

Wile, David S.;

Program Developments: Formal Explanations of Implementation;  
Communications of the ACM 26,11 (November 1983) pp. 902-911.

This paper is concerned with the implementation of a very high-level specification through the use of correctness-preserving transformations. In order to make re-implementation of a modified specification fast and reliable, a formal document called the program development is constructed. A language has been developed to capture and explain the development and the resulting implementation.

A program development is a document explaining the implementation of a specification for subsequent use by maintainers. The language in which the development is written should allow motivations and design decisions made in the original implementation to be clearly explained. To do this, it must allow the structuring of goals and explanations into goals with subordinate goals, and the relating of goals at the same conceptual level to one another. In addition, the language should be capable of expressing all program manipulations necessary for optimization, as well as plans for optimization and detailed optimizations.

The language designed, called Paddle, provides facilities for definition and refinement of program transformations. A transformation is a goal represented as a command with parameters: its subgoals are enclosed in a begin-end pair. Each of the subgoals is further refined, as indicated by the reserved word "by". It is also possible to choose from a set of alternative subgoals enclosed by the choose from - end pair. In addition, the first of - end pair indicates a conditional structure in which the first goal to succeed is the one chosen.

Paddle implements an abstract machine which takes a specification and transforms it to a program through the effect of expressions in the language. It is executed as a programming language at all times.

The process of designing the implementation and its explanation usually consist of five stages; focusing on a program segment, finding an implementation strategy, getting the program into "condition" to allow application of the strategy, applying the strategy, and simplifying the resulting program. The Paddle language is used in the last three stages. When the original specification is modified, the development coded in Paddle can be replayed to obtain a new implementation.

Although the purpose of Paddle is the representation of the program transformation process, it is a high-level programming language in the sense that it allows goals and subgoals to be expressed. It is conceivable that such languages may be used to specify the goals presented in the specification directly, rather than the goals of program transformations to be applied to the specification. The goal structures that have been included in the language should still be appropriate for this purpose.