Marcel H. Rød

Student of Computer Science, Mathematics, and Physics

Passionate about structures of machine learning, applied mathematics, hardware-accelerated computing, and physics.

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EDUCATION

Advanced Study Program
Massachusetts Institute of Technology

09/2022 - Present

Coursework
- Research projects with Prof. Justin Solomon and Prof. Wojciech Matusik in Neural Differential Equations and Differentiable Simulation
- Courses: Differential Geometry, Advanced Computational Photography, Computational Design and Fabrication

MSc Computer Science
University of Oxford

10/2020 - Present

Coursework
- Concentration in Geometric in Deep Learning
- Predoctoral Research Topic: E(n) Equivariant Normalizing Flows for Generative Point-Cloud Models
- Notable courses: Concurrent Algorithms and Data Structures, Quantum Processes and Computation, Advanced Machine Learning, Computational Biology
- Thesis: Graph Rewiring with Gradient Flows for Runtime Optimization. Supervisor: Michael Bronstein

BSc Mathematics
Norwegian University of Science and Technology

08/2017 - 06/2020 *GPA: 5.0/5.0*

Coursework
- Electives in numerical mathematics, statistics
- Thesis: Group Equivariant Convolutional Neural Networks
- Concentration in physics: 8 additional courses, notably fluid mechanics, thermal physics, nanotechnology, electromagnetics, and quantum mechanics

BSc Computer Science
Norwegian University of Science and Technology

08/2017 - 06/2020 *GPA: 4.9/5.0*

Coursework
- Electives in artificial intelligence, deep learning
- Thesis: Computer Vision Techniques for Quality Assurance in Histopathology
- Additional graduate level courses in Deep Learning and AI programming

WORK EXPERIENCE

Technical Student
CERN

01/2021 - 12/2021 *Geneva, Switzerland*

Work
- Design and hardware implementation of machine learning models in use for the CMS experiment
- Model exploration for application in autonomous vehicles in partnership with Zenseact (Volvo)

Contact : Dr. Maurizio Pierini - mpierini@cern.ch

WORK EXPERIENCE

Software Engineering Intern
Palantir Technologies

06/2020 - 09/2020   *London, UK*
Work

- Developed large scale data manipulation for fraud detection in banking with Spark and Python
- Server management and downtime troubleshooting for a server cluster
- Developed and optimized performance-critical time series manipulation software in low-level Rust

Contact : Josh Casale - jcasale@palantir.com

Data Science Intern
Cognite AS

06/2019 - 08/2019   *Oslo, Norway*
Work

- Developed real-time downtime prediction algorithms deployed on oil platforms
- Developed correlation-detection algorithms for finding relationships between sensors in industrial applications

Contact : Dr. Gunnar Staff - gunnar.staff@cognite.com

AWARDS

Aker Scholarship (11/2019) ⬈
Aker
- Full funding for a Ph.D. or Master's degree

NORAM Scholarship (09/2022) ⬈
The Norway-America Association
- Funding for graduate studies in the US

RESEARCH

Differentiable Two-Way Coupled Fluid Simulation
- Work on a fully differentiable two-way coupled fluid simulation for optimization of UUVs and UAVs.
- Method allows for detailed simulation of soft bodies that affect themselves through fluid interactions.
- Work with Prof. Wojciech Matusik and Dr. Peter Yichen Chen at MIT.
- Planning journal submission in early February.

Graph Rewiring with Gradient Flows for Runtime Optimization (05/2022 - Present)
- Developed a differentiable clustering method for use in the gradient flow framework for optimizing the runtime performance of graph neural networks on specialized hardware. This method enables a novel tradeoff between runtime and prediction performance.
- Work with Prof. Michael Bronstein at Oxford.
- Planning journal submission in January.

Standardizing Neural ODEs and Continuous Normalizing Flows (09/2022 - Present)
- Developing a state of the art library for using Neural ODEs in Jax and PyTorch. My implementation is flexible and most of the time 15x faster than current standards.
- Exploring new methods of regularization that result in interesting effects on the Neural ODE for applications in geometry and animation.
- Work with Prof. Justin Solomon at MIT.

CERN CMS Experiment - L1 Triggering (01/2021 - 12/2021)
- Developed and evaluated neural network architectures suitable for deployment on FPGA at ultra-low latency (~10ns) for the CMS triggering system.
- Side-project working on image segmentation models on FPGA for Zenseact (Volvo's autonomous vehicle division). Published in Machine Learning: Science and Technology.
- Work with Dr. Maurizio Pierini's Machine Learning for Particle Physics Group at the CMS Experiment at CERN.

Oxford Predoctoral Research Program: E(n) Equivariant Normalizing Flows for Point-Cloud Data (04/2021 - Present)
- Using equivariant frameworks to produce rotationally consistent generative point cloud models.
- Experiments turned out to be too slow with current Neural ODEs, so work is waiting on other research.
- Work with Dr. Emile Mathieu and Michael Hutchinson under Prof. Yee Whye Teh at Oxford.

Modelling Deep Learning as Optimal Control Problems (04/2019 - 12/2019)
- Developed and implemented methods for neural ODEs, exploring the convergence of implicit methods.
- Work with Prof. Brynjulf Owren and Prof. Elena Celledoni at NTNU. Collaboration with researchers at the University of Cambridge.
- Participated in the program for Geometry Compatability and Structure Preservation in Computational Differential Equations at the Isaac Newton Institute in Cambridge in Nov. 2019 for this project.

Computer Vision Techniques for Quality Assurance in Histopathology (01/2020 - 05/2020)
- Extended a collaborative web application for viewing histopathology slides with computer vision methods for ensuring image quality and aiding in identification.
- The result of this project is currently used for pathology by the Regional Health Authority in Trondheim, Norway.
- Group project supervised by Jens Lien at NTNU and Bouvet.

ACHIEVEMENTS

1st place - Renewable Energy AI Hackathon with Equinor (03/2020)

1st/10 groups. Predicted energy production from windmills given weather forecast data and historical production numbers. The solution involved gradient-boosted regression trees, methods for filling in missing data, and data augmentation.

1st place - AI Hackathon with Telenor & NTNU Open AI Lab (03/2019)

1st/12 groups. Created an application for visualizing and predicting city pollution from sensor data. The algorithm used an LSTM and interpolation. Awarded 1750 USD.

4th (tie-breaker for 1st) place, Trondheim - Nordic Collegiate Programming Contest 2019

4th/25. Competitive programming. 4th after tie-breaker for 1st.

3rd place, Trondheim - Nordic Collegiate Programming Contest 2018 (10/2018)

3rd/25. Competitive programming.

1st place - Drone AI Hackathon with Equinor (10/2019)

1st/5 invited groups. Created pathfinding and computer vision algorithms to find and rank rust severity on windmills. The solution involved a genetic algorithm for solving the traveling salesman problem.

1st place - AI Hackathon with Acando & Google (10/2018)

1st/6 invited groups. Created an OCR application for parsing receipts using a hybrid of traditional computer vision techniques and deep learning.

3rd place - Norwegian Collegiate Programming Contest (IDIOpen) (03/2019)

3rd/25. Competitive programming.

SKILLS

`TeX` `Python` `PyTorch` `Jax` `TensorFlow` `Git` `C++` `CUDA` `Linux` `Rust` `HTML5`

LANGUAGES

English (Native) ● ● ● ● ●

Norwegian (Native) ● ● ● ● ●

Spanish ● ● ● ○ ○