

I. IDENTIFICATION DATA

Thesis title:	Machine Learning for the Leptoquark Search Using CERN ATLAS Data
Author's name:	Lukáš Viceník
Type of thesis :	bachelor
Faculty/Institute:	Faculty of Electrical Engineering (FEE)
Department:	Cybernetics and Robotics
Thesis reviewer:	André Sopczak
Reviewer's department:	Institute of Experimental and Applied Physics

II. EVALUATION OF INDIVIDUAL CRITERIA

Assignment	challenging
<i>How demanding was the assigned project?</i>	
This project has been very challenging, as it required to get familiar also with the specific software used in the ATLAS experiment at CERN, namely root and trexfitter. The machine learning development was also challenging, because the mass of the signal is unknown and thus a range of possible signatures had to be investigated.	

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>	
The goals of the thesis were achieved very well. All tasks have been covered. In addition to the expectation, a mass determination was added, which is a valuable surplus.	

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 performance was excellent in terms of the research work done. He kept all deadlines, provided more than weekly reports and asked relevant questions which were well prepared. He showed much ability to work independently.	

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 thesis is clearly written and the student showed very good expertise in the machine learning aspects, he also worked efficiently with new tools used in the CERN/ATLAS computing environment.	

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 formalism is very well followed and the thesis is very extensive. The student chose a very detailed substructure for his thesis organization. The English language is very good.	

Selection of sources, citation correctness	B - very good.
<i>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?</i>	
The references to earlier works are adequate. Sources are cited adequately. The student's work is clearly distinguishable. The bibliographic citations meet the standards.	

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 thesis project has demonstrated different machine learning approaches to the problem of separating signal and background for the reaction under study. The student presented his thesis results in a CERN meeting and it was well received. The thesis demonstrated that there is potential for further analysis in this research channel. Lukáš has been very able and skillfull in analysis software development for scientific research.

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 work met all expectations of the assigned project, in addition the mass reconstructed determination study was added. Lukáš worked very independently and make continuously progress. He mastered the software challenges in the CERN/ATLAS environment. He developed software soundly, which is documented and can be used further.

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

Minor comments/questions:

1)

Figure 8.11, in the legend, it should be a red line, not a red box.

2)

How are the yellow and green uncertainty bands defined and calculated?

Date: **30.5.2022**