

POSITION PAPER

DATA ABSTRACTION, DATA BASES AND CONCEPTUAL MODELLING

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There is no paper with a mathematical foundation that I know of that strikes more at the heart of the subject of this Workshop than that of R.M. Burstall and J.A. Goguen [10], presented at the Fifth International Joint Conference on Artificial Intelligence in August of 1977. The following is from the conclusion of that paper.

The main point of this paper is that it *is possible* to specify complex tasks provided that we do not try to write the specifications in an unstructured way. Our particular language proposal is only important in bringing into focus the problem of devising structured descriptions of specifications and suggesting the kind of operations which should be used to build them up. The basic ideas developed for data abstraction in programming languages should guide us in this task, and we firmly believe that the mathematical ideas about the category of theories can help us to grasp the rather deep concepts involved.

Many with whom I have talked over the past two and a half years have been very impressed (as I have been) with Burstall and Goguen's work; few have understood the mathematics behind that paper. This is not surprising; the authors have just published a mathematical semantics for their specification language, CLEAR, [11], and there are indeed "rather deep concepts involved."

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Together with others of the ADJ group, I have been involved in using algebraic theories for semantics of programming ([1], [2], [5], [7]) and in using algebras for semantics of data abstraction ([3], [4], [6], [8], [9]) along the lines first suggested by Guttag [12] and by Zilles [14]. The ADJ work most closely related to that of Burstall and Goguen is [8] and [9], where parameterized data types are seen as functors between appropriate categories of algebras and the mathematics of actual parameter passing is considered. It is not easy, and similar conceptual difficulties can be found in the semantics of procedures in CLEAR [11]; procedures correspond to parameterized types.

The major problem for those of us working on the algebraic approach to specification and modelling is that of developing, refining and finally simplifying the algebra so that we can better explain the mathematics to others. There is much development and refinement to be done. The operations for building structured descriptions, to which Burstall and Goguen referred in the quotation above will be central to that development. We should work to understand the precise relationship between the theory oriented Burstall-Goguen approach represented by [11] and the algebra oriented ADJ approach represented by [9]. Correctness in the hierarchical design (a problem which is tackled in [9]) must be considered in a specification strategy like that suggested by CLEAR. We should also investigate the possibility that in the representation of dynamic systems, the iterative theories of Elgot [13] or rational theories of ADJ [1] may play a role.

It is crucial that this algebraic work be done in a continued and intensified atmosphere of cooperation between those involved in the practical and in the theoretical aspects of data abstraction, data bases and conceptual modelling. Without that cooperation both sides stand to lose, either from the lack of valid motivation or from the lack of the guidance and insight that a well developed theory can provide.

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