

Instructions for Using Maple Dialogues and Programs

1 Introduction

The dialogues and programs in this book have been implemented in the Maple computer algebra system.

- Dialogues are in the *Maple Worksheet* (mws) format. To access the worksheets, the Maple system must be installed on your computer.
- Maple implementations of the *mathematical pseudo-language* (MPL) procedures are in text (txt) files.

Information about the Maple software can be found at Maple's web site

<http://www.maplesoft.com>.

This document contains instructions for using the dialogues and programs. For general instructions on using the Maple system, consult the *New User's Tour* in the system's *help* menu.

In the book, dialogues and programs in the database are indicated by the word *Implementation* followed by the names of computer algebra systems. For example, the caption to Figure 2.1 on page 19 contains

Implementation: Maple (mws), Mathematica (nb), MuPAD (mnb)

which indicates that the dialogue related to Figure 2.1 is available for each of these systems. In a similar way, the caption to Figure 2.2 on page 23 contains

Implementation: Maple (txt), Mathematica (txt), MuPAD (txt)

which indicates that the MPL procedure in Figure 2.2 is available in a text (txt) format for each of these systems.

Important: Maple worksheets will work in Maple versions 6, 7, and 8 but may not be downward compatible to older versions (< 6). In addition, the form of the output of Maple operators may vary from version to version and may depend on the settings of the system. Procedures in text files will run in earlier versions of Maple as long as all the Maple operators in the procedure are available and perform as in Maple 7.

2 Location of Maple Dialogues and Programs

Files for Maple dialogues and programs are in the folder

MathematicalMethods/Programs/Maple.

This folder contains nine folders

Ch1, Ch2, Ch3, Ch4, Ch5, Ch6, Ch7, Ch8, Ch9

which contain the dialogues and programs for the nine chapters of the book.

3 File Names

The following convention is used for file names.

- Dialogues that are referenced in figures or footnotes use abbreviated names that refer to these objects (e.g., Fig3-4.mws (page 72), Foot3-1.mws (page 65)).
- Dialogues that do not correspond to figures or footnotes have a descriptive name (e.g. Maple-Function-definitions.mws) or the name of a Maple operator (e.g., ifactor.mws for Maple's `ifactor` operator that factors an integer (page 27)).
- Maple implementations of MPL procedures are in text (txt) files that have the name of the procedure. For example, the Maple procedure `Integer_gcd` that corresponds to the MPL procedure in Figure 2.2 on page 23 is in the file *Integer_gcd.txt*. Some files have more than one procedure. In this case, the file name corresponds to the main procedure.

4 Using the Dialogues and Programs

The files can be accessed directly from the CD or from a disk drive by copying the folder *MathematicalMethods* from the CD to the disk drive.

- *Worksheets.* Worksheets can be accessed directly through the Maple interface by following the folder path to the worksheet. For example, to access the Maple worksheet that corresponds to Figure 2.1 on page 19 of the book, follow the folder path

MathematicalMethods \rightarrow *Programs* \rightarrow *Maple* \rightarrow *Ch2*

The worksheet is in the file Fig2-1-integer-operators.mws.

- *Procedures in Text Files.* Procedures in text files can be viewed and modified with a text editor. Text files can be loaded into a Maple session with Maple's `read` command. For example, to load the file *Integer_gcd.txt* the command is

```
> read "c:/MathematicalMethods/Programs/Maple  
/Ch2/Integer_gcd.txt":
```

(We have assume here that the folder *MathematicalMethods* resides on the C drive in a Windows environment. For other environments, modify the path as needed.)

Important: Some of the procedures require other procedures that are either given in the book (and on the CD) or are described in the exercises. These additional procedures are listed in comments at the beginning of a procedure. For example, in Figure 1 we give the Maple implementation of the *Alg_polynomial_gcd* procedure given on page 154 of the book. The comments at the top of this procedure indicate that two other procedures are required. Notice that the statement

`requires additional procedures`

follows the *Alg_remainder* procedure. This indicates that this procedure requires additional procedures and these procedures are listed in the file for that procedure.

Although the source code for procedures that are described in the exercises and used by some procedures is not on the CD, executable versions of these procedures are available in the library file described below.

```

Alg_polynomial_gcd := proc (u,v,x,p,alpha)
#Maple implementation of Figure 4.7, page 154.
#This procedure requires the procedures

#   Alg_remainder (Figure 4.6, page 152, requires additional procedures)
#   Alg_mononic (Exercise 3, page 163)

#Input
# u,v : polynomials in  $\mathbb{Q}(\alpha)[x]$ 
# x : a symbol
# alpha : a symbol that represents an algebraic number
# p : a monic, irreducible polynomial in  $\mathbb{Q}[\alpha]$  with degree  $\geq 2$ 
#Output
# gcd(u,v)
local
    U,V,R;
U := u;
V := v;
while V <> 0 do
    R:=Alg_remainder(U,V,x,p,alpha);
    U:=V;
    V:=R;
od;
RETURN(Alg_mononic(U,x,p,alpha))
end:

```

Figure 1. The Maple implementation of the procedure *Alg_polynomial_gcd*.

5 Library Access to Procedures

Although each procedure can be accessed individually, it is often convenient to load all the procedures at one time with a Maple library module. In a Maple session, this is done with the following commands:

```
> libname:="C:\\MathematicalMethods/Programs/Maple",libname:
> with(Procedures):
> with(linalg):
```

(We have assumed here that the *MathematicalMethods* folder resides on the C drive in a *Windows* environment. For other environments, modify the path as needed.) The first command adds the folder path

MathematicalMethods/Programs/Maple

to the library search, and the second command loads the module *Procedures*. By loading this file, you have access to all procedures given in the book including those from the exercises that are used by these procedures. The third command loads Maple's linear algebra package which is used by some of the procedures in Section 15.3.

6 Catalog of Dialogues and Programs

A catalog of dialogues and programs can be accessed by loading the file

Catalog.htm

in the folder

MathematicalMethods

with a web browser. The catalog lists all the dialogues and programs including the page in the book, the file name, a brief description of the contents, and additional procedures required by a procedure. For example, the entry

Figure 1.6(a), Maple's primitive structural-operators page 9
(Fig1-6(a)-Primitive-structural-operators.mws)

describes the Maple worksheet that corresponds to Figure 1.6(a). In a similar way, the entry

```
Alg\_polynomial\_gcd, Figure 4.7 page 154 (Alg\_polynomial\_gcd.txt,  
requires the procedures  
Alg\_remainder, Figure 4.5 page 152 (requires additional procedures (see file)),  
Alg\_monic (Exercise 3, page 163))
```

describes the Maple implementation of the procedure in Figure 4.7.

All files listed in the catalog are hyperlinked, and in some environments (such as a *Windows* environment using *Internet Explorer*), clicking on the hyperlink brings up the Maple system with the worksheet or displays the text file in the browser. To view the text files with a text editor, from the *Internet Explorer* window choose the menu options

View → *Source*.

Some other browsers have similar menu options.

Important: In order to view Maple worksheets through the catalog, your browser must recognize the worksheet file extension (mws). (This happens automatically in a *Windows* environment when using *Internet Explorer*.) If your browser does not recognize the file extension, it will display the (unintelligible) source code of the worksheet. With some browsers (such as Netscape), you can set the browser to recognize the mws file extension. We have found, however, that the most reliable performance for viewing worksheets from the catalog is obtained with *Internet Explorer* in a *Windows* environment. If you are unable to view the dialogues from the catalog, you can view them using the approach described in Section 4 above.

7 E-book Access to Dialogues and Procedures

In some environments, it is possible to access the Maple worksheets and text files of procedures directly from the *E-book*. This approach is described on pages 2-3 of *Instructions for the E-book*.

8 Programming Style

We use a procedural style of programming that is easily implemented using the mathematical operators and programming structures in the

Maple programming language. Although the Maple system has over 1000 mathematical operators, we use only a small number of them (about 35). A summary of these operators and other elements of the Maple language including the correspondence to our mathematical pseudo-language (MPL) is given in the book in Chapter 1.

Our programming style and the choice of which mathematical operators to use in programs is motivated by the following goals:

- *To present the algorithms in a programming style that applies to the Maple, Mathematica, and MuPAD languages using a small number of mathematical operators from these languages.* Although, in some cases, it is possible to give a shorter or more efficient program by using a particular operator or structure in the Maple language, we have avoided doing this so that we can preserve a common programming style and minimize system dependent issues.
- *To use the Maple mathematical operator with the least computational power that performs a mathematical operation.* In many cases, there is more than one operator in the Maple language that performs a mathematical transformation, and when this happens we use the one with the least computational power.
- *To use the Maple mathematical operators that correspond most closely to the MPL operators in the book.* Since mathematical operators in computer algebra systems are quite involved and may change as new versions of a system are introduced, the correspondence between MPL operators and the Maple analogues is not exact. For this reason, tables in Chapter 1 contain the Maple operators that correspond *most closely* to the MPL versions.
- *When there is an option of using either a Maple operator or a similar operator that is described by an algorithm in the book, we use the Maple operator unless the syntax or semantics of the operator is significantly different from the pseudo-language operator.*

9 Book Web Page

For additional information including worksheet and program updates, see the web site:

<http://www.cs.du.edu/~jscohen/MathematicalMethods>