

Applied Apple Graphics

Pip Forer



74 87
E 715

Applied Apple Graphics

Pip Forer

University of Canterbury, Christchurch, New Zealand



Prentice/Hall



International

Englewood Cliffs, NJ London New Delhi Rio de Janeiro
Singapore Sydney Tokyo Toronto Wellington

8750161

0538/05

Library of Congress Cataloging in Publication Data

Forer, Pip.

Applied Apple graphics.

Bibliography: p.

Includes index.

1. Computer graphics. 2. Apple II (Computer)—Programming. I. Title.

T385.F65 1984 001.64'43 83-19171

ISBN 0-13-039289 8 (pbk.) ISBN 0-13-039330 4 (disk & pbk. package)

ISBN 0-13-039297 9 (disk) ISBN 0-13-039355 X (disk & case package)

British Library Cataloging in Publication Data

Forer, P

Applied Apple graphics

1. Computer graphics 2. Apple (computer)

I. Title

001.64'43 T385

ISBN 0-13-039289 8 (pbk.) ISBN 0-13-039330 4 (disk & pbk. package)

ISBN 0-13-039297 9 (disk) ISBN 0-13-039355 X (disk & case package)

© 1984 by Pip Forer

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, mechanical, photocopying, recording or otherwise, without the prior permission of Prentice-Hall International, Inc.

For permission within the United States contact Prentice-Hall, Inc., Englewood Cliffs, NJ 07632.

ISBN 0-13-039289 8 {PBK}

ISBN 0-13-039297 9 {DISK}

ISBN 0-13-039330 4 {PBK & DISK}

ISBN 0-13-039355 X {CASE & DISK}

Prentice-Hall International, Inc., London

Prentice-Hall of Australia Pty Ltd, Sydney

Prentice-Hall Canada Inc., Toronto

Prentice-Hall of India Private Ltd, New Delhi

Prentice-Hall of Southeast Asia Pte Ltd, Singapore

Prentice-Hall, Inc., Englewood Cliffs, New Jersey

Prentice-Hall do Brasil Ltda, Rio de Janeiro

Whitehall Books Ltd, Wellington, New Zealand

10 9 8 7 6 5 4 3 2 1

Typeset in Great Britain by Parkway Illustrated Press, Abingdon
Printed in the United States of America

Disclaimer of All Warranties and Liabilities

APPLE COMPUTER, INC. MAKES NO WARRANTIES, EITHER EXPRESS OR IMPLIED, REGARDING THE ENCLOSED COMPUTER SOFTWARE PACKAGE, ITS MERCHANTABILITY OR ITS FITNESS FOR ANY PARTICULAR PURPOSE. THE EXCLUSION OF IMPLIED WARRANTIES IS NOT PERMITTED BY SOME STATES. THE ABOVE EXCLUSION MAY NOT APPLY TO YOU. THIS WARRANTY PROVIDES YOU WITH SPECIFIC LEGAL RIGHTS. THERE MAY BE OTHER RIGHTS THAT YOU MAY HAVE WHICH VARY FROM STATE TO STATE.

DOS is a copyrighted program of Apple Computer, Inc., licensed to Prentice-Hall International to distribute for use only in combination with *Applied Apple Graphics*. Apple Software shall not be copied onto another diskette (except for archive purposes) or into memory unless as part of the execution of *Applied Apple Graphics*. When *Applied Apple Graphics* has completed execution Apple Software shall not be used by any other program.

'Apple' and the Apple logo are registered trademarks of Apple Computer, Inc.

The author and publisher of this book have used their best efforts in preparing this book and the programs contained in it. These efforts include the development, research and testing of the theories and programs to determine their effectiveness. The author and publisher make no warranty of any kind, expressed or implied, with regards to these programs or the documentation contained in this book. The author and publisher shall not be liable in any event for incidental or consequential damages in connection with, or arising out of, the furnishing, performance, or use of these programs.

Preface

This book and its disk are about microcomputer graphics and their uses. While the book works at a practical level with a single machine, the Apple II+, Apple IIe and Apple variants compatible with this version, the general emphasis of the text is on the wider ideas behind graphics use.

One of the arguments behind this book is that graphics and the cheap computer can have revolutionary effects on how we present information, handle our personal accounting, amuse ourselves and impart knowledge to our children and each other. Part of this revolution is not that we can do new things but that we can do old things at a new order of speed. It is no discovery to draw a graph, for instance, but to be able to do so with so little effort transforms the use we make of this particular tool for viewing information.

The real appreciation of graphics applications can only come when a user sits down and experiments with different graphics uses and tries to make up his or her own. I love books, but saying what can be done with graphics through the pages of a book can only partly convey the overall possibilities of the computer medium. To circumvent the limitations of the book as a medium, almost all of the examples discussed in the text are on the disk that comes with this book.

To the extent that a book such as this is a journey, the author must give his reader some idea of where the journey starts and where he hopes it may lead. The starting point for the reader is a simple working knowledge of a microcomputer BASIC, including arrays and alphanumeric strings. Any microcomputer BASIC will do, although as you might expect, you will find it simplest if you know an Applesoft BASIC as used on the Apple II.

You will not need to know any graphics commands to start with. Nor will you need to know any machine language. Although we shall come to use commands such as POKE, PEEK and CALL for limited purposes, in general this book is set up for BASIC users. It is assumed that you want to learn to use graphics with as few immediate extra obstacles as possible, and only at a later date may wish to go for the speed of alternative languages.

You should not need a microcomputer by your side to benefit from the main points of this book. However, in writing about graphics one tailors one's points to a typical system one imagines the reader to have. The first few chapters work on the basis of an Apple II with high and low resolution color graphics, 48K RAM memory and a single disk drive. Although other peripherals are discussed later, and some of the applications in Chapter 7 require a second disk drive, this disk works on such a configuration, with a 5 $\frac{1}{4}$ " floppy disk operating under DOS 3.3.

The chapters that follow develop the theme of the multiple uses of graphics, and seek to provide readers with the techniques to employ some of these uses for themselves. For a start microcomputer graphics are put into a wider context of the development of graphics systems. The different views of high and low resolution

xiii

8750161

graphics and character graphics are discussed. Most importantly the types of graphic use are set down and form a basis for the later chapters. These take the reader through the use of simple graphics commands drawing static pictures to the linking of data to graphics and the production of graphs and maps. On the way through this some simple ideas of data-banking are introduced and the examples cover software to set up a limited data bank and to recall and graphically present its contents. The question of animation is raised later, as are the educational uses of graphics. This permits a brief introduction to the PILOT language. Finally, the possibilities offered by peripherals that may not be generally available to the reader are covered. This includes both input and output devices.

You will be aware that many software packages exploiting the graphics potential of the Apple are now commercially available. Travelling through this book we will refer to these as they are relevant. The end of our journey is hopefully to leave you with a better idea of what you and your machine can do, and what further things could be done with an additional investment in hardware or authoring software.

IN SUMMARY

What This Book Does

- Provides a general introduction to microcomputer graphics over a very wide range of applications (not just arcade games or analytic geometry).
- Concentrates on one machine.
- Concerns itself with BASIC examples (although it discusses a variety of graphics options).
- Provides an overview of the analytic geometry needed for 3-D perspective work.
- Introduces existing software utilities for doing particular jobs quickly, with a particular emphasis on how to evaluate such packages.
- Discusses means of upgrading your graphics with new hardware and new languages.
- Provides a disk with working programs and suggestions on projects for them.

What It Does Not Do

- It does not cover assembler or machine-based approaches to any depth (but it will tell you what you can gain and provide references to seek further help).
- It does not provide a complete set of working graphics utilities for every graphics need. (At the latest count that would need at least 47 disks.)
- It does not provide a review of software released last week (no book can . . . but this one *will* tell you what to look for in a good utility).
- It does not oversell microcomputer graphics by discussing applications that the machine is unsuitable for.

What To Do With The Disk

BACK UP YOUR DISK

The first requirement of having this disk is to back it up so you have a secure copy in case your working disk corrupts for some reason. This is doubly necessary for *Applied Apple Graphics* since the examples suggested in the text involve modification of some programs. You may wish to replace original version of these programs by modified programs on your working copy of the disk. Therefore you need both a master and working copy of the disk so that you can always recreate the original disk from the master at any time and rework your *Applied Apple Graphics* examples.

Backing up the entire disk is a simple operation since the disk does not use any proprietary protection techniques. It is in most ways a completely standard Apple DOS 3.3 disk.

To back up the entire disk use the COPYA disk copying program on the DOS 3.3 Systems Master Disk that is supplied with each disk drive system. Simply:

Insert the DOS Systems Master Disk.

Enter the Commands `RUN COPYA` and `RETURN`

Respond to the prompts from the program as detailed in the DOS Manual (pp. 38-40). This is very straightforward if you have two disk drives. If you have only one then specify both source and copy disk drives as the same (normally slot 6 drive 1). It is then necessary to change the disks in the drives several times during the operation. To make sure that you have no problems do *not* remove the write protect tab on your master copy of the *Applied Apple Graphics* disk with either 1 or 2 disk copying. This will ensure that you do not corrupt the master by having it in the wrong drive or entered at the wrong time.

Keep the master disk in a safe place and use only the back-up.

To be doubly sure that you do not lose a working version of *Applied Apple Graphics* repeat this back-up procedure if ever your working copy gets corrupted.

COPY SPECIFIC FILES TO A DISK WITH SPACE IF NEEDED

The *Applied Apple Graphics* disk uses almost the entire storage area on the disk. Since you may want to use certain programs with your own data or routines you may want to transfer individual files across from the master disk or the back-up. For

this you should use the program FID (DOS manual pp. 184–189). Simply place the DOS System Master disk in the disk drive and enter

BRUN FID and RETURN

Choose the copying option from the menu displayed (option 1). This will copy any file on the disk which is type A, B or T. However we have tailored the catalog listing to emphasize the relationship of the chapters to the programs. This has meant that various 'dummy' (S) files have been inserted. Trying to copy these will terminate the copy sequence on FID. You therefore can not use the automatic wild card option to copy XallY named files (i.e. respond = to the question 'What Filename' and N to the query 'Do You Want Prompting'). The FID program will recognize the names of these dummy files alright (so you can = XwithY prompts) but will interrupt on an error condition if you try to copy them.

Like most programs of any complexity many of these programs require a suite of programs, such as companion data files and SHAPE tables, to be present on disk at the time of running. Check with the program notes in the book just which combinations of files will have to be copied to get any one application to run.

READ THE REMs AND LOOK AT THE LISTS

Unlike many computer texts this book is not taken up with a lot of listings. The idea of providing book and disk makes this practice rather redundant. To have bought or borrowed this book you almost certainly have a computer that can LIST and you probably have a printer that can PRINT. Consequently, only the introductory programs or those developed step by step in the text are printed in the book. You have all the rest at your disposal anyway.

The programs are set up with REM remarks that use CNTRL/J to space the listings. These REMs indicate the crucial components of the programs and their main functional blocks. They complement both the program notes sited in the text and the parts of the text dealing with the particular topic being illustrated. For instance, the simple animation demonstrations are best understood by reference to the section on animation, the panel on the ANIMATOR programs and the REMs in the listing itself. The book and disk have designed to work together and will work best if you use them together.

USE THE PROGRAMS AS BASES FOR YOUR EXPERIMENTS

You are encouraged to use these programs and modify them to your personal needs or to transform them into programs for doing things you wish to do. However,

copyright applies to the disk as provided to you, and you are not authorized to copy the disk entire or in portions except for personal use.

The only proprietary software on this disk are the fast unpacking, screen drawing routines, color fills and animation package used in the opening sequences. These are provided from the Graphics Magician by Penguin Software. This software is used under the licence offered by Penguin Software with this package. Full documentation and the editing programs comprising this utility can be obtained from Penguin Software. Their address is provided in the list at the back of this book.

ABOUT THE PROGRAMS ON THE DISK

In producing this book I have had a philosophy that Apple graphics can be approached at three levels. Firstly, there are many tasks for the user which can be handled with skilful application of the standard Applesoft BASIC and a knowledge of the finer points of graphics. Secondly, many more tasks can be handled by using utilities that are interfaceable with Applesoft or some other standard Apple language in one way or another. Finally, some tasks and a minority of users will want customized graphics requiring considerable work with assembler or special processing hardware.

The programs on the disk that accompanies this book are aimed largely at the first level of Apple graphics.

There are two sorts of programs on the disk: those that illustrate simple qualities of Apple graphics and those that provide a simplified idea of how a graphics application might be programmed. None of these programs are professional in the functional way. Professional applications software spends most of its time guarding the user from himself by preventing or trapping various error conditions. Such programs are user transparent and safe but structurally more complicated by the demands imposed on their design.

It is hoped that the programs on the disk are professional in another way: they aid understanding. User transparency is a minor priority for this. The main aim is structural clarity. Consequently, if you are an experienced BASIC programmer, think twice before you condemn the fact that an incorrect input can crash some of these programs, or that the fastest programming option is not always taken. The programs have been designed to include the necessities, nicely parcelled into a recognizable structure (or at least as recognizable a structure as simple BASIC allows).

Many have been deliberately left with potential for development. Learning is a sequential process and it would be mistaken to use all the concepts developed in the book in all the programs. However the building blocks are there for easily improving the simpler programs by combining programs through the use of the standard DOS Renumber/Append program.

The text in the book reviews what software utilities can offer and also provides pointers to evaluating the utilities and to alternative language options. For many uses (unless you enjoy programming for its own sake) utilities are the best solution for the person who wants to create his or her own working programs with maximum effect and minimum time. This is especially true of teachers and educationalists experimenting with graphics for teaching in their own subject areas. Using utilities sensibly is the intelligent way to utilize any graphics computer unless you are aiming to write custom software. A particular example of this is 3-D graphics, where utilities offer the only choice between unacceptably slow speed and an enormous personal investment in retooling to a new language and software authoring.

Enjoy the programs and experiment with the ideas suggested in the text and with improvements of your own. As a final caution remember how this guide to the disk started: back up your master copy NOW.

LIST OF PROGRAMS AND FILES

KICKSTART

Chapter 2

FLAG
POTSHOT

Chapter 4

ALPY
SHAPESEE
INFLATING ART

Chapter 6

BACKCOLORDEMO
STRIPER

Chapter 7

DATAUP
DATEDITOR
PLOTASERIES
HRTEXTSUB

Data file

TOURDAT

Chapter 9

ROTATE
HERITAGE
HERITAGE.KEY.PAK
HERITAGE.CLIPON
BI.MAP.PIC
PACAIRNET

PACIFIC.NAMES

PACIFIC.MAP.PAK

PACIFIC.1958

OZ.MAPPER

OZ.FILLER

OZ.MAP.PAK

OZ.NAMES

OZ.DATA

OZ.VARNAMES

ISLE OF WIGHT

ISLE OF WIGHT.RASTER

PACKER1

SWAPEM

GIGGLE

Chapter 10

PERSPECTIVE
SPIKED TRIANGLE

Chapter 11

EXECDEMO
RETAILGAME
MOONWALK
ANIMATOR1
ANIMATOR2
ANIMATOR3

Chapter 12

RAMEXPLORER
VISIONCORE

SHAPE Table and Utilities

EXPOSHAPES.SHP

LETTERS.SHP

SYMBOLS.SHP

BI.SHP

MOONMEN.SHP

GRANDSHAPES.SHP

HOMES.SHP

RUNPACK

US.MAP.PAK

PICDRAW

HEADERDEMO.SPC

Contents

Preface	xiii
What To Do With The Disk	xvii
Applications Of Computer Graphics	1
1 An Overview Of Computer Graphics	2
Terms To Remember (A regrettable but necessary preliminary)	3
The pixel or atom of graphics	
Coordinate systems	
Bytes and bits: the structure of computing	
What The Big Boys Do: The Current Scope Of Graphics	6
Types Of Graphics	10
What are Graphics Applications?	14
Interactive and elapsed time graphics	
Of 2-D, wire frames and solid geometry	
An End-use Perspective	17
Stages In Image Creation: Passing Through Hardware	19
Three ways of drawing (and the rise of raster graphics)	
Memory Mapped Graphics	22
The Transition From Memory To Screen	24
2 Familiarizing With Low Resolution Graphics	26
Getting To LRG And Plotting	27
COLOR	28
PLOT	29
Checking The Viewport	29
Drawing Lines: The Potential For Plotting	31
VLIN	31
HLIN	32
Interaction: A Simple Starter	36
Interrogating the screen	
Interaction And Primitive Animation	37
On Jerk And Flicker	42
Higher Low Resolution	42
3 Of Memory And Visions I: Controlling Memory	44
Low Resolution Display Memory	46
High Resolution Display Memory	47
Tools To Manage RAM	48
Accessing Graphics Memory For Display	49
The Secret Writing Secret	51
Promises Of Further Secrets	54

4 Pictorial High Resolution Graphics: Putting A Finer Point On Things	55
Drawing A Landscape	56
Clearing the slate: HGR and HGR2	
Growing the grass	
Drawing the sky	
Drawing mountains: further use of HPL0T	
Plotting the plains: farms and towns	
Saving the Picture	63
BSAVE (Binary SAVE)	
BLOAD (Binary LOAD)	
The Shape Of Things To Come: Fast Figure Drawing	65
XDRAW	
A SHAPE Creation Example	71
SHAPE Playing Example	75
A Requiem For SHAPE Creation As A Fireside Pastime	78
 5 Of Memory And Visions II: Inside Graphics RAM	 80
Monitor Calls: Edging Towards Machine Language	83
 6 Supercharging Graphics: Screen Creation Utilities	 85
SHAPES And Utilities	85
BACKCOLORDEMO: A Play With SHAPES	88
Homely homilies from BACKCOLORDEMO	
... And rules on making SHAPES	
Screen Composition Beyond SHAPES	92
A Simple Screen Creation Example	96
Mixing Utilities	101
Final Comment	101
 7 Fact Watching: Data And Graphics	 104
Graphics And Data Display	106
Pioneers at Shantytown	
Disks And Data	110
Tracks, sectors and files	
Data Arrangements And Moving Around In Files	114
Harnessing dead data: simple reads and writes	
Setting up the data file: priority one—minimize error	
Reading the data	
Highlighting Live Data: A Simple Display Example	120
Playing with displays	
Axes to find	
More Jigs And Reels	127
Imitating Lisa	131
Plotting data and controlling screen layout	
Making The Viewport Work For You	134
Data display: further reading	
Final Touches	136
Putting text on the high resolution screen	
Commercial Software	137

8 More on Memory Management	143
Resetting the program location	
9 Mapping: Space, Data And Graphics	147
Spatial Data Bases	149
The Real World And The Mapper's Window	151
Windowing	
Establishing a common coordinate system	
Working with resolution	
Saving My Atlas: Picture Packing Momma	164
Backgrounds, SHAPes And Maps: Program HERITAGE	165
Shapes and Backgrounds	
DRAW/ERASE loops	
Data base	
Getting really interactive	
Mapping Networks: A Better Data Bank	173
Color And Areas: Shading Maps	177
Knowing where the area is and if you are in it	
Raster fills of outlines	
Mixed Colors And Intelligent Fills	180
Socioeconomic Data Display: Mapping Australia	182
Commercial Mapping Options	185
10 Supercharging Graphics II: Three-Dimensional Perspectives	199
Three-Dimensional Graphics Utilities	200
Coding objects	
A worked example	
Behind Three-dimensional Graphics	207
Working In Three Dimensions	209
Perspective for display	
How To Move Houses	213
Translation	
Scaling individual axes	
Overall scaling	
Rotation	
A Note For The Technical: Putting It All Together	221
The importance of relativity	
Perspective revisited and some final tricks	
Where To Go From Here	227
11 Of Education, Simulation, Animation And Application	228
Graphics In Education	228
PILOT And CAI	230
The Character Editor	233
Turtle Graphics And LOGO	237
Turtle graphics	
Simulation And Graphics	242
Animation in Applesoft	246
Of flicker and jerk	
Animation in Applesoft: coping with flicker	

ANIMATOR1: things with speed or objects that travel	
Things with life: objects that move	
Moving and travelling objects	
Limitations and problems of Applesoft	
The Key To Really Fast Graphics	253
Animation Utilities: A Simpler Path To Speed	257
Applications at The Extremes Of The System	260
Image Processing	
CAD/CAM	
12 Of Memory And Visions III	266
The Structure Of Graphics RAM Revisited	266
Exploring the screen RAM map	
How best to access graphics	
Some Further Insights	270
Getting more into monitor	
13 Extensions To A Graphics System	277
Manual Devices For Interaction And Data Entry	278
Of Paddles, joysticks and light pens	
Light pens	
Digitizers	
The three dimension digitizer	
Hard Copy Peripherals	288
Printers	
X-Y plotters: slightly out of key?	
Photographic capture	
RAM Cards And Video Interfacing For Data Storage And Acquisition	294
Video Digitizing For Input	297
The Horizons Of Graphics	298
Microcomputers and the video communications complex	
The Video-Graphics Symbiosis	300
Improving Your Graphics: The Language Barrier	303
Pascal graphics: fast turtles	
Journeying On	308
Appendix 1 Compatibility With Other Machines Using Apple II Format Graphics	311
Appendix 2 Addresses Of Screen RAM	313
Appendix 3 Intrinsic Monitor Subroutines And Linkages For The Apple II+	315
Appendix 4 Useful Addresses For Apple Graphics	318
Appendix 5 The Apple IIe Enhancements	323
The keyboard	
The monitor	
Video signal modifications	
Additional memory	
Appendix 6 Mapping Data For The United States	325
Data tables	
Bibliography	328

Index	333
Index of Disk Files And Graphics Command Syntax	339
Prentice-Hall Addresses	341