SCIENCES & BIOENGINEERING SCIENCES

The Research Group

Artificial Intelligence Lab

has the honor to invite you to the public defense of the PhD thesis of

Axel Abels

to obtain the degree of Doctor of Sciences

Joint PhD with Université Libre de Bruxelles

Title of the PhD thesis:

Resolving Knowledge Limitations for Improved Collective Intelligence

A novel online machine learning approach

Promotors:
Prof. dr. Ann Nowé (VUB)
Prof. dr. Tom Lenaerts (ULB)

The defense will take place on
Tuesday, April 23, 2024 at 5p.m. in the Solvay Room (NO building, 5th floor, ULB Plaine Campus)
The defense can also be followed through Teams [ID: 331 388 378 442, pass: AaSaeq]

Members of the jury

Prof. dr. Gianluca Bontempi (ULB, chair)
Prof. dr. Vincent Ginis (VUB, secretary)
Prof. dr. Lynn Houthuys (VUB)
Prof. dr. Christine Decaestecker (ULB)
Prof. dr. Yingqian Zhang (Eindhoven University of Technology, the Netherlands)
Prof. dr. Vincent Corruble (Sorbonne Université, France)

Curriculum vitae

Axel Abels earned his Master's degree in Computer Science from the Université Libre de Bruxelles (ULB) in 2018. Following his graduation, he started his PhD within the Machine Learning Group (MLG) at the ULB, supervised by Prof. Dr. Tom Lenaerts. He soon entered a joint PhD collaboration with the VUB's Artificial Intelligence Lab under the co-supervision of Prof. Dr. Ann Nowé.

Abels' research is concerned with the study of group decision-making, the individual and social biases which affect it, and techniques which might mitigate the detrimental effects of said biases. In particular, he aims to uncover methods for harnessing the rich diversity of knowledge from varied groups to its fullest potential.

His contributions to the field have been recognized through publications in leading international conferences and journals dedicated to artificial intelligence and machine learning.

Abstract of the PhD research

One of the reasons human groups struggle to make the best decisions is that they are inherently biased in their beliefs. In essence, our perception of what is true is often distorted by individual and social biases, including stereotypes. When individuals deliberate about a decision, they tend to transmit these beliefs to others, thereby steering the entire group away from the best decision. For example, a senior doctor could spread a misinterpretation of symptoms to junior doctors, resulting in inappropriate treatments.

The primary objective of this thesis is to mitigate the impact of such biases on decision-making in domains such as medical diagnostics, policy-making, and crowdsourced fact-checking. We propose to achieve this by having humans interact through a collective decision-making platform in charge of handling the aggregation of group knowledge. The key hypothesis here is that by carefully managing the collectivization of knowledge through this platform, it will be substantially harder for humans to impose their biases on the final decision.

The core of our work involves the development and analysis of algorithms for decision-making systems. These algorithms are designed to effectively aggregate diverse expertise while addressing biases. We thus focus on aggregation methods that use online learning to foster collective intelligence more effectively. In doing so, we take into account the nuances of individual expertise and the impact of biases, aiming to filter out noise and enhance the reliability of collective decisions. Our theoretical analysis of the proposed algorithms is complemented by rigorous testing in both simulated and online experimental environments. Our results demonstrate a significant improvement in performance and a reduction in bias influence. These findings not only highlight the potential of technology-assisted decision-making but also underscore the value of addressing human biases in collaborative environments.