Explainable AI for Longitudinal Behaviour, Health and Quality of Life Data

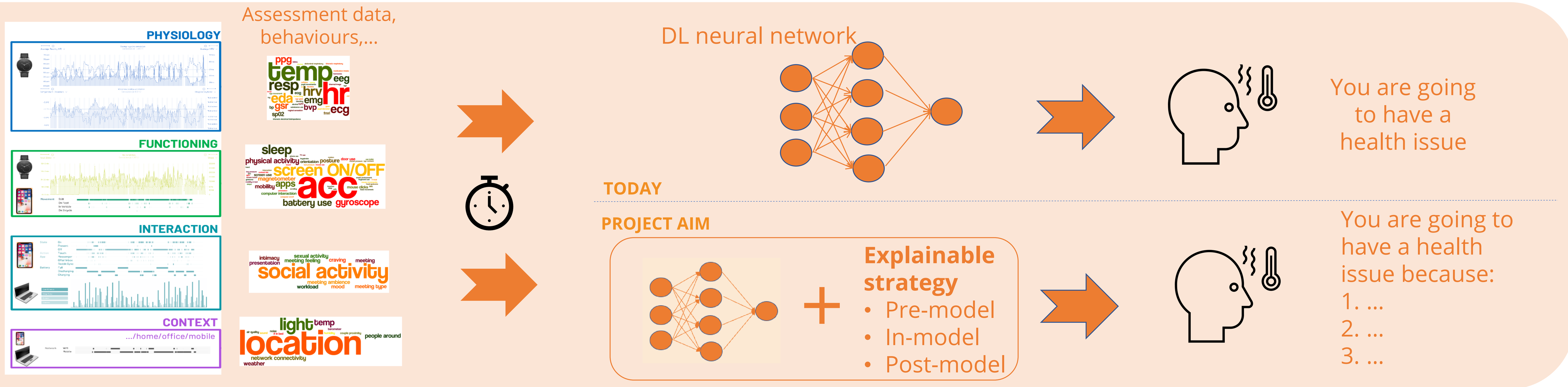
Dr. Clauirton Siebra & Prof. Katarzyna Wac

{clauirton.dealbuquerque, katarzyna.wac}@unige.ch

Quality of Life Technologies Lab

University of Geneva

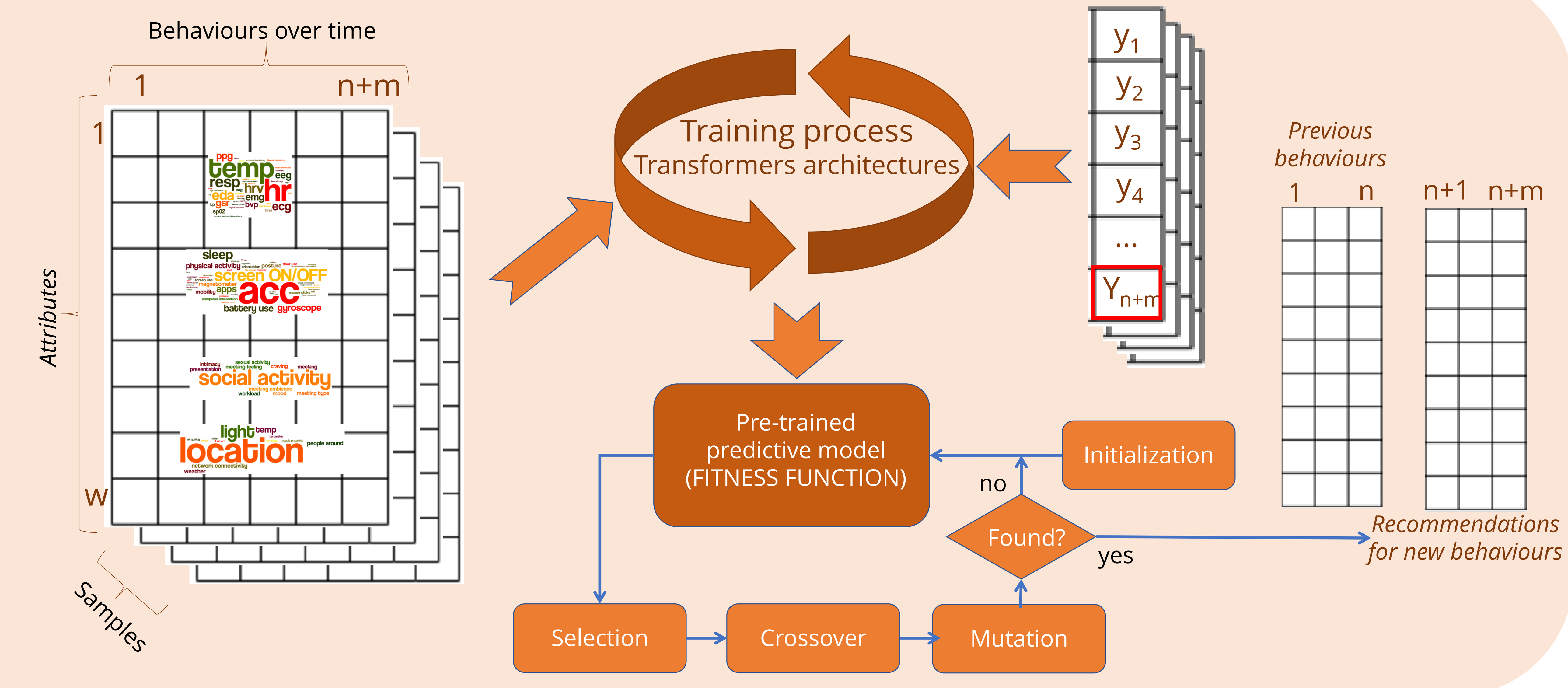
Problem



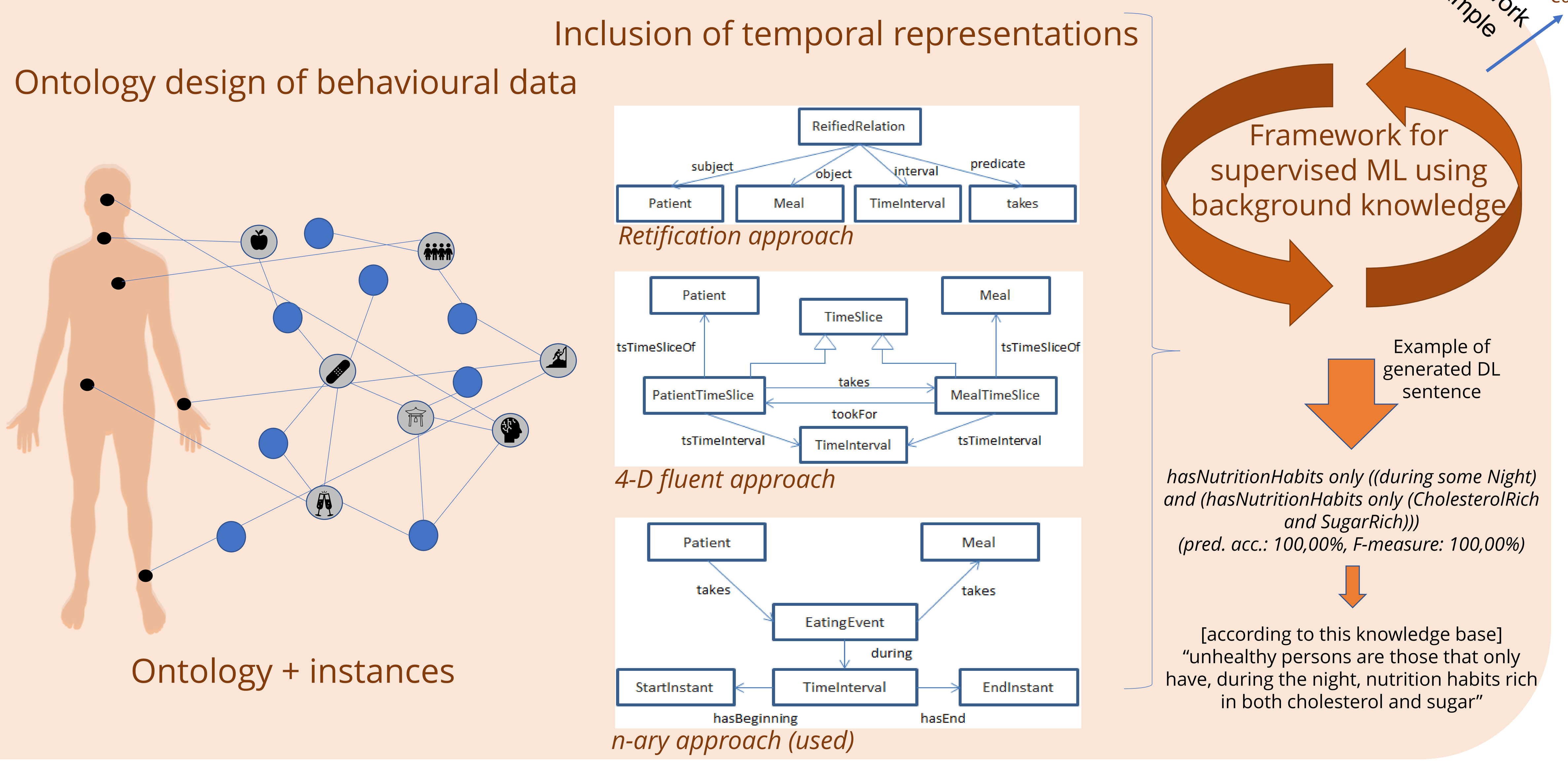
- Tjoa, E., & Guan, C. (2020). A survey on explainable artificial intelligence (xai): Toward medical xai. *IEEE Transactions on Neural Networks and Learning Systems.*
- Arrieta, A. B., Díaz-Rodríguez, N., Del Ser, J., Bennetot, A., Tabik, S., Barbado, A., ... & Herrera, F. (2020). Explainable Artificial Intelligence (XAI): Concepts, taxonomies, opportunities and challenges toward responsible AI. *Information Fusion*, 58, 82-115.

Proposal 1

- Each column represents a **behaviour** β characterised by *w* **attributes**. These behaviours are sequentially assessed from 1 to n+m. A set of these matrixes are used in the training process to generate a **predictive model**. The aim of this model is to predict the value of y_{n+m}.
- After created, the predictive model works as an evaluator **(fitness function)** of **recommendations** generated by a genetic algorithm.
- This evaluation process tests each matrix formed by concatenating **the previous behaviours** (β_1 to β_n) and the **generated behaviours** (β_{n+i} to β_{n+m}), inducing a value for the prediction variable.
- The recommender must consider the **difference between the usual and recommended behaviours of individuals** (i.e., no dramatic changes). Thus, a Gauss distribution is used to constraint the initial population and mutation process.
- This process evaluates several aspects:
  - ✓ DL architectures for longitudinal data (e.g., LSTM, CNN/LSTM, TPA – **Temporal Pattern Attention**, etc.)
  - ✓ Use of **individual** vs. populational data
  - ✓ Configuration of the training dataset
- This architecture must be **as simpler as possible** since it is designed to run in **mobile/wearable devices**.



Proposal 2

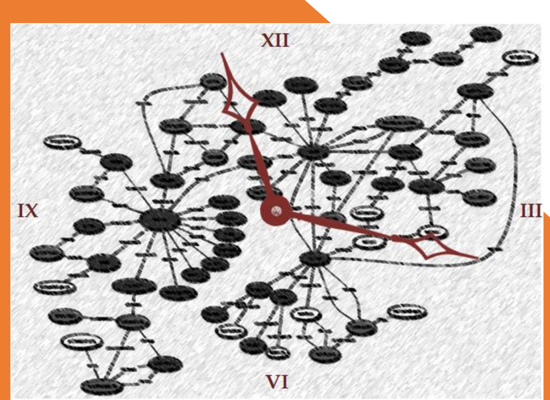


T. Procko, T. Elvira, O. Ochoa and N. Del Rio, "An Exploration of Explainable Machine Learning Using Semantic Web Technology," *2022 IEEE 16th International Conference on Semantic Computing (ICSC)*, 2022, pp. 143-146

- This study used 24 from initially 120 mHealth applications to create a unified ontology that represents the health condition of mobile users and can be used as background knowledge to generate explanations for inductive reasoning.
- We give special attention to the representation of temporal aspects because they are usually embedded into the health information, but ontologies present limitations for this type of representation since temporal relations are ternary and cannot be directly handled by ontology languages.
- The results show that the extension of ontologies using temporal n-ary models improves the expressiveness of the explanations, exploring temporal relations and concepts that better support the understanding of the inductive reasoning outcomes.
- Explanations are returned as DL sentences. Thus, a post-stage based on context-sensitive grammar is important to map such sentences to their semantically equivalent natural language forms.

Discussion

- ➢ The health systems' ability to explain their reasoning is critical to users' acceptance of their decisions.
- ➢ While the first proposal can be integrated to any type of DL architecture, the second approach defines specific inductive algorithms that directly use ontological instances to make conclusions
- ➢ Initial results regarding proposal 1 emphasise the better efficiency of the attention-based approach compared to DL traditional architectures. This fact is in accordance with the literature, which presents several studies that adapt attention-based methods to their domains
- ➢ The second approach uses the concept of background knowledge and the expressivity of DL sentences to generate explanations. Research directions tend to use this same concept integrated to deep learning approaches (neuro-symbolic approach).
- ➢ The main challenge of this type of research is to find (or create) good quality (e.g., low noise and missing data rate) datasets since wearable/mobile data is usually collected *in the wild.*



ONTO-mQoL Project
Marie Sklodowska-Curie grand agreement
H2020-MSCA-IF2020-101024693

https://www.unige.ch/onto-mqol/
clauirton.dealbuquerque@unige.ch