Autumn School on Scientific Machine Learning

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CWI: Dutch institute for math and computer science

- Founded in 1946
- Located in Amsterdam
- Part of Dutch Organisation for Scientific Research (NWO)

Mission
Conducting pioneering research in mathematics and computer science, generating new knowledge in these fields and conveying it to industry and society at large.

CWI: Dutch institute for math and computer science

- Workforce:
  - 184 researchers
  - 45 support staff
  - 15 research groups
- 90-100 projects per year
- ~ 300 papers per year
- several software products
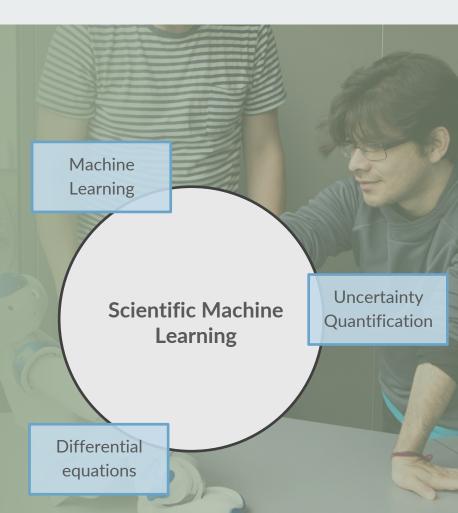- 23 spin-off companies

- Research groups
  - Scientific computing
  - Machine learning
  - Multiscale dynamics
  - Computational imaging
  - Stochastics
  - Networks and optimization
  - ....

Scientific Computing group

Predictive science at the interface of ML, UQ and PDEs

Common theme: use physics knowledge to steer design of ML & UQ algorithms

- Closure models
- Reduced order models
- Bayesian inverse problems
- Neural networks

Machine Learning

Uncertainty Quantification

Scientific Machine Learning

Differential equations

Scientific Machine Learning semester programme

Scientific computing **with** machine learning
Speakers: Jan Hesthaven (EPFL Lausanne), Stefania Fresca (Politecnico di Milano)

Scientific computing **for** machine learning
Speakers: Sid Mishra (ETH Zurich), Andrea Walther (Humboldt Universität Berlin)

Scientific machine learning in **applications**
Speakers: Dirk Hartmann (Siemens), Elías Cueto (Universidad de Zaragoza)

Monday 9 October
Data-driven multiscale methods, turbulence
09:30 - 10:00 Walk-in, coffee
10:00 - 10:10 Welcome and opening
10:15 - 11:15 Andrea Beck
11:30 - 12:30 Romit Maulik
12:30 - 13:30 Lunch
13:30 - 16:30 Syver Agdestein, Benjamin Sanderse
with coffee break at 15:00

Tuesday 10 October
Reduced order models
09:00 - 10:30 Andrea Manzoni, Mengwu Guo
10:30 - 11:00 Coffee break
11:00 - 12:00 Karen Veroy
12:00 - 13:00 Lunch
13:00 - 15:30 Mengwu Guo, Andrea Manzoni
15:30 - 17:30 Poster session and drinks

Wednesday 11 October
SINDy, DMD, Koopman
09:00 -10:00 Steven Brunton
10:00 - 10:30 Coffee break
10:30 - 12:30 Urban Fasel
12:30 - 13:30 Lunch
13:30 - 14:30 Urban Fasel
14:30 - 15:00 Coffee break
15:00 - 17:00 To be decided in discussion with participants

Thursday 12 October
PDE-inspired neural networks
10:00 - 11:00 Paris Perdikaris
11:00 - 11:30 Coffee break
11:30 - 12:30 Erik Bekkers
12:30 - 13:30 Lunch
13:30 - 16:00 Erik Bekkers
with coffee break at 15:30
±17:30 dinner @Maslow

Friday 13 October
Neural ODEs, differentiable physics
09:00 - 12:30 Chris Rackauckas
with coffee break at 10:30
12:30 - 13:30 Lunch
13:30 - 14:00 Overview of approaches and key learning points
14:00 - 15:00 Hod Lipson

Practical

- Coffee, lunch: in the "foyer". Feel free to go outside and get some fresh air.

- Poster session: in adjacent room, "Newton"

- Wifi:
  - Eduroam
  - CWI-gast, password "gastheer CWI" (note space)

Hands-on sessions

- Many sessions will revolve around PDEs like Burgers equation or Navier-Stokes equations

- Each day, a different approach will be explained

- Challenge: gather the results of the different days into one overview.

Hands-on session

- For today's session, go to https://github.com/agdestein/NeuralClosure

- Julia and VSCode **installed?**

    - **Yes** -> Choose **Option 1**

    - **No** -> Choose **Option 2**