



Supervisor's statement of a final thesis

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Student: Bc. Martin Vatrť
Thesis title: Performance Optimisation of tH(bb) Signal and Background Separation Using Machine Learning
Branch / specialization: Knowledge Engineering
Created on: 24 May 2023

Evaluation criteria

1. Fulfillment of the assignment

- [1] assignment fulfilled
- [2] assignment fulfilled with minor objections
- [3] assignment fulfilled with major objections
- [4] assignment not fulfilled

All items of the assignment have been fulfilled. In particular, also the bonus item regarding the systematic uncertainty analysis was completed using adequate assumptions for simplification.

2. Main written part 90 / 100 (A)

The presented research fulfils a high standard in content and scope. Results are correct and sufficient cross-checks for consistency were performed. The flow of the thesis structure is natural and comprehensible to the reader. Notations are used correctly and the typographic and language fulfils a publishable standard, Relevant sources are properly cited. The citations are complete and in accordance with usual practice. Software and other copyrighted works have been used in accordance with their license terms.

3. Non-written part, attachments 95 / 100 (A)

The overall quality of the created software is high. Complex code from the ATLAS collaboration has been mastered, both for the data storage, and data analysis. Particular mentioned deserves the integration of the created analysis code into the ATLAS collaboration system which creates the "analysis ntuples". This allows the outcome of the project to be used in the future for new productions of the datasets towards a publication.

4. Evaluation of results, publication outputs and awards

90/100 (A)

Results of the thesis are very competitive and extend previous sensitivity in the search for a Higgs boson produced in association with a single top quark. As a standard practice the analysis is performed on simulated data, and it only applied to the recorded data once the analysis is frozen and with official ATLAS collaboration approval. Therefore, the current analysis is "blinded" which means the recorded data is not used in displays where the signal to background ration is above a certain threshold. Finalising the analysis would require the complete inclusion of the systematic uncertainties. A major step towards this has also been made by including the analysis code in the group ntuple production code. Overall, the results are a valuable addition to previous analyses and extended the sensitivity.

5. Activity of the student

- ▶ [1] excellent activity
- [2] very good activity
- [3] average activity
- [4] weaker, but still sufficient activity
- [5] insufficient activity

The student has been very active throughout his thesis project. Because of some paid-work commitment, there were some time periods where the student was less active, also it was clear he always made the best effort. Overall, he has been very dedicated to his project, and showed excellent activity.

6. Self-reliance of the student

- [1] excellent self-reliance
- ▶ [2] very good self-reliance
- [3] average self-reliance
- [4] weaker, but still sufficient self-reliance
- [5] insufficient self-reliance

The student has been very good in self-reliance. He pushed himself to the maximum to finish assigned tasks, however, his time-management was often too tight, and he could profit in the future by better planning for himself to following more closely suggested time-lines.

The overall evaluation

90/100 (A)

Result are excellent, this sensitivity has never been achieved before. The complex software structure was perfectly used, and the technical aspects in the deployment were beyond expectations. The systematic uncertainty inclusion was a great achievement for a Master thesis, and the results are convincing. The student presented his results in several meetings of the ATLAS working group and the analysis passed their scrutiny. Excellent and fully adequate has been his communication with the international team members. He presented his results with the agreement of the ATLAS collaboration at the Germany Physical Society meeting in the student session in Dresden in March 2023.

Instructions

Fulfillment of the assignment

Assess whether the submitted FT defines the objectives sufficiently and in line with the assignment; whether the objectives are formulated correctly and fulfilled sufficiently. In the comment, specify the points of the assignment that have not been met, assess the severity, impact, and, if appropriate, also the cause of the deficiencies. If the assignment differs substantially from the standards for the FT or if the student has developed the FT beyond the assignment, describe the way it got reflected on the quality of the assignment's fulfilment and the way it affected your final evaluation.

Main written part

Evaluate whether the extent of the FT is adequate to its content and scope: are all the parts of the FT contentful and necessary? Next, consider whether the submitted FT is actually correct – are there factual errors or inaccuracies?

Evaluate the logical structure of the FT, the thematic flow between chapters and whether the text is comprehensible to the reader. Assess whether the formal notations in the FT are used correctly. Assess the typographic and language aspects of the FT, follow the Dean's Directive No. 52/2021, Art. 3.

Evaluate whether the relevant sources are properly used, quoted and cited. Verify that all quotes are properly distinguished from the results achieved in the FT, thus, that the citation ethics has not been violated and that the citations are complete and in accordance with citation practices and standards. Finally, evaluate whether the software and other copyrighted works have been used in accordance with their license terms.

Non-written part, attachments

Depending on the nature of the FT, comment on the non-written part of the thesis. For example: SW work – the overall quality of the program. Is the technology used (from the development to deployment) suitable and adequate? HW – functional sample. Evaluate the technology and tools used. Research and experimental work – repeatability of the experiment.

Evaluation of results, publication outputs and awards

Depending on the nature of the thesis, estimate whether the thesis results could be deployed in practice; alternatively, evaluate whether the results of the FT extend the already published/known results or whether they bring in completely new findings.

Activity of the student

From your experience with the course of the work on the thesis and its outcome, review the student's activity while working on the thesis, his/her punctuality when meeting the deadlines and whether he/she consulted you as he/she went along and also, whether he/she was well prepared for these consultations.

Self-reliance of the student

From your experience with the course of the work on the thesis and its outcome, assess the student's ability to develop independent creative work.

The overall evaluation

Summarize which of the aspects of the FT affected your grading process the most. The overall grade does not need to be an arithmetic mean (or other value) calculated from the evaluation in the previous criteria. Generally, a well-fulfilled assignment is assessed by grade A.