NorwAI

ANNUAL REPORT 2021

NORWEGIAN RESEARCH CENTER FOR AI INNOVATION

Summary

In its first full year of operation the Norwegian Research Center for AI Innovation, NorwAI, has developed into a full-fledged research center that is already contributing to the AI community in Norway.

An important task in 2021 was the establishment of a robust and lean NorwAI organization. With three universities, two research institutes and 11 companies on board, NorwAI needed to find a structure that balances research concerns with industrial needs. While the center is hosted by NTNU, the chairman is from Schibsted, and four of the eight work packages are managed by our industrial partners. Last year we set up two advisory boards, the Innovation Advisory Board, and the Scientific Advisory Board, that we believe will be vital to the success of the center. The members of these boards are prominent internationally recognized experts, and we are happy to receive them in Trondheim in April this year for some tough discussions on the nature of research-driven innovation.

Even though we are still in the early phases on the center's life cycle, there are already some promising research results that are likely to have a significant impact on partners' innovations. The Norwegian language model projects at the University of Oslo and NTNU have both demonstrated the potential of large-scale language models in advanced NLP applications. The models have been met with great interests both within and outside NorwAI, and there are now plans to generate much larger models that we hope will find its way into Norwegian companies' products and services.

NorwAI is the primary arena for Norwegian research institutions and industrial companies to discuss AI, exchange experiences and form partnerships and alliances on the use of AI. The NorwAI Innovate conference in October 2021 mobilized the whole AI community in Norway and was attended by more than 200 participants from research and industry. We expect the annual NorwAI Innovate conference series to be instrumental to the industrial adoption of AI in Norway in the years to come.

Professor Jon Atle Gulla,
NorwAI Center Director,
Trondheim 2021-03-17

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Innovation Board
Is AI still cool?

*Combining research
and AI is not trivial.*

Ieva Martinkenaite
VP Analytics and AI, Telenor
Chair AI Innovation Advisory Board,
NorwAI

There were plenty of AI gurus telling us their fantastic visions few years ago.They all talked about the moon-shot projects in AI, such as self-driving cars, robo-taxis, human-like virtual assistants.

– Come October 2021 and the entry of 2022, and guess what?

It is clear that the real-world complexities – or better frictions – of getting the AI technology to work and be accepted as safe and reliable, will delay its arrival.

Ieva Martinkeinate said she still drove her own car although an American government secretary in 2016 said there would be self-driving cars everywhere in 2021. She cannot order a robot taxi at Gardermoen that could drive her home although Elon Musk in 2019 said there would be a million robot taxis the next year. And the virtual assistants still have å long way to go to be really helpful in all situations.

– On top of that, many of us wait for ML to solve complex real-world problems and move beyond toy problems, such as beating the best human champion in the game Go or chess.

What technology evolution theory teaches us, is that hyping early-stage development of tech is very normal. However, every cycle of excitement leads to pragmatism and hard work, Ieva Martinkeinate said.

Serious observers, like the the Economist, declared back in 2020 that "AI autumn breeze" is coming with less research activity and attention towards AI back.

Ieva Martinkenaite, however, stated that there is progress in AI and more specifically in machine learning ML. Progress is everywhere as software is helping us to navigate in streets and avoid traffic jams, filtering email spam, recommending our most favorite songs, food or movies, or even reducing power consumption on energy grids.

Even so, after giving a detailed walk through of specific challenges in the crossroad between academic research and business developers, she asked:

Is AI still cool?

Her answer:

– Definitely yes!
– Because AI hype is diminishing and moves from exuberance to pragmatism. Obviously mostly cited moonshot projects, such as self-driving cars, will be delayed.

Instead, focus is shifting towards AI fighting against the pandemic, climate change and optimizing everything also the mission critical infrastructure. Due to powerful AI hardware and more accessible software, 2022 will see AI solving practical problems and becoming increasingly embedded in business processes, she said.

The so-called weak AI requires hard work and fundamental change in how companies learn – building data pipelines, developing talent,

creating software, embracing diversity and responsibility in how we build and use AI, she added.

Ieva Martinkenaite is chair of NorwAI's Innovation Advisory Board. She set high goals for the Research Center:

AI brings breakthrough to research and innovations, which gives hope that the biggest Research Centre on AI in Norway will succeed in spinning out some unique, global unicorns and help our large businesses to optimize processes.

Her hope for the pathway forward was high, as she said research nerds from academia and innovators from business do cross seamlessly for the best – green and sustainable future of Norway's AI.

– My experience shows that combining AI research and innovation is not trivial. There is hard work, investments and ambition needed, Ieava Martinkeinate added.

" *NorwAI Innovation Board chair, Ieva Martinkenaite of Telenor, gave the main keynote at NorwAI Innovate in October 2021. This article is a shortened version of her views.*
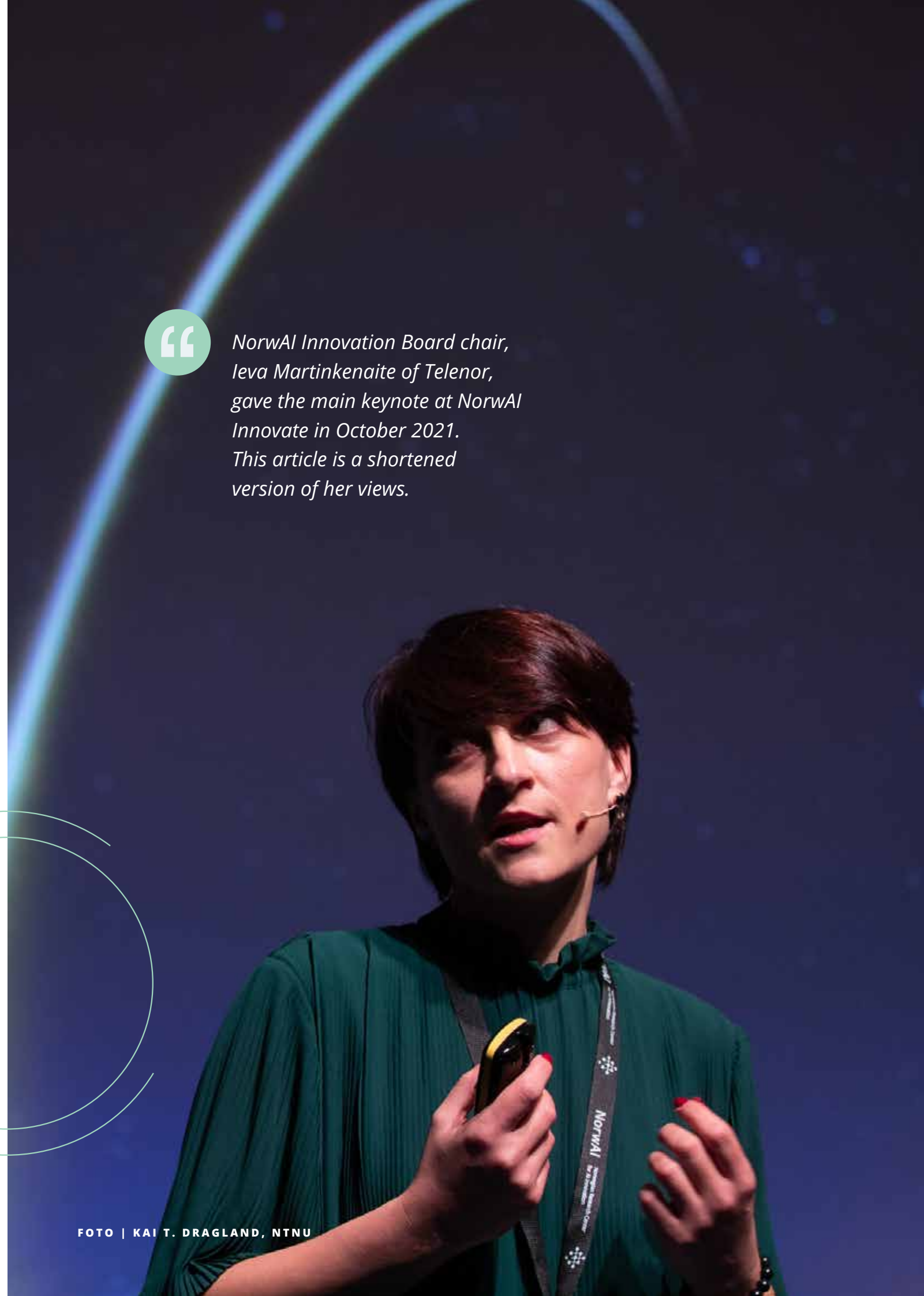
Enabling
adoption of AI
through increased trust

The pace of digital transformation and new technologies are re-enforced by the pandemic.

Frank Børre Pedersen
Vice President and Programme Director at DNV

The digital transformation has been going on for some time, with technology development accelerating at a rapid pace. The last two years with the pandemic have re-enforced this exponential trend, where we have seen fast adoption of new digital technologies and completely new ways of working.

The opportunities offered by the digital transformation goes well beyond enabling Teams meetings and more efficient work processes.

Fundamentally, we start to see that part of society increasingly rely on decisions and activities made by machines and models that are now fuelled with live data.

This will enable completely new ways of addressing current challenges, but more importantly, these technologies will be cornerstones in addressing all the important transformations we face, such as the energy transition, climate change and the transition to more sustainability.

Data-driven, model-driven and AI approaches will play a key part and we will also see new business models emerge to even further the value from these technologies.

The starting point for trusting the technology is understanding its performance.

Important aspects to consider ensuring trustworthy, explainable and safe AI:

Better assurance on the data used for training, validation of representativeness of the scenarios experienced during use, and the assessment of robustness towards uncertainty.

Furthermore, by combining domain knowledge encoded into physical models with the data-driven model we may achieve better explainability and performance. This is particularly important for safety-critical applications of AI.

But the value creation potential and performance of AI are not the only decisive factors in its adoption. Use of AI also introduces new emerging risks and new trust gaps. In addition to the challenges of using conventional model-based decisions, AI introduces something more fundamental as far as trust is concerned, as we do not fully understand the inner workings of the technology.

It becomes important then to know not only the technical accuracy of the technology, but also how it was developed: by whom, with what intentions, how it was trained, potential biases in the data, etc. This calls for trust beyond the technology itself.

To address some of these issues, we see that AI is increasingly regulated.

The EU is proposing regulations on the use of AI, whereby high-risk use will be strongly regulated, and certain uses even banned. This is necessary to ensure that the deployment of AI can be trusted and that we can benefit fully from scaling the technology.

Research activities
Visions and views

Norway has advantages in building AI services.

> **Kerstin Bach**
> Program Manager at NorwAI,
> Professor in AI, NTNU

Where is Norwegian AI research heading (where can we expect results short term/ long term)?

I can see that Norwegian as well as European AI research institutes focus more and more on transparency, explainability, and trustworthiness in AI. While many national and international AI strategies put the topic high on the agenda, researchers currently develop AI methods that create transparent and/or explainable methods.

Therefore, Norwegian AI research is contributing on developing AI methods that consider bias in data and are explainable when decisions are made.

As AI applications are maturing and more and more businesses become interested in the using them, creating ecosystems and toolboxes will become more essential. Norway has large amounts of publicly available data, high levels of digitalization which allows research to build upon and create services using AI that enrich our lives.

Second, I think human-centered AI methods are a field we will focus on in the future. Understanding the impact AI has on decision making processes and augmenting the capabilities of humans is a highly relevant field of research and will contribute to the maturing process of AI methods and applications.

How can research facilitate innovation in your opinion?

Research can be an excellent testbed for innovative ideas when the problem or case description is done in close collaboration with the industry. It is important that both parties agree on what should be solved and then give researchers the freedom to explore and be creative in finding solutions.
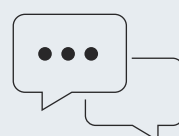
Of course, an innovation process is much more than a great idea, but novel services and applications will develop in centers like NorwAI where researchers and businesses meet.

Hence, in research we can explore novel ideas and take risks during the developmental phases.

Looking forward, what is success for NorwAI?

There are many paths to success in the center: The collaborations between the partners to find common problems we can address in a research setting.

I believe it's crucial to work on joint research goals involving our partners and the talented Ph.D. students and postdocs in the center.

Allowing them to work on real-world problems and publishing their work, obtaining their degrees, and building a career in AI research or industry would be a great success for the center.

Inspiring students at the university for our field and being creative during course projects and master's theses. We have creative and smart students that can become excellent ambassadors for using AI methods in suitable applications that matter.

The use of use cases
Innovation at work

Svein Størmer Thaulow
EVP Schibsted Group,
Chief Data and Technology
Officer, Chair Executive Board,
NorwAI

NorwAI partner Schibsted innovation approach is focused on starting with a user or brand need or problem, opposed to having data or technology as the starting point.

– By working with a use case - or a "job to be done" as we say - we focus on outcome and THEN use data and technical capabilities to solve it, says Chief Data and Technology Officer Sven Størmer Thaulow.

By understanding a user need and for instance identify its value potential, make us understand if and how the problem should be addressed by our data and technical capabilities, says Chief Data and Technology Officer Sven Størmer Thaulow.

At NorwAI Innovate the Schibsted EVP gave NorwAI partners and the conference audience a recipe for innovation at work. The multi-national and multi-diversed Schibsted company with 5000 employees, separate brands, diverse business models and lots of local autonomy, had worked hard to find their way of generating value from shared use of data and technology.

The methodology from Schibsted for analyzing new product ideas has been made available to the multi-partner and multi-diversed NorwAI Research Centre.

– Industry partners have prepared and handed over possible use cases to the consortium. A key point is to use the cases to identify specific areas for cooperation between the partners, says NorwAI Innovation Director Arne Jørgen Berre at SINTEF.

The use cases will be prioritized and related to the research tasks of the PhD candidates and the research activities in the centre.

As a part of this, all PhD candidates will be linked to partners and use cases in their research work, and research stays with these partners are planned.

Arne Jørgen Berre
SINTEF, Innovation
Director at NorwAI
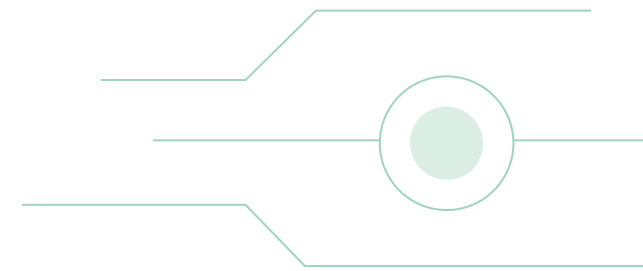
To NorwAI, the work packages for Language Technologies and Personalization will focus on use cases linked to:

> user modeling and behavior prediction

> personalised and contextualised content creation

Likewise, use cases in work packages for Streaming & Sensor-based Data, Hybrid AI Analytics and Data and Platform for AI will focus on:

> predictive maintenance and operational availability

> IoT sensor anomaly detection

> Hybrid digital twins

are linked to the research areas of AI for

We need to refocus and ramp up our AI efforts, to stay competitive in the market.

Sven Størmer Thaulow, also chair at NorwAI Executive Board, says the use of use cases mitigate the AI/ML risks:

– Artificial Intelligence and Machine Learning are amongst the most important enabling technologies now, and in the forthcoming years. But it is still early days. There are high risks like lack of tools, process, and skills maturity.

– Also, there is less understanding of match between problem and possible solution. For Schibsted, and other industries as well, there are extra steps and complications involved in labelled data, choosing appropriate KPIs and goal functions and training as well as validating models.

Nevertheless, AI and ML enables development of new offerings and business models, but also fundamentally changes business processes and enterprise operations.

– We need to refocus and ramp up our AI efforts, to stay competitive in the market, says Sven Størmer Thaulow.

Research activities
Visions and views

Serendipitous connections between people and partners as the source for success.

Kenth Engø-Monsen
Fellow of Telenor Research

Where is Norwegian AI research heading (where can vi expect results short term/long term)?

– The extraordinary, methodological developments within the AI-field over the past decade, has been fueled by vasts amounts of data and data-greedy methods.

In the coming decade, I expect to see more proliferation of AI methods and that we will see numerous, new application domains for AI methods.

The world is also demanding more energy-efficient methods which will fuel the development of more efficient and green AI methods.

How can research facilitate innovation in your opinion?

– To me, innovation boils down to handling two types of orthogonal risks: 1) technological risk relating to the functionality of a product or service, and 2) the market risk relating to a potential market. There will always be a distinct, and important place for technological research in order to handle the technological risk that any product or service is facing – which I consider to be the main type of risk that NTNU is paying most attention to.

The truly magical source for a SFI research program success is to facilitate serendipitous connections between people and partners.

Looking forward, what is success for NorwAI?

– Success cannot be measured in a one-dimensional manner, and this needs to be considered in the relevant context. Diversity needs to be embraced, and personally, I believe that regardless of "key-performance-indicators" the truly magical source for success for a SFI-based research program, is to facilitate serendipitous connections between people and partners.

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Organization

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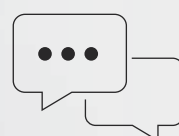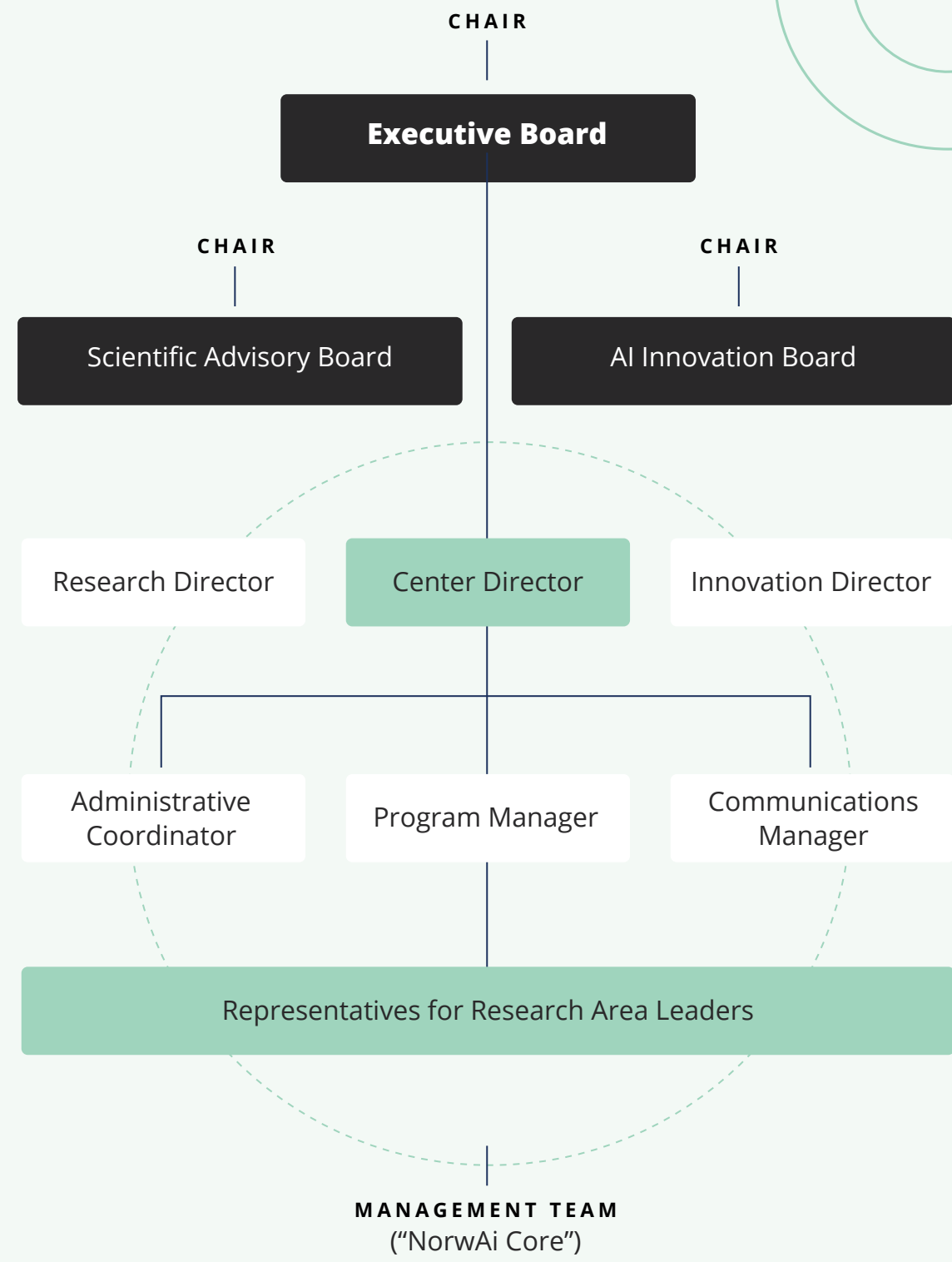
MANAGEMENT TEAM
("NorwAi Core")

Center management team

The Center Management Team is responsible for the day-to-day operation of the center and consists of:

Jon Atle Gulla
Professor, NTNU,
Center Director

Karolina Storesund
Administrative
Coordinator, NTNU

Kjetil Nørvåg
Professor, NTNU,
Research Director

Rolf Dyrnes Svendsen
Head of NxtMedia Lab
and affiliated to NTNU,
Communications Manager

Arne Jørgen Berre
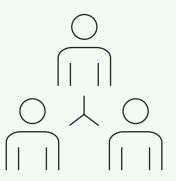Chief Scientist, SINTEF,
Innovation Director

Helge Langseth
Professor, NTNU,
Research Area Leader (WP4)

Kerstin Bach
Professor in AI, NTNU
Program Manager

Anne Marthine Rustad
Research Manager, SINTEF,
Research Area Leader (WP7)

Some of the largest and technologically most ambitious companies and research institutes in Norway have joined the consortium.

Consortium

RESEARCH PARTNERS

NTNU, the Norwegian University of Science and Technology, Department of Computer Science is host for the center, the other research partners are Norwegian Computing Center (NR), SINTEF, University of Oslo, and University of Stavanger.

INDUSTRIAL PARTNERS

The group of industrial partners in NorwAI consists of Cognite, Digital Norway, DNB, DNV, Kongsberg Digital, NRK, Retriever Norway, Schibsted, SpareBank 1 SMN, Telenor, and TrønderEnergi.

Soft-boiled eggs
and artificial intelligence

When His Royal Highness Crown Prince Haakon Magnus wanted to know more about artificial intelligence, he invited the research center NorwAI to a breakfast meeting in Stiftsgården, the royal residence in Trondheim.

Over coffee, soft-boiled eggs and rolls, the conversation quickly picked up speed an early October morning. The tone around the table was jovial.

Professor and center leader Jon Atle Gulla was inspired, and gave an inspired introduction to the subject in general, and NorwAI in particular. Three universities, two research centers and 11 of the Norwegian industrial locomotives have joined forces on the largest academic initiative in the AI field.

The Crown Prince was particularly concerned about the industrial opportunities for the future of Norway, both on land and at sea. Then he sought answers from those who know the place where 3 out of 4 Norwegian master's students in technology are educated. Rector Anne Borg of NTNU and SINTEF's CEO Alexandre Bech Gjørv sat by his side and heard Karianne Tung, head of the innovation district Trondheim Tech Port, talk about how she would play an urban area that accommodates 40,000 students, 9,000 researchers, 3 Nobel Prizes and 767 technology companies well together for the national benefit.

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UTOPIA? – Professor Jan Inge Sørbø asked a challenging question

FUTURE – Professor Jon Atle Gulla gave examples of the future capabilities of the new language model NorwAI is developing.

When silence fell upon the Commission for Freedom of Expression

The eloquent Commission on Freedom of Expression became quiet and silence fell upon the room.

Professor Jon Atle Gulla had just completed his review of the intelligent language model being developed at NTNU by the NorwAI research center. The prospects were staggering:

– The model will be able to produce its own, advanced text on a large scale. It will be able to outperform all current chatbot robots and Apple's Siri and Google Home, it can extract sentiments and make perfect summaries of many documents itself. This is good news for those who want to defend the Norwegian language area, said Jon Atle Gulla.

The Freedom of Expression Commission took the trip to Trondheim in October 2021 to understand more of the technology development. Professor Gulla told enthusiastic about a future where the model, for example, would be able to write poems with surprising twists and creative sensitivity that few would recognize as machine-controlled.

Utopia or dystopia?
Commission member and professor Jan Inge

Sørbø broke the silence in the meeting:
– I have a slightly provocative question:

– Can this machine write our NOU?
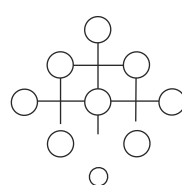
Research activities
Visions and views

*What we want
is tailored bank services
to customer's need.*

Astrid Undheim
Executive Director at
SpareBank 1 SMN

Where is Norwegian AI research heading?
Norwegian bank customers are digital mature with high expectations in terms of access to bank services, convenience, and speed. Norwegian banks have invested heavily in new digital channels and tools and are today technologically advanced.

Use of data in the finance sector, including utilizing AI and ML, will increasingly be one of the key components for keeping up with the expectations from customers – including delivering faster service and better customer support. In practice this means getting a loan approval faster, getting a better overview of your personal economy, more relevant product offers from your bank, and in general having a banking service more tailored to you needs and preferences.

At the same time, the regulatory environment facing Norwegian and European banks, including

anti-money laundering and fraud detection, put demands on the use of digital technology. The complexity of these tasks, and the increased expectations from customers and regulators, means that these tasks can no longer be solved efficiently without more advanced data analysis. Reacting to transactions in real-time, finding patterns in transactions, and identifying abnormal activity will be mandatory activities. Systems that learn and that are able to detect and react to new and unseen situations from higher transaction volumes and more complex customer relationships, demands AI.

*Customer expectations:
faster loan approvals, better
overview of personal economy,
relevant product offers, a
banking service more tailored.*

How can research facilitate innovation in your opinion?
A strong Norwegian AI Research community is important to Norwegian banks to stay competitive, both in the customer and the regulatory dimension. Building this type of competence in Norway is important both for the competitiveness of Norwegian industry, but also because some of the problems are unique to Norway, including problems requiring Norwegian language understanding and problems requiring understanding of Norwegian laws and regulations.

Looking forward, what is success for NorwAI?
Training students and researchers in industry problems will increase innovation pace in Norwegian industry and makes the studies more relevant and hopefully more interesting. A win-win!

Innovation in the AI space will happen through close collaboration between research and

industry. The NorwAI SFI ambitions to strengthen some of the key success factors to accelerate innovation will be fundamental, including

> A low barrier for introducing industry problems to students and researchers

> a world-class research community, and

> a curious industry looking for innovative solutions and with a willingness to put results into practical use.

AI is a research field where the path from research to innovation is becoming shorter, which calls for even closer collaboration between research and industry.
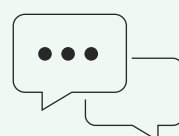
Research activities
Visions and views

One area where the Norwegian AI scene stands out is the genuine interest in fairness, transparency, and explainability.

Krisztian Balog
Professor,
University of Stavanger
Staff Research
Scientist Google

Where is Norwegian AI research heading (where can vi expect results short term/long term)?

I can answer this question from the perspective of information access and decision support systems. Many problems in this space are still either too complex or too important to be fully automated with humans removed entirely from the loop (consider, for example, financial decision making or content creation). That said, there are numerous smaller, specific steps within these more complex processes where AI can help assist humans—think of search engines helping with query formulations, forms suggesting automatic categorization of content, or conversational agents being able to tackle simple tasks. Thanks to improved natural language understanding, we can expect to see a lot more of these in the short term and a significant expansion both in terms of scope and complexity in the long term.

One particular area where the Norwegian AI scene stands out is the genuine interest in fairness, transparency, and explainability, which align with societal values.

Therefore, I can see Norwegian AI research taking a world-leading role in these areas.

How can research facilitate innovation in your opinion?

I can think of opportunities on at least three fronts.

First, there is often a critical performance threshold for methods or components in a given application setting. Research is continuously trying to improve performance to reach (and push beyond) these thresholds. Also, there is a great deal of research effort directed towards ensuring that the "right things" are measured and in a sound way.

Second, the cost of deployment or data annotation can be a barrier to innovation. Research can help lower these barriers by making techniques more accessible (e.g., by building on top of widely used software frameworks and open-sourcing solutions) and by developing methods that are less data-hungry.

Third;

Research produces a continuous steam of novel tasks and creative approaches.

These can lead to innovative products or user experiences.

Looking forward, what is success for NorwAI?

Success comes in many forms. For academic partners, success may be impactful publications or methods/ideas making it to being deployed and used in products. It would also be success to see some of the PhD candidates funded by NorwAI ending up as future leaders in the industry. For industry partners, success may be increase in key performance indicators, the launch of innovative services, or increase in in-house AI expertise. For all project partners, continued and extended collaboration beyond NorwAI would be a sign of success.

Ultimately, success for NorwAI, in addition to all of the above, may be recognition, both within and outside Norway, as an exemplary model of academic-industry collaboration.

Members of the board

Sven Størmer Thaulow
Chief Data and Technology Officer,
Schibsted Media Group

Ingrid Schjølberg
Dean and Professor, Faculty of
Information Technology and
Electrical Engineering, NTNU

Sergei Savenko
CTO, Retriever (from March 2022)

Frank Børre Pedersen
Vice President & Program Director
"Future of Digital Assurance", DNV

Trond Runar Hagen
Research Director, SINTEF

Dagfinn Myhre
Senior Vice President,
Telenor Research (from April 2022)

Stein-Roar Skånhaug Bjørnstad
CTO, Kongsberg Digital

Gøril Forbord
EVP Technology, TrønderEnergi

Karl Aksel Festø
Head of CoE Advanced Analytics, DNB

John Markus Lervik
CEO, Cognite

Liv Dingsør
CEO, Digital Norway

Stephan Oepen
Head of Department for
Informatics, University of Oslo

Heidrun Reisæter
Director of Technology, NRK

Astrid Undheim
Executive Director, Sparebank1 SMN

Tom Ryen
Head of Department for
Informatics, University of Stavanger

André Teigland
Deputy Director, NR

Innovation Advisory Board

*Exclusive group of innovaters to
advice NorwAI on innovation*

The AI Innovation Advisory Board (AIB) will provide advice on how to create innovations from research for the NorwAI partners. The AIB will follow up on the innovation results on a regular basis and help to monitor the overall progress following SFI success criteria for innovation and commercialization. The Innovation Advisory Board is planned to meet with the Center director and the innovation director twice a year.

Ieva Martinkenaite, Vice President, Analytics and AI at Telenor leads the Innovation Advisory Board.

NorwAI was happy to welcome a generous mix of international internationally recognized experts from both abroad and Norway as it's its advisors. The Norwegians are well connected to core industry in NorwAI. The other two are core members of the AI community in both Europe and the US East Coast.

Ieva Martinkenaite, VP Analytics and AI, Telenor

IAB chair Ieva Martinkenaite is among the key figures at Telenor Group contributing to building AI research and innovation ecosystem in Norway. She leads a team of data scientists and Machine Learning engineers in Telenor and several high profile regional and national appointments in AI. As Vice President of Telenor Research and Head of Analytics and AI team, Ieva is responsible for advancing research and driving research-based innovation in Telenor within data analytics, AI and IoT. Her work also involves advisory to Telenor executives and business leaders on digital technologies and innovation strategy. Concurrently, Ieva leads a joint AI task force of Europe's largest telecommunication operator association ETNO and GSMA Europe. She has more than 15 years of experience in product development, business research and advisory, and holds several Board memberships positions. During 2018-2020 Ieva represented Telenor in the European Commission's High-Level Expert Group on Artificial Intelligence that provided ethics guidelines for Trustworthy AI and recommendations on the implementation of European Strategy on AI.Ieva holds a PhD in Strategic Management from BI Norwegian Business School.
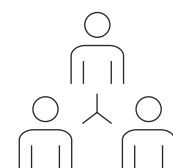
MEMBER OF THE INNOVATION ADVISORY BOARD

Sophie V. Vandebroek, Board Director, Trustee, Advisor

Sophie is a founder of Strategic Vision Ventures LLC and serves on several corporate and non-for-profit boards, among those are IDEXX Laboratories, Inari Agriculture and Wolters Kluwer. She is a trustee at the Boston Museum of Sciences and serves as a member of the international advisory board of the Flanders AI Research Program. Recently she was appointed Honorary Professor at the KU Leuven Facultry of Engineering Sciences.

Her last corporate positions were Chief Operating Officer of IBM Research, and for over a decade she was Xerox's Chief Technology Officer leading Xerox's global laboratories, including PARC, Inc. She was also the MIT Inaugural School of Engineering Visiting Scholar. Sophie is a Fellow of the Belgian-American Educational Foundation and a Fellow of the Institute of Electrical & Electronics Engineers. She was inducted into the Women in Technology International Hall of Fame and elected to the Royal Flemish Academy of Arts & Sciences.

Sophie's passion for creating inclusive organizations where innovation thrives has earned her many awards among which is Xerox's Inaugural Lifetime Diversity Leadership Award of Distinction. Sophie has a master's degree in Engineering from KU Leuven, Belgium and a Ph.D. in Engineering from Cornell University, Ithaca, New York.

MEMBER OF THE INNOVATION ADVISORY BOARD

Saskia Steinacker, Global Head Strategy & Digital Transformation, Bayer

Saskia is a recognized digital leader and business transformer with extensive global experience in Life Science Industry. She has 17 years of outstanding track record in successfully defining sustainable strategies, leading the implementations, and delivering outstanding outcomes. In her executive roles she proved to have a unique ability to simplify complexity, steer diverse groups of stakeholders across all levels and functions towards business goals and build high-performing, diverse teams. Saskia is actively shaping international governance and regulations in the digital space, through appointments to global expert groups of B20 (G20 subgroup) and European Commission High Level Expert Group AI. She is a Director of National Board of Directors at YMCA-US and serves as a Presidency Committee Member at ECO, Europe´s largest Association for Internet Industry. Saskia has been recognized as a Digital Leader of the Year 2019, Health Influencer 50 (PRWeek, MM/A). Saskia is featured at Forbes, Financial Times, South by Southwest (SXSW), NOAH etc. She has an MBA with distinction from University of Liverpool, UK.
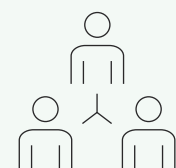
MEMBER OF THE INNOVATION ADVISORY BOARD

John Markus Lervik, Founder & CEO, Cognite

John Markus is a founder and CEO of Cognite AS, an industrial software company headquartered in Oslo, Norway serving oil and gas, power and utilities, renewable energy and other asset-heavy industries. He is also a founder of Cxense (listed on the Oslo Stock Exchange), an AI-powered Data Management and Intelligent Personalization platform for publishers and marketers around the globe. Previously he served as a CTO and CEO of the Fast Search & Transfer (acquired by Microsoft) and was a Corporate Vice President at Microsoft. John Markus is recognized as one of the most successful entrepreneurs and digital leaders in Norway with a track record in leading the online advertising, search, data analytics and IT businesses. In 2005 he was mentioned as one of the key innovators in the Forbes E-gang: Masters of Information. John Markus has a Ph.D. from the Norwegian University of Science Technology, Trondheim for which he earned the Esso academic award.

MEMBER OF THE INNOVATION ADVISORY BOARD

Øystein Larsen Indrevær, Senior Vice President Data-driven Sales, DnB

Øystein is a Senior Vice President and Head of Data-driven Sales at DNB, Norway´s largest financial services group. He is responsible for Data Management, Data Quality, Data Privacy and Data Science in the Personal Market division of the bank. Previously Øystein worked at the Centre of Excellence for Advanced Analytics in the Chief Data Officer organization of the DnB bank, focusing on value realization of advanced analytics use cases, ensuring excellence and cohesive way-of-work of the data scientists. Øystein has a track record of experience in the Corporate Governance field working as Advisor to CEO and Company Secretary in DNB in the 2010s. He holds an Executive Master of Management degree from BI Norwegian Business School (Norway) with specialization in Analytics for Strategic Management.
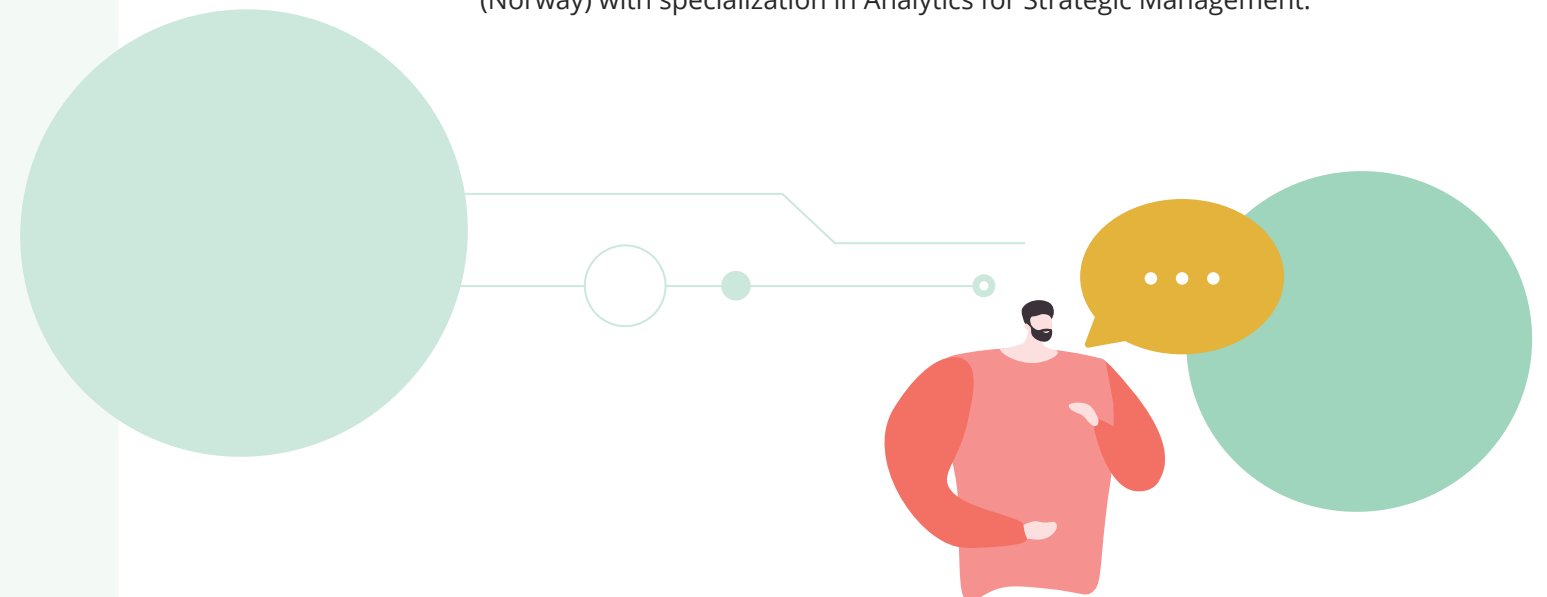
Gearing up for more
collaboration and Innovation

*NorwAI has every reason
to be proud of 2021.*

Jon Atle Gulla
Professor at NTNU, Center Director

*This was the research
center's first full year of
operations, and we already
see a strong AI research
community forming around
the partners and their
respective networks.*

A number of gifted PhD candidates have joined the team and are now working on extremely tough and important AI research challenges. Thanks to the hard work of our work package leaders, the organizational part of our center is now mostly in place with processes for planning, implementing and reporting ongoing research tasks.

Research activities have been initiated and are motivated from industrial use cases, ideas and experiences are shared among partners, and we already have an abundance of ideas for new AI projects or products.

We are however always pondering how we can improve further and strengthen our research center's ability to accelerate the development and adoption of AI in Norwegian industries.

*Research-driven innovation
is by nature a demanding
exercise that requires not only
insight into relevant aspects of
research and business, but also
a profound understanding of
the dependencies between
the two.*

We believe that communication and collaboration are key ingredients to succeed as a center for research-driven innovation. Research experts and domain experts need to interact and collaborate in a systematic manner. Companies need to learn from each other, both within an industry and across industries.

New ideas and new insights often emerge when new perspectives or new applications are brought in.

On this basis we decided at the end of 2021 to simplify and streamline the work package structure somewhat.

The original work package structure had a separate work package, AI innovation areas, that was intended to coordinate innovation activities across research packages. The work package has been responsible for collecting use cases from partners, elaborating their underlying technology needs and identifying the relevant supportive research packages. Now that the first list of use cases is in place, the next step is to make sure that research and use cases are properly aligned in every work package and develop a common understanding of the research needs among AI and domain experts. In this process it is important that research and innovation are viewed as a whole, and that both aspects pervade all tasks of our work packages. A natural decision is then to dissolve the AI innovation areas work package and distribute its content over the other research packages.

*This means that other
work packages receive some
additional resources, and
SINTEF will engage themselves
in innovation activities across
work packages.*

Also, it turned out that two work packages, AI for personalization and AI for language technologies, were very similar both in terms of technologies and partners. They depend on the same textual data sets, use many of the same machine learning approaches, and address some of the same underlying business needs. Any product or service coming out of these two packages would most likely include results from both packages.

*Merging these two
packages, we ensure that
NLP and personalization
experts work closer together
and simplify the coordination
between and reporting from
the two packages.*

Hopefully, it may also act as a spur to products that introduce novel combinations of NLP and personalization.

These two changes were confirmed by the executive board on January 11 2022 and are operational from January 2022.

WP1 Management and Communication

WP2 SOC: All in Society

WP4 PERS: AI for Personalization

WP5 LANG: AI for Language Technologies

WP6 STREAM: AI for Streaming and Sensor-based Data

WP7 HYB: Hybrid AI Analytics

WP8 DATA: Data and Platform for AI

WP3 TRUST: Trustworthy AI

WP9 AI Innovation Ecosystems

WP10 AI Innovation Areas

IA1 Explainability and verification
IA2 User modeling and bahaviour prediction
IA3 Personalized and contextualized content creation
IA4 Predictive and prescriptive maintance
IA5 IoT sensor anomaly detection
IA6 Hybrid digital twins
IA7 Data Quality analysis and enchancement

RESEARCH AREAS

INNOVATION AREAS

ADMIN Management and Communication

SOC AI in Society

LAP Language Personalization

STREAM AI for Streaming and Sensor-based Data

HYB Hybrid AI Analytics

DATA Data and Platform for AI

TRUST Trustworthy AI

INNOECO AI innovation Ecosystems

We are gearing up for more innovation in 2022. These organizational changes will contribute, though there are several other initiatives that should give innovation more emphasis in NorwAI and help us turn deep AI research into great products or services. The Innovation Advisory Board is now operational, and we are finalizing plans for some interesting innovation workshops at the center. Internal partner presentations about innovation are also planned. And finally, we are bringing in additional people that have extensive experience with turning research into industrial products or even to new companies.

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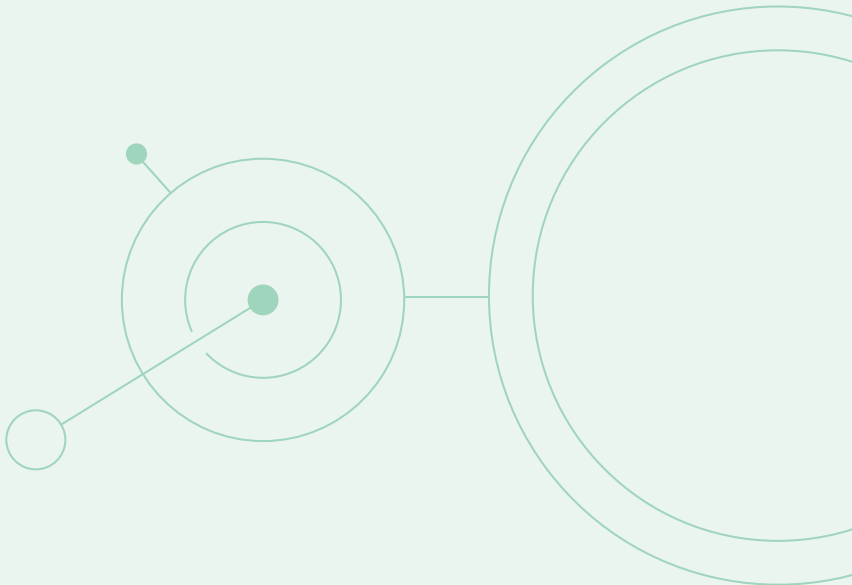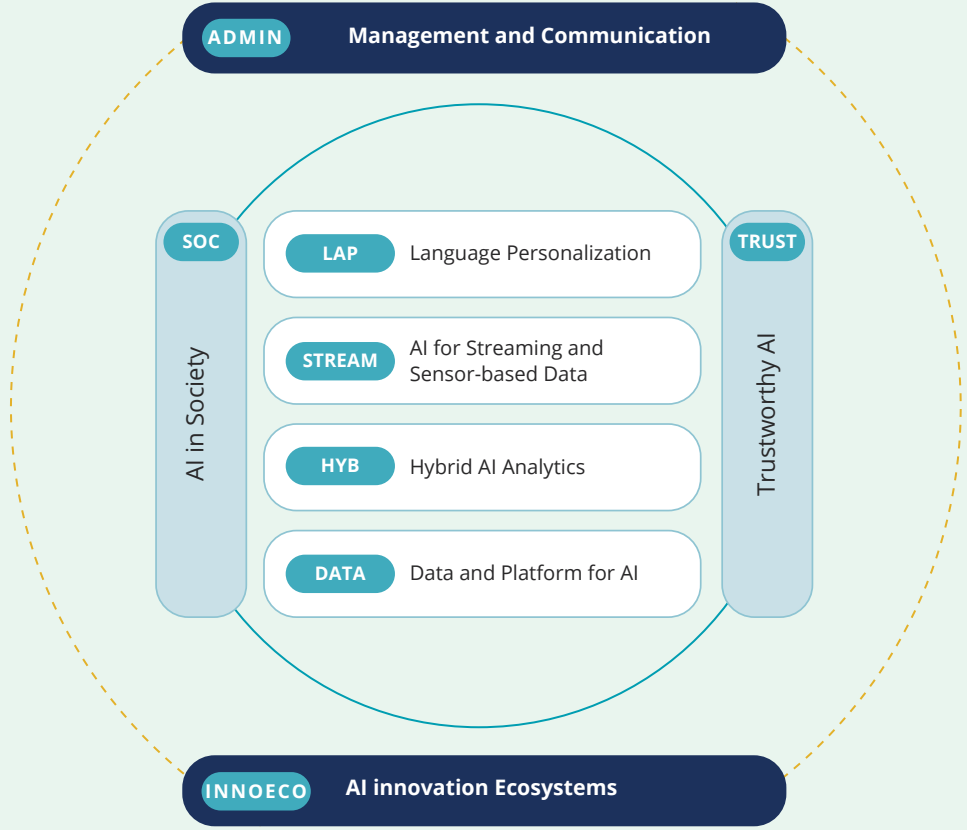
NorwAI
objectives

The objective of the NorwAI research center is to provide a strong and robust arena for industry, research and academic institutions to collaborate on the development of AI ideas and techniques, share results, and iteratively explore how technology can transform existing businesses and enable entirely new business avenues.

The primary objective – or mission – of NorwAI is to:

Accelerate the innovation of sustainable and trustworthy artificial intelligence solutions across Norwegian industries.

This primary objective is further broken down into objectives and secondary objectives, as shown on the next page.

Artificial intelligence constitutes a paradigm shift in computer science, enabling substantially shorter development cycles, extremely powerful solutions, and immediate transfer of technologies from one domain to another. The innovation cycles become very dynamic, representing both challenges and opportunities at the same time. New systems may completely transform existing practices, render old value chains worthless, or open for brand new business opportunities. NorwAI supports innovation as a platform for continuous interaction between industry and academia, and will act as an

ecosystem for creating alliances, joint venturing and building synergies among all partners. NorwAI will thereby enhance the ability of the business sector to innovate and create value through a greater focus on long-term research.

NorwAI acknowledges that the deep impact of AI makes it necessary to ensure efficient sharing of knowledge and enable businesses to adapt their innovation processes to this new situation and provides the skills for business transformation. At the same time, it is critical that the technology is applied with care and with respect for the needs of individuals and societies. The objectives of true personalization of services by providing data and platforms for AI innovations address the AI research needed to implement, deploy and evaluate companies' use case innovations. Finally, the overall quality and reputation of the research center will affect the center's ability to help companies develop and deploy research-based innovations and establish NorwAI as an international leading AI research and innovation center.
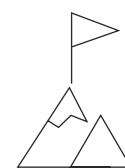
NorwAI objectives
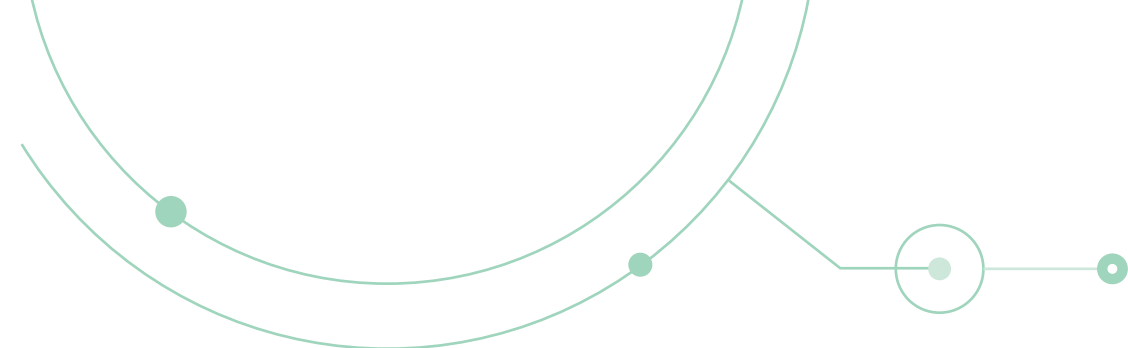
O1 — Understanding impact on society

O1.1 Understanding how contributions from NorwAI can affect society at large

O1.2 Understanding fear of unethical AI uses and consequences

O2 — Reinforce common understanding of safe and responsible AI

O2.1 Validate need for trust in AI

O2.2 Establish trust in safe and responsible AI

O2.3 Create guidelines for sustainable and beneficial use of AI

O2.4 Ensure privacy-preserving technologies

O2.5 Develop principles for explainable and transparent AI

O2.6 Develop principles for independent assurance of AI deployment

O3 — Provide true personalization of services

O3.1 Develop truly explainable, fair and transparent personalization techniques

O3.2 Enable proactivity in customer relations

O3.3 Provide and individualized experience that provably respects privacy concerns

O4 — Develop language processing capabilities for Scandinavian languages

O4.1 Develop large-scale Scandinavian language models

O4.2 Enable human-like content creation and conversations

O4.3 Develop individualized content

O5 — Develop modern AI for streaming and sensor-based data analysis

O5.1 Provide anomaly detection and predictions with low quality streaming data

O5.2 Provide uncertainty quantification and explainability with streaming data

O5.2 Enable combinations of streaming and static data for efficient data analysis

O6 — Merge physical models and AI systems

O6.1 Use machine learning to increase understanding of physical systems

O6.2 Quantify uncertainty from non-representative training data

O6.3 Apply machine learning on imperfect data

O6.4 Ensure robustness and explainability of model predictions

O7 — Provide data and platforms for AI innovations

O7.1 Develop mechanisms for preparing business data for sharing

O7.2 Establish platforms for efficient AI development processes

O7.3 Provide infrastructure for sharing data and implementations

O8 — Cultivate an AI-based innovation culture

O8.1 Transfer AI knowledge and expertise in short innovation cycles

O8.2 Establish an innovation arena for effective value creation

O9 — Establish NorwAI as an internationally leading AI research and innovation center

O9.1 Attract additional funding

O9.2 Attract additional partners to NorwAI
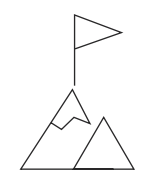
O9.3 Establish PhD research school on responsible AI

O9.4 Increase number of AI PhD and MSc graduates

O9.5 Establish networks with leading AI communities

The Scientific
Advisory Board

An Ambitious Board

The Scientific Advisory Board of NorwAI held its first meeting in October 2021. At the first meeting, a hybrid meeting with both physical and digital participation, the Board discussed and prepared for its future work and cooperation with NorwAI. The Board exchanged ideas and experiences to contribute to NorwAI's ambitions. The Board agreed on preparing for a meeting in Trondheim during spring 2022.

Furthermore, two of the Board members, prof de Rijke at University of Amsterdam and prof Dignum at Umeå University, were keynote speakers at NorwAI Innovate, the biggest AI dissemination conference in Norway.

The overall goal of the Board is to provide external scientific reviews of research activities, evaluate plans and progress, and contribute to shaping the center's research ambitions. The Board will report to the Executive Board of NorwAI.

MEMBERS OF THE SCIENTIFIC ADVISORY BOARD

Christian S. Jensen
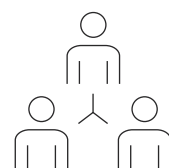Chair and Professor,
Aalborg University

Maarten de Rijke
Professor, University
of Amsterdam

Concha Bielza
Professor,
Technical University of Madrid

Virginia Dignum
Professor,
Umeå University
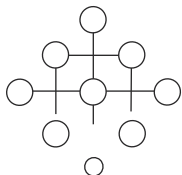
Research
strategy

Our approach to research at NorwAI is fundamentally multi-disciplinary, consisting of both technical-oriented and socio-economic research. Current research on AI is diverse and reflect many disciplines or perspectives covering theoretical contributions from a wide range of disciplines together with more applied work from system designers and application developers working with data from many different domains.

Our research is partner-driven and rooted in a strategic and systematic approach towards innovation to create lasting value and impact. The consortium represents considerable breadth on the problem owner side with respect to business needs, experience with artificial intelligence and capabilities for commercializing technological research results to capture value. Sensitivity towards this variety necessitates tailoring of the innovation processes for each user partner. We adopt a user driven innovation process both with respect to needs common to several partners and needs that are unique to a single partner. The foundation for our approach is dynamic and continual collaboration between partners to iteratively understand strategic needs, research and design solutions and test resulting technologies, tools and methods. It is simple yet effective.

Research in NorwAI focus on generic research areas within AI that can support the innovation activities in the center. The research areas will be evaluated every year in the center's lifetime, making sure new areas can be added based on research needs from future innovation areas or in case of integrating new partners. Existing areas might also be merged or concluded and come to an end.

Our research is parner-driven and rooted in a strategic and systematic approach towards innovation to create lasting value and impact.

NorwAI Innovate
fueled with talents

Our ambition for NorwAI was to launch the largest and the most interesting AI tech conference in Norway for partners and company professionals, researchers, students, and technology interested citizens. With close to 230 participants and an extraordinary line-up of keynotes, NorwAI Innovate lived up to its expectations.

We also wanted to give energy to future NorwAI event as a unique showroom for what to expect from this research center.

This new arena opened up for people to connect and relate on a cross discipline, cross profession and cross generation basis.

Sidekicks like poster demos and hackaton fueled NorwAI Innovate with next generation AI talents.

Rector Anne Borg opened the NorwAI Innovate Conference, mobilizing the whole AI community in Norway.

Conferences used to be valuable halts in daily routines offering an opportunity to refresh competence and relations. The pandemic reduced our possibilities for these events. NorwAI Innovate 2021 contributed to a rebirth in the post-covid society. At their best, conferences provide cross discipline exchange and a technology transfer between players across borders.

Ieva Martinkenaite,
Telenor

John Markus Lervik,
Cognite

Knut Magne Risvik,
Microsoft

Virginia Dignum,
University of Umeå

Nicolay Astrup,
Parliament member

Pål-Christian Njålstad,
Autodesk

Elizabeth Traiger,
DNV

By continuous interaction between industry and academia – such close contact will indentify and unlock AI technologies – our intention is not only to contribute to the international AI research and innovation networks but create one of own.

A possible time machine providing a trip to the future.

NorwAI may provide compelling future developments for media, finance and telecom as well for asset-intensive industry, mixed with a search to identify societal and ethical impacts of technology. Gathering people to interact on the supercharger of change in our times, namely data, is one of the inspirational objectives of NorwAI.

Brain and AI Research
Bridging advanced research

*Amazing similarities, and
the gap between them.*

- Our brain is the world's most advanced computer. But understanding the brain can also promote the development of artificial intelligence.

The words are professor Edvard Moser's at the Kavli Institute for Systems Neuroscience.

He highlighted an exciting interdisciplinary perspective when he gave the final speech at the new, national AI conference NorwAI Innovate in Trondheim in October.

The Nobel laureate was invited by Professor Jon Atle Gulla at the newly established NorwAI - Norwegian Research Center for AI Innovation - which challenged Moser on the relationship between brain research and artificial intelligence.

Although a processor and living brain cells are vastly different as "hardware", both operate in circuits.

Admittedly, the brain's network is unimaginably large with nearly 100 billion cells, each with 10,000 connections, giving the brain a unique ability to handle huge amounts of information in millions of channels simultaneously in real time.

This network structure carries some similiarities to complex machine learning models.

In addition, the brain neurons can learn from and train each other – something we try to emulate in current AI research.

There are results, for example in navigation research, on how artificial intelligence can assist brain research in choosing optimal solutions, and vice versa, as biology has often shown the way.

So after the meeting at the conference, Kavli and NorwAI decided to look more closely at the possibility of mutual benefit from each other's capacities.

KEY NOTE – Edvard Moser talked on the remarkble brain research results at the Kavli Institute.

Make a prototype
in 24 hours!

NorwAI Hackaton Session 2021.

> **Nils Barlaug,** *Industrial PhD candidate for Cognite*

Cognite is all about new ideas and ways of operating for industrial companies. This resonates with technology students who are boiling over with creativity - and we were excited to run the NorwAI Innovate 2021 Hackathon.

At the hackaton, programmable robot cars were handed out to all competing student teams.

They were asked to come up with an interesting and novel use case for robots in industry, make a prototype in 24 hours, and present it at NorwAI Innovate before a jury.

The students delivered above and beyond. From automatic spill detection and automatic analog gauge reading using computer vision to triangulating Bluetooth devices for search and rescue.

Not only were the ideas creative, but they were also able to implement convincing rapid prototypes.

The winners were picked by a committee of judges from both NTNU and Cognite and won 20.000 NOK. A young trio named Purple Rhino were awarded the prize.

Kristoffer Gjerde, software engineer at Cognite, currently working on data collecting robots, is happy to praise the initiative and the ideas presented:

"We were very impressed by the students - both in terms of creativity and technical inginuity. This is a great way for Cognite to interact with the next generation of tech talents", said Kristoffer Gjerde, also welcoming more opportunities to run hackathons in cooperation with NorwAI again in the future.

For Cognite, the hackaton was a great source of inspiration, and the company brought all the ideas back for further brainstorming. Company representatives underlined the value of contact with the students to introduce them to interesting industrial challenges and hopefully motivate them to a future career within industrial software engineering.
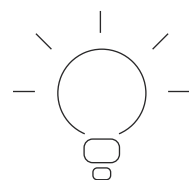
TALENTS – students Åsmund Runningen, Anders Haarberg Eriksen and Hilmir Straumland won the Cognite Hackaton Award

WINNER – Industrial PhD Nils Barlaup won the Poster Award

Next gen programmers
heeded the AI call

Poster Session at NorwAI Innovate 2021.

> **Benjamin Kille**
> *NTNU postdoctoral fellow*

Researchers tend to live in their ecosystem. They contemplate hypotheses, conduct experiments, and analyze their observations. Venues such as the NorwAI Innovate Conference in 2021 open the research world to interested parties.

NorwAI Innovate had published a call for poster contributions. A diverse group of 49 researchers took notice and submitted 22 abstracts. An expert group of reviewers assessed the submissions.

Due to space limitations at the venue, we could accept only about ten posters.

After some tough decisions, ten posters were approved for presentation.

One author for each poster had the chance to give a short summary of the work in a lightning round at the end of the session on "Research Excellence". The presentation led to considerable interest in the posters, which were crowded in the following break.

Some presenters had a hard time enjoying the drinks and food as the questions kept coming.

As another demo highlight, NorwAI presented a student project called "Kaia – the social Robot".

A group of students had implemented a conversational agent on the Furhat platform.

Contributions covered a broad spectrum of AI research. Topics ranged from the use of language models, case-based reasoning, explainable AI to more application-oriented work. The effect of deep learning architectures on current trends was noticeable.

At the final session on the second day, the best poster award was handed over to industrial PhD Nils Barlaug for his work on explainable entity matching.

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International
cooperation

AI will affect economies, societies and cultures profoundly at a national and global level. Achieving the international benefits of artificial intelligence will require international cooperation.

Already there is a global AI network of relations, cooperations and partnerships, both academically and in business. Companies, institutions, professionals, professors and students are all, either individually or via projects, connected to the international ecosystem of AI communities.

NorwAI is positioned to further extend these relations. The research partners of NorwAI already have a high degree of international collaboration. Our goals are active cooperation between innovative industries in Norway and prominent research communities abroad, as well as facilitate contact between the Norwegian

partners of the center and leading innovative companies abroad. In order for the project to benefit from the international partners, a number of actions are under way.

NorwAI will emphasize its cooperation and participation in the growing Nordic scientific and business AI ecosystem.

Parallel to establishing the NorwAI consortium itself, the initiators harnessed opportunities to strengthen relations within Scandinavia to prepare for a future benefit for NorwAI. In addition, a majority of NorwAI's business partners have international ambitions and are already active in the Nordic region. NorwAI will emphasize its cooperation and participation in the growing Nordic scientific and business AI ecosystem.

Also beyond the Scandinavian borders, the NorwAI consortium is well connected to outstanding research communities worldwide, and with Europe as a center of gravity.

Academically, selected researchers, which are among the leaders in their fields, will cooperate on tasks in the project, and our planned extensive exchange program will enable researcher exchange between NorwAI and their research groups.

Together with strong European and American universities we plan to establish an international PhD school on Data-Driven AI. All PhD students in NorwAI are expected to have a research stay abroad for 6 months, funded by NorwAI. Countrywise NorwAI is especially well connected to universities and research centers throughout Europe and also in US and China. NorwAI's scientific and innovation boards have attracted international experts within their domains.

Europe is paving its own way for AI research and innovations. The EU ranks among global leaders in AI Science. In the Commissions' own words its innovation performance in AI could be revamped. At the same time, the EU has been leading in promoting trustworthy, ethical and human-centric AI – values deeply integrated in NorwAI's goals as well. The launching of Horizon Europe program by the end of 2020, investing a stimulus of 95 billion Euro anchored in the pillars of excellent science, European industrial competitiveness and innovation, invites ambitious researchers and entrepreneurs to

join forces to unlock unprecedent digital achievements. NorwAI looks into these possibilities.

NorwAI partners NTNU and Telenor are among participants to AI4EU with a goal of mobilize the entire European AI community to make AI promises real for European society and economy, and nuture economic growth. NorwAI partner SINTEF has the technical lead of Norwegian Committee for AI; a national mirror to the European standardization committee.

NorwAI partners have contributed to the recent AI SRIDA – Strategic Research, Innovation and Deployment Agenda for AI, Data and Robotics (with the 5 European organisations BDVA, CLAIRE, ELLIS, EurAI and euRobotics) – and will continue to be involved in the new ADR – AI, Data and Robotics Private Public Partnership (PPP) related to these topics for the new Horizon Europe and Digital Europe programs from 2021 to 2028.

The vision of this partnership is to boost European competitiveness, societal wellbeing and environmental aspects to lead the world in researching, developing and deploying value-driven trustworthy AI, Data and Robotics based on fundamental European rights, principles and values.
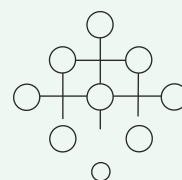
Research and innovation
Joint effort by NTNU SFIs

Post doctoral Fellow
Benjamin Kille

NIKT, the Norwegian ICT conference for research and education, took place on November 29th to December 2nd, 2021, at NTNU, Trondheim.

The main conference was followed by a number of workshops. By initiative of Prof. Anne C. Elster from the SFI Center for Geophysical Forecasting (CGF), two workshops were organized jointly by the SFIs CGF and NorwAI (both hosted by NTNU), covering various aspects of AI.

The first workshop, AI and HPC in Geophysical Forecasting, was organized by SFI CGF. It consisted of four invited talks, ranging from topics such as quantum computing, AI & HPC challenges, use of optical cables as sensors, and development of complex but trustworthy systems with AI.

The second workshop, AI and Innovation, was organized by SFI NorwAI. After a welcome by Center Director Jon Atle Gulla, NorwAI's postdoc Benjamin Kille and master's student Lars Ådne Heimdal gave a presentation and demonstration of Kaia, our social robot. The presentation was followed by high interest in the audience, which also got that chance to interact with Kaia themselves during the following break.

The second session in the AI and Innovation workshop was dedicated to two invited talks,

one on self-supervised learning for aquaculture applications by PhD student Håkon Måløy from NTNU, followed by an inspiring talk from Odd Erik Gundersen from TrønderEnergi on reproducibility in AI.

The two workshops concluded in a joint panel debate on challenges within research-based innovation, chaired by Prof. Elster. The panel included several of the invited speakers as well as participant from both SFI's, CGF Center Director Martin Landrø and Research Director of NorwAI Kjetil Nørvåg.

PROGRAM LINK

www.ntnu.edu/web/nikt2021/workshops
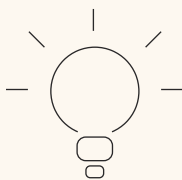
Internal
seminars

NorwAI's PhDs and Postdocs launched before summer of 2021 an internal lunch seminar series to present recent publications, ongoing activities, an overview of research field, preliminary results or unsolved problems.

The quality of the seminars was good, and in it's plans for the upcoming 2022 NorwAI will expand the distribution of the seminars to NorwAI partners digitally.

DATE	PRESENTER	TITLE
19.05.2021	Ludvig Killingberg	Bayesian Deep Learning
02.06.2021	Yanzhe Bekkemoen	Correcting Classification: A Bayesian Framework Using Explanation Feedback to Improve Classification Abilities
18.08.2021	Nils Barlaug	LEMON: Explainable Entity Matching
01.09.2021	Lemei Zhang	Demystifying Knowledge-Aware User Intents for Session-based News Recommendation
15.09.2021	Hassan Abedi Firouzjaei	Querying Trajectories with Text—A Mini-Review
29.09.2021	Peng Liu	Large-Scale Norwegian GPT-2 Language Models
03.11.2021	Tu My Doan	A survey on political viewpoints identification
17.11.2021	Emil Blix Hansen	Reinforcement Learning
01.12.2021	Yujie Xing	Generating suitable Responses through Balancing Methods on generative Conversational Agents

Meet our PhD
Lemei Zhang

Lemei Zhang began her PhD studies at NTNU in 2016, moving from China to Norway, and defended her thesis in December 2021.

«Exploring Multifaced User Modelling in Textual Data Streams" addresses a difficult problem well known to the media industry.

Industries often face fly-by customers or non-subscribers. In the media world, for example, there are many users who do not have an account, and are hardly recognized over time when they use different devices. In other cases, it may be privacy audits that make it difficult to store user profiles.

Lemei's solution is to use machine learning (more specifically deep learning) to recommend articles based on what the user has read in this specific session. No information about the user is stored over time - she starts with clean slates every time the user comes to the newspaper portal. We call this "session-based recommender systems".

Session-based recommendations are difficult to perform because one has little information about the user. They are often referred to as "cold starters".

Lemei compensates by trying to find a pattern in what kind of articles are read in the same session (but does not care who the user in the session is), and she tries to use more of the user's context to come up with good recommendations.

Since incorporating complex external knowledge in recommender engines is challenging, Lemei's research also deals with techniques for extending collaborative filtering techniques with semantic structures from knowledge graphs.

How Scandinavian mediahouses have tested recommender systems

Scandinavian newspapers were early adapters to online services 25 years ago. Gradually some of them explored how recommender systems would enable individually tailored news streams. In an article in AI Magazine NorwAI associates, headed by Center director Jon Atle Gulla, explored how Scandinavian media organizations were coping with these new technological opportunities.

News personalization means that the media outlet is adapting its news content and presentation to individual users' known or inferred preferences. The underlying technological solution is often referred to as a news recommender system, which is normally embedded into a comprehensive media platform that integrates journalistic work and decisions with large-scale information processing capabilities.

In AI Magazine, the NorwAI authors argue that recommender technologies, in addition to influencing the content and style of news stories and the working environment of journalists, have been part of a profound digital transformation of the whole media industry.

It is well known how large-scale media houses and technology companies have successfully made use of recommender systems, research indicating substantial improvements of click rates and user satisfaction.

SMALLER MEDIA HOUSES

It is less understood how smaller media houses are coping with this new technology, how the technology affects their business models, their editorial processes, and their news production in general.

In this research article, the authors report on the experiences from numerous Scandinavian media houses like online publications of Polaris Media and broadcasters like NRK. They have experimented with various recommender strategies and streamlined their news production to provide personalized news experiences.

MAN AND MACHINE

Interestingly, editor governed media houses have found it undesirable to automate the entire recommendation process. In the intersection between man and machine, many media houses look for approaches that combine automatic recommendations with editorial choices.

Gulla, J. A., Svendsen, R., D., Zhang, L., Stenbom, A. og Frøland, J., H. (2021).
Recommending News in Traditional Media Companies. AI Magazine, Volume 42, nr 3

Cooperation between the center's partners

Considerable breadth
and increased interaction

The NorwAI consortium contains eleven companies, most of them from different industries and in some cases even competitors, together with five five research institutions. The consortium represents considerable breadth with respect to business needs, experience with artificial intelligence and capabilities for commercializing technological research results to capture value.

NorwAI's research strategy has a sensitivity towards this variety. Consequently, all NorwAI's work packages always have more than one partner in every research area to promote cross industry and industry-academic cooperation.

Furthermore, NorwAI has strived to balance leadership in the work packages. These work packages are led by both experienced industry leaders and senior researchers.

Cooperation between research and business is key to a research-driven innovation center.

To NorwAI, the industry's own use cases, identifying possibilities for innovation, are basis for the work. The industry partners have listed their use cases, and efforts are invested in coordinating and establish a common ground on the research needs among AI and domain experts for use-case owners and the researchers.

The streamlining of NorwAI's work packages, starting in 2022 will add additional strength and promote further cooperation between partners and between the research institutions and businesses.

Integrating our PhDs with the industry partners is another part of NorwAI's program for cooperation. Every PhD candidate and post doc fellow will have research stays with industrial partners to learn and understand user's needs and to establish a closer relationship and wider network. This program is at work as some PhDs are already assigned to selected partners.

Master's students collaborate with NorwAI industry partners as part of their master's thesis projects on highly relevant topics for both the student and the company involved. The students all have two supervisors, a main supervisor from the university, and a co-supervisor from the industry partner. This way, they are part in strengthening the cooperation between the research community and the industry.

Recruitment

Phd Candidates

STARTED IN 2021:

Egil Rønningstad
Nationality: Norway
Topic: norwegian opinion summarization and entity-level sentiment analysis
Started: October 2021
Main supervisor: Prof. Erik Velldal, University of Oslo
NorwAI Work Package: WP5 LANG

David Baumgartner
Nationality: Austria
Topic: Data analysis with noisy and low-quality data streams
Started: September 2021
Main supervisor: Prof. Heri Ramampiaro, NTNU
NorwAI Work Package: WP6 STREAM

Bjørnar Vassøy
Nationality: Norway
Topic: Fairness, accountability, transparency and privacy in personalization/recommender systems
Started: August 2021
Main supervisor: Prof. Helge Langseth, NTNU
NorwAI Work Package: WP4 PERS

Katarzyna Michalowska
Nationality: Poland
Topic: Informed machine learning
Started: January 2021
Main Supervisor: Prof. Morten Hjort-Jensen, University of Oslo
NorwAI Work Package: WP7 HYB

Nikolay Nikolov
Nationality: Bulgaria
Topic: flexible deployment of big data pipelines on the cloud/edge/fog continuum
Started: January 2021
Main Supervisor: Dr. Dumitru Roman (Senior Research Scientist at SINTEF Digital and Assoc. Professor at University of Oslo, Norway)
NorwAI Work Package: WP8 DATA

Phd Candidate

DISSERTATIONS IN 2021

Lemei Zhang
Associated PhD to the SFI, successfully defended er thesis December 7th 2021. The title of her PhD thesis is Exploring Multifaced User Modelling in Textual Data Streams.

Web and social media

WEBPAGE
norwai.org

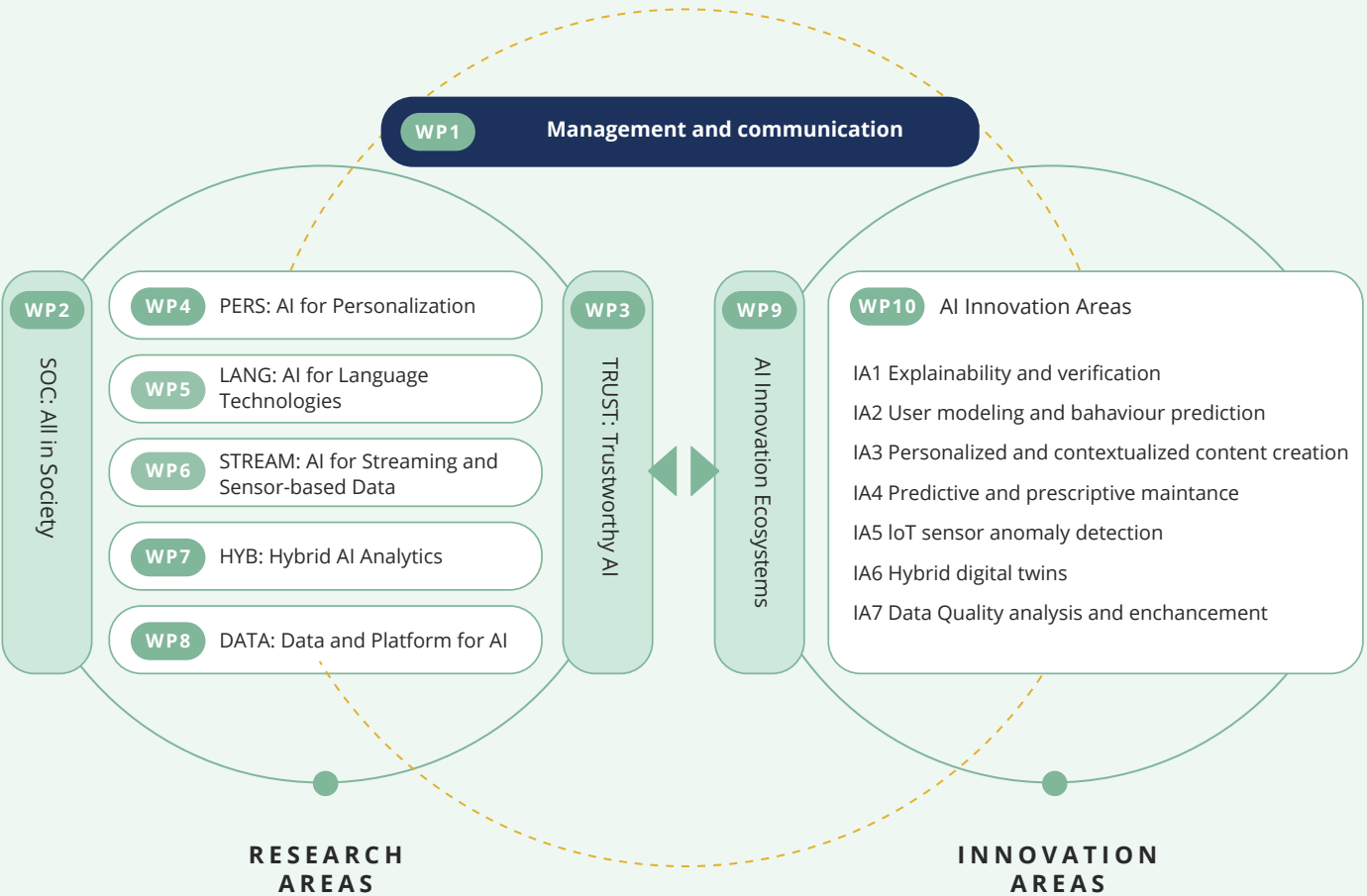**LINKEDIN**
www.linkedin.com/ company/ norwai

TWITTER
@SFI_NorwAI

The workpackages

NorwAI has until end of 2021 consisted of 10 work packages, which have been organized as described in this figure:

WP1 — Management and communication

RESEARCH AREAS

WP2 — SOC: All in Society

WP4 — PERS: AI for Personalization
WP5 — LANG: AI for Language Technologies
WP6 — STREAM: AI for Streaming and Sensor-based Data
WP7 — HYB: Hybrid AI Analytics
WP8 — DATA: Data and Platform for AI

WP3 — TRUST: Trustworthy AI

WP9 — AI Innovation Ecosystems

INNOVATION AREAS

WP10 — AI Innovation Areas

IA1 Explainability and verification
IA2 User modeling and bahaviour prediction
IA3 Personalized and contextualized content creation
IA4 Predictive and prescriptive maintance
IA5 IoT sensor anomaly detection
IA6 Hybrid digital twins
IA7 Data Quality analysis and enchancement

NorwAI's work package structure.

WP1: MANAGEMENT AND COMMUNICATION

Work package 1 concerns communication and dissemination, as well as the day-to-day operations of the center.
Work package leader: Jon Atle Gulla

WP2: AI IN SOCIETY (SOC)

The purpose of work package 2 is to:

- Understand AI technologies in their societal aspects as they are implemented across domains
- Examine the social shaping of AI technologies within ongoing valuation and standardization processes
- Study emergent AI infrastructures together with their publics

This work package investigates broader societal challenges that arise with development and implementation of AI technologies. It combines close-up case studies of selected AI devices and examines the societal stakes, as AI technologies shape problem solutions and enter everyday lives. We will follow how AI technologies are implemented in automation, predictive modeling, and machine learning and examine how they configure societal relations more broadly. By opening up AI matters to broader publics, we will enable transdisciplinary engagements and deliberation.
Work package leader: Susanne Bauer, University of Oslo

WP3: TRUSTWORTHY AI (TRUST)

The purpose of work package 3 is to reinforce a common understanding of safe and responsible AI, specifically:

- Establish trust in safe and responsible AI
- Ensure privacy-preserving in AI technologies
- Create guidelines for sustainable and beneficial use of AI
- Develop principles for explainable and transparent AI
- Develop principles for independent assurance of AI deployment

Trust in AI is a necessary condition for the scalability and societal acceptance of these technologies. Without trust, innovation can be stalled. This research investigates, from an interdisciplinary perspective, the multiple dimensions of trust raised by the deployment of AI and builds tools, methods, and a framework for assuring the safe and responsible deployment of AI in industry and society. This work package aims to answer the question: How can such tools address the safety and needs of individuals, organizations and society at large, addressing both non-technical and technical issues? The research will address issues related to safety, explainability, transparency, bias, privacy and robustness, as well as human-machine interactions and co-behavior all in the context of industry regulations and societal expectations.
Work package leaders: Elizabeth Traiger / Frank Børre Pedersen, DNV

WP4: AI FOR PERSONALIZATION (PERS)

The purpose of work package 4 is to:

- Build AI systems that can adapt to an individual user's interests while still respecting user's need for fairness, transparency and explainability
- Enhance these systems to utilize diverse data sources across different services and products without violating the users' privacy.

Personalization and contextualization have been successfully employed in diverse applications over the past decade, and currently see an extended usage, for instance in proactive interaction with customers and individualization of news stories. WP4 will contribute to developing such systems while ensuring that the system usage will be ethical and respecting users' requirements for privacy, fairness and accountability.

Work package leader: Helge Langseth, NTNU

WP5: AI FOR LANGUAGE TECHNOLOGIES (LANG)

The purpose of work package 5 is to:

- Build robust natural language processing for Scandinavian languages
- Provide conversational search and recommendations in natural language
- Develop natural language summarization of content, user preferences, and recommendations

Building Scandinavian language models requires the compilation of large-scale reusable language resources, including general-purpose corpora from public sources (e.g., news and social media) as well as industry- and domain-specific text collections. We will address the scarcity of the latter by pre-training on the former and developing transfer learning methods. These large-scale language models will then be utilized in real-life scenarios by formulating a number of specific summarizations, explanation, and conversational tasks based on our partners' use-cases. WP5 will develop appropriate evaluation methodology with user-oriented evaluation measures and objectives. It will thus contribute to providing measurable quantification of the amount of domain-specific training material needed in order to provide a language service that is of sufficiently high quality.

Work package leader: Krisztian Balog, University of Stavanger

WP6: AI FOR STREAMING AND SENSOR-BASED DATA

The purpose of work package 6 is to develop modern AI for streaming and sensor-based data analysis. This will be done by:

- Providing anomaly detection and predictions with low quality streaming data
- Providing uncertainty quantification and explainability with streaming data
- Enabling combinations of streaming and static data for efficient data analysis
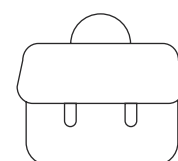
Streaming data can be used for automation, recommendations and decision making. Often this involves predictions and anomaly detection in multivariate time series, as well as providing explanations for the conclusions drawn. IoT sensors are increasingly instrumenting the physical world, and efforts have been made to use AI for solving these tasks also in low-quality data regimes. This research area will identify robust techniques for analysis of streaming data within several domains (including telco network, industrial IoT), with a particular focus on improving interpretability for cases with multivariate time series with low quality data.

Solving the research problems in WP6 is crucial to successfully innovate how IoT data can be fully used in anomaly detection and contribute to breakthrough in applying AI in predictive maintenance and operational availability.

Work package leader: Kenth Engø Monsen, Telenor

WP7: HYBRID AI ANALYTICS (HYB)

The purpose of work package 7 is to:

- Develop robust, stable and explainable data-driven models for physical systems
- Constrain models to enforce meaningful predictions
- Transfer data-driven models from simulations to reality
- Characterize and quantify uncertainty of data-driven models

This work package will develop methods to predict and reduce the uncertainty of data-driven models. The models will be constrained by existing knowledge, allowing to interpret the model (explainable AI) and reducing the amount of required training data. Applying these methods on real world applications will allow the industry partners to better predict the behavior of their facilities and improve their simulations, e.g. for condition monitoring, predictive maintenance, optimal utilization.

Work package leader: Anne Marthine Rustad, SINTEF (photo)

WP8: DATA AND PLATFORM FOR AI (DATA)

The purpose of work package 8 is to develop techniques and tools for the automatic creation and management of knowledge graphs.

Real impact of data-driven AI depends on the availability of live data of sufficient quality and quantity in an automatically discoverable format that both humans and machines can understand. WP8 will investigate how the semantics of data, through automatic creation and mapping of suitable knowledge graphs, can be leveraged to scale AI models from one situation to all similar situations and how complex graph-based structures can be efficiently stored and processed.

Work package leader: Alexander Gleim, Cognite
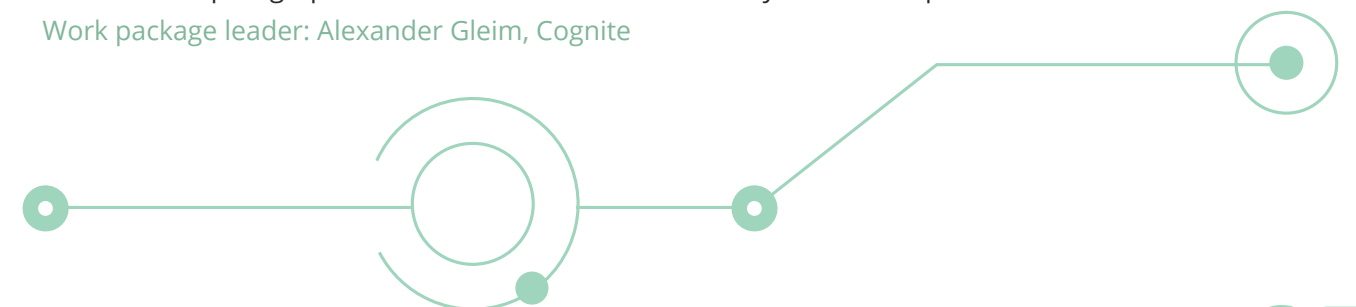
WP9: AI INNOVATION ECOSYSTEMS

The purpose of work package 9 is to:

- Create an Innovation Ecosystem among NorwAI partners for sharing both research findings, innovations, business solutions and change models within the AI domain.
- Share this knowledge to a broader audience, emphasizing small and medium sized businesses.

WP9 will contribute to narrowing the existing gap of understanding of what AI can do in terms of business solutions, by many non-AI experts by conveying state of the art knowledge in a way so that those without AI background can understand it. This will be obtained this by producing cases, hold presentations, conferences, and course spanning from limited tutorials to university courses. The following topics will be covered: what AI is, its business opportunities, its limitations, its strategic impact, and HR-change issues. To achieve these objectives both AI and HR experts will be embraced in the work.

Work package leader: Endre Sjøvold, NTNU

WP10: AI INNOVATION AREAS

Work package 10 is focusing on achieving research driven AI Innovation among the NorwAI partners in the following areas.

AI Innovation in Media and Finance – with a focus on:

- User modeling and behavior prediction
- Personalized and contextualized content creation

AI Innovation in Energy, Maritime and Telecom with a focus on:

- Predictive maintenance and operational availability
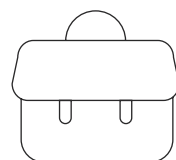- IoT sensor anomaly detection
- Hybrid digital twins

Cross domain AI Innovations on Explainable AI and Data Quality – with a focus on:

- Explainability and verification
- Data quality analysis and enhancement

These are linked to the Research areas of AI in Society, Trustworthy AI and Data and Platform for AI.

Work package leader: Arne Jørgen Berre, SINTEF Digital

Presentations and communication

TITLE	NAME	TYPE / PLACE
Trustworthy Industrial AI Systems	Asun Lera St.Clair	Trustworthy Complex and Intelligent Systems Webinar Series
Machine Learning in Contextual Advertising	Armin Catovic, Schibsted	NAIL&NorwAI Webinar Series on AI Research and Innovation
Towards smart and autonomous industry	Stein H. Danielsen, Cognite	NAIL&NorwAI Webinar Series on AI Research and Innovation
Introduction to change detection	Martin Tveten, NR	NAIL&NorwAI Webinar Series on AI Research and Innovation
Kunstig intelligens i DNB	Karl Aksel Festø, DNB	NorwAI Innovate Conference
Social and Ethical Artificial Intelligence	Virginia Dignum, Umeå University	NorwAI Innovate Conference
Key challenges to benefiting from AI in assets heavy industries	Geir Engdahl, Cognite	NorwAI Innovate Conference
Becoming Data-Driven: DATA, PTBS and PEOPLE	Engø-Monsen, Kenth, Telenor	NorwAI Innovate Conference
New language models	Jon Atle Gulla (NTNU) Peng Liu (NTNU) Kutuzov, Andrey (UiO)	NorwAI Innovate Conference
Trønderenergi – Innovation tutorial	Odd-Erik Gundersen, TrønderEnergi	NorwAI Innovate Conference
Understanding Organizations' Adoptation of AI Technologies	Theodor L. Holmsen (NTNU)	NorwAI Innovate Conference
Asset industry: To build an industrial iPhone moment	John Markus Lervik, Cognite	NorwAI Innovate Conference
From hype to hard work. Is AI (still) cool?	Ieva Martinkenaite, Telenor	NorwAI Innovate Conference
The use of use cases - How Schibsted works to deliver value from data	Sven Størmer Thaulow, Schibsted	NorwAI Innovate Conference
Risks, opportunities, ethics and AI impact	Elizabeth Ann Traiger	NorwAI Innovate Conference
AI Workshop at womENcourage Pre-Event	Kerstin Bach, NTNU	Workshop co-hosted by NorwAI, NAIL, IDUN, Better balance in informatics
NorwAI og språkmodeller	Jon Atle Gulla, NTNU	Presentasjon for Ytringsfrihetskommisjonen
SFI NorwAI introduction	Jon Atle Gulla, NTNU	Workshop med Nasjonalbiblioteket

TITLE	NAME	TYPE / PLACE
New language models in NorwAI	Jon Atle Gulla, NTNU	Norwai.org
Ultimately it leads up to industrial innovations	Arne Jørgen Berre, SINTEF Digital	Norwai.org
Industrial transformation through AI solutions	John Markus Lervik, Cognite	Norwai.org
My return to old halls	Sven Størmer Thaulow, Schibsted	Norwai.org
Consumers on the move - and we must reconnect	Karl Aksel Festø, DNB	Norwai.org
Bringing assets to the table	Annita Fjuk, Digital Norway	Norwai.org
Wind power - powered by AI	Gøril Forbord, TrønderEnergi	Norwai.org
NorwAI will forge data to values	Gulla, Jon Atle (NTNU), Arne Jørgen Berre (SINTEF Digital) Sven Størmer Thaulow (Schibsted)	Norwai.org
- Fem grunner til at kunstig intelligens er på rett vei	Anders Løland, NR	Digi.no
Kunstig intelligens: kan vi stole på den svarte boksen?	Anders Løland, NR	Arendalsuka, arrangør: Simula Research Laboratory AS
Hva er maskinlæring og hvordan utvikler en maskinlæringsmodeller?	Anders Løland, NR	Bruk av maskinlæring i offentlig forvaltning – muligheter og problemer
Spoken language understanding: from RNNs to Transformers	Pablo Ortiz, Telenor Research	Guest lecture in Machine Learning for Signal Processing course (TTT4185), NTNU
#18 Sven Størmer Thaulow: Hvordan være en god teknologileder	Sven Størmer Thaulow, Schibsted	All In med Oslo Business Forum Podcast
Artificial intelligence in Media - NxtMedia Conference 2020	Sven Størmer Thaulow, Schibsted	Videoopptak fra NxtMedia Conference 12 november 2020
Hvordan skape gull av data?	Sven Størmer Thaulow, Schibsted	Eiendom Norge konferansen 2021
Innspillsmøte om fremvoksende teknologier	Anders Løland, NR	Innspillsseminar for Personvernkommisjonen
Kunstig intelligens – kan vi stole på den svarte boksen?	Anders Løland, NR	Samling Norges Forskingsråd

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NorwAI
in the media
in 2021

Kommisjon til unnsetning
(Klassekampen, 2021-11-20)

**Samfundet-lederen tok imot
kronprinsen: – En 70 år gammel
drøm går i oppfyllelse**
(Adressa, 2021-10-21)

Inviterte til Stiftsgården
(kongehuset.no, 2021-10-21)

**Nå kan maskinene tolke hva
du føler og mener**
(forskning.no, 2021-04-29)

**Nå er maskinene klare til å tolke
hva du føler og mener**
(titan.uio.no, 2021-04-06)

**Retriever shares big data with new
research center for artificial intelligence**
(retrievergroup.com, 2021-03-25)

**Kompetanseløft i Forsvaret krever
robuste partnerskap**
(Forsvarets forum, 2021-01-15)

**Kunstig intelligens og læringsanalyse
for læring og vurdering**
(Bedre Skole, 2021-11-12)

Personnel

NAME	INSTITUTION	MAIN RESEARCH AREA
Alexander Gleim	Cognite	Big Data
Elizabeth Ann Traiger	DNV	Trustworthy AI
Frank Børre Pedersen	DNV	
Anders Løland	Norsk Regnesentral	Machine Learning, Statistics
Pierre Lison	Norsk Regnesentral	NLP, Privacy and Security, Machine Learning, Information Retrieval, Semantics, AI and Society, Big Data
Ildiko Pilán	Norsk Regnesentral	NLP, Privacy and Security, Machine Learning
André Teigland	Norsk Regnesentral	Machine Learning, Statistics
Boye Høverstad	NTNU	Machine Learning
Endre Sjøvold	NTNU	Innovation Processes
Helge Langseth	NTNU	Machine Learning, Probabilistic AI
Heri Ramampiaro	NTNU	Information Retrieval, Machine Learning
Jon Atle Gulla	NTNU	NLP, Personalization
Kerstin Bach	NTNU	AI and Society, Innovation Processes, Personalization, Machine Learning, Trustworthy AI
Kjetil Nørvåg	NTNU	NLP, Data Mining, Database Systems, Big Data, Information Retrieval
Alexander Stasik	SINTEF	Machine Learning, Hybrid Analytics
Anne Marthine Rustad	SINTEF	Hybrid Analytics, Cybernetics
Arne Jørgen Berre	SINTEF	AI Innovation, Semantics and Standardization
Signe Reimer-Sørensen	SINTEF	Machine Learning, Hybrid Analytics
Volker Hoffman	SINTEF	
Dumitri Roman	SINTEF	
Ieva Martinkenaite	Telenor	Innovation processes
Kenth Engø Monsen	Telenor	Big data, AI and Society, Privacy and Security, Machine Learning
Susanne Bauer	Oslo University	AI in Society
Erik Velldal	Oslo University	NLP, Machine Learning
Lilja Øvrelid	Oslo University	NLP
Krisztian Balog	University of Stavanger	NLP, Semantics, Personalization, Information Retrieval, Machine Learning

VISITING RESEARCHERS

NAME	AFFILIATION	N	SEX	DURATION	TOPIC
Hamid Asgari	VTT	Iran	M	2021-10-04 – 2021-10-15	Data Analytics, Machine Learning, Systems Engineering
Emil Blix Hansen	Aalborg University	Denmark	M	2021-11-06 – 2021-12-01	AI verktøy for små og mellomstore bedrifter

POSTDOCTORAL RESEARCHERS

Researchers with financial support from the center budget

NAME	NATIONALITY	SEX	PERIOD	TOPIC
Peng Liu	China	M	2020-12-07 – 2023-12-06	Language models for natural language processing, Conversational systems

POSTDOCTORAL RESEARCHERS

Researchers working on projects in the center with financial support from other sources

NAME	FUNDING	N	SEX	PERIOD	TOPIC
Benjamin Kille	NTNU	Germany	M	2021-05-01 – 2024-04-30	Personalization, Natural Language Processing, and Machine Learning for Banking and Finance

PHD STUDENTS

Students with financial support from the center budget

NAME	NATIONALITY	SEX	PERIOD	TOPIC
David Baumgartner	Austria	M	2021-09-21– 2025-08-31	Data analysis with noisy and low-quality data streams
Bjørnar Vassøy	Norway	M	2021-08-02 – 2025-08-01	Fairness, Accountability, Transparency and Privacy in Personalization/ Recommender systems
Egil Rønningstad	Norway	M	2021-10-14 – 2024-10-13	Entity-level Sentiment Analysis
Katarzyna Michałowska	Poland	F	2021-01-01 – 2024-12-31	Informed machine learning
Nikolay Nikolov	Bulgaria	M	2021-01-01 – 2024-12-31	Flexible Deployment of Big Data Pipelines on the Cloud/Edge/Fog Continuum

PHD STUDENTS

Students working on projects in the center with financial support from other sources

NAME	FUNDING	N	SEX	PERIOD	TOPIC
Yujie Xing	DNB	China	F	2021-01-30 – 2023-01-27	Informed Machine Learning
Shiva Shadrooh	DNB	Iran	F	2020-02-20 – 2024-09-30	Anomaly detection in streaming graphs
Hassan Abedi Firouzjaei	NTNU	Iran	M	2019-06-20 – 2023-06-19	Querying and mining location -based social network data
Ludvig Killingberg	NTNU	Norway	M	2019-10-01 – 2024-09-30	Bayesian deep learning and reinforcement learning
Mateja Stojanovic	NTNU	Serbia	M	2020-12-01– 2024-11-30	Recommender Systems for Enhancing Students' Learning in Higher Education
Lemei Zhang	RCN	China	F	2016-04-01– 2021-03-01	User Modeling and Recommender System
Tu My Doan	NTNU	Vietnam	F	2020-01-06 – 2024-01-05	Political Text Mining
Nils Barlaug	RCN/Cognite	Norway	M	2019-08-01 – 2022-07-31	Data Integration
Stella Maropaki	RCN	Greece	F	2016-05-01 – 2022-05-31	Database systems
Yanzhe Bekkemoen	NTNU	Norway	M	2019-10-01 – 2024-09-30	Probabilistic approaches to explainable AI and reinforcement learning.
Shweta Tiwari	NTNU	India	F	2017-10-01 – 2022-01-11	Machine Learning Method for Outlier Detection in Energy Trading
Anna Rodum Bjøru	NTNU	Norway	F	2021-11-11 – 2025-11-10	Explainable deep bayesian learning

Master students obtaining their degree on NorwAI topics in 2021

NAME	SEX	TOPIC
Tinius Sola Flagstad	M	Transfer Learning for HVAC Control using Deep Reinforcement Learning
Torjus Tønnesen Iveland	M	Transfer Learning for HVAC Control using Deep Reinforcement Learning
Ludvig Killingberg	M	Generative Adversarial Networks for Flexible Variational Posteriors in Bayesian Neural Networks
Yanzhe Bekkemoen	M	Correcting Classification: A Bayesian Framework Using Explanation Feedback to Improve Classification Abilities
Johannes Kvamme	M	Achieving Trustable Explanations Through Multi-Task Learning Neural Networks
Pål-Edward Larsen	M	Achieving Trustable Explanations Through Multi-Task Learning Neural Networks
Anna Rodum Bjøru	F	The importance of disentanglement when learning representations
Andreas Haukeland	M	Graph Convolutional Networks for Predicting Cerebral Palsy in Infants
Sindre Aarnes Aubert	M	Graph Convolutional Networks for Predicting Cerebral Palsy in Infants
Helene Janine Stang	F	A Hybrid Multi-document Summarization System for Biomedical Articles
Ingeborg Sætesdal Sollid	F	A Hybrid Multi-document Summarization System for Biomedical Articles
Theodor L. Holmsen	M	Understanding Organizations' Adoption of AI Technologies: Challenges, Opportunities and Impact
Thea Tokstad	F	Pre-trained transformers with transfer learning and handcrafted-features for entity matching
Eivind Fålun	M	Explainable Neural News Recommender System
Lars Kristian Gjelstad	M	Explainable Neural News Recommender System
Mikkel Benjamin Lerberg Nygard	M	Active Learning with Transformer Pre-trained Language Models for Entity Matching
Øyvind Samuelsen	M	Active Learning with Transformer Pre-trained Language Models for Entity Matching
Leif Ulvund	M	Explaining Fake News
Jon Steinar Folstad	M	Transformer Pre-trained Language Model and Active Learning as a Strategy to Induce Improved Blocking Performance in Entity Matching

Master students obtaining their degree on NorwAI topics in 2021

NAME	SEX	TOPIC
Fredrik Gyllenhammar	M	Automated Pollen-Grain Counting
Dina Rosvoll	F	Unsupervised Deep Learning Applied to Multivariate Time Series for Human Activity Recognition
Christer Rustand	M	Unsupervised Deep Learning Applied to Multivariate Time Series for Human Activity Recognition
Odd Eirik Resell Igland	M	Using multispectral band combinations and deep learning for predicting ship behavior from satellite images
Sigbjørn Nøst Skauge	M	Vigorous Activity Detection in Human Activity Recognition
Kristian Kanck	M	TexTraClus: A Spatio-textual Sub-trajectory Clustering Framework
Marius Aleksander Kaasbøll	M	Exploring Exemplar Trajectory Query
Erik Nystø Rahka	M	Exploring Exemplar Trajectory Query
Ingrid Seip Domben	F	Detecting Influential Events
Lise Presthus Hove	F	Mining Periodic Topic Trajectory Patterns in Spatiotemporal Textual Data
Anja Rosvold From	F	Fake News Detection by Weakly Supervised Learning
Ingvild Unander Netland	F	Fake News Detection by Weakly Supervised Learning
Odd Gunnar Aspaas	M	Leveraging Graph Attention Networks and Knowledge Graphs for Fake News Detection
Oscar Carl Vik	M	Leveraging Graph Attention Networks and Knowledge Graphs for Fake News Detection
Miriam Finjord	F	Privacy in Recommender Systems: Can Recommendations Reveal Your Location?
Pål Fossnes	M	Narrative Driven Recommendation
Olaf Liadal	M	Using Scientific Knowledge Graphs
Henrik Haugland Syverinsen	M	Supervised Pre-training for Dialogue Act Classification in Task-oriented Dialogue
Ivica Kostric	M	Soliciting User Preferences in Conversational Recommender Systems via Usage-related Questions

NAME	SEX	PERIOD	PROJECT
Lars Ådne Heimdal	M	2021-06-01 – 2022-05-31	"Kaia" the social robot
Christian Riksvold	M	2021-06-01 – 2021-07-31	"Kaia" the social robot
Even Flem Hagen	M	2021-09-01 – 2022-05-31	"Kaia" the social robot

Accounts

2021	FUNDING	COSTS
The Research Council	3575	
The Norwegian University of Science and Technology (NTNU)	6029	7140
Research Partners*)	2435	5149
Enterprise partners**)	12054	11804
Total	24093	24093

*) Norwegian Computing Center (NR), SINTEF, University of Oslo and University of Stavanger.

**) Cognite, Digital Norway, DNB, DNV, Kongsberg Digital, NRK, Retriever Norway, Schibsted, Sparebank1 SMN, Telenor, TrønderEnergi.

All figures in 1000 NOK.

Publications

JOURNAL PAPERS

Gulla, J. A., Svendsen, R., D., Zhang, L., Stenbom, A. og Frøland, J. (2021).
Recommending News in Traditional Media Companies. AI Magazine, Volume 42, nr 3

Barlaug, N. and Gulla J. A. (2021)
Neural Networks for Entity Matching: A Survey. ACM Transactions on Knowledge Discovery from Data (TKDD) 15(3): 1-37.

Liu, P., et al. (2021).
Multilingual Review-aware Deep Recommender System via Aspect-based Sentiment Analysis. ACM Transactions on Information Systems (TOIS) 39(2): 1-33.

Tiwari, S., Ramampiaro, H., & Langseth, H. (2021).
Machine Learning in Financial Market Surveillance: A Survey. IEEE Access.

PUBLISHED CONFERENCE PAPERS

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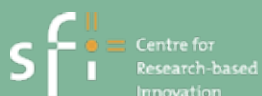
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