

I. IDENTIFICATION DATA

Thesis title:	Optimization of the ttH Selection Including Systematics Using Machine Learning with ATLAS Data
Author's name:	Vladyslav Yazykov
Type of thesis :	master
Faculty/Institute:	Faculty of Electrical Engineering (FEE)
Department:	Cybernetics
Thesis reviewer:	Doc. Dr. André Sopczak
Reviewer's department:	IEAP CTU in Prague

II. EVALUATION OF INDIVIDUAL CRITERIA

Assignment	challenging
<i>How demanding was the assigned project?</i>	
The project has been challenging as it required to get familiar with the specific computing environment of the CERN ATLAS collaboration and the ATLAS data storage structure using dedicated ntuples. A major software package to use was TRExFitter, which allowed the numerical evaluations of the results in a standard format. The Machine Learning challenge was the handling for large data sets. Although filters were already applied, there were about 8 million data sets for background and 800k data sets for the signal were used. A particular challenge for a Master thesis project was the inclusion of systematic uncertainties.	

Fulfilment of assignment	fulfilled
<i>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.</i>	
All aspects of the project assignment were fulfilled. Several models of ML were tested and evaluated. A major technical task was the evaluation of the systematic uncertainties, resulting from the experimental uncertainties on the features for the ML input. This evaluation was performed in a novel way using the network output without modifying the large (2.6 TB) data set of systematic ntuples.	

Activity and independence when creating final thesis	A - excellent.
<i>Assess whether the student had a positive approach, whether the time limits were met, whether the conception was regularly consulted and whether the student was well prepared for the consultations. Assess the student's ability to work independently.</i>	
The time limits were met very well by the student. The student has been very pro-active, and making excellent suggestions to advance the analysis. His preparations for the regular consultations were very good. He has demonstrated a very high ability to work independently. He has been very efficient in programming and made very good suggestions for solving problems.	

Technical level	A - excellent.
<i>Is the thesis technically sound? How well did the student employ expertise in his/her field of study? Does the student explain clearly what he/she has done?</i>	
The chosen techniques were correctly applied and results cross-checked. The thesis explained very well his expertise. Technical aspects are described clearly and concisely.	

Formal level and language level, scope of thesis	A - excellent.
<i>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?</i>	
The environment of particle physics introduced a manifold of new expressions and definitions. These have been explained as required. The organization of the thesis is done in a logical way. The language is clear and to the point. His English was already very good in the first draft which I received.	

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?

Analyses in the ATLAS collaboration are typically long-term, over several years, therefore, it is particularly important to give adequate references to earlier work in the field of research and to explain the novelties beyond the existing works. This has been done. The selection of the sources is adequate and the citations meet the standard.

Additional commentary and evaluation (optional)

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.

The overall quality of the thesis is excellent, the results are sound and advance the field. The including of systematic uncertainties and the application of the training without preselection to increase the sensitivity are novelties. The student is a very good communicator and problem solver with very good academic research skills. He also gave presentations about his research in dedicated CERN working group meetings, and presented his study already in the student section of the German Physical Society meeting in Dresden, March 2023.

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.

The thesis fullfills all goals of the project. The student's independent research and skillfulness in programming and developing solution to arising problem are strong point. His presentation skills and interactions in the international environment of CERN were full appropriate.

The grade that I award for the thesis is **A - excellent**.

Date: **21.8.2023**

Signature: