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Funtional Programming Languages in Education

First International Symposium, FPLE '95
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Proceedings

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Preface

This volume contains the papers accepted for presentation at the first international symposium on *Functional Programming Languages in Education*, held near Nijmegen, The Netherlands, December 4–6, 1995. These proceedings represent current trends in using functional languages to support computer science education. Functional languages are to be understood here in a broad sense; lazy and strict functional languages, languages with a powerful functional subset, and algebraic specification formalisms.

Functional languages are increasingly used for teaching in a number of important areas such as algorithms and data structures, compiler construction, computer architecture, computer graphics, mathematics, problem solving, and the semantics of programming languages. Experience gained in these areas is represented in this volume.

Functional languages are gathering momentum in education because they facilitate the expression of concepts and structures at a high level of abstraction. This makes it possible to cover more ground than when using a more traditional approach to teaching. This claim is substantiated by many of the authors who have contributed to this volume.

The first paper is an invited paper by one of the pioneers of functional programming: Professor David Turner. His paper on strong functional programming represents an exciting avenue that should have important implications for our teaching practice.

The next four papers describe the use of functional languages at the very beginning of the curriculum. The subjects include teaching the principles of programming and problem solving (Keravnou), programming in C as a second language (Davison), an introduction to computer science for science students (Jacquot and Guyard), and data structures (Núñez et al).

The next two papers consider the use of functional programming in a more advanced context. Thompson and Hill offer a broad perspective on functional programming in undergraduate teaching of computer architecture, computer graphics and the semantics of programming languages. Jarvis et al. discuss teaching functional programming at graduate level in the context of a large research project.

The support of functional programming for teaching in areas of mathematics is explored in the next set of four papers. The papers by Karczmarczuk and Fokker discuss algebraic and other mathematical structures in connection with type and constructor classes. The use of powerful type systems offered by modern functional languages has been found to be helpful in gaining an understanding of complex mathematical structures. Karczmarczuk is critical of the facilities offered by Gofer and Haskell. Further research in this area is needed to develop even more powerful type systems.

The paper by Lester and Mintchev, and the paper by Burton address the important concepts of induction and recursion. Lester and Mintchev describe the use of a theorem prover to help students with the development of inductive

proofs; Burton offers a taxonomy of recursive structures to guide the students through a myriad of choices.

Broadly speaking the subjects of the first ten regular papers are mainly to do with programming and with mathematics. The connection with functional programming is immediate, as functional programming is intimately associated both with mathematics and with programming. Not so obvious, but very exciting, is the connection between functional programming and the subjects of the next two papers: computer architecture and databases.

O'Donnell discusses a course in circuit design and computer architecture on the basis of a functional language. Koopman and Zweije present an introduction to databases using a functional language. In both papers the high level of abstraction afforded by the use of a functional language makes it possible to discuss all levels of abstraction that are relevant to the course.

The next two papers describe the use of functional languages in compiler design. Kluge et al. describe the use of an interactive reduction system to support the teaching of abstract machine concepts and compilation. Hilsdale et al. describe the construction of a realistic compiler in a limited amount of time.

In most of the first 14 regular papers of this volume, teaching experience is discussed in some detail. However, the emphasis is generally on technical issues. The last two papers specifically look at teaching experience. Hartel et al. consider the (lack of) basic proof skills of computer science students and investigate the relation between teaching a functional language and the level of proof skills. Clack and Myers discuss in detail the sort of mistakes that students can make when they are learning functional programming. They give valuable advice to teachers on how to avoid common problems.

The papers in this volume represent the current state of the art in using functional languages in education. However, many of the courses that are described in this volume are only taught at a few institutions. There is a need for text books covering new approaches to teaching on the basis of a functional language. Several of the authors who have contributed to this volume are indeed writing new text books. The appearance of such texts will undoubtedly stimulate others to take up the new teaching methods that are being developed today.

We look forward to a period wherein these approaches are consolidated and a wider dissemination of these approaches is achieved. We also hope that functional languages may be found useful in teaching other subject areas. It is clear to us that functional languages do have their role to play in education, as do imperative, object oriented, and logic languages.

On behalf of the programme committee we thank all those who submitted papers. We thank the referees for their careful work in the reviewing and selection process. Jacqueline Parijs has done most of the local organisation, which is gratefully acknowledged.

Pieter H. Hartel, Amsterdam
Rinus Plasmeijer, Nijmegen
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