Computer Science are teaching assistants on the course. 'It too has managed to bring together people from the different schools of Aalto and even some people from other universities around the world. We are critically examining ethical policies and design practices around technology and everything surrounding that,' explains Henriette Friis.

Sid Rao notes that the fairness research in artificial intelligence (AI) and machine learning (ML) remains largely rooted in Western concerns, and the injustices, datasets, measurement scales, or legal tenets used to

refer mainly to mainstream Western societies and ideologies. 'These discussions seem to have neglected the perspectives and experiences of the minorities and underrepresented.'

He adds that non-Western countries are in a rush to implement large-scale AI and ML systems, such as facial recognition and border control, by replicating and reusing the tools and methods from their Western counterparts. 'We felt the need to ignite discussions among the CS students on how any automated system cannot be naively generalized without taking into consideration its impact on society.'

Moreover, he notes that AI and ML courses often lack critical evaluation from non-technical aspects. 'Unfortunately, any technology that exists today has a societal, political, ethical, and humanitarian angle to it which diminishes in the arms race of finding the best solution to a problem. Many problems cannot be solved with tech-only solutions, rather they need critical interrogation of both problem and solution space from non-CS fields such as social science, anthropology, design thinking, and ethnography.'

Many researchers involved in the collective have contributed, for example, to setting up a new Aalto University series called Color of Science, an initiative where scientists of colour and from indigenous communities talk about their experiences and struggles. The Crisis Interrogatives collective also plans to arrange live and hybrid public events in the future once the pandemic restrictions ease up.

Speaking about crises from a single perspective is impossible

Crisis Interrogatives welcomes new members from various backgrounds if they can identify with the community's interests and manifesto and want to view the society critically.

Natalia Villaman points out that, in fact, it would be impossible to speak about crises from a single perspective. Each of us is more than the sum of their profession and education, and even those who work in the same field come from diverse merging backgrounds and cultures.

Henriette Friis sees that it is important to support diversity and inclusion in our work, as everyone sees the world through their own lenses. Those lenses always highlight and neglect certain relevant aspects because of our own experiences, privileges, and biases. 'We can't see everything, and we shouldn't be expected to see everything, but when we come together, we see more of the reality of the world and more of the needs and possibilities.'

Whenever this new community gathers to chat online, their aim is not to reach a consensus or find ways to forcefully agree with each other. Instead, they actively work towards finding new ways to challenge things together and chasing critical change.

By Anu Haapala

Photo by the Crisis Interrogatives collective

Alumnus Kyunghyun Cho wants to support women who study data science and artificial intelligence

Kyunghyun Cho, Associate Professor at New York University and an alumnus of Aalto University School of Science, has made a significant donation of 30,000 euros to the Department of Computer Science. His donation will be distributed as scholarships to female computer science students from outside the EU.

Cooperation, published: 1.6.2021

The scholarships from **Kyunghyun Cho**'s donation will be awarded to foreign female students who have chosen Machine Learning, Data Science and Artificial Intelligence as the main subject of their master's studies. The subject develops competencies that are central in solving the major challenges of our time, such as combating climate change, and understanding the causes of epidemics.

'I thoroughly enjoyed my years at Aalto University, and these years have had a profound impact on my career and personal life. With this contribution, I hope that a more diverse set of students from all over the world can enjoy and benefit from studying at Aalto University, just like I did. A bit selfishly, I also hope some of these students will become role models in the field of artificial intelligence for my niece and our younger generation', says Kyunghyun Cho.

'We are grateful for this impactful donation from Kyunghyun Cho. We at Aalto University also consider him a role model. This donation advances equality and inclusion that are central goals for Aalto community', says Jouko Lampinen, Dean of the School of Science at Aalto University.

Increasing the number of female students is a key goal in all Aalto University's technical schools. For instance, Aalto University organises events like "Shaking up Tech" which offer young women facing career and study choices a deeper understanding of technology as a field.

Targeting a donation is also an effective way of encouraging and supporting more and more women to choose careers in technology.

Kyunghyun Cho studied for a Master's degree and a PhD at Aalto University under the supervision of Professor **Juha Karhunen**, Dr. **Tapani Raiko** and Dr. **Alexander Ilin**, completing his PhD in 2014. He was awarded Alumni of the Year by the school of Science in 2020. He is an associate professor of computer science and data science at New York University.

Aalto University has given me so much, both for my career and life in general. This is a chance for me to give back and support Aalto to become even more international and diverse.

By Annika Linna

Career course gathered a diverse range of views, alumni and students around user experience

A career course on user experience arranged by the Department of Computer Science offered a variety of career stories from those working for top companies in the industry. Students were given an opportunity to truly consider their priorities in studies and career plans.

Studies, published: 11.6.2021
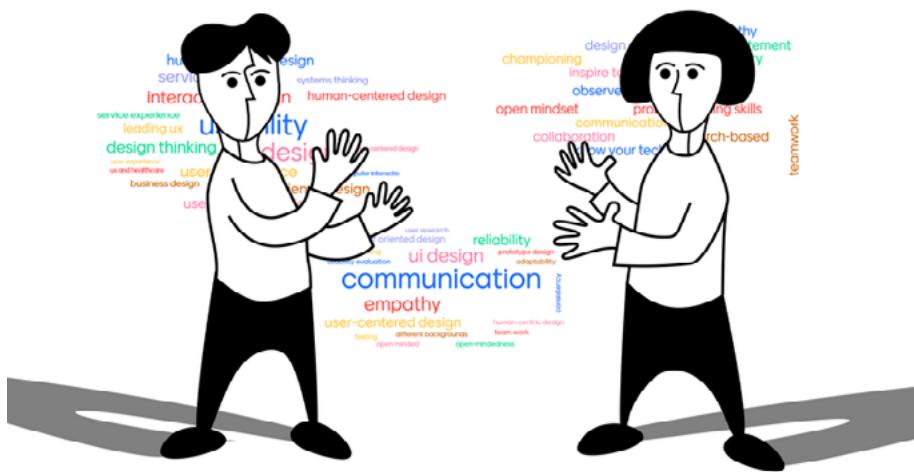
The current coronavirus situation and remote teaching did not slow down Professor of Practice **Johanna Kaipio**'s research group at Aalto University's Department of Computer Science as the group proceeded to arrange a completely new type of career course in the spring of 2021. The course focused on software engineering, user experience (UX) and UX management of the user experience in organisations. "Research in the field seeks to find a deeper understanding of how people as users of software and digital services should be considered in engineering and development," Kaipio summarises. The course included guest lectures from experts working in companies within their field. A total of 14 experts visited the course as either lecturers or guests. Many of the experts were Aalto's alumni or alumni of the former Helsinki University of Technology or the University of Art and Design Helsinki.

The user experience is never far from practical issues, and it often revolves around strategic questions of organisations' leadership and administration as well as the lives of people who use

digital solutions.

"In software engineering and service development, it is important to consider the wishes and needs of different user groups," says **Paula Valkonen**, Doctoral Candidate at Aalto and one of the course's active instructors.

The user viewpoint is so important that entirely new research areas, such as human- and user-centred design, usability engineering and service design, have been dedicated to it.

"At Aalto, we also apply this perspective to the research of healthcare IT systems and eHealth," Kaipio adds.

"Companies in the field are also seeing a clear transition in their cultures towards users being increasingly included in the design process," states **Inkeri Saiku**, a usability specialist working in the healthcare sector and guest speaker on the course.

Two alternatives

The remote course had participants from both master's and doctoral programmes. Students were allowed to choose from two alternative ways of carrying out the course: focusing on

writing a seminar paper or working on one's CV and portfolio.

"We had the idea for the course after comparing our experiences on how companies lead and manage user experience by drawing on our different backgrounds, yet established careers. This perspective on management was not included in our own master-level studies, and we wanted students to learn about contemporary examples from the corporate world while considering their future career paths," says **Mari Tyllinen**, one of the course's instructors.

The course's visitors were not present only as lecturers, but in some cases also tutored participants on their course works, giving them feedback and development ideas.

"It felt exceptionally good to get personal feedback during the course," says **Saara Peltomäki**, a student of the Master's Programme in Information Networks. She attended the portfolio section of the course. **Kaisa Tsupari**, who began her doctoral studies last February and chose to focus on writing a seminar paper during the course, is grateful for the good viewpoints the course provided for the article.

Combining different backgrounds

The field of user experience involves people from a diverse range of backgrounds, providing an almost palpably interdisciplinary setting.

"The diversity of people working in our field became abundantly clear during the course," Tsupari and Peltomäki point out. Professionals in the field have often studied computer science, engineering, design, psychology, business and several other fields. A deep understanding of IT systems is, however, the clear cornerstone of the

field. This means that logical and technical skills should not be overlooked.

"In my work as a usability specialist, it is crucial to understand information systems and complete technical certificates on IT systems," Saiku notes.

The significance of working with stakeholders is becoming more prominent in the field, and the development of future technologies calls increasingly for a diverse range of professionals: in addition to technical skills, the perspective of human behaviour is needed.

"Current students in the field also often come from differing backgrounds, and there are students who have completed less technical studies. Perhaps these types of examples and career stories will encourage students to try out different things and choose alternative study paths," Peltomäki and Tsupari reflect.

Career paths are seldom straightforward

Based on the polished CVs of professionals in the industry, one might think that the person in question has aimed for a particular job or career choice. Yet the career stories presented on the course quickly revealed the turns that the experts' career paths had often taken. "As someone who opted for a change of field, it is encouraging to find that even a different and winding path can lead you to the same work as those who have continued with a single line of study," says one of the course's instructors **Nina Karisalmi**.

"The career stories also nicely highlighted the fact that finding your professional viewpoint may take time and that developing your professional identity is a process," Tsupari points out.

Sometimes a student may find it difficult to perceive the possibilities of their future career, and different alternatives may seem vague or distant. "I believe that these stories provide support for particularly those students who have only discovered their skills in theory and may still be looking for their own thing. Perhaps a course like this also makes it easier to describe one's know-how and set specific goals for studies," says Peltomäki, who had a

chance to hone her portfolio during the course.

"Don't stress and remember your fellow students"

The lively discussion between students and experts in the field was considered a highlight of the course. Practical tips provided by the visiting alumni were also valued.

"Planning the future should not be something to stress about. The more different experiences you dare to seek during your studies, the more you have to work with and put to practice in the future," says visiting alumna on the course and service designer **Tia Sistonen**.

"When studying, it is good to try out different things and focus on what excites you. This also increases the likelihood of finding work among matters that you find inspiring. Working with your teeth grit is hardly the key to the best work results, either!" Saiku concurs.

The course visitors also point out that interests outside work and studies are also important and require attention. Student activities and networks established during studies were also deemed important by the visiting alumni.

"I started a company with a person I knew from studies because we wanted the freedom to develop our expertise in a direction we believe in and find exciting," says **Laura Snellman-Junna**, an alumna of Helsinki University of Technology and entrepreneur in the field of software consulting.

Communication with companies should start during bachelor studies

Many of the course's visiting experts were from a corporate environment, which students found particularly valuable. Business perspectives on the user experience are central, but students seldom get an opportunity to ask detailed questions directly from those working in the corporate world, as companies often have non-disclosure agreements and business secrets.

"It was great to see how relaxed the atmosphere of the course was, de-

spite the restrictions," Tsupari and Peltomäki state.

On the other hand, it is good to remember that working for public organisations is also common in the field, and customers operate in a variety of settings. Course discussions revealed significant growth in the field of user experience, along with its growing social impact.

"Design methods are already being applied to multiple contexts, but the public sector, along with social innovation and development projects need more professionals," says designer and visiting alumnus on the course **Nicolas von Flittner**.

The course's student participants found the encounters between students and those working in the corpo-

> **"Your professional viewpoint may take time and that developing your professional identity is a process,"**

rate environment meaningful and as something that should actively be promoted in the future as well – through career courses such as this one.

Consultant Sistonen also looks back on her time as a student and highlights the importance of joint projects with companies during her studies. The course guests, for their part, saw the career course as a singlehandedly positive experience.

"It was a pleasure to provide guidance, see what today's students are like and discover the tools and methods younger people currently work with," Sistonen summarises.

"I would hope that Aalto provided more such courses, perhaps already for bachelor-level students. At that stage, many are still in the process of considering what they want to include in their studies," Peltomäki and Tsupari point out.

By Aija Kukkala
Illustration Matti Ahlgren

CS S4 Student Symposium served remote pizza, socializing and interesting discussions on AI

Doctoral students in computer science organized an interesting symposium focusing on societal side of AI, and discussed how to keep student networks up and running during an exceptional pandemic situation

Events & Conferences, published: 22.6.2021

CS S4 Scientific Symposium by Students for Students event was organized by computer science doctoral students from Aalto University and University of Helsinki on 10 June, 2021. This was the second time when such a symposium brought doctoral students together. The local organizer group consisted of four active students, **Nidia Obscura Acosta**, **Onur Poyraz**, **Tolou Shadbahr** and **Mine Öğretir**.

The original idea was to organize the event already in spring 2020, but coronavirus suddenly changed plans. "We hoped for a long time that the symposium could have been held as a normal live event, but we had to postpone it over and over again due to continuing corona restrictions", tells Onur.

The doctoral student organizers also had to improvise a bit as the event was eventually held remotely in Zoom. "We asked participants to submit short video introductions upon registration", says Mine. "It turned out to be a nice way of getting to know people and start the whole symposium", confirms Onur.

The best part of the symposium was absolutely networking and getting to know other doctoral students in computer science. Many doctoral students have been very alone during this pandemic and therefore discussions were spinning around on how to keep in touch in a challenging situation like this. Especially the wellbeing session with Aalto University psychologist **Maria Törnroos** sparked a lively discussion on these topics. For instance, it was brainstormed on how universities could develop their services and improve doctoral students' work and wellbeing. "Providing opportunities to discuss informally with senior researchers and supporting interdisciplinary encounters were found important", says Tolou.

The scientific part of the symposium was not modest either – rather the opposite. The theme of the symposium "AI for the public good" was found interesting by the attendees and two keynote talks by **Albert Ali Salah** (Utrecht University) and **Oguzhan Gencoglu** (Top Data Science) were true highlights. "AI industry is very young. What we will be working on in three years' time is completely different from what we are doing now. It was fascinating to hear examples about roles of data and AI in changing societal and public contexts", states Nidia. "As a researcher, I usually ended up in my own box time-to-time, where I only focus on similar topics related to my research field. I love the idea of informal symposium, where you get to expose with new concept and ideas that not only can be used in your research field at some point but also broaden your perspective and knowledge. An example of this, happened during this symposium when there was discussion about the concept of FAIRNESS in AI models", states Tolou.

Other key elements of the symposium were free remote pizza lunch and final quiz competition. Both were also considered excellent ideas by the participants. Overall, the organizers felt that this year's event was a success. "In my opinion, organizing this symposium was a great experience", says Nidia. "Perhaps next time we get to meet face to face", concludes the organizing team.

By Aija Kukkala

Samuel Kaski receives major international funding for the development of AI methods

Aalto University Professor Samuel Kaski has been awarded the Turing AI World-Leading Researcher Fellowship to establish a new center of excellence. The funding relates to Kaski's work at the University of Manchester, but Finnish research on modeling user intent will also benefit.

Funding News, published: 30.7.2021

Samuel Kaski, Aalto University professor and director of the Finnish Center for Artificial Intelligence FCAI, has received the Turing AI World-Leading Researcher Fellowship. With the funding, a new center of excellence in the field of AI research is to be founded.

Kaski divides his time between Aalto University and the University of Manchester. He receives the Turing-funding from UKRI (UK Research and Innovation) in his role at the latter. The funding covers the work of a research group for five years. The new project involves multiple partners, among others Aalto, the coordinating institution of FCAI.

"UK is extremely strong in AI, and already a central partner for me, FCAI and therefore also for Aalto. This funding will enable even stronger collaboration, which will directly advance also Finnish AI research."

In practice, the new funding will strengthen the line of research already at the center of FCAI. The new research unit will develop AI that can help people define and specify the goals that they want to steer AI to strive towards. Especially medical research breakthroughs are believed to benefit from this work.

A similar objective is central to FCAI, which has defined the development of

AI-assisted decision-making, design and modeling as its joint methodological goal.

"This is as compatible to FCAI research as possible, in its objectives and collaboration possibilities", Kaski describes the new project.

"Developing this kind of AI is a major challenge and all now received investments and partners are needed. And there is room for more."

Kaski says that the award also affirms his belief that FCAI is on the right track.

"While excellent ideas coming from individual researchers are extremely important, to create attractive research clusters, we also need a focus. This is what we at FCAI have been building in Finland, and now, through the new collaboration possibilities, it will get even stronger."

Kaski wants to send his warmest thanks to his research group, and welcomes future members aboard.

The Fellowship is an exceptional award even for a seasoned professor.

"For a researcher who aims for new discoveries, positive feedback is a rare treat – instead, it is very common to hear that an idea is bad or a direction wrong. An acknowledgement is heartwarming also for an experienced researcher."

Kaski will continue as a part-time professor at Aalto and as the director of FCAI. In Manchester, he works as the research director of the Christabel Pankhurst Institute for Health Technology Research.

The Turing Artificial Intelligence World-Leading Researcher Fellowships were now given out for the first time. The funding was given to five researchers. Kaski's UKRI funding amounts to a good 5 million euros, in addition to which the University of Manchester and partners will be providing over 10 million euros.

By Minna Tiainen

Assistant Professor in Machine Learning Arno Solin nominated for Young Academy Finland

Young Academy Finland has selected Arno Solin as a member for the four-year period of 2021-2025.

Awards & Nominations, published: 31.8.2021

When **Arno Solin** received an email in June inviting him to join Young Academy Finland, it didn't take long for him to answer yes.

"It's a big honor", Solin says. "There was no way I could have turned down the offer."

Young Academy Finland is a fairly new organization, established by the Finnish Academy of Sciences and Letters in 2017, with an endowment from the Emil Aaltonen Foundation. The main goal of Young Academy Finland is promoting the role of science in the society. Members are young academics from different disciplines who show great promise in their field.

Of the values of Young Academy Solin particularly appreciates focus on multidisciplinary actions and promoting science in our society. Solin is known to actively take part in the public discussion and popularizing of AI and machine learning.

Facilitating dialogue between different disciplines is important, because the scientific community often finds itself in filter bubbles, Solin argues. He has noticed this is the case not only between different disciplines, but even inside the field of Computer Science.

"That's just how we are. Scientists like to hang out with people who have similar research interests", he laughs.

Universities have an important role in trying to solve issues and making a difference in society. Solin believes that a multidisciplinary approach is key when solving societal issues.

"When the scientific community takes a stand for something, the impact is much higher if we engage people from all different disciplines."

Solin is also interested in a program that The Young Academy is running, which brings academics to schools to talk about their research.

This fall is exciting for Solin also for another reason. He is starting a new research project as an Academy Research Fellow to look at how machine learning models could become faster and more reliable in real-world applications.

By Roosa Savo,
Photo Matti Ahlgren

Kahvit näppikselle

The Kahvit Näppikselle -podcast asks what technology can teach us about the world, relationships, and ourselves, and explains in an entertaining way how technology plays a key role in solving different kinds of problems. It shows how computer science is involved in basically everything.

Kahvit näppikselle -podcastin is hosted by Professor of Practice **Risto Sarvas**.

The language of the podcast is Finnish.

aalto.fi/fi/podcastit

Aalto-yliopiston tietotekniikan laitoksen podcast on kiinnostunut teknologiasta – mutta myös ihan kaikesta muusta, etenkin ihmisistä. Kahvit näppikselle kysyy, mitä teknologia voi opettaa meille elämästä, ihmissuhteista ja itsestämme sekä miten teknologia voi muuttaa maailmaa.

Kahvit näppikselle -podcastin juontaa tietotekniikan kymmenottelija, Aalto-yliopiston työelämäprofessori **Risto Sarvas**.

Follow Computer Science research in Aalto University

@CSAalto

Department of Computer Science

School of Science, Aalto University

Konemiehentie 2, Espoo Finland

cs.aalto.fi

Research news of 2020-2021 from
the Department of Computer Science
at Aalto University

A! Aalto University
School of Science