A Selection of Research Topics and Applications in Machine Learning and Artificial Intelligence

Jesse Read

Data Science and Mining Team **DaSciM**,
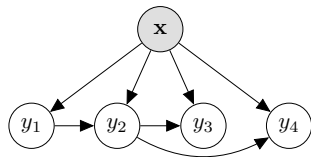A member of the *Data Analytics and Machine Learning* pôle at

ÉCOLE POLYTECHNIQUE

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Topics in Machine Learning and AI

- Multi-label Classification
- Structured-Output Prediction
- Time Series
- Evolving Data Streams
- Transfer learning
- Reinforcement Learning
- Probabilistic Inference (Monte Carlo methods)
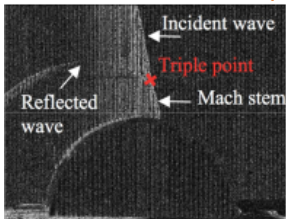- Interpretation/Explainability

Tracking and Forecasting

- Work with colleagues at Aalto University: Urban mobility

- Work with D. Gomez, and Institut de Radioprotection et de Sûreté Nucléaire: Blast wave propagation; tracking and modelling
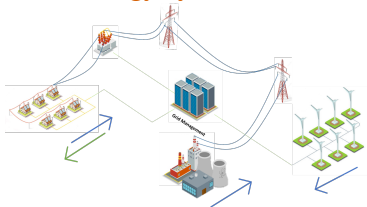

Challenges:

- Scalability: modeling in real-time; low powered devices
- Big data vs small data; adaptation to concept drift/shift
- Problem definition; interaction with domain experts

Energy Modeling and Control

- With PhD candidate Mohamed Alami (and SystemX):
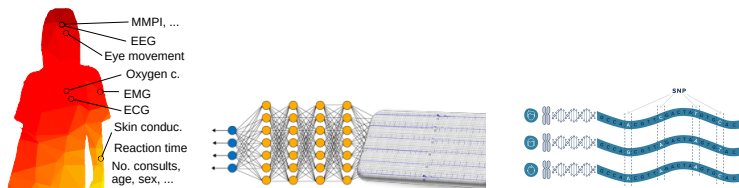 Reinforcement learning for demand response in complex multi-energy systems

- With Alban Puech and DEIF Wind Power Technology: Improved yaw control for wind turbines via reinforcement learning

Challenges:

- Limited direct control; concept drift
- Multi-modal data; sensor fusion
- Method deployment is non-trivial

Bio and Medical Modelling and Diagnosis

Work with PhD students:

- O. Pallanca: Diagnosis and treatment of chronic insomnia
- E. Antonenko: Phenotype prediction from GWAS, SNP-data
- E. Zvoloni (co-supervised by J. Behar at Technion): Diagnosis and risk prediction of cardiac diseases
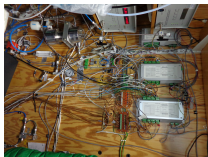
Challenges:

- Interpretation and explainability of models
- Noisy/incomplete real-world data
- Missing labels

Agricultural/Forest, Climate/Vegetation

With colleagues at INRA and the University of Helsinki:

- Modeling the relationship of climate to global vegetation type/land cover
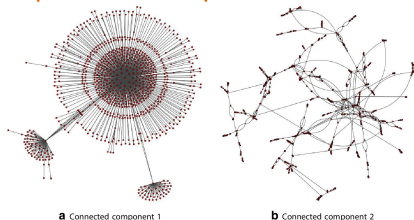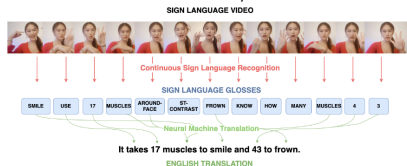- Modeling the main drivers for growth in Scots Pine trees

Challenges:

- Structured input and prediction
- Incomplete data
- Interaction with domain experts; explainability and interpretability

Other Examples (titles of recent papers)

- with Sammy Khalife: Structure and influence in a global capital-ownership network, 2021

a Connected component 1   **b** Connected component 2

- with Kayo Yin: Better sign language translation with STMC-Transformer, 2020

Thank you.

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