Report on a Bachelor Thesis

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Thesis title:	Analysing data from two-layer Timepix3 detector
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Study program:	Computer Science
Specialization:	Computer Science with specialisation in Artificial Intelligence
Review author:	Ing. Pavel Koupil, Ph.D.
Position:	Reviewer
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Review text:

The aim of the thesis was to design and implement a system for processing data from Timepix3 two-layer detectors. The result was to be a system consisting of two parts. The first part was to be a user application with a graphical interface for filtering and analyzing coincidence events on the two-layer detectors. The second part was to be an extensible library of scripts and functions that can batch process entire data sets with selected parameters to determine the composition of the detected particle stream, with an emphasis on the detection of neutrons with different energies.

To the whole work	**better**	**average**	**worse**	**not suitable**
Difficulty of the assignment	■	☐	☐	☐
Completion of the assignment	■	☐	☐	☐
Scope of the work	■	☐	☐	☐

The text part of the thesis consists of an introduction, six chapters, a conclusion and appendices. In the introduction, the motivation is mentioned, however, I did not find an elaborated list of objectives. I would recommend to list a few main objectives right in the introduction and to discuss them very briefly in order to reflect on their achievement in the conclusion.

Chapter 1 provides an introduction to elementary particle detectors, including the particle detectors that preceded Timepix3.

Chapter 2 clarifies how the datasets obtained from the detector are structured, and explains the use of the ROOT framework and cluster design.

Chapter 3 discusses related work adequately.

Chapter 4 actually completes the introduction. This text should have been included in the introduction.

Chapter 5 discusses in great detail the design options for the project, including the various constraints that had to be addressed. All the essentials are covered in the text, however I would have appreciated at least some diagram representing the high level architecture of the implementation and a diagram representing the workflow, which would have made the text easier to navigate.

Chapter 6 outlines the goals and utilization of machine learning in the application and explains the results of its usage.

The conclusion begins with the words "The goals that were intended to be fulfilled by this application are all completed". As I have already mentioned, I would have liked to have seen these objectives clearly stated in the introduction and a statement on the fulfilment of these objectives in the conclusion. However, the conclusion contains a summary of the benefits and a brief future work (hence adequate).

Although this is an implementation work, the conventional programming documentation is missing in the text. However, this is not a disadvantage at all, as all aspects of the work and alternative solutions are described and illustrated in a very detailed and readable way.

User documentation is included in the appendix. The documentation implicitly assumes

knowledge of the C++ environment and the installed libraries. In addition, the documentation is not suitable for less advanced users. I would recommend creating a script that guides the user through the installation of each library and project setup. Using Docker or another suitable alternative would also greatly simplify deployment.

The text of the thesis is written in very readable English. The text is well connected and very well structured into individual sections. My only objection would be that the text is written in the first person singular (I will). I would recommend writing the thesis in the plural (We will), even though there is only one author.

The typesetting is of a good level. However, I would appreciate vector graphics in the case of graphs and visualizations where it makes sense.

Text part of the thesis	**better**	**average**	**worse**	**not suitable**
Formal arrangement	■	□	□	□
Text structure	□	■	□	□
Analysis	□	■	□	□
Programmer documentation	□	■	□	□
User documentation	□	■	□	□

The technical design documentation is not part of the submitted thesis, but the discussion of implementation in Chapter 5 replaces it adequately.

The source code is very well structured and contains documentation. However, I have not found unit or integration tests and therefore it is not possible to assess the stability of the implementation.

The commit history suggests that the student has been working on the implementation continuously and independently.

I would also comment that the `.DS_Store` file is part of the repository. I would recommend using `.gitignore` so that private configurations and similar files are not pushed to the central repository.

Implementation part of the thesis	**better**	**average**	**worse**	**not suitable**
Design quality	☐	■	☐	☐
Implementation quality	■	☐	☐	☐
Implementation stability	☐	☐	☐	☐

The bachelor thesis (both the text part and the implementation) is very well done. The scope is more than adequate. The text part describes the implementation very well and together with the source code documentation partially replaces the missing programming documentation. The only thing completely missing are unit and/or integration tests, which could be used to more competently verify the stability of the implementation. Nevertheless, I consider the thesis assignment fulfilled.

I recommend the thesis for defense.

I suggest to not consider the thesis for the annual award.

19 June 2024

Signature: