Towards Learning Feedback in Intelligent Tutoring Systems by Clustering Spaces of Student Solutions

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Abstract

Since about 1990, intelligent tutoring systems (ITS) have been getting more and more popular. Designing an ITS usually requires precise models of the underlying domain as well as of how a human tutor would respond to student mistakes. As such, the applicability of ITSs is typically restricted to well-defined domains where such formalization is possible, and large scale applications where development costs do not play a significant role. For ill-defined domains, human tutors still by far outperform the performance of ITSs, or the latter are not applicable at all. This poster proposes a novel ITS approach which extends the applicability of ITS systems to ill-defined domains by means of machine learning techniques which can autonomously infer structures and feedback options from given data (e.g., student solutions). The proposed approach uses prototype-based methods and recent developments for general non-vectorial data structures, extended in a way that they allow to simultaneously structure solution spaces, learn metrics for structures, align student solutions with clusters of other solutions, and infer appropriate feedback based thereon. The adaptation mechanisms are designed to work in fully unsupervised scenarios or settings with only partial feedback to take into account the requirements for ITSs in ill-defined domains where an automated assessment of student solutions is rarely possible. A first validation of the approach was conducted using a dataset from the domain of programming. The results show that clusters of structurally similar solutions could be detected, and that an automated provision of student feedback based on this clustering seems feasible.