Basic Research Problems:

The Problem of Selecting an Approach Based on Prior Success*

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Abstract. This article is the twenty-sixth of a series of articles discussing various open research problems in automated reasoning. The problem proposed for research asks one to find criteria for choosing from among previously answered questions a question that dictates the approach to take for attacking the problem of current interest. Especially because the better automated reasoning programs often offer a wide range of choices for representation, inference rule, and strategy, a solution to the proposed problem would materially reduce the difficulty of using these powerful aids for research.

Key words. Automated reasoning, choice of approach, unsolved research problem.

Question: *When a particular question is being attacked, what criteria can be used for wisely choosing a previously answered question to dictate the approach to be used on the current question?*

(This question is the thirty-second of 33 problems proposed for research in [3] and will be referred to as Research Problem 32 throughout this article. All references to sections, chapters, test problems, and such also refer to [3].)

Researchers in mathematics and in other fields, when presented with some specific new question, frequently use (if possible) the technique that was employed to answer some earlier question that seems sufficiently 'similar'. For example, if presented with some new theorem to prove in group theory, a mathematician might attempt to prove that theorem by imitating the style of proof that was successfully used to prove a different but related theorem. In particular, the decision might be to use generators and relations because the theorem under consideration brings to mind an earlier study in which the use of generators and relations proved successful. Instead, the decision might be to employ an obvious case analysis—like that used in proving that subgroups of index 2 are normal by considering the case in which the possibly offending element is in the subgroup and the case in which it is not—because of some property of the new study that is shared by the study of subgroups of index 2. (The index 2 problem is discussed as Test Problem 1 in Section 6.1.1 of [3].)

We can quickly give evidence, taken from experiments with an existing automated reasoning program, of the value of trying to answer some new question by selecting an approach that was used to successfully answer an earlier question. When we succeeded in answering various open questions in finite semigroups [2] with the assistance of the automated reasoning program AURA [1], we chose to employ generators and relations because of earlier experiences in algebra. When we answered various open questions in equivalential calculus [6] with that same program, we based our approach on our initial success in that field—specifically, by using schemata with the goal of classifying all deducible theorems.

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Research Problem 32 asks for criteria for selecting the appropriate 'similar' question when confronted with a new question to answer with the assistance of an automated reasoning program. For example, when we began our study of many-valued sentential calculus, to guide our attack, we continually looked to similar problems from equivalential calculus [4].

If Research Problem 32 were solved, the corresponding selection mechanism could then be used to enable one to choose the representation, inference rule(s), and strategies to be employed. In particular, the question designated as similar could be used to guide one's choice for both the weights [3, 5] and the set of support [3, 5] to be used.

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