

Fourth International Derive TI-89/92 Conference

Liverpool John Moores University, July 12 – 15, 2000

Constructing Mathematical Tools using MathematicaTM's Programming Language

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Overview

During the last 30 years Computer Algebra Systems (CAS) have proved to be a powerful tool in many fields of science and engineering. In mathematics education, one of the most important applications, they have been used in order to facilitate and to encourage experiments, to illustrate new mathematical content and to bring a more effective way of teaching abstract mathematical subjects. Such a system may serve as a tutor for students who need to improve their knowledge as well as a challenge for good students. The use of CAS for educational purpose can help students to learn how to deal with mathematics and can increase the certainty of their own knowledge and skills.

Software systems for distance education generally fall into two categories (Buchberger 1990).

White box systems are collections of sample-formulae and/or programs presented in source code in a certain programming language or CAS, sometimes accompanied by black box implementations or some additional functions needed by the examples. The formulae/algorithms complement a textbook by illustrating various notions from it, and are intended to be executed interactively by students. The disadvantage of these type of systems is that students have to become familiar with the programming language that is used, usually requiring some significant effort.

Black box systems are collections of executable programs/routines which implement various algorithms and data structures corresponding to notions presented in the textbook, and which can be executed using menu, input forms (for specifying parameter) etc. The produced results are then presented as numbers, table, graphics, animation, etc. The disadvantage of this type system is that only a very narrow class of problems can be implemented by each program routine, hence illustrating a textbook can become a huge task.

The aim of the workshop is to illustrate how to use: MathematicaTM as a programming language; and library functions provided by MathematicaTM in order to construct an interactive package introducing students to the study of a chosen mathematical subject. The packages can be structured as following:

- a main menu contains the main topics;
- for each topics theory, exercises, examples and help are available;
- the theory is presented in a hypertextual notebook;
- exercises are randomly generated;
- for each exercise the student has three possibilities: automatic solution, step by step solution and verification routines (we will describe them in more details later).

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The packages are constructed in such a way that the “black box” philosophy has been merged with step by step solutions to the exercises, enabling students to learn the process underlying the solutions. Moreover, the packages have been given a structure designed in order to make the final user interface as friendly as possible. Such an improvement has been obtained by the insertion of buttons and links that make it possible to use all implemented functions without prior knowledge of their syntax.