The approach to student queries classification for adaptive computer teaching SQL

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Abstract:
Analysis of existing computer tutor systems for teaching SQL is performed. The research task is connected with development of the approach to student SQL-queries classification, which combines merits of different systems and eliminates their demerits. This approach is described. It combines absence of alpha and beta errors with rules which can be very useful for delivery of hints and help to the students. Also every student can discover his own solution of the task including SQL-queries which are better than known to system ones.

1 Introduction

Recently IT-specialties became in great demand. Quality of such specialists preparation directly influences on quality (including reliability) of various IT-systems which services are used by millions people daily. At the same time traditional teaching “One teacher, many students” even in the presence of very good teacher possesses an essential lack. This is principled impossibility to adapt for each student [1]. Since 1960th researchers all over the world develop various intelligent and adaptive computer tutor systems (CTS). Nevertheless a comprehensive solution of perfect computer teacher creation is still unachieved. This article is devoted to development of adaptive CTS for acquisition of skills to compose SQL queries, that is one of the most common and important requirement to modern IT-specialist.

2 Analysis of existing developments

The most known system for teaching SQL is SQL-Tutor developed at the University of Canterbury, New Zealand under the guidance of A. Mitrovic [2, 3]. Each task in it consists of data model and the task statement. A student writes SQL-queries filling in the forms. After submitting the query SQL-Tutor analyzes it, finds errors and gives set of help information levels. A student can choose required level. After getting help and correcting the query a student can submit it again. For analysis of student queries SQL-Tutor includes set of constraints as the knowledge base. Each constraint consists of relevance and satisfaction conditions. At first all relevance conditions are matched against the student solution. Then the satisfaction conditions of constraints whose relevance conditions match the student solution are matched. If a satisfaction condition matches the solution, the constraint is satisfied, and SQL-Tutor doesn’t do anything.
Otherwise the constraint is violated. So the student model includes all violated constraints. In our opinion main drawback of this development is possibility of alpha and beta errors (see also [4]). Thus some right student solutions apprehend as wrong though may be better than known to system, some wrong student solution apprehend as right. The alternative approach implemented in the form of bug-rules is described in [5]. 37 classes of the most widespread semantic SQL-errors made by students are presented. For detection of these errors classes the computer system sqllint was developed. The obvious drawback is the absence of errors classes set completeness.

There are also another known systems such as eSQL [6] for queries processing conception teaching, AsseSQL [7], SQLator [8], SQL-EX.RU [9] for student queries examination and assessment, SQLify [10] for enhanced automatic assessment of student achievements and peer reviews. Though there is no a system that can satisfy all modern requirements to adaptive computer teacher.

3 Task statement

To develop the approach to student SQL-queries classification, which combines merits of different approaches and eliminates their demerits.

4 Gist of the approach

The stages of the approach are presented in the Fig. 1 and the graphical classification scheme is presented in fig.2. Consider it in detail.

Task generation  Writing a query as a text  Reading a query  Lexical analysis of a query  Reduction a query to a canonical form  Semantic analysis and classification of a query

Fig. 1. The stages of the approach

After new task generation student receives the verbal statement of the task and the database scheme for it. Then he writes SQL-query as a text. System performs reading, lexical analysis and reduction the query to the canonical form. The canonical form of the query means uppercase of all symbols and filling the sections SELECT, FROM, WHERE and others by lexicographically ordered tuples of parameters including replace of aliases if necessary. Further system compares student query with etalon queries. Every etalon query is characterized by set of quality parameters connected with performance and memory capacity. Thus we can consider as optimal as nonoptimal queries. If student solution coincides with etalon one then the task is solved in the best way. Else if there is nonoptimal query then system can either insist on writing optimum or
satisfy by good-enough solution. Decision making should be based on the student model. If student solution is unknown to the system then it is necessary to check query whether it violates any rule in knowledge base. Every rule is connected with the component of competence and if it is violated then the student doesn’t have this competence. So system should teach the student to do it. If the query coincides with all rules then system performs testing it with the aid of different datasets. Such approach is undertaken also in [9]. After that we can suppose that student solution is correct. Final decision should be made by human-teacher. Also if such decision is made and it is positive then system can add new query and its parameters to the list of etalon queries.

5 Conclusions and future work

Now software for this approach is being implemented. But the advantages of it are obvious. It combines absence of alpha and beta errors with rules which can be very useful for delivery of hints and help to the students. Also every student can discover his own solution of the task including SQL-queries which are better than known to system ones.

References:


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