DIGITAL HEALTH
DEPARTMENT OF COMPUTER SCIENCE

*BREAKING NEW GROUND*
AALBORG UNIVERSITY

Digitalisation and the increasing amount of health data offer huge opportunities within the prevention, detection, monitoring and treatment of health conditions.

Key research areas at the Department of Computer Science at Aalborg University (CS) provide a wide range of technologies and methods that support the development of more precise diagnostics and better treatment.

CORE AREAS

- Data Engineering, Science and Systems
- Data, Knowledge and Web Engineering
- Distributed, Embedded and Intelligent Systems
- Human-Centered Computing
- AI and Machine Learning

SELECTED TOPICS WITHIN DIGITAL HEALTH
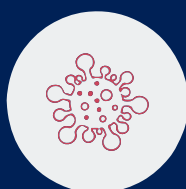
### PLAYING AGAINST COVID-19 USING AGENT-BASED MODELS

What happens when cities experience COVID-19 flare-ups? Would closing schools and directing parents to work from home have any effect?

Agent-based models allow for easy capturing and analysis of different scenarios on a very detailed level.

With the world-renowned tool UP-PAAL, researchers from CS have modelled, predicted, and controlled the spread of COVID-19 based on, among other things, evaluation and comparison of various lock-down measures, the risk of viral exposure, the impact of super-spreader events and the use of tracing apps.

KEYWORDS: MODELLING, ANALYSIS AND CONTROL OF DYNAMIC SYSTEMS

Project: Agent-based models for forecasting and for assessment of interventions
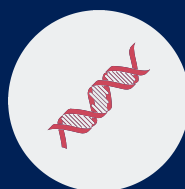
DEEP LEARNING TO SUPER-CHARGE GENOME RECOVERY

Microbial communities play a vital role in most processes in the biosphere and are essential for solving numerous challenges, incl. developing new antibiotics.

Together with colleagues, researchers from CS have demonstrated how the integration of long-read DNA sequencing and graph-based deep learning can go beyond the current state of the art in bacterial genome recovery and metagenomic binning.

The researchers will continue this work and develop technologies to integrate external data, provide novel analyses, and support microbial genome data and metagenomic binning at an unprecedented scale.

KEYWORDS: DATA ENGINERING, GRAPH ANALYTICS AND MACHINE LEARNING

Projects: Illuminating Microbial Dark Matter through Data Science and Data Science meets Microbial Dark Matter

EXPLAINABLE AI IN MEDICAL EDUCATION

Medical errors can lead to fatalities - often due to clinicians working alone with minimal supervision.

Researchers from CS are part of a project aiming to support human-AI collaboration in surgery training.

Part of this work is assessing and developing robotic surgeons' skills in combination with AI-based decision support including how to present AI suggestions in a timely manner and handle disagreement between the human expert and the AI-system.

KEYWORDS: HUMAN-CENTERED AI AND EXPLAINABLE AI

Project: EXPLAIN-ME: Learning to collaborate via explainable AI in medical education

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WE MAKE KNOWLEDGE MATTER

PROJECTS WITHIN DIGITAL HEALTH

Agent-based models for forecasting and for assessment of interventions
Kim Guldstrand Larsen, Peter Gjøl Jensen, Danny Poulsen, Marco Muniz and Kenneth Yrke with the Department of Electronic Systems (AAU)

Biochemical Reaction Networks
Max Tchaikowsky with Oxford University

DarkMatter: Data Science meets Microbial Dark Matter
Katja Hose, Thomas D. Nielsen and Andre Lamurias with Centre for Microbial Communities (AAU)

Drug Discovery with Graph-based Learning
Christian S. Jensen and Jilin Hu with students

EXPLAIN-ME: Learning to collaborate via explainable AI in medical education
Mikael B. Skov, Niels van Berkel and Naja K. Kollerup Als with NordSim AUH, CAMES at Rigshospitalet, Zealand University Hospital, DTU, KU and RUC

Finding causalities and temporal patterns in temporal health data
Nguyen Ho, Van Long Ho and Torben Bach Pedersen with Stockholm University

Illuminating Microbial Dark Matter through Data Science
Katja Hose, Thomas D. Nielsen and Andre Lamurias with Centre for Microbial Communities (AAU)

Improved utilization of the health care system's capacity in the North Jutland region
Emil Riis Hansen and Thomas Dyhre Nielsen with BI og analyse and The North Denmark Region

Improving Sleep Quality Using Sound Intervention
Anders Bruun and Shagen Djanian with SoundFocus

ISOBEL: Interactive Sound Zones for Better Living
Jesper Kjeldskov, Peter A. Nielsen, Mikael B. Skov, Rune M. Jacobsen and Kasper F. Skov with Bang&Olufsen, Wavecare ApS, SoundFocus ApS and Department of Electronic Systems (AAU)

Knowledge discovery in evolving biomedical ontologies
Daniele Dell'Aglio with VU Amsterdam and UZH

Medicine discovery by molecular retrosynthesis
Peng Han, Chenjuan Guo and Bin Yang with Renmin University of China, Microsoft Research Asia

Mining a graph representation of COVID patients and infections for emerging patterns
Katja Hose and Tomer Sagi with Centre for Microbial Communities (AAU), the Danish Covid-19 Genome Consortium (DCGC) incl. Aalborg University Hospital, Hvidovre Hospital and Statens Serum Institut

Patient risk stratification based on pre-hospital data
Katja Hose, Tomer Sagi and Emil Riis Hansen with Aalborg University Hospital, Forskningens Hus and The North Denmark Region

Predicting Patient Flow at the Emergency Department of Aalborg University Hospital
Kristian G. Olesen with HUGIN Expert, Aalborg University Hospital and Data Proces

Prediction of Future Needs in Accordance to the Social Service Act, Section 83 and 83a
Kristian G. Olesen with HUGIN Expert, Hjørring Municipality, Treat Systems and Data Proces

Privacy-preserving publication of health data using differential privacy and knowledge graph technologies
Daniele Dell'Aglio with Hong Kong University and UZH

Privacy-preserving synthetic data generation of multimodal patient data
Katja Hose, Daniele Dell'Aglio and Antheas Kapenekakis with Aalborg University Hospital and Athena Research Centre

Private and secure data exchange between health care insurances
Daniele Dell'Aglio with UZH

S4OS: Scalable analysis and Synthesis of Safe, Secure and Optimal Strategies for Cyber-Physical Systems
Kim Guldstrand Larsen, Andreas Holck Høeg-Petersen, Anton Christensen, Asger Horn Brorholt, Martijn Goorden, Nikolaj Jensen Ulrik, Pieter Jan Laurens Cuijpers and Sean Kristian Remond Harbo

Statistical Model Checking for Biological Systems
Kim Guldstrand Larsen, Danny Poulsen and Marius Mikučionis

Using machine learning to profile patients from their medication history
Katja Hose, Tomer Sagi and Emil Riis Hansen with Aalborg University Hospital and the University of Liverpool

Using probabilistic machine learning for risk stratification and prognosis of patients with Hospital-Acquired Infections
Thomas Dyhre Nielsen with The Centre for Clinical Research, North Denmark Regional Hospital

Want to know more? Contact research leaders below

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