

# WS22-23: Seminar Social Network Analysis

## Review report for the paper "A k-shell decomposition method for weighted networks"

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### I. SUMMARY OF THE PAPER

The paper presents an innovative method called "weighted k-shell decomposition" designed to overcome the limitations of the traditional unweighted k-shell decomposition method when applied to weighted networks. Edges in weighted networks have associated weights, representing the strength or intensity of the connections between nodes. The authors argue that these weights play a vital role in understanding the structure and dynamics of complex networks and should be incorporated into the analysis.

To address this, the authors develop a new algorithm for weighted k-shell decomposition, providing a comprehensive explanation of its implementation. They perform a comparative analysis between weighted and unweighted k-shell decomposition methods, showcasing the benefits of accounting for edge weights when studying complex networks.

In addition, the authors demonstrate the practical application of their weighted k-shell decomposition method on real-world networks:

- Corporate Ownership Network (CON)
- The collaboration network of scientist working in network science (SCIE)
- The neural network of the nematode *C. elegans* (CEL)
- The US air transportation network (AIR)

This serves to highlight the method's usefulness and relevance in various scientific disciplines.

The paper explores the complex aspects of shell placement and the potential for spreading within networks, providing valuable information on network behavior and susceptibility to disruption. By incorporating the edge weights into the analysis, the authors contribute a more accurate and powerful tool for understanding the structure and dynamics of weighted networks, which are prevalent in numerous scientific fields.

### II. POSITIVE ASPECTS

We can highlight multiple positive aspects for the paper:

- Important problem
- Novelty of the approach
- Application for real-world networks

### III. NEGATIVE ASPECTS

At the same time several important points were not mentioned in the paper:

- Comparison to existing methods
- Computational complexity
- Bad presentation of empirical results

### IV. EVALUATION OF RELATED WORK

First of all the main novelty of the paper is the weighted k-shell approach including parameters and edges normalization. The authors provide a sufficient discussion of related work on k-shell decomposition and weighted network analysis. However, the paper would benefit from a more detailed comparison with state-of-the-art methods for identifying influential nodes in weighted networks, such as eigenvector centrality, PageRank, or HITS. Additionally, the authors should consider citing more recent works on the topic to provide a more comprehensive view of the current state of the field.

### V. DETAILED EVALUATION

First of all let's discuss positive aspects of the paper.

#### A. Important problem

The paper addresses an important problem in network analysis, specifically the identification and quantification of influential nodes in weighted networks. The proposed method can have significant applications in various domains such as social networks, transportation networks, and biological networks.

#### B. Novelty of the approach

The authors introduce a novel algorithm that extends the traditional k-shell decomposition technique by incorporating edge weights into the analysis. This approach allows for a more accurate representation of the network and improves the identification of influential nodes.

#### C. Application for real-world networks

The empirical evaluation of the proposed method on real-world networks is thorough and provides strong evidence for the effectiveness and robustness of the k-shell decomposition method for weighted networks.

Let us now highlight the negative aspects of the topic.

#### D. Comparison to existing methods

The paper would benefit from a more comprehensive comparison with other state-of-the-art approaches for analyzing weighted networks such as eigenvector centrality, PageRank, or HITS. By including a wider range of techniques in their evaluation, the authors could better demonstrate the advantages of their proposed method.

### *E. Computational complexity*

The authors should also provide a clearer discussion of the computational complexity of their proposed algorithm. This information would help readers understand the scalability and applicability of the method to large networks.

### *F. Bad presentation of empirical results*

Lastly, the presentation of the results could be improved. The authors include several network visualizations and tables, but it is sometimes difficult to discern the key findings and comparisons between different methods. The authors should consider reorganizing the presentation of their results to make it more clear for readers.

## VI. REPRODUCIBILITY

The paper provides sufficient approach explanation to reproduce results. The authors clearly describe the algorithm, and the data sets used in the evaluation are publicly available. But at the same time the authors should consider providing a reference implementation of the algorithm to further support reproducibility.

## VII. EDITORIAL REMARKS

To check potential errors in grammar, the LanguageTool [1] was used. It is a "multilingual grammar, style, and spell checker" that offers a document checker feature compatible with .docx files. To facilitate this process, I converted the PDF to a .docx format. Upon examination, the tool confirmed that the paper is well-prepared from an editorial standpoint.

## VIII. STANDARD OF WRITING

The writing in the text is of a high quality. The author successfully conveys the fundamental concepts in the introduction, and maintains an intuitive and easily understandable writing style, including the choice of vocabulary, throughout the following chapters.

## IX. OVERALL JUDGMENT

I recommend a weak accept (1) for this paper. The proposed method is innovative and shows promising results, applied for the real-world networks, but the paper does not have the comparison with the state-of-the-art and no computation complexity.

## X. STATEMENT OF CONFIDENCE

I estimate a medium level of confidence in my review. While I am not familiar with the subject but my assessments are reasonable.

## REFERENCES

- [1] *LanguageTool*, <https://languagetool.org/>, Accessed: 2022-03-15.