The use of functional languages in teaching computer science

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Abstract

This survey presents information concerning the use of functional languages (both strict and non-strict) for teaching in higher education. It lists the languages used by over 70 different institutions, the years in which the courses are given, and the recommended textbooks.

1 Introduction

This survey summarizes information concerning the use of functional languages for teaching in higher education, which was collected in response to questionnaires between April and August 1992. The data are presented, according to the institutions which responded, in three tables which show the usage of particular languages, the years of study, and recommended textbooks. The postal addresses of the institutions which responded and the electronic mail addresses of the respondents are included in the Appendix.

Responses were received from 78 institutions. Some offered information about courses using Lisp variants and/or Scheme; these have not been included, because the data collected on such courses was far from complete.

A survey similar to this was published electronically in the Internet newsgroup comp.lang.functional in January 1990. Similarities and differences between the results of the two surveys are mentioned where it seems appropriate.

2 Languages

The analysis of the particular languages used by the different institutions is shown in Table 1. The notation *a–b* used in the table denotes the institutions numbered *a* through to *b* inclusive. The final column shows the total number of institutions using each language. Some people reported that one functional language was used on several different courses at their institution (and often the particular courses varied from year to year); to simplify the collating process, only one entry has been included in the table in such cases.

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Table 1. *Particular languages used by institutions*

Language	Institutions (see Appendix)	Total
ML	51, 78	2
SML	1–36, 38, 40–44, 46, 50, 60, 69, 72, 75	48
LML	51	1
CAML	37, 45, 76, 77, 78	5
Miranda	14, 27, 32, 35, 39, 53–59, 61, 63, 65, 66, 68, 71, 73, 74	21
Orwell	28, 52	2
RUFL	47, 64	2
Gofer	32, 63, 67, 70	4
Hope	57	1
Massey Hope + C	64	1
Glide	62	1
Haskell	33, 48, 62	3
Id	49	1
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Some respondents indicated both the languages they had used in the past, and those they would be using in the future; all the languages referred to were included in the table. SML proved to be the most frequently used language, being cited in 48 out of the 92 cases (52%). This figure rises to 61% if the other ML variants are included.

The second most popular language mentioned was Miranda[1], which was reportedly used by 23% of the institutions. The languages Miranda, Orwell, RUFL, Gofer, Glide and Haskell taken together accounted for 33 of 92 instances (36%). These statistics show a considerable move towards SML since the 1990 survey, which reported only seven institutions using SML, and an equal number using Miranda (out of a total of 32 instances).

3 Year of study

The analysis of the stages at which functional programming is introduced to students by the different institutions is shown in Table 2. The actual year reported has been used in the table, despite the fact that students in different countries may be at different stages in their educational development.

Some institutions reported that students were given the choice of taking a functional language course in a number of years, in which case an entry has been included in the table for each possible year.

The table shows that 27% of the courses offered were for postgraduates, and 23% for first year undergraduates. This represents a slight shift since the 1990 survey,

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[1] Miranda is a trademark of Research Software Ltd.

Table 2. *Year at which functional programming is introduced to students*

Year of study	Institutions (see Appendix)	Total
UG1	2, 14, 17, 25, 26–31, 35, 37, 41, 44, 46, 48, 50, 53, 54, 57, 59, 60, 63, 65, 73–77	29
UG2	2, 11, 17, 19, 25, 28, 30, 32–34, 43–45, 49, 52, 55, 56, 61, 62, 68, 72	21
UG3	1, 2, 7–10, 12, 14, 16, 17, 19, 21, 24, 25, 30, 32, 35, 64, 66, 67, 69, 78	22
UG4	1, 2, 4, 9, 11, 14, 16, 17, 19, 28, 34, 47, 50, 51, 56, 64, 66, 69, 71	19
PG (MSc and PhD)	2, 6, 7, 10, 11, 13, 16–18, 21, 22, 23, 26–29, 32, 34, 36, 37, 39, 42, 47, 49–51, 57, 61, 69–71, 74, 78	33
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which reported that 30% of courses were aimed at postgraduates, and 18% at first year undergraduates.

4 Textbooks

Table 3 contains a list of the recommended textbooks, arranged alphabetically by author.

These statistics show that the most popular textbook for recommendation is Bird and Wadler, followed by Paulson, and then Wikström.

5 Summary

In the previous survey only 23 institutions reported using functional languages for teaching, compared with the 78 who responded for this survey. It is very likely that the actual use of functional languages is higher than this survey implies, due to the difficult nature of the information gathering process. However, even if this were not the case, the information summarized here indicates a substantial interest in the use of functional languages for teaching in many different parts of the world.

Acknowledgements

Table 3. *Recommended textbooks*

Textbook	Institutions (see Appendix)	Total
Abelson, H., Sussman, G. J. and Sussman, J. 1987. *Structure and Interpretation of Computer Programs*, MIT Press.	25, 39, 49	3
Appel, A. W. 1991. *Compiling with Continuations*, Cambridge University Press.	51	1
Bailey, R. 1990. *Functional Programming with Hope*, Ellis Horwood.	64	1
Bird, R. and Wadler, P. 1988. *Introduction to Functional Programming*, Prentice-Hall.	27, 28, 32, 35, 39, 47, 48, 52–57, 61–63, 65–68, 71, 73	23
Japanese edition	70	
Burge, W. H. 1975. *Recursive Programming Techniques*, Addison Wesley.	62	1
Darlington, J., Henderson, P. and Turner, D. A. (eds). 1982. *Functional Programming and its Applications: An Advanced Course*, Cambridge University Press.	62	1
Davie, A. J. T. 1992. *An Introduction to Functional Programming Systems*, Cambridge University Press.	62	1
Field, A. J. and Harrison, P. G. 1988. *Functional Programming*, Addison Wesley.	62, 64, 69	3
Friedman, D. P., and M. and Haynes, C. T. 1992. *Essentials of Programming Languages*, MIT Press and McGraw-Hill.	24	1
Hardin, T. A. and Donzeau-Gouge Viguie, V. 1992. *Concepts et Outils de Programmation*, InterEditions.	76, 77	2
Harper, R. 1986. Introduction to Standard ML, *Edinburgh University Internal Report LFCS-86-14*.	1–4, 8, 22, 27, 50	8
Harrison, R. 1989. *Abstract Data Types in Modula-2*, John Wiley.	35, 59	2
Henderson, P. 1980. *Functional Programming Application and Implementation*, Prentice-Hall.	62	1
Holyer, I. 1991. *Functional Programming with Miranda*, Pitman.	35, 54–56, 58, 74	6
MacLennan, B. J. 1990. *Functional Programming, Practice and Theory*, Addison Wesley.	64	1
Milner, R. and Tofte, M. 1991. *Commentary of Standard ML*, MIT Press.	42	1
Milner, R., Tofte, M. and Harper, R. 1990. *The Definition of Standard ML*, MIT Press.	42	1
Myers, C., Clack, C. and Poon, E. 1992. *Programming with SML*, Prentice-Hall.	34	1
Paulson, L. C. 1991. *ML for the Working Programmer*, Cambridge University Press.	1–3, 6, 14, 17, 18, 22, 24, 25, 33, 35, 38, 42, 43, 60, 75	17
Peyton Jones, S. L. 1986. *Implementation of Functional Languages*, Prentice-Hall.	69	1

Table 3. (*contd.*)

Textbook	Institutions (see Appendix)	Total
Reade, C. 1989. *Elements of Functional Programming*, Addison Wesley.	16–18, 21, 29, 50, 62, 69	8
Sethi, R. 1988. *Programming Languages: Concepts and Constructs*, Addison Wesley.	2, 4, 11, 19, 64	5
Stansifer, R. 1992. *ML Primer*, Prentice-Hall.	12, 13	2
Watt, D. A. 1990 *Programming Language Concepts and Paradigms*, Prentice-Hall.	2, 10, 18, 46	4
Wikström, Å. 1987. *Functional Programming Using Standard ML*, Prentice-Hall.	7, 10, 17, 18, 26, 27, 29, 30, 32, 33, 35, 41, 44, 46, 50, 60	16

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