

Improving Deep Knowledge Tracing: pre-training and encoder-decoder architecture

—Towards analyzation of hidden vector representation —

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e-Learning is the future of personalized learning. In major e-learning platforms such as intelligent tutoring systems (ITSs) and massive open online courses (MOOCs), the students are often recommended what course materials to take based on their past interactions. Using the big data collected on the systems to improve the recommendation algorithms is essential to make these e-learning systems better.

Knowledge Tracing (KT) is the task of modeling students' academic abilities. Given a sequence of student's learning history, it models to predict how well they will perform in the next interaction. Bayesian Knowledge Tracing (BKT) tackles this task with a model that is easy to interpret. However it requires human professionals to tune its parameters. Deep Knowledge Tracing (DKT) does not require professionals for tuning parameters. It uses a recurrent neural network (RNN) to capture the underlying structure of the student's understandings. The model parameter is hard to explain but archives higher accuracy.

In this paper, we point out the *accuracy ratio* problems that the model won't reproduce the accuracy ratio. Given a sequence of dummy all-correct data, it occasionally gives lower prediction than when given all-wrong data.

To measure the accuracy ratio, we introduced the Knowledge State Vector loss, which can also be used to train the model to better represent the accuracy rate.

Also, we proposed a novel encoder-decoder deep knowledge tracing model (EDDKT). It is a sequence to sequence model with two long short term memory networks (LSTM). When training with this model, it seems to obtain better generalized hidden representation and reaches better scores. This model can be turned into generative model, which opens up wider possibilities of real world usage.

Finally, we proposed to use pre-train technique. This simple yet powerful method solves the accuracy ratio problem pretty well, and brings the model to better accuracy.

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