Report on the doctoral dissertation

Name of Student: Šárka Zehnalová
Dissertation Title: ASQ: Local Properties of Social Networks
Supervisor: Prof. Václav Snášel

Reviewer: Prof. Mária Bieliková
Institution: Slovak University of Technology in Bratislava

The results of the work:

Submitted dissertation falls into the area of a highly relevant and active research topic of social networks analysis. Social networks are just one example of broader context in which the networks can be considered as complex systems represented as graphs that provide a useful model for studying various processes, including biological, technological and social networks.

The thesis focuses mainly on investigating local characteristics of social networks and application of local methods on large datasets. The author introduces novel local measures for node importance, which can be used for many purposes, e.g. for ranking of nodes or for community detection for large networks. She presents also other analyses all have in common large graphs as objects of the analysis.

Main outcome of the dissertation is a proposal of two novel local measures for node importance. Based on this the author provided several experiments with large real datasets and enhanced it by further work in network analysis. The results were published at the international level – 2 papers in journals with impact factor, 11 papers in international conference proceedings mostly published by IEEE, ACM or Springer with 9 conference papers with the author of this thesis as the first author. The publication outcome is well above standard.

Dissertation structure:

The dissertation is organized mostly as a collection of several topics that reproduce previously published work co-authored by the dissertation author. It consists of Introduction (containing also a description of topics of research) followed by a short chapter on theoretical background, five chapters devoted to particular research topics, which present main part of the dissertation, and Conclusion.

The author presents aims of the dissertation indirectly (I would expect it in the introduction). However, in the description of research topics, it is clear what is focus of the research. Conclusions include a description of main contributions, which are well related to the research topics described in the introduction.
The dissertation structure copies the research topics – local dependency, local representativeness, co-authorship network model and experiments, email networks analysis. The structure is influenced by published work of the author as she based every chapter in the main part of the dissertation (from chapter 3 to 7) to the published work unambiguously (every publication has one chapter where it is presented) and used parts of text of published work, which she authored (except chapter 6, which seams unpublished yet). This results in related work and discussion presented locally in each chapter.

This approach is all right, but I would expect then more extensive introduction and conclusion with a discussion on big picture of the dissertation and also some reflections on the focused area in context of further research and development (instead of just two sentences in the conclusions chapter). Moreover, in some cases this approach leads to a sequence of sections, which are not well motivated (such as section 3.7, which is important, but reading the dissertation sequentially the motivation for this section is not clear in the moment of its appearance, or section 3.9, which is an application of dependency defined in previous sections, but as this is not motivated at the beginning, the reader does not know why this section is here).

I would expect more discussion also in particular chapters, e.g. section 4.5.1 presents in detail methodology and procedures used, results achieved, but only minimal discussion extended beyond the particular topic is provided, section 4.7 titled discussion in fact presents mostly summary of the chapter 4.

**Language, graphic and formatting level:**

In overall, the dissertation is well written and readable including its graphic level too. The author properly arguments and discusses alternatives and limitations. The language level is fine. There are only small formatting issues such as non-referenced table 4.13 or a reference on p. 55 to table 6.2 presented on p. 94.

**Question for defense:**

- The dissertation investigates several characteristics of large networks, modelling and experimenting with large networks. What is the dissertation author’s vision on this field, and how machine learning can influence progress of research in this field?
- In which situations is graph reduction applicable and what is suitable log base for particular cases? What is effect of the log base change?

**Conclusions:**

The dissertation gives research contributions to large-scale network representation and visualization in active and important research area. As the most important research contributions I consider

- proposal of local dependency measure that is designed to reflect non-symmetrical relationship of nodes, which was proven to be effectively used for the ranking of nodes or for the transformation of an originally unweighted network to a weighted network
• proposal of local representativeness measure that is designed to find the representatives, i.e. objects which due to being nearest neighbors of most of the nodes in their surrounding may serve as a substitute to them; it was proven to help in reducing data using local information only or transferring vector data to networks useful for e.g. data visualization in a natural way.

The main contributions are complemented by further experimental research work in field of networks analysis, which was realized in two domains, namely real large-scale co-authorship networks and email communication in small teams.

The author used suitable research methodology. The results are well accepted internationally by community. I appreciate publication activity of the author.

In summary, Šárka Zehnalová proved particular knowledge and eligibility to creative research work already accepted by international community. The results achieved present a contribution into the research field in accordance with the evaluation above. Without doubt Šárka provided contributions which are worthy of a PhD degree, even though their presentation in the dissertation could be improved. So I can state that Šárka Zehnalová in her doctoral dissertation has demonstrated the ability to work independently and creatively in the specified field.

The dissertation meets the standard requirements imposed on a doctoral dissertation in the specified field.

I recommend accepting the dissertation as fully satisfactory to the degree of Doctor of Philosophy.