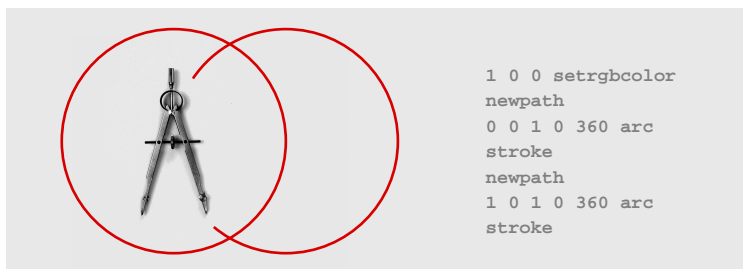


Preface



This book will show how to use PostScript for producing mathematical graphics, at several levels of sophistication. It includes also some discussion of the mathematics involved in computer graphics as well as a few remarks about good style in mathematical illustration.

To explain mathematics well often requires good illustrations, and computers in our age have changed drastically the potential of graphical output for this purpose. There are many aspects to this change. The most apparent is that computers allow one to produce graphics output of sheer volume never before imagined. A less obvious one is that they have made it possible for amateurs to produce their own illustrations of professional quality. Possible, but not easy, and certainly not as easy as it is to produce their own mathematical writing with Donald Knuth's program \TeX . In spite of the advances in technology over the past 50 years, it is still not a trivial matter to come up routinely with figures that show exactly what you want them to show, exactly where you want them to show it. This is to some extent inevitable—pictures at their best contain a lot of information, and almost by definition this means that they are capable of wide variety. It is surely not possible to come up with a really simple tool that will let you create easily all the graphics you want to create—the range of possibilities is just too large. All you can hope for is that the amount of work involved in producing an illustration is in proportion to the intrinsic difficulty of what you want to do. And the intrinsic difficulty of producing a good mathematical illustration inevitably means that you should expect to do some interesting mathematics as well as solve interesting computational problems along the way. Mathematical illustrations are a special breed—a *good mathematical illustration almost always requires mathematics in the process of making it*.

Nowadays there are many tools to help one produce mathematical graphics, of course. A partial list would include the free packages `xfig`, `pictex`, `PSTricks`, `MetaFont` and `MetaPost`, as well as commercial mathematical programs such as `Maple` and `Mathematica` and professional graphics design tools such as `Illustrator`. Which one to choose apparently involves a trade-off between simplicity and quality, in which most go for what they perceive to be simplicity. The truth is that the trade-off is unnecessary—once one has made a small initial investment of effort, by far the best thing to do in most situations is to write a program in the graphics programming language PostScript. There is practically no limit to the quality of the output of a PostScript program, and as one acquires experience the difficulties of using the language decrease rapidly. The apparent complexity involved in producing simple figures by programming in PostScript, as I hope this book will demonstrate, is largely an illusion. And the amount of work involved in producing more complicated figures will usually be neither more nor less than what is necessary.

The principal advantage of PostScript is that it allows essentially complete control over the final product, something impossible with all of the graphics packages I listed above. Having such fine control over your figures means that once your code is in place, it is often quite easy to modify it. This makes it a great tool for discovering, not only explaining, mathematics.

The advantage of control is very evident to those who have used, say, `xfig` or `pictex`, less so perhaps for `Maple` and `Mathematica`. What becomes apparent in the course of heavy usage, however, is that a program like `Maple` is designed for graphics only incidentally. It produces *huge* files—really, unnecessarily huge—and in practice seems reluctant to draw exactly what you want to draw. It does do all sorts of interesting computations, but normally the best way to use this talent is to have it output data files which a PostScript program can then access. The program `Mathematica` seems to be better adapted for graphics, but there are still many simple tasks it has trouble