

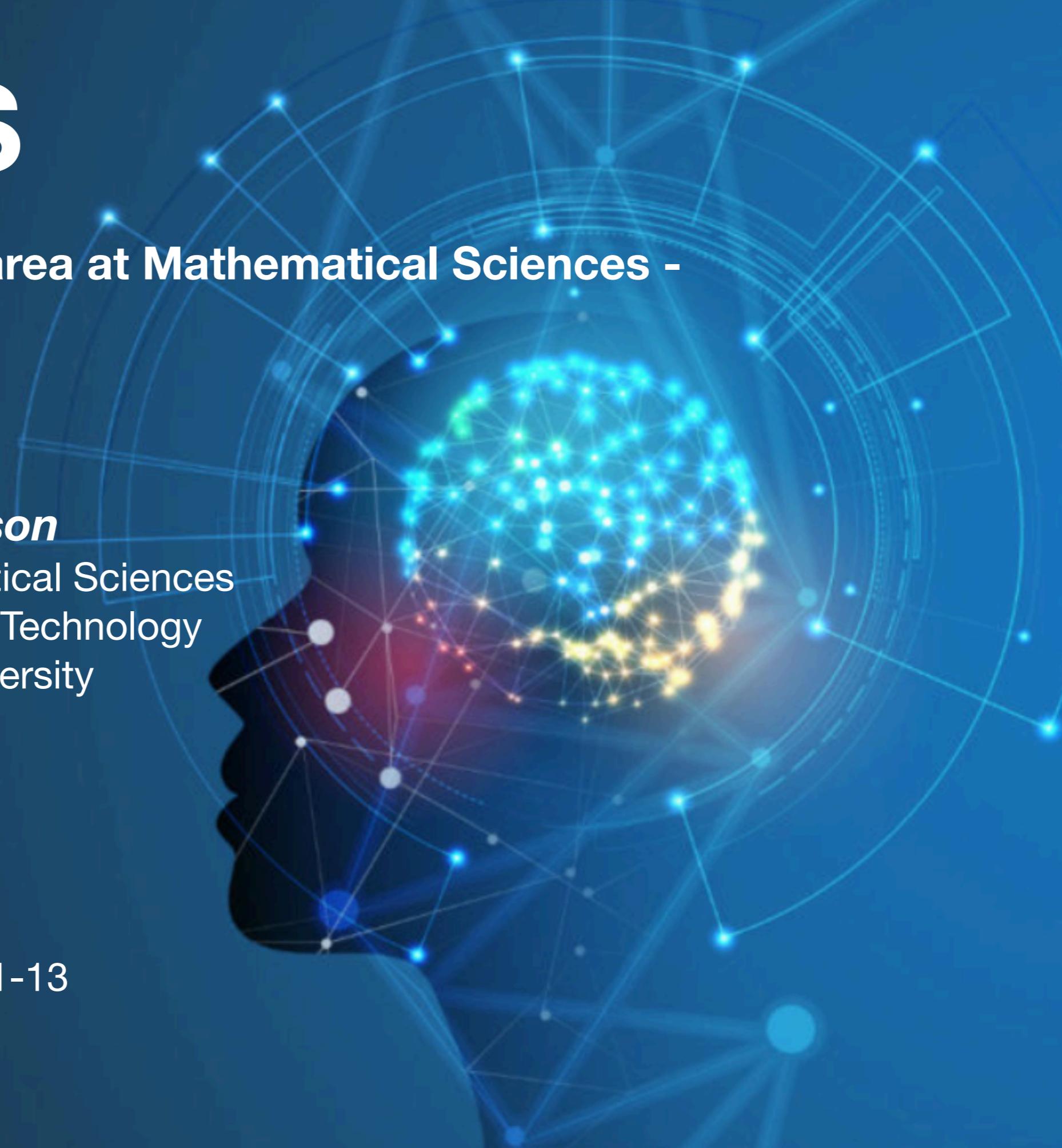
# AI@MS

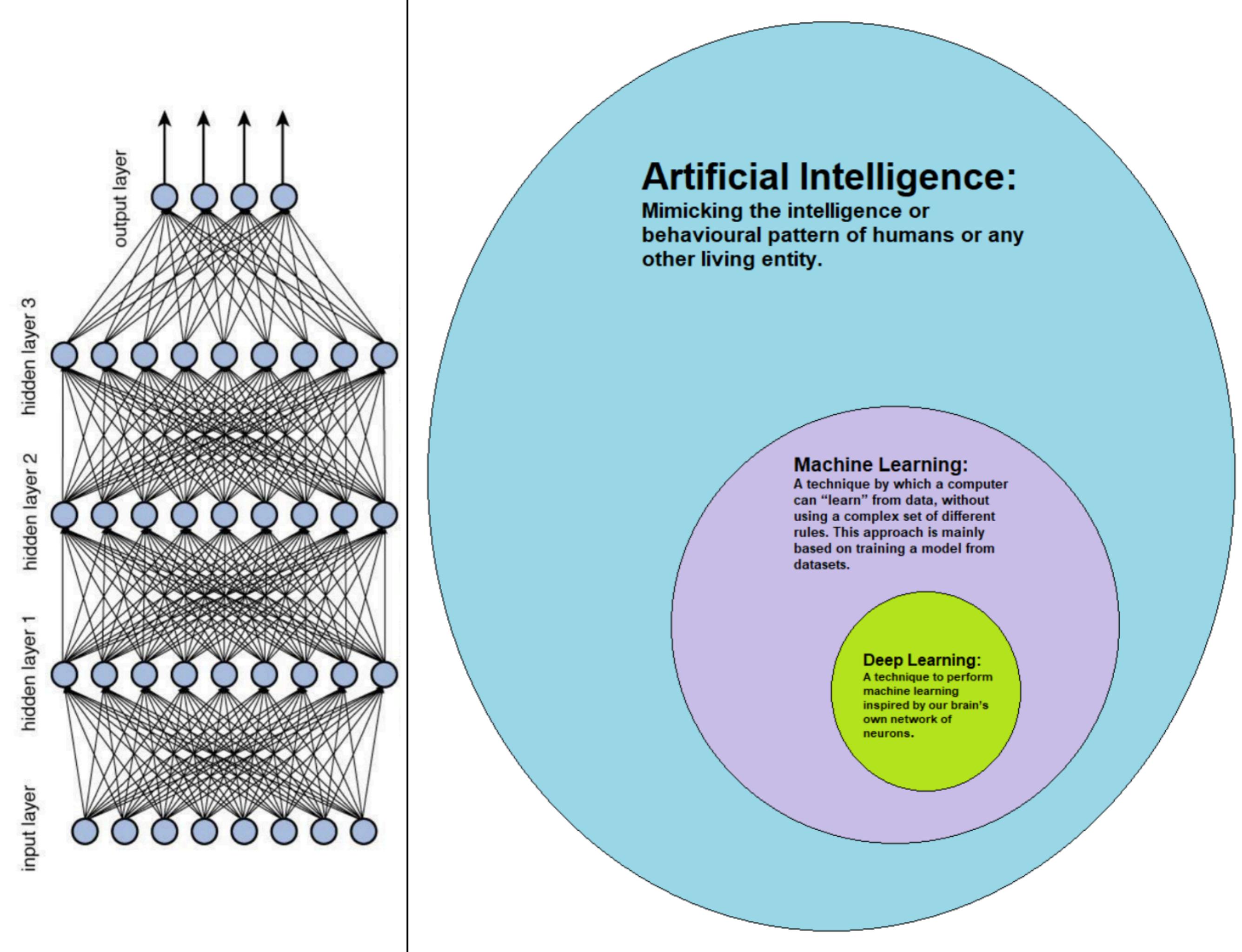
- A new research area at Mathematical Sciences -

*Daniel Persson*

Department of Mathematical Sciences  
Chalmers University of Technology  
Gothenburg University

Faculty Day  
Wednesday 2019-11-13





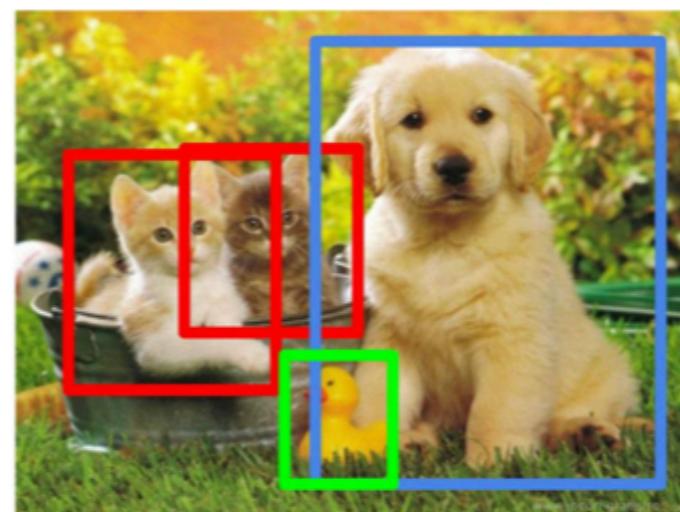
## Classification



## Classification + Localization



## Object Detection



## Instance Segmentation



CAT

CAT

CAT, DOG, DUCK

CAT, DOG, DUCK

Single object

Multiple objects



[Picture from [thispersondoesnotexist.com](https://thispersondoesnotexist.com)]

**Picture generated using a GAN**

# WASP AI ANNOUNCES 18 PHD POSITIONS IN AI-MATH

**Application deadlines passed for all positions.**

Wallenberg AI, Autonomous Systems and Software Program (WASP) is Sweden's largest individual research program ever. WASP provides a platform for academic research and education, fostering interaction with Sweden's leading technology companies. Part of the initiative in AI within WASP deals with increasing our understanding of fundamental mathematical principles behind AI.

**We now offer up to 18 university PhD positions** at seven university sites, with focus on mathematics behind AI.

For further descriptions of positions and to apply, follow the links to the coordinating universities. The positions included in this call are at Chalmers, KTH, Linköping university, Lund university, Stockholm university, Umeå university and Uppsala university. **Please note** different final dates for applications.

## Chalmers

### Optimization algorithms for machine learning:

Optimization methods have played a major role in modern machine learning: in particular, many of the recent successes rest on the development of highly scalable stochastic optimization methods such as stochastic gradient descent (SGD) and accelerated versions of it. The goal of this project is to explore further ideas around these concepts and apply them to fundamental ML problems such as matrix completion and optimal transport.

### Four positions in mathematics for AI within the following areas/projects:

Learning with noisy labels, Deep learning and statistical model choice, Deepest learning using stochastic partial differential equations, Quantum deep learning and renormalization: A group-theoretic approach to hierarchical feature representations.

### Understanding deep learning: From theory to algorithms.

The purpose of this project is to increase our theoretical understanding of deep neural networks. This will be done by relying on tools of information theory and focusing on specific tasks that are relevant to computer vision.

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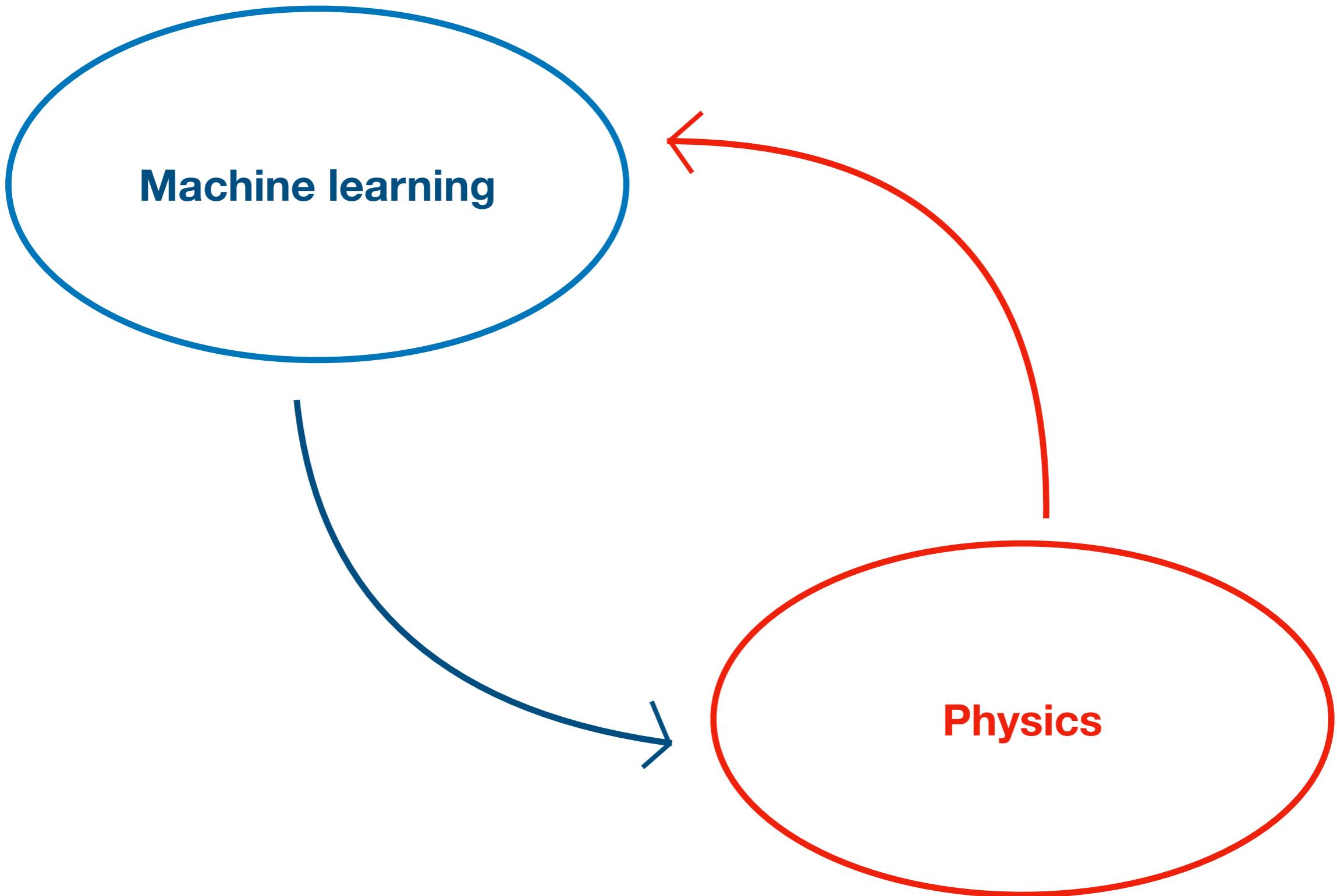
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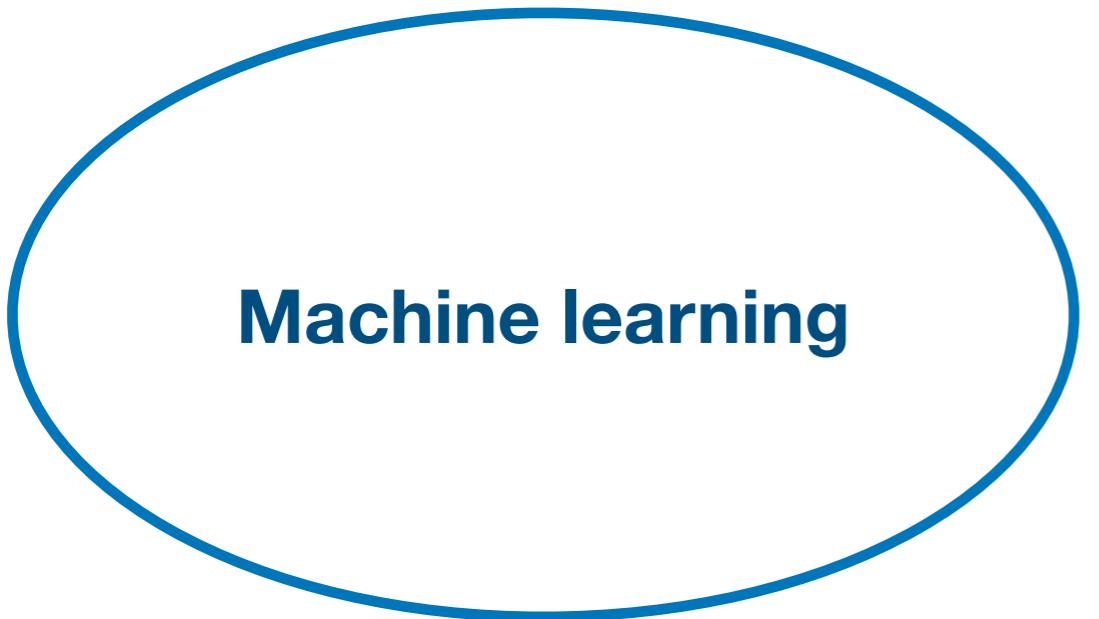
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**+ One WASP Assistant Professor position**  
(including a PhD position and 4 postdoc years)

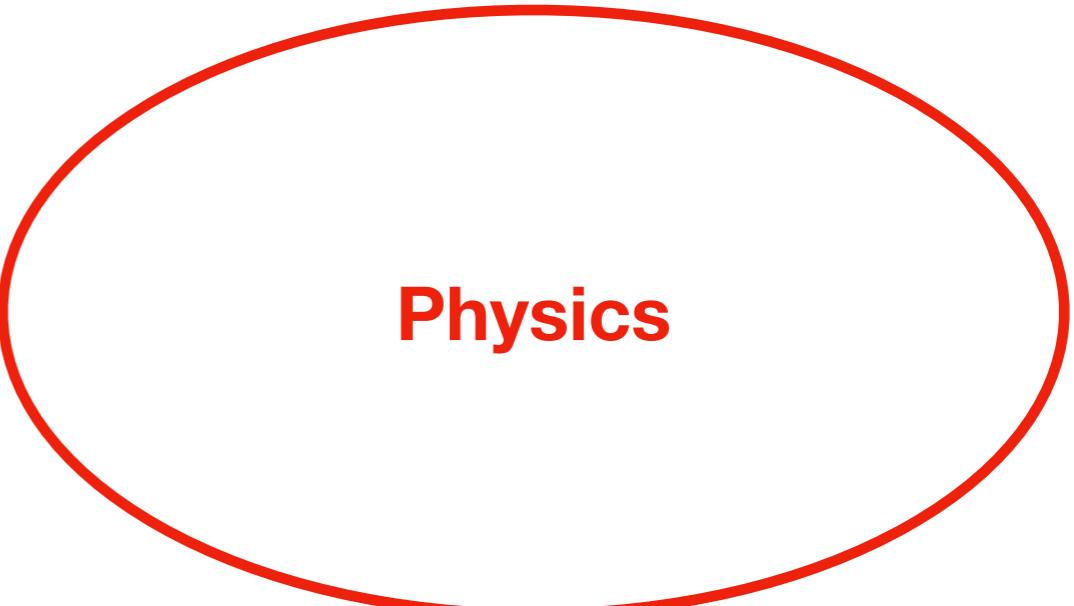
# **AI-related activities in Gothenburg**

- AI Innovation of Sweden (Vinnova, Zenuity, Volvo...)
- **WASP AI**  
(Wallenberg AI Autonomous Systems Program)
- **WACQT**  
(Wallenberg Centre for Quantum Technology)
- **CHAIR**  
(Chalmers AI Research Centre)
- **GAIA**  
(Gothenburg AI Alliance)





**Machine learning**



**Physics**

**model complex systems**

**pattern recognition**

**many body states**

**strongly correlated systems**

**symmetries**

**conservation laws**

**dynamical systems**

**gradient flow**

**transport theory**

**information theory**

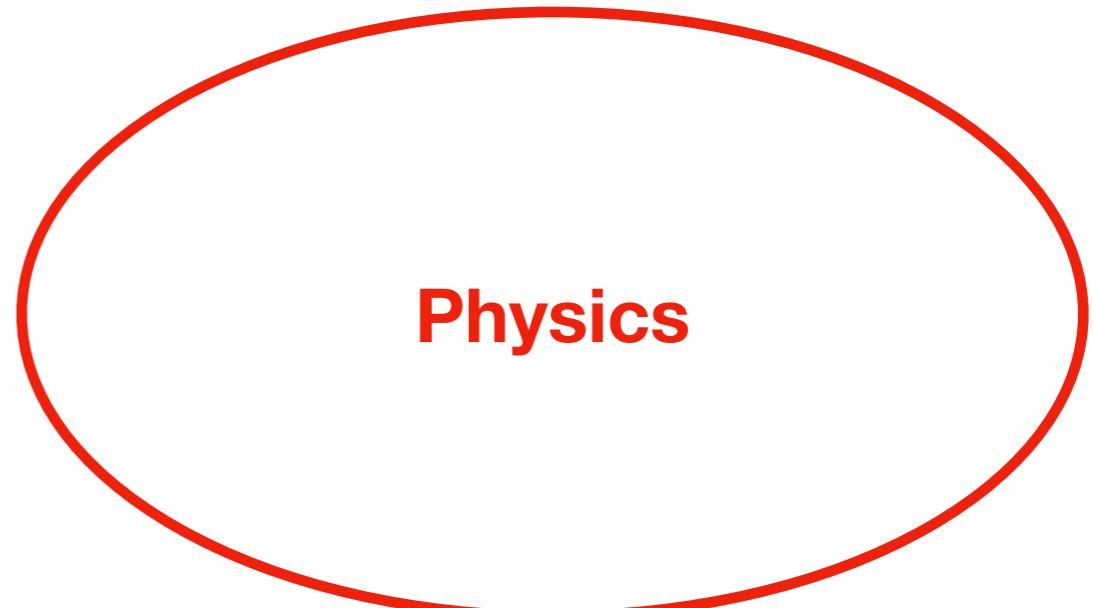
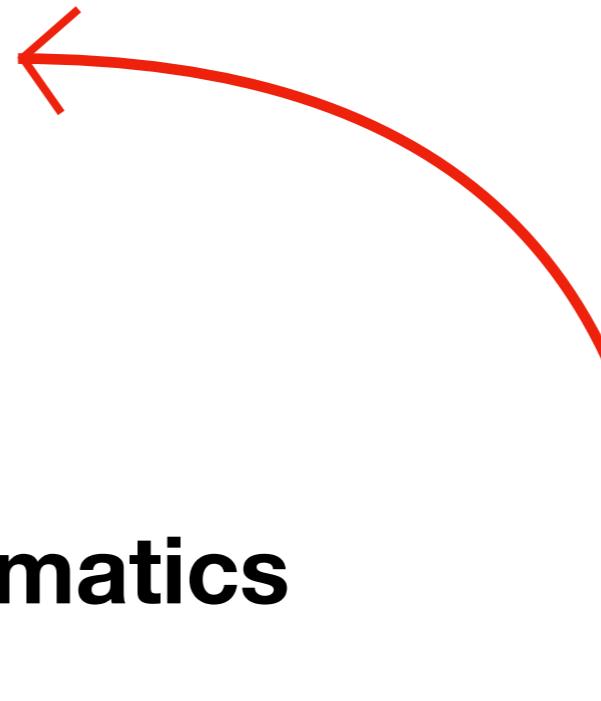
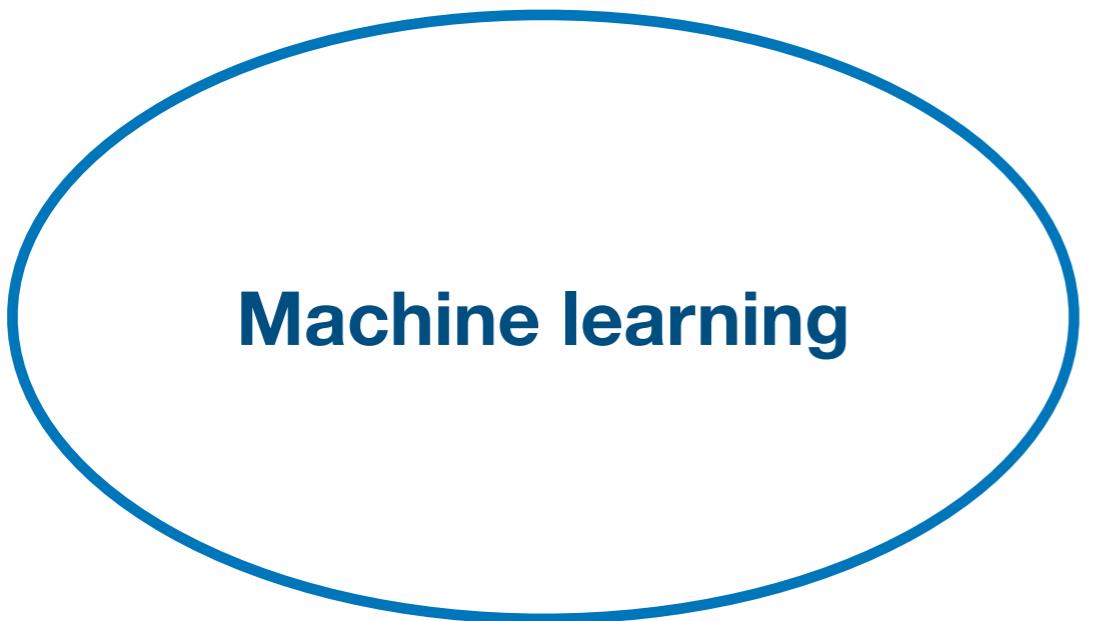
symmetries  
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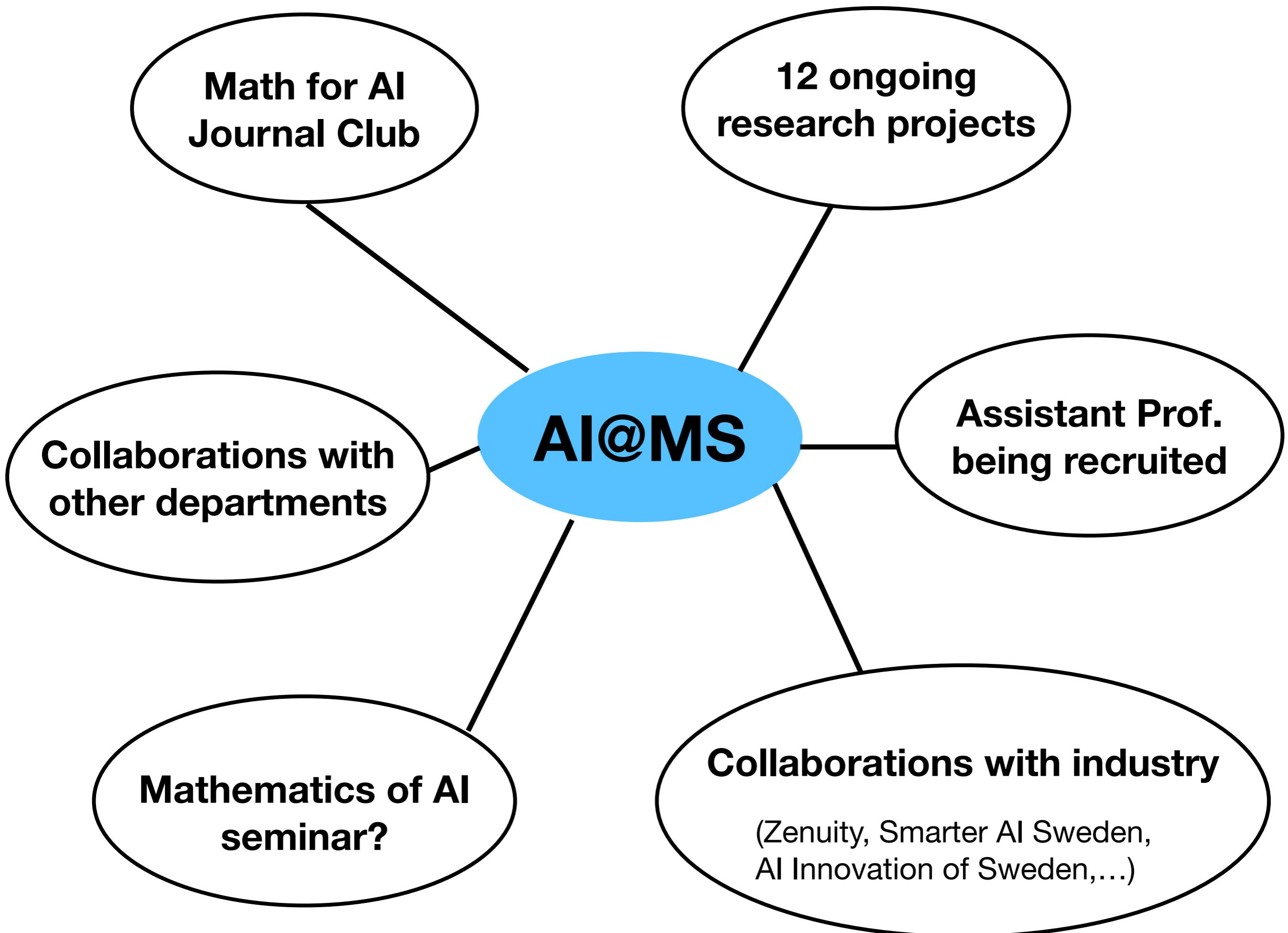
## Mathematics

Machine learning

model complex systems  
pattern recognition  
many body states  
strongly correlated systems

Physics





## Mathematical Sciences

Education	+
Research	-
Research areas	-
Algebraic geometry and number theory	+
Artificial Intelligence	-
AI@MS Journal Club	
Biomathematics and biostatistics	+
Complex Analysis of Several Variables	+
Computational Mathematics	+
Harmonic Analysis and Functional Analysis	+
Mathematical Physics	



# AI@MS - Artificial Intelligence at Mathematical Sciences

An explosion of artificial intelligence (AI) technology is currently sweeping over the world. The new technologies bring new challenges, both technological and societal. Many of these challenges are mathematical in nature.

The Gothenburg area in particular is buzzing with AI initiatives:

- [Chalmers AI Research Centre \(CHAIR\)](#)
- [AI INNOVATION of Sweden at Lindholmen](#)
- [WASP AI/Math projects](#)
- [Gothenburg Artificial Intelligence Alliance \(GAIA\)](#)
- [AI Journal Club](#)



**Exciting times ahead!  
Thank you!**