

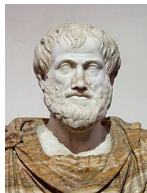
Analytical Solutions and Reasoning

MSc topics 2024

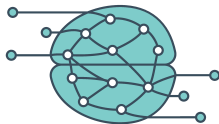
Universitetet i Oslo

25 September 2024

ASR – Analytical Solutions and Reasoning



Logic,
Reasoning



Data Science
AI/ML



Digital
Twins



Semantic Web
Technologies



Data
Management

ASR MSc topics

ASR:

<https://www.mn.uio.no/ifi/studier/masteroppgaver/asr/>

Topic areas

- Machine Learning, Data Science
- Ontology-Based Information Systems
- Data Streams and Applications
- Logic and Theoretical Computer Science

How trainable are GNNs?

(Comparing trainability of Graph Neural Networks for logic-expressible functions)

- Graph Neural Networks (GNNs):
 - a family of modern NN architectures
 - work with structured data (e.g., knowledge graphs)
- (Theoretical) expressivity of GNNs:
 - different GNN architectures express different sets of functions on graphs
 - well-understood by connecting to logics
- (Practical) trainability of GNNs:
 - "can express in theory" does not imply "can be trained"
 - Question:
Which GNNs architectures can be trained for which logic-expressed functions?

Supervisors: Egor V. Kostylev (egork@ifi.uio.no), Roxana Pop (roxanap@ifi.uio.no)

Reasoning in Large Language Models

- It has been noted in the literature that human-like reasoning differs from classical logic reasoning. To a human, the sentence

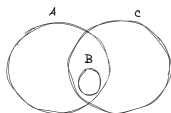
Some A are B *implies* Some A are not B

while logically, *Some A are B* does not exclude *All A are B* .

- Participants of a study inferred that "All A are C " given

All B are A

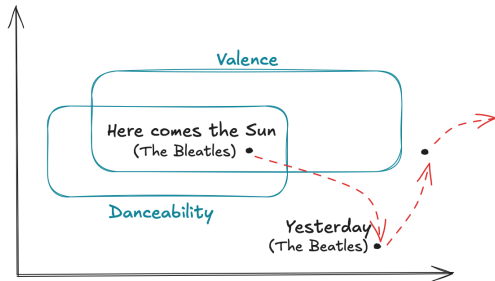
All B are C .



- Since LLMs are trained on human generated text, the task is to **explore whether LLMs replicate patterns in human reasoning.**

Geometric User Journeys

- Everything is becoming a service, e.g. Netflix, Spotify
- Geometric models embed knowledge into vector spaces
- User profile would be sequence of vectors

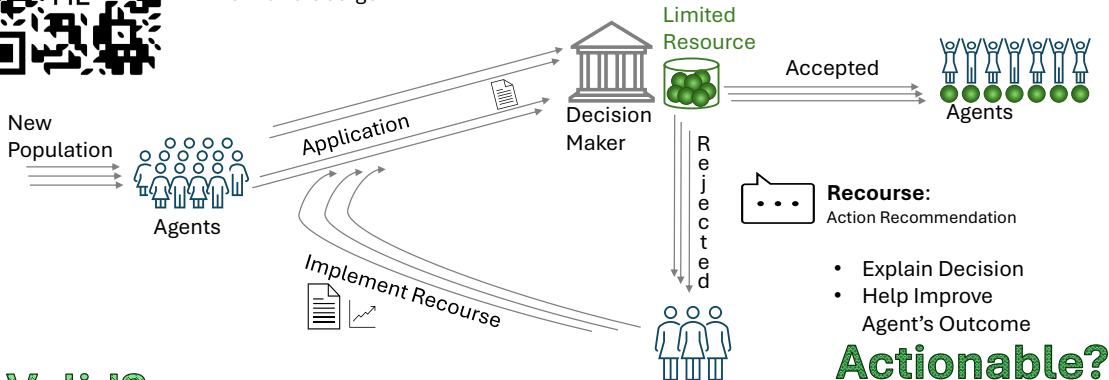


- Task: Create geometric models using the music stream service dataset
- Extract user journeys (trajectory of vectors associated with tracks)



Actionable Recourse & Fairness Over Time

Ingrid Chieh Yu
Anne-Marie George



Valid?

New Application Situation

- New / changed agents (features)
- Different Policy, Resource Limit

Fair?

- Are the costs of implementing recourse appropriate? fair?
- Is the decision fair towards groups of agents? Unbiased?

Actionable?

SPARQL Query Optimisation with SHACL Constraints

SPARQL

```
SELECT ?x ?y WHERE {  
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  OPTIONAL {  
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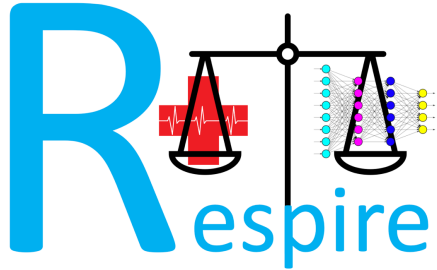
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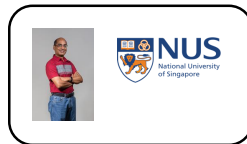
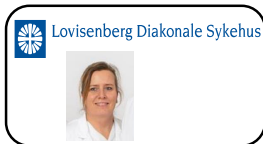
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Contact: Martin Giese (martingi@ifi.uio.no)

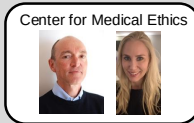
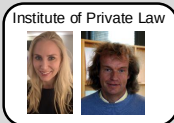
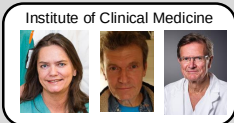


Respire - Responsible Explainable Machine Learning for
Sleep-related Respiratory Disorders

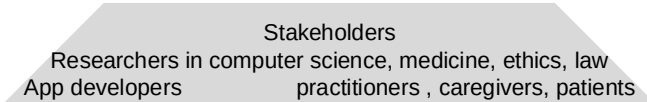
Respire Interdisciplinary Team



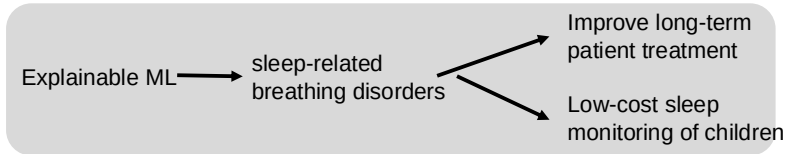
UiO: University of Oslo



Interdisciplinary Challenges



What are good explanations? For whom? How to determine and handle (un-)certainty?

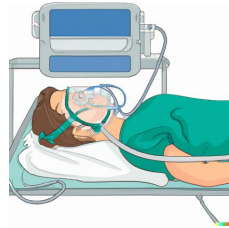


What are the legal and ethical concerns?

Do we detect or define the world?

Explainable AI to improve treatment of patients suffering from severe respiratory disorders with mechanical ventilators

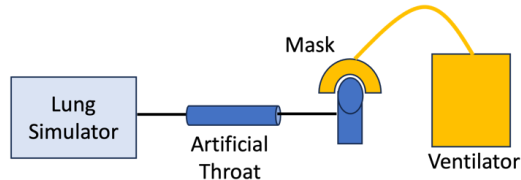
- **Background:** Patients with severe respiratory disorders require special respiratory support to increase oxygen saturation, typically provided through mechanical ventilators.
- **Current Issue:** Multiple sources of problems like wrong mask size and leaks can result in imperfect support.
- **Monitoring and Personalization:** Mechanical ventilators with sensors can detect issues like sleep apnea and help understand how well the ventilator is personalized for the patient.



Generated by Dall-E 2

Simulation Bench Setup

- **Lung Simulator ASL 5000:** Generates physical airflow based on patient breathing models.
- **Artificial Throat:** Simulates obstructions and mask leaks.
- **Mask and Mechanical Ventilator:** State-of-the-art devices connected to simulate real conditions.



Basic set-up of simulation bench

Masters Thesis Topics

- Systematic data generation
- Data quality quantification
- Extensible data pipeline from mechanical ventilator to structured data storage
- Explainable AI
- Uncertainty quantification
- Detection of **patient-ventilator asynchrony** and classification of the types of asynchrony (e.g., double triggering, auto-triggering, reverse triggering, uncoupling, ineffective effort, etc.)

If you are interested please get in touch with us:
Thomas Plagemann, plageman@ifi.uio.no
Farzan Majeed Noori, farzanmn@ifi.uio.no
Ingrid Chieh Yu, ingridcy@ifi.uio.no