

The McGraw-Hill Companies

SCHAUM'S
outlines

COMPUTER GRAPHICS

ZHIGANG XIANG | ROY A PLASTOCK

Second Edition

- ▲ Simplifies all aspects of creating digital graphics.
- ▲ Detailed discussions on Computer Animation, Graphic I/O Devices.
- ▲ Algorithms presented in 'C' language.
- ▲ Over 410 solved examples, problems and objective questions.



For sale in
India, Pakistan,
Nepal, Bangladesh,
Sri Lanka and
Bhutan only

Adapted by: P S AVADHANI

Contents

<i>Preface to the Adapted Edition</i>	xiii
<i>Preface</i>	xv
1. INTRODUCTION	1
1.1 A Mini-Survey	2
1.2 Overview of Image Representation	6
1.3 The RGB Color Model	6
1.4 Direct Coding	8
1.5 Lookup Table	9
1.6 Display Monitor	10
1.7 Printer	12
1.8 Image Files	15
1.9 Setting the Color Attributes of Pixels	16
1.10 Example: Visualizing the Mandelbrot Set	18
1.11 What's Ahead	20
<i>Solved Problems</i>	20
<i>Supplementary Problems</i>	26
<i>Answers to Supplementary Problems</i>	26
2. OVERVIEW OF GRAPHIC I-O DEVICES	27
2.1 Random Scan Displays	27
2.2 Raster Refresh Graphics Displays	28
2.3 Interactive Devices	30

2.4	Logical Functioning of Graphic I-O Devices	33
2.5	Output Devices	33
	<i>Solved Problems</i>	34
	<i>Supplementary Problems</i>	36
	<i>Answers to Supplementary Problems</i>	36
3.	SCAN CONVERSION	37
3.1	Scan-converting a Point	37
3.2	Scan-converting a Line	38
3.3	Scan-converting a Circle	42
3.4	Scan-converting an Ellipse	47
3.5	Scan-converting Arcs and Sectors	53
3.6	Scan-converting a Polygon	54
3.7	Region Filling	58
3.8	Scan-converting a Character	62
3.9	Aliasing Effects	64
3.10	Anti-aliasing	65
3.11	Image Compression	68
3.12	Recursively Defined Drawings	70
	<i>Solved Problems</i>	72
	<i>Supplementary Problems</i>	85
	<i>Answers to Supplementary Problems</i>	86
4.	TWO-DIMENSIONAL TRANSFORMATIONS	89
4.1	Geometric Transformations	90
4.2	Coordinate Transformations	92
4.3	Composite Transformations	94
4.4	Instance Transformations	99
	<i>Solved Problems</i>	100
	<i>Supplementary Problems</i>	112
	<i>Answers to Supplementary Problems</i>	113
5.	TWO-DIMENSIONAL VIEWING AND CLIPPING	121
5.1	Window-to-Viewport Mapping	122
5.2	Point Clipping	123
5.3	Line Clipping	123
5.4	Polygon Clipping	128
5.5	Example: A 2D Graphics Pipeline	131
	<i>Solved Problems</i>	134
	<i>Supplementary Problems</i>	147
	<i>Answers to Supplementary Problems</i>	147

6. THREE-DIMENSIONAL TRANSFORMATIONS	150
6.1 Geometric Transformations	150
6.2 Coordinate Transformations	153
6.3 Composite Transformations	153
6.4 Shearing Transformations	154
6.5 Instance Transformations	155
<i>Solved Problems</i>	155
<i>Supplementary Problems</i>	163
<i>Answers to Supplementary Problems</i>	164
7. PROJECTIONS	166
7.1 Taxonomy of Projection	167
7.2 Perspective Projection	167
7.3 Parallel Projection	171
<i>Solved Problems</i>	174
<i>Supplementary Problems</i>	195
<i>Answers to Supplementary Problems</i>	195
8. THREE-DIMENSIONAL VIEWING AND CLIPPING	199
8.1 Three-Dimensional Viewing	199
8.2 Clipping	204
8.3 Viewing Transformation	207
8.4 Example: A 3D Graphics Pipeline	208
<i>Solved Problems</i>	209
<i>Supplementary Problems</i>	225
<i>Answers to Supplementary Problems</i>	225
9. CURVE AND SURFACE DESIGN	226
9.1 Simple Geometric Forms	226
9.2 Wireframe Models	227
9.3 Curved Surfaces	228
9.4 Curve Design	229
9.5 Polynomial Basis Functions	232
9.6 The Problem of Interpolation	234
9.7 The Problem of Approximation	236
9.8 Curved-Surface Design	239
9.9 Transforming Curves and Surfaces	241
9.10 Quadric Surfaces	242
9.11 Example: Terrain Generation	244
9.12 Fractal Geometry Methods	246
<i>Solved Problems</i>	248

<i>Supplementary Problems</i>	252
<i>Answers to Supplementary Problems</i>	252
10. HIDDEN SURFACES	255
10.1 Depth Comparisons.....	255
10.2 Z-Buffer Algorithm.....	258
10.3 Back-Face Removal.....	259
10.4 The Painter's Algorithm.....	261
10.5 Scan-Line Algorithm.....	265
10.6 Subdivision Algorithm.....	267
10.7 Hidden-Line Elimination.....	267
10.8 Rendering of Mathematical Surfaces.....	269
10.9 Warnock's Algorithm.....	270
10.10 Weiler-Atherton Algorithm.....	270
<i>Solved Problems</i>	287
<i>Supplementary Problems</i>	288
<i>Answers to Supplementary Problems</i>	288
11. COLOR AND SHADING MODELS	289
11.1 Light and Color.....	289
11.2 The Phong Model.....	295
11.3 Interpolative Shading Methods.....	296
11.4 Texture.....	299
<i>Solved Problems</i>	303
<i>Supplementary Problems</i>	310
<i>Answers to Supplementary Problems</i>	310
12. RAY TRACING	312
12.1 The Pinhole Camera.....	312
12.2 A Recursive Ray-Tracer.....	313
12.3 Parametric Vector Representation of a Ray.....	316
12.4 Ray-Surface Intersection.....	316
12.5 Execution Efficiency.....	319
12.6 Anti-Aliasing.....	320
12.7 Additional Visual Effects.....	321
<i>Solved Problems</i>	323
<i>Supplementary Problems</i>	332
<i>Answers to Supplementary Problems</i>	333
13. COMPUTER ANIMATION	335
13.1 Design of Animation Sequences.....	335

..... 252
 252
255
 255
 258
 259
 259
 261
 265
 267
 267
 269
 270
 270
 287
 288

289
 289
 295
 296
 299
 303
 310
 310

12
 312
 313
 316
 316
 319
 20
 21
 23
 32
 33

5
 5

13.2 Basic Rules of Animation	336
13.3 Problems in Animation	337
13.4 Techniques of Animation	337
13.5 Morphing	337
<i>Solved Problems</i>	338
<i>Supplementary Problems</i>	338
<i>Answers to Supplementary Problems</i>	339

APPENDIX 1: MATHEMATICS FOR TWO-DIMENSIONAL COMPUTER GRAPHICS 340

A1.1 The Two-Dimensional Cartesian Coordinate System	340
A1.2 The Polar Coordinate System	345
A1.3 Vectors	346
A1.4 Matrices	348
A1.5 Functions and Transformations	350
<i>Solved Problems</i>	353

APPENDIX 2: MATHEMATICS FOR THREE-DIMENSIONAL COMPUTER GRAPHICS 368

A2.1 Three-Dimensional Cartesian Coordinates	368
A2.2 Curves and Surfaces in Three-Dimensions	369
A2.3 Vectors in Three-Dimensions	372
A2.4 Homogeneous Coordinates	375
<i>Solved Problems</i>	377

APPENDIX 3: OBJECTIVE QUESTIONS 390

Answers	399
---------------	-----

INDEX 400