# THESIS REVIEWER'S REPORT

## I. IDENTIFICATION DATA

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| **Thesis title:** | Generative Models for High Energy Physics Measurements |
| **Author's name:** | Lukáš Viceník |
| **Type of thesis :** | master |
| **Faculty/Institute:** | Faculty of Electrical Engineering (FEE) |
| **Department:** | Department of Cybernetics |
| **Thesis reviewer:** | Jan Kybic |
| **Reviewer's department:** | Department of Cybernetics |

## II. EVALUATION OF INDIVIDUAL CRITERIA

**Assignment**                                        **challenging**

*How demanding was the assigned project?*

The student used complex but  previously known techniques to generate synthetic data, which was then used to train a classifier for a high energy physics experiment.

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**Fulfilment of assignment**                            **fulfilled**

*How well does the thesis fulfil the assigned task? Have the primary goals been achieved? Which assigned tasks have been incompletely covered, and which parts of the thesis are overextended? Justify your answer.*

Yes, the goals were mostly achieved, although the new methods turned out to perform worse and the experiments seem to lack uncertainty and significance analyses.

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**Methodology**                                      **correct**

*Comment on the correctness of the approach and/or the solution methods.*

Yes, the methods were chosen well.

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**Technical level**                                  **A - excellent.**

*Is the thesis technically sound? How well did the student employ expertise in the field of his/her field of study? Does the student explain clearly what he/she has done?*

It seems that the student has a very good command of the deep learning and other machine learning technologies, although, it is not clear, how much of the work (implementation as well as the technical analysis) the student  had to do himself and which part he could reuse. The source code provided contains almost no comments and attributions. The experimental evaluation seems does not offer any comparison with alternative methods. It also does not evaluate the statistical significance of the reported differences. The more advanced methods finally failed to outperform the more classical methods and it is not clear why.

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**Formal and language level, scope of thesis**             **C - good.**

*Are formalisms and notations used properly? Is the thesis organized in a logical way? Is the thesis sufficiently extensive? Is the thesis well-presented? Is the language clear and understandable? Is the English satisfactory?*

The methods are sometimes not sufficiently described and are not sufficiently clear or precise (e.g. XGBoost), important steps are skipped, symbols are not defined and equations are not fully correct.  Sometimes inappropriate words are used, which is confusing (e.g. entaglement, calling choice or definition an "assumption", calling true positive a "building block"). The structure of the text could also be improved, for example a chapter called "Augmentation" talks about autoencoders and low-dimensional embedding. There is not enough information to allow somebody to repeat the experiments. There are minor English errors (e,g, "loos" instead of "loss", "can not" instead of "cannot", "metrices" instead of "metrics" or "measures").

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**Selection of sources, citation correctness**           **B - very good.**

*Does the thesis make adequate reference to earlier work on the topic? Was the selection of sources adequate? Is the*

| *student's original work clearly distinguished from earlier work in the field? Do the bibliographic citations meet the standards?* |
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| The choice of the references is good but references should be given to the primary archival source (e.g. conferences or journals) and not only to arXiv and web. |

| **Additional commentary and evaluation (optional)** |
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| *Comment on the overall quality of the thesis, its novelty and its impact on the field, its strengths and weaknesses, the utility of the solution that is presented, the theoretical/formal level, the student's skillfulness, etc.* |
| I appreciate the student choosing to work with such advanced tools. |

### III. OVERALL EVALUATION, QUESTIONS FOR THE PRESENTATION AND DEFENSE OF THE THESIS, SUGGESTED GRADE

*Summarize your opinion on the thesis and explain your final grading. Pose questions that should be answered during the presentation and defense of the student's work.*

The student successfully fulfilled the assignment. The results are not always conclusive, the text is sometimes hard to read and student's contribution is not always clearly identified.

The grade that I award for the thesis is B - very good.

**Questions for the defense:**

- In what sense is the result provided by the $Z_1$ definition most reliable (page 49)?
- Section 8.2: why does the generation start to be memory demanding for a large number of samples? What needs to be remembered? Are the generated samples not discarded?
- Are the differences, e.g. in Table 8.5 and others, statistically significant?

Date: **31.5.2024**                    Signature: