

Supervisor's Report for PhD Thesis Defense by Martin Plajner on Adaptive Testing Using Bayesian Networks

Martin Plajner's thesis addresses the problem of Computerized Adaptive Testing (CAT) with Bayesian networks used as a model of the tested person. The classical test theory has been studied already for more than a half of century starting with the works of George Rasch and Frederic M. Lord with the Item Response Theory as the main paradigm of psychometrics. Much later, Bayesian networks were introduced into psychometrics as a model that is able to capture better the interplay of different skills required to solve the tests correctly. During his PhD study Martin Plajner managed to extend the use of Bayesian networks in CAT in several direction.

The initial experiments with real data and the problems Martin Plajner had to solve during the implementation of the proposed approach based on Bayesian networks provided a good motivation for new theoretical developments. The main result is the development of gradient based learning of Bayesian network parameters from data constraint by monotonicity conditions. This algorithm Martin Plajner implemented in the programming language R, tested on real data and compared with other methods applicable to the same problem. Martin Plajner's method was superior to other methods, especially in case of limited size of learning data. He also studied different methods for question (item) selection and performed experimental comparisons.

Martin Plajner has shown very good programming skills as he implemented an extensive library of functions for CAT with Bayesian networks in the programming language R. He prepared and performed several experiments on real data that required careful preparation of their collection (in the case of the first test set) and negotiations with organizers of the nationwide mathematics graduation exam to get access to the whole dataset from two years.

To mention also a weak point, sometimes, his presentation of proposed methods was not precise enough so that it could be hard for some readers to understand the details. The presentation could be organized more clearly. However, always, he patiently revised the texts which lead to improvements of the presentation. The cooperation with Martin Plajner was always smooth and pleasant.

Martin Plajner was able to publish his results in several peer reviewed conference proceedings which are considered of high quality in the machine learning community. He

also published a paper in the International Journal of General Systems, which is a journal indexed in the Web of Science.

I would like to conclude by stating that I consider Martin Plajner's thesis to be of a high quality, the achieved results are interesting for the scientific community and his work was already cited in research papers of other authors. It should be possible to prepare at least one additional journal paper based on the results achieved during his PhD research. His research also opened new research questions that can be studied by Martin Plajner or other researchers in future.

I recommend the thesis for the defense.

In Světlice, September 22, 2020

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