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Jury Member Report – Doctor of Philosophy thesis.

Name of Candidate: Viktoriia Chekalina

PhD Program: Computational and Data Science and Engineering

Title of Thesis: Computationally efficient Natural Language Processing methods using tensor representations

Supervisor: Associate Professor Alexander Panchenko

Name of the Reviewer: Steffen Eger

I confirm the absence of any conflict of interest (Alternatively, Reviewer can formulate a possible conflict)	**Date: 15-08-2023**

The purpose of this report is to obtain an independent review from the members of PhD defense Jury before the thesis defense. The members of PhD defense Jury are asked to submit signed copy of the report at least 30 days prior the thesis defense. The Reviewers are asked to bring a copy of the completed report to the thesis defense and to discuss the contents of each report with each other before the thesis defense.

If the reviewers have any queries about the thesis which they wish to raise in advance, please contact the Chair of the Jury.

Reviewer's Report

Reviewers report should contain the following items:

- Brief evaluation of the thesis quality and overall structure of the dissertation.
- The relevance of the topic of dissertation work to its actual content
- The relevance of the methods used in the dissertation
- The scientific significance of the results obtained and their compliance with the international level and current state of the art
- The relevance of the obtained results to applications (if applicable)
- The quality of publications

The summary of issues to be addressed before/during the thesis defense

The thesis of Viktoriia Chekalina is about computationally efficient tensor representations. In the age of transformers, with billions of parameters, having efficient methods is highly desirable, so this thesis is without any doubts very timely. The thesis consists of seven chapters. An introduction and background chapter (Chapters 1 + 2) give background on relevant techniques such as matrix and tensor decompositions as well as knowledge graphs. Chapter 3 discusses MEKER, a method for efficient knowledge graph embedding using the CPD approach. This chapter relates to a student research workshop paper published at ACL 2022. Chapters 4+5 discuss efficient SVD and TTM representations of fully-connected layers and an efficient GPT-2 model building on this. The corresponding paper is currently under review. Chapter 6 focuses on question answering using TTM decomposition, which is partly based on a systems demonstration paper published at EACL 2021. Chapter 7 is then discussing transformer-based encoder compression with a paper currently under review, too.

This reviewer is absolutely no expert for tensor decompositions (in fact it is the first time I read about them) but finds the approaches quite interesting and the thesis objectives of exploring these techniques for the area of NLP quite laudable.

At the same time, I see several limitations in the current presentation of results which could be fixed to demonstrate more rigor on part of the thesis author: first, there are several typos or ungrammatical statements (such as “intriduced”, “it losses the possibility”, “presiesely”, “The matrix ia reshaped”, “Than axis are permute”, “Now cores store store only”), which in an age of Grammarly and GPT could have been much better addressed. Second, the approaches are sometimes quite technical, with a stronger focus on mathematical exposition, at the neglect of explaining certain concepts to the reader. For example, as far as I can see, the concept of knowledge graph embedding is not explained in Chapter 3 at all and neither is it explained in the background chapters preceding it. As a consequence, I ended up reading this background material from Wikipedia. Third, while I appreciate the mathematical nature of the thesis, I must observe that the math is often presented in a way typical of engineers, i.e., with a lot of unexplained symbols whose meaning must be inferred out of context and sometimes using matlab notation. Fourth, when I look at the evaluation part, I wonder whether all comparisons are rigorous. To take chapter 5 as an example, I notice that Table 5.2 compares five models, Table 5.3 compares four models and Table 5.4 three models. As this is unexplained, it leaves the impression on the reader that baselines are removed in order to present more convincing results? While this may not be true, an explanation should be given. Finally, some of the chapters are also presented in a way that clearly prioritizes mathematical modeling and results presentation over a wider discussion of competitor techniques and implications of the results.

The quality of publications is decent but not excellent. For example, there is one accepted system demonstration paper, one student research workshop paper (listed as A* publication venue; while I agree that ACL is an A* venue, I am not sure if this applies to the SRW subvenue) and three CLEF papers (a conference that I am not familiar with, but the thesis indicates that it is neither A*, A or B quality). Two papers are only submitted as of now.

I want to point out a final fun fact: as far as I can see, there is only one chapter that starts with a quote, namely, chapter 6. The quote is by the thesis author herself. The quote looks quite strange to me (usually, quotes are of a philosophical nature). I also sincerely doubt the veracity of the quote: for example, I cannot imagine who would want a “pipeline based on neural network linguistic models” to make decisions for them. :-))

Finally, page 47 takes about “due to space constraints”, but as far as I can see, the thesis has no space constraints. This must be an artefact of verbatim copying from the corresponding conference

submission.
Provisional Recommendation
☒ *I recommend that the candidate should defend the thesis by means of a formal thesis defense*
☐ *I recommend that the candidate should defend the thesis by means of a formal thesis defense only after appropriate changes would be introduced in candidate's thesis according to the recommendations of the present report*
☐ *The thesis is not acceptable and I recommend that the candidate be exempt from the formal thesis defense*