

Problems in Mathematics & Experiments with Mathematica

How to use the book

Introduction

This book is a hypermedia system written in *Mathematica*. It can be used as a conventional problem collection in Calculus with some hypermedia features. In addition, it gives the possibility to solve problem with the help of *Mathematica*, and to do experiments. Readers, who want only to understand and solve the classical problems, have only be able to navigate in a *Mathematica* document (called notebook), and have to understand some *Mathematica*-specific notations. They do not have to read the parts that concerns the technical parts about or with *Mathematica*. We recommend the printed version for them, where the *Mathematica* details are hidden. We hope that those readers who would like to do Calculus with the help of *Mathematica* will find this book really useful. They can have the advantages of the hypermedia system and the interactive problem-solving with *Mathematica*. Finally, the *Mathematica* programs developed for this book can serve good programming example, and they can be used in other applications.

The hypermedia structure of Mathematica

The *Mathematica* documents (notebooks) have hypermedia structure. A notebook itself contains hierarchically structured cells. The groups of cells are showed by brackets on the right-hand side, or a small open-close icon on the left.

Click on the open-close icon in the next line. Then click again.

PROBLEM 1.1.1

Now, click on the outer bracket on the right-hand-side of the next line.

○ SOLUTION

It is easy, isn't it? Pay attention, how the form of the outer bracket is changed.

○

Hyperlinks

The reader will find links in the notebooks pointing to other notebooks, or parts of the Mathematica help. The linked notebooks can be activated by clicking on the blue underlined text. For example:

[Inverse function](#) points to a section about inverse functions.

[Plot](#) points to the help of the Plot statement.

The structure of the book

The book consists of chapters, sections and subsections, numbered hierarchically by arabic numbers. This sectioning more or less corresponds to the *Mathematica* notebooks (see the [Table of Contents](#)).

The chapter: A short introduction to *Mathematica* can be skipped by the beginners. Each notebook contains the following main parts (we use the same style of them here):

Theory

This section briefly summarizes the theoretical basics of the considered topic.

Mathematica

Here, the *Mathematica* statements related to the given topic are described, and some special user-friendly functions are defined. These short programs are good examples for those readers who are interested in making advanced applications in *Mathematica*.

Exercises and problems

This section contains the following items.

■ *Mathematica initialization*

Run the *Mathematica* statements in this group if you want to work on the problems with *Mathematica*.

The reader finds three types of problems. Solved problems are typical sample problems and their solutions are written in details. The solutions use *Mathematica* statements. Problems should be solved by the reader. Experiments are simple *Mathematica* projects for better understand and skill. These different problems are typed in different color, but they use the same numbering system.

SOLVED PROBLEM 1.1.2

○ SOLUTION

○

PROBLEM 1.1.3

◦ SOLUTION

◦

EXPERIMENT 1.1.4

The problems can contain subproblems. The numbering of subproblems is relative to the given problem. The solution or the result of the problems are sometimes enclosed in a closed group (open the group, and you can find it). If the solution is not attached to the problem, the formulation follows the preceeding solved problem or subproblem. Run the statements in that solution for the new functions and data and you will obtain the results. See the next example.

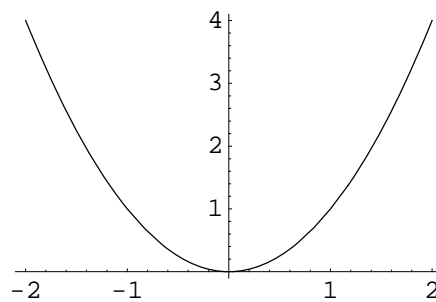
PROBLEM 1.1.5

Plot the following functions.

$$(1) \quad f(x) := x^2$$

◦ SOLUTION

```
Plot[f[x], {x, -2, 2}];
```



◦

$$(2) \quad f(x) := x^3;$$

Pay attention to this notation. This form to define a function is *Mathematica*-specific, but not embarrassing. In the above Solution group and everywhere in this book, we follow the usual *Mathematica* syntax (Standard Form, that is different from the classical) to emphasize that the result is provided by *Mathematica*. Beginners may only look at the final result.

In other cases, running the input cells in the given problem will give immediately the solution. See the following example:

PROBLEM 1.1.6

Integrate

$$(1) \quad \int x^2 dx$$

$$\frac{x^3}{3}$$

Printed version

A printed simplified version of this book is also available. It can also be used as a problem book, but the advantages interactivity and Mathematica-aid are not available.

Using the book with MathReader

The CD-ROM contains the free *MathReader* by Wolfram Research to those users who do not have Mathematica. The newest version can be downloaded from the WWW page of Wolfram Research (<http://www.wolfram.com>). MathReader enables to read the hypermedia version, view animations, but not to perform *Mathematica* input cells. Thus, using *MathReader*, this book is a hypermedia book without the possibility of computer-aided problem-solving.