Exploring the Applications of Neural Networks in the Adaptive Learning Environment

Authors : Baladitya Swaika, Rahul Khatry

Abstract : Computer Adaptive Tests (CATs) is one of the most efficient ways for testing the cognitive abilities of students. CATs are based on Item Response Theory (IRT) which is based on item selection and ability estimation using statistical methods of maximum information selection/selection from posterior and maximum-likelihood (ML)/maximum a posteriori (MAP) estimators respectively. This study aims at combining both classical and Bayesian approaches to IRT to create a dataset which is then fed to a neural network which automates the process of ability estimation and then comparing it to traditional CAT models designed using IRT. This study uses python as the base coding language, pymc for statistical modelling of the IRT and scikit-learn for neural network implementations. On creation of the model and on comparison, it is found that the Neural Network based model performs 7-10% worse than the IRT model for score estimations. Although performing poorly, compared to the IRT model, the neural network model can be beneficially used in back-ends for reducing time complexity as the IRT model would have to re-calculate the ability every-time it gets a request whereas the prediction from a neural network could be done in a single step for an existing trained Regressor. This study also proposes a new kind of framework whereby the neural network model could be used to incorporate feature sets, other than the normal IRT feature set and use a neural network's capacity of learning unknown functions to give rise to better CAT models. Categorical features like test type, etc. could be learnt and incorporated in IRT functions with the help of techniques like logistic regression and can be used to learn functions and expressed as models which may not be trivial to be expressed via equations. This kind of a framework, when implemented would be highly advantageous in psychometrics and cognitive assessments. This study gives a brief overview as to how neural networks can be used in adaptive testing, not only by reducing time-complexity but also by being able to incorporate newer and better datasets which would eventually lead to higher quality testing.

Keywords : computer adaptive tests, item response theory, machine learning, neural networks
Conference Title : ICAIDM 2018 : International Conference on Artificial Intelligence and Data Mining
Conference Location : Mumbai, India
Conference Dates : February 22-23, 2018