



**Advanced Functional Programming: Third
International School, AFP'98, Braga, Portugal,
September 12-19, 1998, Revised Lectures (Lecture
Notes in Computer Science)**

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In this volume you will find the lecture notes corresponding to the presentations given at the 3 summerschool on Advanced Functional Programming, held in Braga, Portugal from September 12-19, 1998.

This school was preceded by earlier ones in Bastad (1995, Sweden, LNCS 925)

and Olympia, WA (1996, USA, LNCS 1129). The goal of this series of schools is

to bring recent developments in the area of functional programming to a large group of students.

The notes are published in order to enable individuals, small

study groups, and lecturers to become acquainted with recent work in the fast

developing area of functional programming.

What made this school particularly interesting was the fact that all lectures introduced useful software, that was used by the students in the classes to get hands-

on experience with the subject taught. We urge readers of this volume to

download the latest version of this software from the Internet and try to do the

exercises from the text themselves; the proof of the program is in the typing.

The first lecture, on Sorting Morphisms, serves as a gentle introduction to the things to come.

If you have always been afraid of the word "morphism", and you

have been wondering what catamorphisms, anamorphisms, hylomorphisms, and

paramorphisms were about, this is the paper to read first; you will discover that

they are merely names for recursion patterns that occur over and over again when writing functional programs.

The algorithms in the paper are all about sorting,

and since you are likely to know those algorithms by heart already, seeing them

structured and analyzed in a novel way should serve as a motivation to read on to these second lecture.

The second lecture, on Generic Programming, is almost a book in a book.

The notes can be seen as the culminating point of the STOP-project, sponsored

by the Dutch government at the end of the 80's and the beginning of the 90's. Its

overall goal was the development of a calculational way of deriving programs. The

project has provided deeper insight into real functional programming and into

the theory behind many things commonly written by functional programmers.

One of the main achievements of the project has been to make people aware

of the fact that many algorithms can be described in a data-independent way.

The PolyP system introduced in these notes is one of the translations to the Haskell-

world of this theoretical underpinning. The third lecture, on Generic Program Transformation, can also be seen as

an application of the theory introduced in lecture two. Many efficiency-improving

program transformations can be performed in a mechanical way, and these would

not have been possible without insight into the correctness of such transformations

gained in the lecture on Generic Programming.

The fourth lecture, on Designing and Implementing Combinator Languages,

introduces an easy-to-write formalism for writing down the catamorphisms introduced in earlier chapters.

It is shown how quite complicated catamorphisms, that

at first sight seem rather forbidding by making extensive use of higher-order do-

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mains, can actually be developed in a step-wise fashion, using an attribute gr-

marview; it is further more shown how to relate this way of programming with concepts from the object-oriented world thus making clear what the strengths and weaknesses of each world are. The 7th lecture, titled Using MetaML: A Staged Programming Language, introduces the concept of partial evaluation. It serves as another instance of the quest for "the most generic of writing programs at the lowest cost". The staging techniques show how costs that were introduced by adding extra levels of abstraction, may be moved from run-time to compile-time. It has been common knowledge to users of modern functional languages that the type system can be a great help in shortening programs and reducing errors. In the extreme one might see a type as a predicate capturing the properties of any expression with that type. In the sixth lecture on Cayenne-Spiceup your Programming with Dependent Types it is shown in what direction funct

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