Invitation

You are cordially invited to the public defense to obtain the academic degree of

DOCTOR OF BUSINESS ECONOMICS (Ghent University)
DOCTOR OF ENGINEERING SCIENCE (Royal Military Academy)

by Bart De Clerck

IDENTIFYING ONLINE MISINFORMATION AND DISINFORMATION SPREADING USING GRAPH THEORY

Supervisors:
Prof. Dr. Luis Enrique Correa da Rocha (Ghent University)
Prof. LtCol Dr. Ir. Filip Van Utterbeeck (Royal Military Academy)

Friday, 20 September 2024 at 15h30
in the auditorium "Frank De Winne", Royal Military Academy, Hobbemastraat 8, Brussels.
Due to security protocols, we kindly request you to provide the following details for each attendant:
First name, last name, nationality, and passport or identity card number.
The venue is easily reachable by public transport, but if you intend to come by car, please specify this as well.
Please send the above information to Bart.DeClerck@UGent.be no later than September 6th.

EXAMINATION BOARD

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Abstract

In the digital age, social media platforms have transcended their original purpose of connecting people, morphing into powerful tools for influencing public opinion and shaping political landscapes. As these platforms increasingly serve as primary sources of news and information, they also become battlegrounds for various actors - from political entities to clandestine groups - seeking to manipulate societal beliefs and behaviors. This manipulation, often subtle and insidious, leverages the complex interplay of algorithms, echo chambers, and network effects to spread misleading information at scale. The consequences of such activities can be profound, affecting not only individual perceptions but also public trust and the integrity of democratic processes.

This thesis investigates the manipulation of public opinion on social media platforms through the lens of complex systems theory. Central to our approach is the development of network-based representations that model social media interactions as complex networks. We explore various network representations, focusing particularly on the use of maximum entropy models, to identify statistically significant interactions and filter out noise within these networks. The research also integrates Natural Language Processing (NLP) techniques and temporal analysis to uncover more subtle forms of coordinated behavior and information diffusion.

We provide a broader context for the research by examining the historical evolution of information manipulation, illustrating the shift from traditional media to digital platforms and the corresponding changes in manipulation tactics, and how these can be detected and countered. Next, we explore the concepts of graph randomization and maximum entropy models, leading to the creation of MaxEntropyGraphs.jl, a Julia package specifically designed for efficient graph randomization and analysis. This tool offers several benefits, including high performance and versatility, making it suitable for a wide range of applications beyond social media network analysis.

The effectiveness of the methodologies is demonstrated through the analysis of real-world disinformation campaigns, including an analysis of datasets from the Twitter information operations report, and a detailed study of a Belgian disinformation case. These studies not only validate our methodologies but also reveal insightful patterns and tactics used in modern disinformation campaigns. The thesis concludes by underscoring the increasing challenges posed by the evolving landscape of information manipulation, particularly with the rise of generative AI, and highlights the need for interdisciplinary collaboration and continuous adaptation of detection strategies.

Curriculum vitae

Bart De Clerck graduated from the Royal Military Academy (RMA) in 2011, where he earned a Master's degree in Engineering Science. Before joining the operational branches of the Belgian Defence, he completed an internship in the construction department at the RMA, focusing on blast effects on buildings and risk assessments. Between 2012 and 2016, he held a technical position in Belgium's Artillery Battalion. During this period, he oversaw the production of target drones, acted as the firing range's safety officer, and participated in multinational firing exercises. He also took part in Operation Vigilant Guardian following the 2016 terrorist attacks in Belgium.

In the summer of 2016, he returned to the RMA as a teaching assistant in the mathematics department. There, he has been involved in multiple courses and has supervised bachelor's and master's theses at both faculties of the RMA as well as other institutions. Within the Belgian Defence and NATO, he is involved in several research projects, one of which is the topic of this dissertation. His research has led to several contributions, including three published papers, five presentations or posters at scientific conferences, and several presentations for a broader audience.