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A Practical Introduction to Computer Graphics

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Contents

<i>Preface</i>	vii
1. An Informal Introduction to Two-dimensional Graphics	1
2. An Introduction to Two-dimensional Geometry	11
3. Transformations of Two-dimensional Space; Matrix Representation	23
4. Clipping and Covering	32
5. The Coordinate Geometry of Three-dimensional Space	42
6. Matrix Transformation of Three-dimensional Space; Orthographic Projections	56
7. Perspective and Stereoscopic Views	74
8. Hidden Line Algorithms	84
9. Setup Techniques	97
10. Computer Movies	111
11. Projects	127
12. Conclusion: What Next?	138
<i>Index</i>	143

Preface

Until recently, all but the most trivial computer graphics was the province of specialised research groups. Now with the introduction of reasonably priced graphics devices, the subject will reach many more users and its full potential can be realised. Computer-produced pictures always impress the layman, and the ‘mysterious’ techniques used for drawing them have gained a (false) reputation for complexity.

This book, as its title implies, is a practical first step in understanding the methods of computer graphics. After studying the contents and implementing the examples and exercises, the reader will be ready to attempt most tasks in graphics, whether these be the production of elementary data graphs, pie charts, etc., the drawing of patterns or diagrams for books, pamphlets or as teaching aids (all the diagrams in this book were drawn by computer) or the development of far more sophisticated design and technical drawing programs used in the aeronautics, automobile and other industries. Hints on how to tackle some of these sophisticated programs are also given.

It is assumed that the reader has an elementary knowledge of the Fortran IV programming language, and of cartesian coordinate geometry. This knowledge will be used to produce simple diagrams, and to produce the basic programming tools and routines required for the more ‘complicated’ designs. Then, hopefully, the reader will be inspired to seek a greater understanding of geometry and also to read more advanced works on computer graphics and to use the commercially available packages.

This book was designed to be completely self-contained, therefore no references are given. The contents reflect what I consider to be the logical development of the basic concepts in computer graphics, produced independently of the preconceived ideas of other authors, although standard terminology is used where appropriate.

The only way to understand any branch of computer science completely is to study and write a large number of programs; this is why the format of this book is that of ‘understanding through worked examples’. The chapters are centred around numerous examples and the ideas that lead from them. Many students readily understand the theory behind graphics, but they have great difficulty in implementing the ideas. Hence great emphasis is placed on the program listings; over seventy program segments are given — some quite substantial. Total understanding will only be achieved by running these programs and experimenting

with them. The programs can be thought of as an embryonic graphics package, but most importantly they are the means of describing the algorithms required in the solution of the given problems. They are readily translatable into other computer graphics languages such as Pascal or Basic. The routines described were devised for use with both Tektronix Interactive Graphics Consoles and microfilm, but again they can be made to run on any graphics system, be they paper plotters, other 'scopes, etc., with a minimum of thought.

The figures drawn are deliberately kept simple in order that the description of the detail in scenes should not obscure the new ideas being introduced. Complexity is left to the reader! No claims are made regarding the efficiency of the program segments; instead, a balance is maintained between efficiency of code and clarity of the description of the algorithm. As far as possible the programs were written in modular form. There are many cases where, by reorganising the programs, combining routines and perhaps obscuring the code, redundancy of data variables and statements may be eliminated. This can be considered a general exercise that runs throughout the book.

The main purpose of this book, which is essentially a third-year degree course given to undergraduates at Royal Holloway College, University of London, is to set out the groundwork of computer graphics, but to leave as much as possible to the imagination of the user — an exciting prospect. As one who found it 'difficult to draw a straight line with a ruler', I hope that my excitement in the discovery of computer graphics and its potential will become apparent in the following pages. I have been most gratified by the high standard and ingenuity of design produced by my students. In fact I have used diagrams produced by four of them: Hilary Green (figure 4.1), Jemma Coombe (figure 11.1), Helen Davies (figure 11.8) and Paul McLean-Thorne (figure 11.10). They have found that computer graphics is *fun*; I hope the reader will make the same discovery and spend many enjoyable and productive hours in front of a graphics console.

For those wishing to study computer graphics in more detail after reading this book, I recommend that they read W. M. Newman and R. F. Sproull, *Principles of Interactive Computer Graphics* (McGraw-Hill, 1973). It gives a good survey of the more complicated and theoretical aspects of the subject as well as containing an excellent bibliography.

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