

Jury Member Report – Doctor of Philosophy thesis.

Name of Candidate: Valentin Khrulkov

PhD Program: Computational and Data Science and Engineering

Title of Thesis: Geometrical methods in machine learning and tensor analysis

Supervisor: Professor Ivan Oseledets, Skoltech

Name of the Reviewer: Artem Babenko

I confirm the absence of any conflict of interest	Signature: <i>Artem Babenko</i> Date: 08-10-2020
---	--

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 presented thesis written by Mr. Valentin Khruikov is based on a series of papers. It has an introduction section, a paper overview section, and is followed by a series of chapters with each chapter being a separate paper. These papers were all published on top machine learning and computer vision venues, as well as in a well-known SIAM Journal on Matrix Analysis and Applications; some of them were additionally recognized by a long talk at a conference (ICML 2018) or a spotlight presentation (CVPR 2018). The strict review process in these venues and these honors are strong indications of the high quality of these works, which I as well readily confirm.

The common line in these papers is the application of various geometrical ideas to the field of machine learning: these ideas include measuring topological properties of generated manifolds in the field of generative modeling, understanding the theoretical properties of neural networks, designing a novel optimization algorithm via the geometry of matrix manifolds, and utilization of hyperbolic geometry to build efficient low-dimensional representations of visual data. These papers made a significant impact on the community as confirmed by the citation counts. All the (more practically oriented) papers are supported by relevant codes to simplify their implementation (<https://github.com/KhrulkovV>); in the papers, all the results are benchmarked against state-of-the-art results. This is particularly important in modern machine learning where the reproduction of results lies in the heart of its development and demonstrates the affinity of the Ph.D. candidate to the open and fair research.

Critical comments:

I only have a minor critical comment. While being of high quality, this thesis differs from classical ones in its structure. A thesis written in a form of a coherent story may be more accessible to the readers since papers written in a form of scientific research usually assume knowledge of the topic by a reader. However, I am fine with it as the research questions are clearly stated and addressed, as well as supported by the literature review. Short reviews of the areas provided in the introduction are also helpful.

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