CTU
CZECH TECHNICAL UNIVERSITY IN PRAGUE

THESIS REVIEWER'S REPORT

I. IDENTIFICATION DATA

Thesis title:	**Methods for group anomaly detection**
Author's name:	**Bc. Štěpán Šubík**
Type of thesis :	master
Faculty/Institute:	Faculty of Electrical Engineering (FEE)
Department:	Department of Computer Science
Thesis reviewer:	Ing. Martin Grill, Ph.D.
Reviewer's department:	Resistant AI s.r.o.

II. EVALUATION OF INDIVIDUAL CRITERIA

Assignment **challenging**

How demanding was the assigned project?

The research assignment is ambitious as well as relevant. Multiple instance (bag or group based) learning is currently very popular research topic especially in the fields of computer/network security, video processing or medical image processing. Applying multiple instance learning approaches for anomaly detection is a challenging problem that has high number of potential applications across different fields.

Fulfilment of assignment **fulfilled with major objections**

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.

The thesis evaluates combination three cardinality distribution models with two feature density models. But the comparison with any other existing method, as stated in the assignment, is missing which does not allow for proper evaluation of the contribution of the proposed work to the field.

Methodology **partially applicable**

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

The proposed method of detecting anomalies using the combination of density estimators and proposed ranking function is theoretically sound, but the evaluation of the approach has several flaws. Many of the datasets used in the experiment section are not suitable for anomaly detection task as they have high number of anomalies, in some cases (e.g. Mut1) even higher number of anomalies than normal observations. Therefore, it might happen that the principle will treat the anomalies as normal observations. Additionally, in many cases the total number of samples is so low that the application of GMM or autoencoders for learning the probability will not be robust.

Technical level **D - satisfactory.**

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?

The presented approach uses standard algorithms for estimating the probability density: GMM and Autoencoder together with proposed ranking function. Student proved his full understanding of these methods by describing them in detail in the thesis. On the other hand, the experimental evaluation is questionable. A lot of the experimental details are missing leading to doubts about the achieved results and the experimental evaluation discussion is weak without any strong claims about the effectiveness of the proposed solution.

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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 thesis is written in English containing several typos that do not affect its overall intelligibility. A lot of attention is given to derive or introduce some of the basic concepts like Gaussian distribution, GMM, expectation maximization or autoencoders and lot less space is given to the more important parts like the novel ranking function, experimental settings or the final evaluation.

Selection of sources, citation correctness **E - sufficient.**
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?
The review of related work is extremely brief with only couple of other methods described in a single paragraph. The expectation for a master thesis is to have comprehensive review of state-of-the-art works containing more detailed description of the methods accompanied with possible advantages or disadvantages against the proposed method. In some parts of the work it is hard to distinguish the student's original work from the referenced work and identify the novelty of the proposed approach.

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 proposes a method for detecting anomalies within grouped data using combination of a probability density estimator and a ranking function. A lot of attention is paid to describe the GMM and Autoencoders estimators and less space is left for the more important ranking function reasoning and the final evaluation. The evaluation seems to be done on an inappropriate dataset lacking more detailed explanation of the experimental settings and settings of both the autoencoder and GMM estimators. There is no comparison with any existing method which makes the assessment the effectiveness of the proposed method impossible.

Questions:

- *How were the datasets split into training and testing?*
- *How did the empirical distributions of cardinality for the individual datasets look like? Does the discrepancy between modeled and empirical distribution explain the poor performance of some of the cardinality distributions?*

The grade that I award for the thesis is **D - satisfactory.**

Date: **2.6.2022** Signature: