

The \LaTeX Graphics Companion

Illustrating documents with \TeX and PostScript

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Abstract

This handy reference describes techniques and tricks needed to illustrate \LaTeX documents, and answers common user questions about graphics and PostScript fonts. It provides the first full description of the standard \LaTeX color and graphics packages, and shows how you can combine \TeX and PostScript capabilities to produce beautifully illustrated pages. Following the successful format of *The \LaTeX Companion*, this new book will be an invaluable \LaTeX resource for incorporating pictures into text.

Keywords: Abstract, Table of Contents, Preface, for The \LaTeX Graphics Companion

You will learn how to: Incorporate graphic files into a \LaTeX document

- Program technical diagrams using several different languages
- Produce color pictures
- Achieve special effects with fragments of embedded PostScript
- Make high-quality musical scores and games diagrams

You will find detailed descriptions of: Important packages like XYPIC, PSTricks, and METAPOST

- The standard LaTeX color and graphics packages
- PostScript fonts and how to use them in \LaTeX
- The dvips dvi to PostScript driver
- Ghostscript, the free interpreter that lets you view or print PostScript files, even if you do not have a PostScript printer

The authors examine a number of packages that extend or modify \LaTeX 's basic illustration features, and present hundreds of examples of useful solutions to graphics and font problems. In addition to pack-

ages for general drawing, the book also presents specific tools for mathematicians, physicists, chemists, engineers, and for people interested in games and music typesetting.

All the packages and programs described in this book are freely available in public software archives, and the source code for all examples has been placed on CTAN, the \TeX archives. (Details in Appendix B)

Michel Goossens is the President of the TeX Users Group (TUG) and a coauthor of *The \LaTeX Companion*. His work responsibilities have included LaTeX support for other scientists. Sebastian Rahtz is Secretary of TUG, a cofounder of the CTAN archives, and creator of the \TeX Live CD-ROM. Frank Mittelbach is Manager of the \LaTeX 3 Project, in which capacity he oversaw the release of \LaTeX 2 ϵ . He, too, is a coauthor of *The LaTeX Companion*, as well as the editor of a series of publications on *Tools and Techniques for Computer Typesetting*.

For more information about this and other books: <http://www.awl.com/cseng>

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PREFACE

In this book we describe techniques and tricks of extended \LaTeX typesetting in the area of graphics and fonts. We examine how to draw pictures with \LaTeX and how to incorporate graphics files in a \LaTeX document. We explain how to program pictures using METAFONT and METAPOST as well as how to achieve special effects with small fragments of embedded PostScript. We show how to manipulate whole \TeX pages in PostScript and how to exploit all the features of PostScript Type 1 fonts. And, of course, we also look in detail at a whole range of tools for building graphics in \TeX itself.

\TeX is the world's premiere markup-based typesetting system, and PostScript is the leading language for describing the printed page. This book describes how they can produce even more beautiful results when they work together. \TeX 's mathematical capability, its paragraph building, its hyphenation and its programmable extensibility can cooperate with the graphical flexibility and the font-handling capabilities of PostScript, to provide a rich partnership for both author and typesetter. We describe dvi-to-PostScript drivers, look at tools for manipulating PostScript files, and discuss in detail the features of the free program Ghostscript which lets you view or print PostScript files even if you do not have a PostScript printer.

This volume is not a complete consumer guide to packages. In trying to teach by example we present hundreds of examples of the most useful types of solutions based on proven and well-known implementations. But, in the space available, we cannot provide a full manual for every package. Our main aim is to show how easy it is to use a given package and whether or not it seems to do what is required, not to dwell on precise details of syntax or run options. Nevertheless, we have described in more detail a few selected tools that we consider especially important.

We assume you know some \LaTeX ; you cannot read this book by itself if you have never used \TeX before. We recommend that you start with *\LaTeX : A Document Preparation System, Second Edition* (Lamport, 1994), and continue with *The \LaTeX Companion* to explore some of the many (non-graphical) packages available.

Why \LaTeX , and why PostScript?

This book is about \LaTeX , graphics, and PostScript. We believe that the structured approach of a system

like \LaTeX is the best way to use \TeX , and \LaTeX is by far the most widely used \TeX format. This means that it attracts those developing new packages (especially since the major revision of \LaTeX in 1993), and thus some of what we describe works only in \LaTeX (this applies especially to material to do with font selection schemes). We apologize in advance for our \LaTeX bias to those who appreciate the elegance of the original plain \TeX format and its derivatives and promise them that most of the packages work well with any \TeX dialect: the delights of systems like METAPOST, PSTricks, XYPIC, and Musix \TeX are open to all.

We also want to explain why we talk about PostScript so much. This language has been established for over a decade as an extremely flexible page-description language and it remains the tool of choice for professional typesetters. Among the features that make it so attractive are:

- the quantity, quality, and flexibility of Type 1 fonts;
- the device-independence and portability of files;
- the quality of graphics and the quantity of drawing packages that generate it;
- the facilities for manipulating text;
- the mature color-printing technology;
- the encapsulation conventions that make it easy to embed PostScript graphics;
- the availability of screen-based implementations (Display PostScript and Ghostscript/GhostView).

In the last few years PostScript has spawned an enterprising child, the PDF (Portable Document Format) language used by Adobe Acrobat. Designed for screen display with hypertext features, PDF offers a new degree of portability and efficiency. While we do not cover PDF here, \LaTeX works well in producing "rich" PDF documents, and special versions of \TeX that produce PDF directly will probably be available by the time this book is published.

Again, we apologize to those of you who are disappointed not to read about \LaTeX 's association with QuickDraw, TrueType fonts, the Windows GDI, HPGL, PCL, etc, but with so many packages available, we had to make a choice.

Please note that the absence of a given package or tool in this book in no way implies that we consider it as less useful or of inferior quality. We do think, though, that we have included a representative set of tools and packages, and we sincerely hope that you will find here one or more subjects to entertain you.

How this book is arranged

This book is subdivided in two basic ways: by application area, and by technique. We suggest that all readers look at Chapter 1 before going any further, since this introduces how we think about graphics and summarizes some techniques developed in later chapters. We also suggest you read Chapter 2, which covers the LaTeX standard graphics package, since the tools for including graphics files will be needed often.

We have tried to make it possible to read each of the other chapters separately; you may prefer to go straight to the chapters that cover your subject area or look at those that describe a particular tool. Three chapters are dedicated to particular programs and packages:

3. Working with METAFONT and METAPOST shows how to exploit the power of Knuth's METAFONT language; this can work well with LaTeX and provides unparalleled expressive power for describing many types of diagrams.
4. Harnessing PostScript inside \LaTeX : the PSTricks Package describes what we think is the most powerful system to integrate LaTeX closely with the PostScript language.
5. The XYPIC Package introduces a package that goes to great lengths to define a notation for many kinds of mathematics diagrams and implements it in a generic and portable way.

Then follow three chapters that discuss problems in special application areas and survey some packages in each:

6. Applications in chemistry, physics, and engineering looks at chemical bonds, Feynman diagrams, and circuit diagrams.
7. Preparing music scores with TeX considers the powerful MusixTeX package and some of the support programs that you can use to print beautiful musical scores.
8. Playing games is for those who use LaTeX for play as well as work; we show how to typeset chess boards, annotate diagrams for bridge or other card games, or even handle backgammon and Go.

Our last three chapters address areas of general interest, mostly not related to particular LaTeX packages or subject areas:

9. The world of color provides full details about the standard LaTeX color package and also describes other packages based on it. We also look at some issues of color design and problems related to color printing.
10. Using PostScript fonts describes the ins and outs of using PostScript fonts with LaTeX, including AFM files, virtual fonts, font naming, and Multiple Master fonts.
11. PostScript drivers and tools provides a complete reference to some of the most commonly used free software packages—dvips, ghostscript, the psutils suite, and programs to convert PostScript fonts to PK format.

Finally the appendixes contain technical information that complements the above chapters. They also give the Internet location of all software described in this book and show sample sessions to help you download it in different ways.

Using, and finding, all those packages and programs

We describe many packages and options that extend or modify \LaTeX 's basic possibilities. In order to show their action, we must in principle load them all at the same time. For various reasons, however, that is impractical, if not impossible. Indeed, many packages use a lot of internal variables for which most implementations of TeX have fixed limits. In producing this book we used a different strategy (pioneered with *The \LaTeX Companion*): we ran nearly all the examples as separate jobs and included them as EPS files. In almost all cases this was entirely automated—the code printed here is exactly that used to prepare the output. To help you run the examples yourself, each piece of \LaTeX code also shows the 'usepackage' commands needed to run it.

We have put the source of the examples on CTAN (Comprehensive TeX Archive Network—see Appendix B) in the directory info/lgc. Most examples are identified by a number enclosed in a box. This means that the exact code used to create the picture is available, with the identifying number as filename. Most files are in \LaTeX source format (with an extension of ltx) but there are also plain TeX files (extension ptx), METAPOST source files (extension mp), MusixTeX preprocessor source files (extensions abc and mpp), pic files (extension pic), and m4 sources (extension m4).

All the packages and programs described in this book are freely available in public software archives; some are in the public domain, while others are protected by copyright. Some programs are only available in source form or work only on certain computer platforms, and you should be prepared for a certain amount of “getting your hands dirty” in some cases. We also cannot guarantee that later versions of packages or programs will give results identical to those in our book. Many of them are under active development, and new or changed versions appear several times a year; we completed this book at the end of 1996, and tested the examples with the versions current at that time.

In Appendix B are given full details on how to access CTAN sites and how to download files using the Internet. You can also purchase a CD-ROM from the TeX Users Group containing implementations of TeX for various systems and many packages and fonts. This CD-ROM contains all the packages described in this book and *The LaTeX Companion*.

Acknowledgments

This book has two sources. First, it descends from a survey by Sebastian Rahtz of TeX and graphics originally prepared for the TeX eter conference in 1988, revised many times and distributed as a technical report in 1989 by Southampton University Computer Science Department, and from Rahtz’ ongoing support and documentation for using PostScript fonts in \LaTeX . Second, it descends from material that Michel Goossens, Frank Mittelbach, and Alexander Samarin could not include in *The LaTeX Companion*. It became clear, long before that book was finished, that it could not do full justice to graphics and PostScript and that another book (at least) would be needed. This book was conceived, born, and brought up at CERN, arising from text-processing support for this great laboratory by Michel Goossens, assisted in 1993–1994 by Sebastian Rahtz.

We have many people to thank. Our primary debt, of course, is to the authors of the programs and packages we describe. Every author whom we contacted to discuss problems provided us with practical help in the spirit of the TeX community, and often gave us permission to reuse examples from their documentation.

Christel Mittelbach substantially improved the music chapter and Leonor Barroca spent a great deal of time on the METAFONT and METAPOST chapter—

without their work we would never have finished this book.

We gratefully recognize all our many colleagues in the TeX world who developed the packages, not only those described here, but also the hundreds of others that help users typeset their documents faster and better. Without the continuous effort of all these enthusiasts, TeX would not be the magnificent and flexible tool it is today. We tried to do them justice by mentioning, when first describing a given package, the original author and/or other major contributors.

We are greatly indebted to Dwight Aplevitch, Barbara Beeton, Karl Berry, David Carlisle, Malcolm Clark, L. Peter Deutsch, Denis Girou, John Hobby, Alan Hoenig, Ross Moore, Thorsten Ohl, Kris Rose, Tom Rokicki, Chris Rowley, Virgil Stokes, Ulrik Vieth, and Timothy van Zandt for their careful reading of various chapters of the manuscript. Their numerous comments, suggestions, corrections, and hints have substantially improved the quality of the text.

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Feedback

We would like to ask you, dear reader, for your collaboration. We kindly invite you to send your comments, suggestions, or remarks to any of the authors. We shall be glad to correct any mistakes or oversights in a future edition, and are open to suggestions for improvements or the inclusion of important developments we may have overlooked. We will maintain a list of errata in a file called `grphcomp.err` in the \LaTeX distribution, and this will contain current addresses for the authors.