



UNIVERSITÀ DEGLI STUDI DI NAPOLI
FEDERICO II

itee^{PhD}
information technology
electrical engineering



Oumaima Achour

Influence Maximization in Multiplex Social Networks

Tutor: Pr. Lotfi Ben Romdhane
Cycle: XXXVIII

co-Tutor: Pr. Giancarlo Sperli
Year: Second

My background

- MSc degree: Distributed Computer Science @ ISITCom, University of Sousse, Tunisia.
 - ❖ Thesis: Computing User Credibility Using Social Networks Data
 - ❖ Supervisor: Pr. Lotfi Ben Romdhane
- PhD Starting year: 2022-2023
- Research group: MARSlab with Pr. Lotfi ben romdhane (USO)
PICUlab with Pr. Giancarlo Sperli (UNINA)
- Scholarship type: No

Research Field of Interest

Social network analysis and multilayer networks



Social networks data are widely used by various applications such as recommendation systems, link prediction, influence maximization (IM)



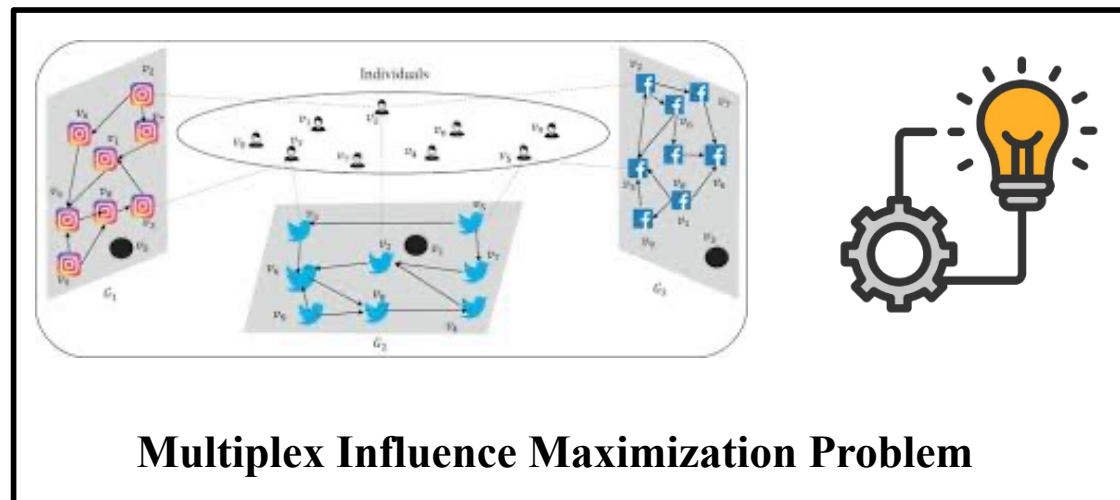
Nowadays, users join multiple social networks simultaneously, creating a complex communication environment, known as «**Multiplex social network**»



Multiplex networks: An effective representation to model complex systems such as transportation, biological, citation, etc. Where each layer represents a specific interaction between the same set of nodes

IM problem: aims to select top-k users who can influence a large fraction of users in the network

Social Networks Application



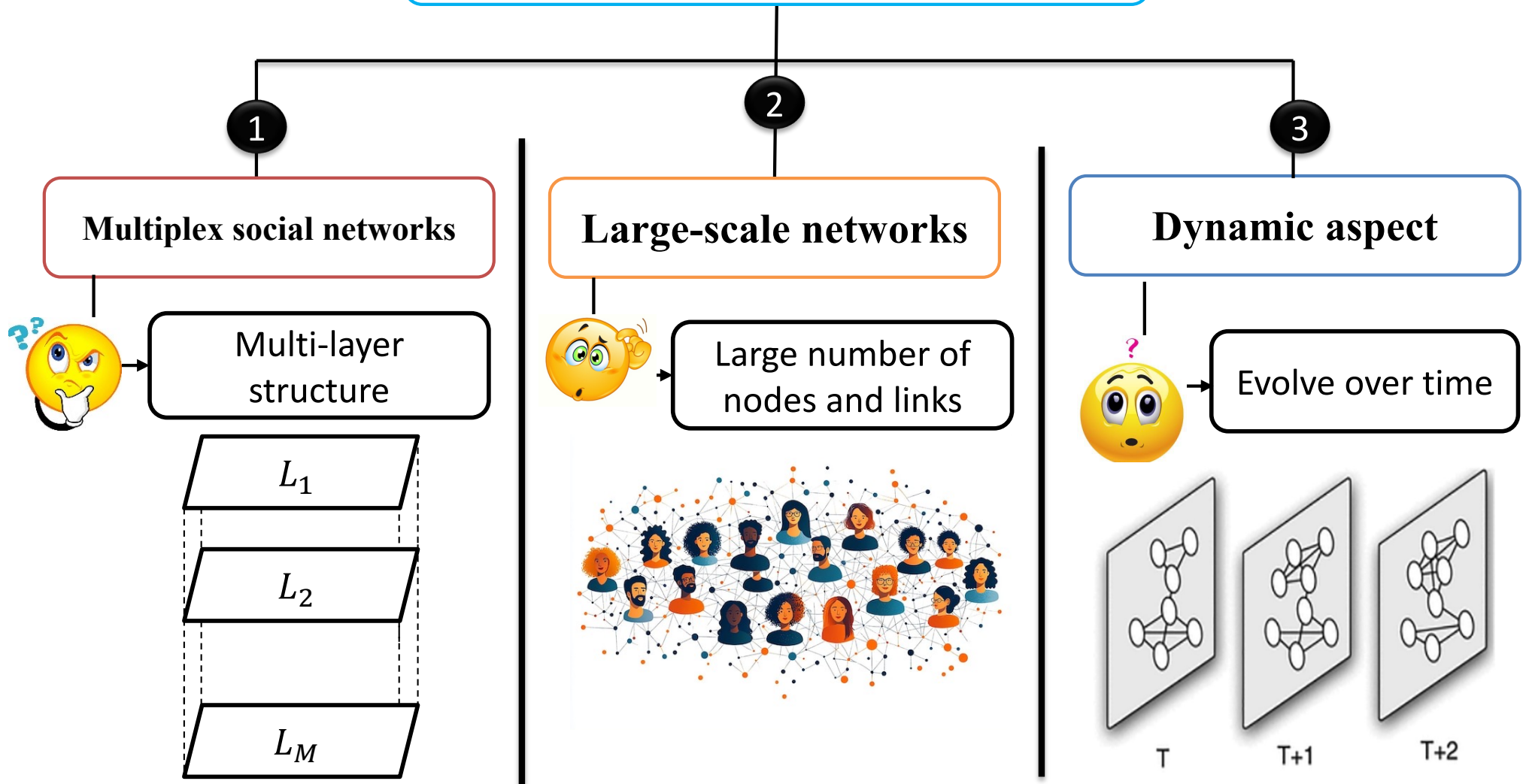
Multiplex Influence Maximization Problem

Influential users

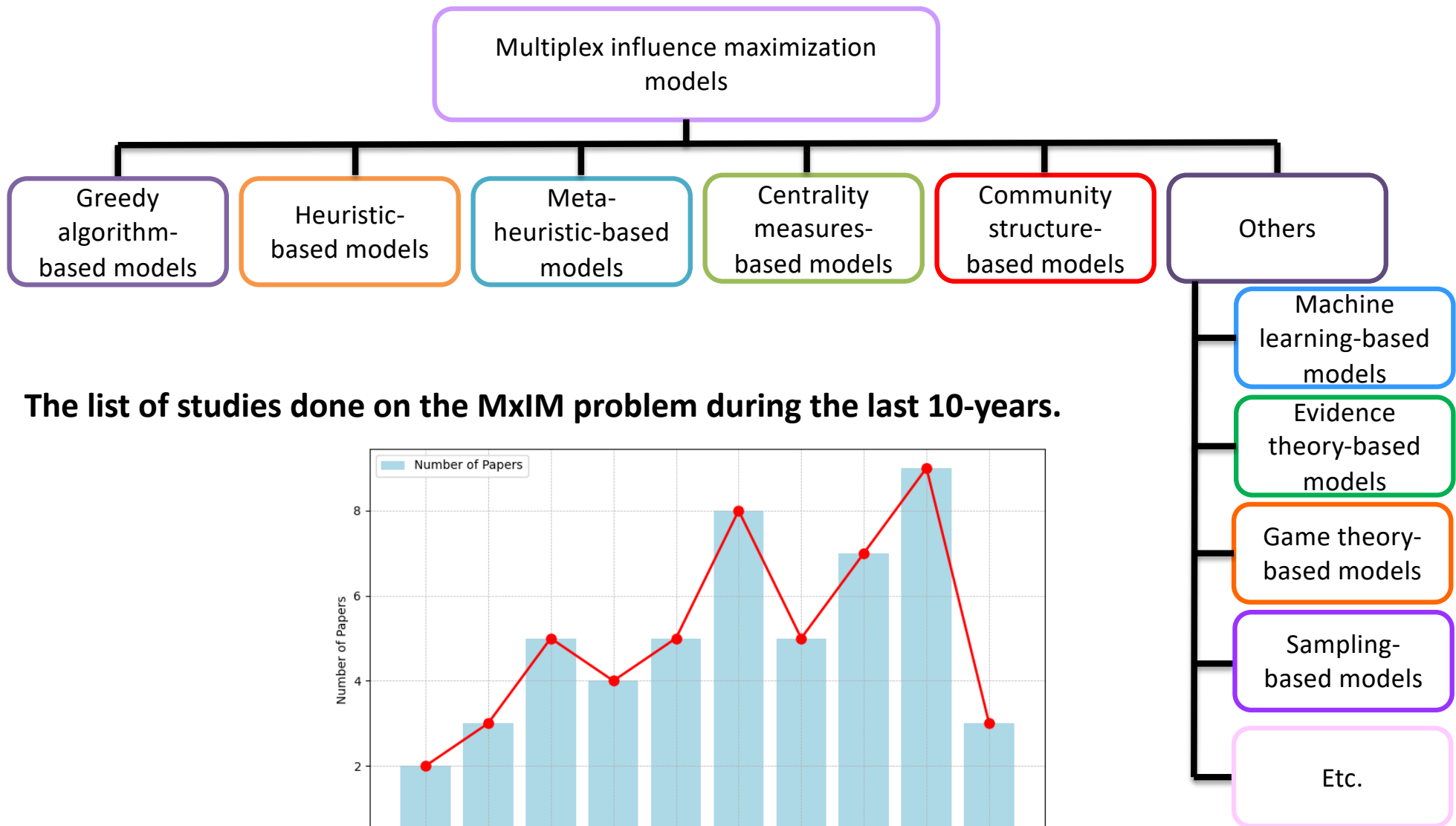


Research Activity: challenges

PhD thesis Challenges



Research Activity: existing models



Research Activity: research questions

Three main research questions:



RQ1. How we will deal with the multilayer structure of the networks?

RQ2. How we will deal with the large-scale size of social networks?

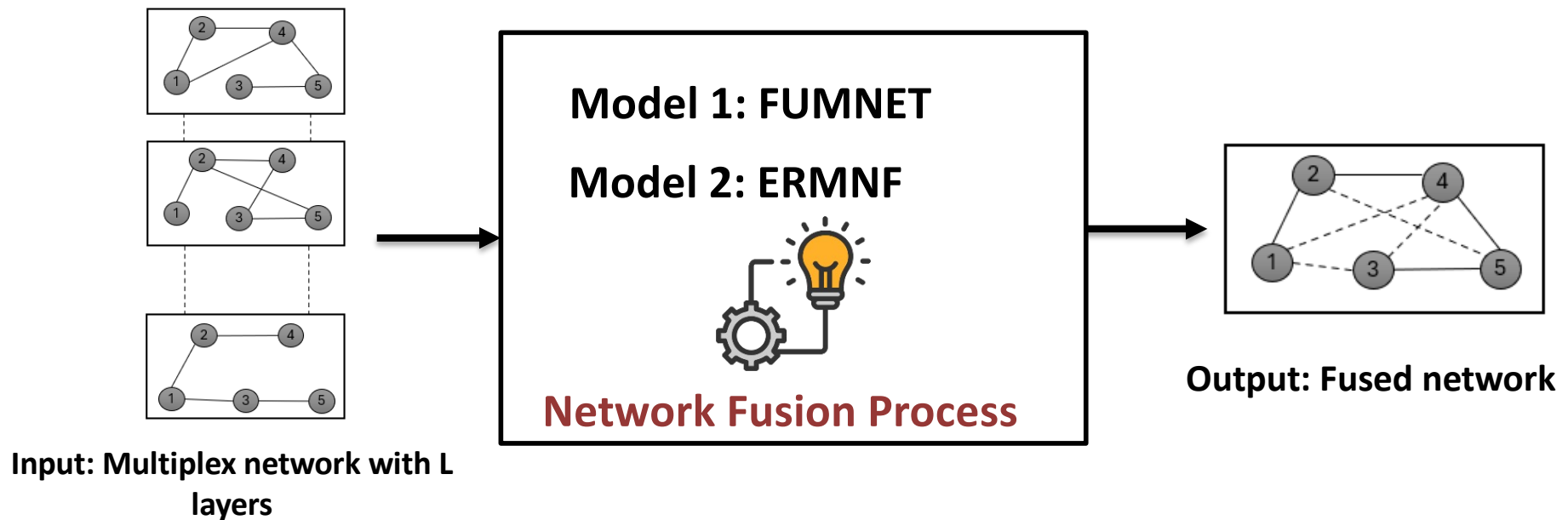
RQ3. Taking into consideration the dynamic aspect of the networks, how we will detect influential nodes (top-k)?



Research Activity: methodology (RQ1)

Phase 1: Network Fusion Process

In order to answer the first research question, we suggest in this PhD thesis to transform the multiplex network into a single-layer network taking into consideration the interlayer information of the network using two different ways as follows:

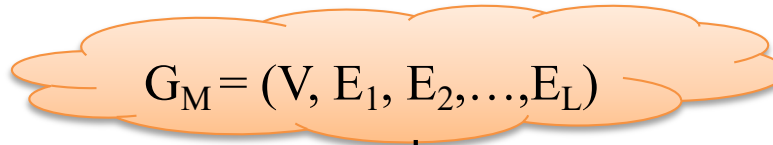


➔ The experiments are performed using various social network tasks such as link prediction, community detection, influence spread, and network structural properties

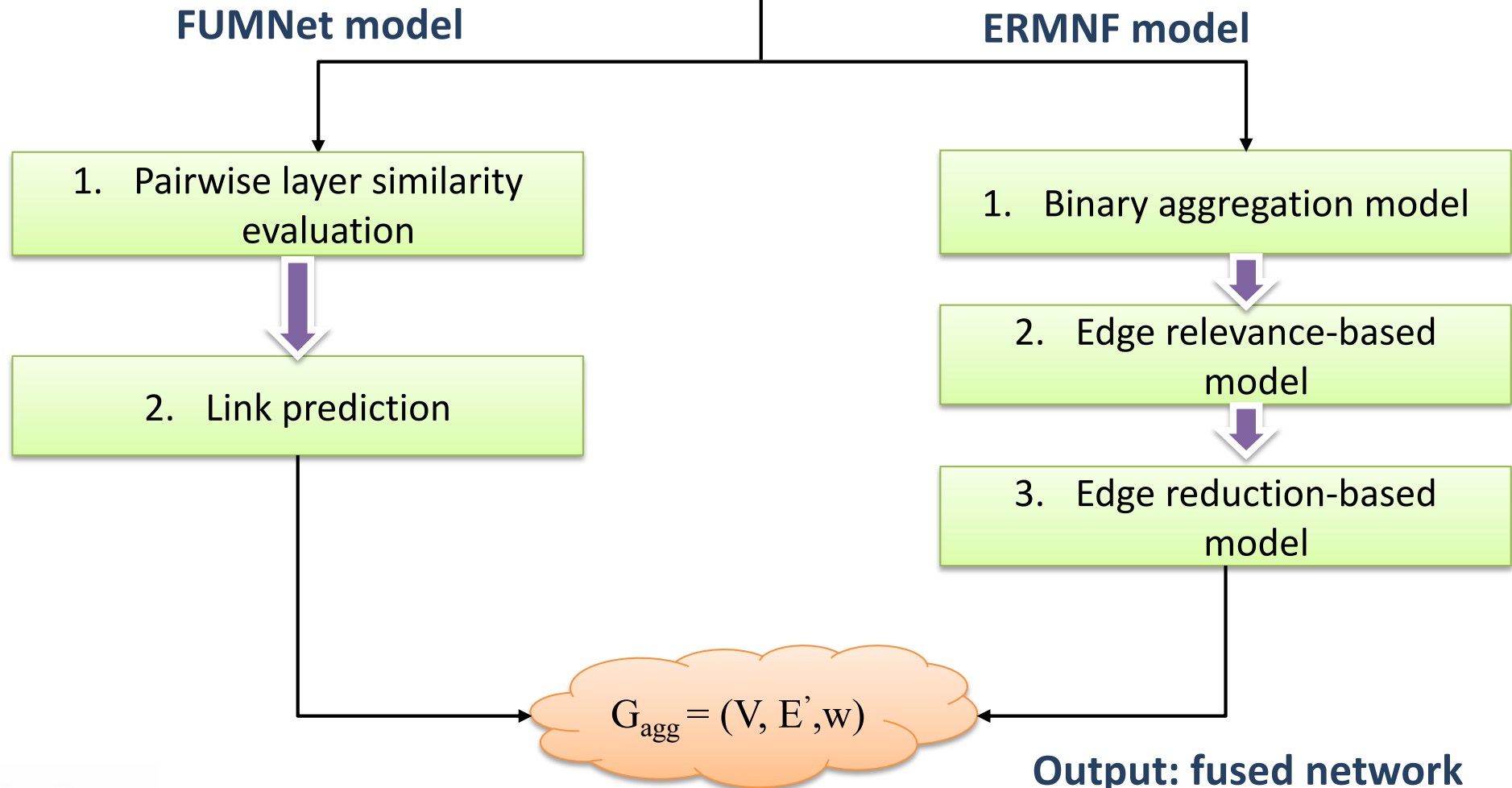
Research Activity: methodology (RQ1)

FUMNet: A Fuzzy Fusion Model of Multiplex Networks for Influence Maximization

Input: multiplex network



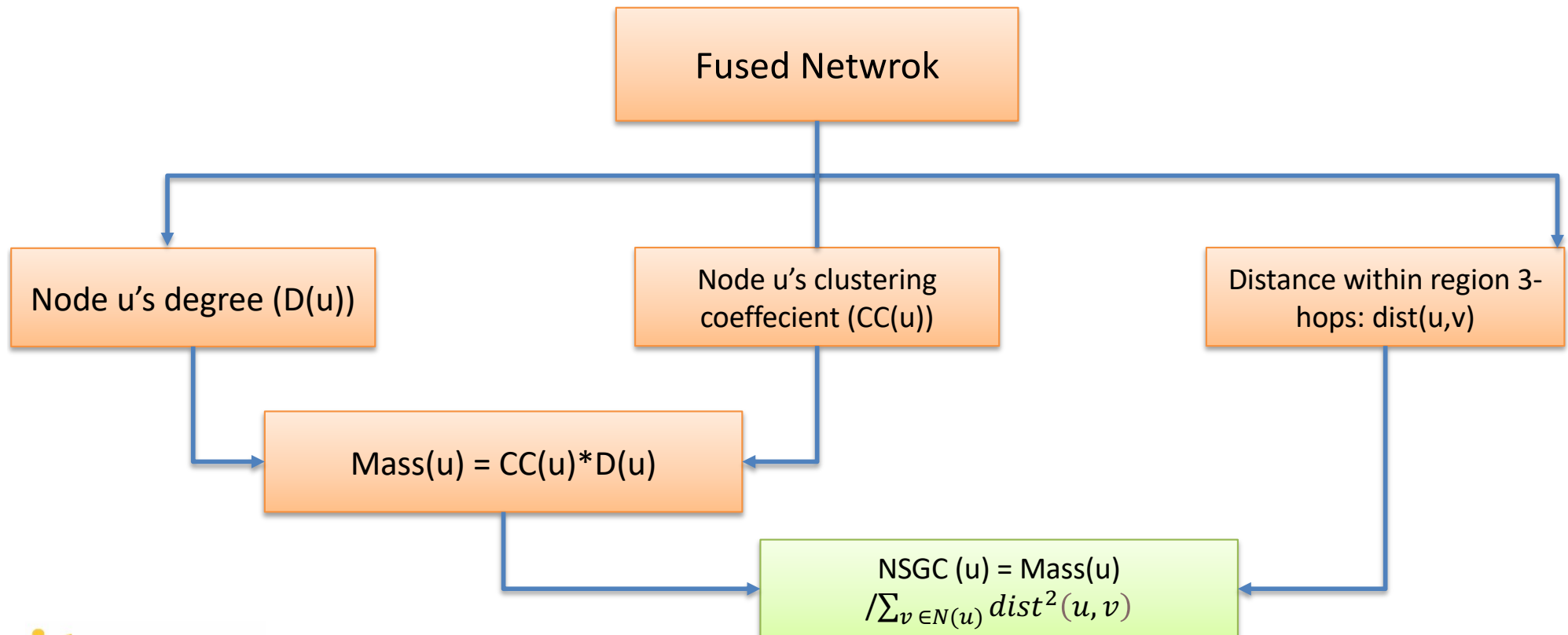
ERMNF: Edge relevance-based multiplex network fusion model for complex network analysis tasks



Research Activity: methodology (RQ2)

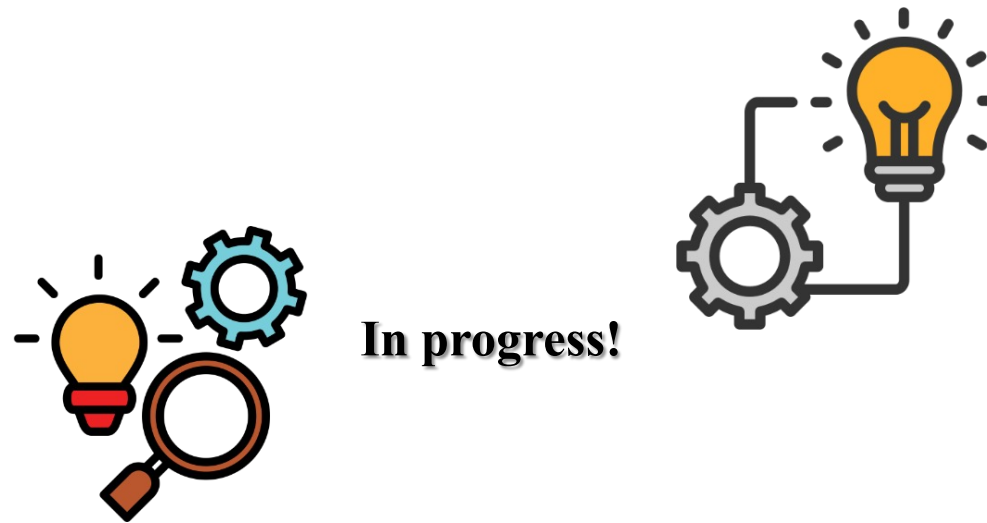
Phase 2: Network Sampling Process

Real-world social networks are large-scale networks, often exceeding billions of nodes. Consequently, handling these networks—and in our case, working with multiple networks—poses significant challenges and can be time-inefficient. To address this issue, we present a node sampling-based model, denoted as NSGC (Node Sampling-based Gravity Centrality), which operates as follows:



Research Activity: methodology (RQ3)

Phase 3: Dynamic influential nodes detection



Summary of study activities

- Ad hoc PhD courses
 - Strategic Orientation for STEM Research & Writing at ITEE department
 - Research methodology @ EDSI, University of Sousse.
- Training course in English language @ EDSI, university of Sousse.
- Participating in:
 - ✓ Seminar 1: On the Single Allocation hub location problems: New Formulations and Solving Methods; (0.2)
 - ✓ Seminar 2: Using support vector machines for feature selection and outlier detection; (0.2)
 - ✓ Workshop: Awareness workshop against plagiarism @EDSI
 - ✓ Masterclass: **Deep Learning with Bayesian Principles** @EDSI
- Research and study on influence maximization in multilayer networks (particularly focusing on multiplex networks, which are a special case of multilayer networks and challenges posing by their multilayer structure)

Products

[P1]	Influential nodes detection in multiplex social networks: A comprehensive study	Under review at KAIS Journal
[P2]	A theoretical review on multiplex influence maximization models: Theories, methods, challenges, and future directions	Revised decision at ESWA Journal
[P3]	FUMNet: A Fuzzy Fusion Model of Multiplex Networks for Influence Maximization	Under review at IEEE TCSS Journal
[p4]	Edge relevance-based multiplex network fusion model for complex network analysis tasks	Submitted at CNs Journal
[C1]	Reducing the Size of Large-Scale Multiplex Social Networks: A Parallel Node Sampling Model using SPARK paradigm	In progress

KAIS: Knowledge and Information Systems Journal

ESWA: Expert Systems with applications Journal

IEEE TCSS: IEEE Transactions on Computational Social Systems Journal

CNs: Computer networks Journal

Thanks for the attention!

