

Contents

List of Figures	xiii
1. Introduction	1
1.1 Application fields	1
1.2 From a real scene to an image	3
1.3 Organisation of the book	4
2. Basic principles of two-dimensional graphics	7
2.1 Raster versus vector graphics	7
2.2 The first Java 2D program	10
2.3 Basic geometric objects	14
2.4 Basic geometric objects in Java 2D	17
2.5 Geometric transformations	23
2.6 Homogeneous coordinates	28
2.7 Applications of transformations	31
2.8 Geometric transformations in Java 2D	33
2.9 Animation and movements based on transformations	37
2.10 Movements via transformations in Java 2D	39
2.11 Interpolators for continuous changes	41
2.12 Implementation of interpolators in Java 2D	44
2.13 Single or double precision	45
2.14 Exercises	48
3. Drawing lines and curves	49
3.1 Lines and pixel graphics	49
3.2 The midpoint algorithm for lines	52

3.3	Structural algorithms	60
3.4	Pixel densities and line styles	63
3.4.1	Different line styles with Java 2D	66
3.5	Line clipping	67
3.6	The midpoint algorithm for circles	75
3.7	Drawing arbitrary curves	79
3.8	Antialiasing	80
3.8.1	Antialiasing with Java 2D	82
3.9	Drawing thick lines	83
3.9.1	Drawing thick lines with Java 2D	84
3.10	Exercises	86
4.	Areas, text and colours	87
4.1	Filling areas	87
4.2	Buffered images in Java 2D	91
4.2.1	Double buffering in Java 2D	92
4.2.2	Loading and saving of images with Java 2D	94
4.2.3	Textures in Java 2D	95
4.3	Displaying text	96
4.4	Text in Java 2D	97
4.5	Grey images and intensities	99
4.6	Colour models	101
4.6.1	Colours in Java 2D	106
4.7	Colour interpolation	107
4.8	Colour interpolation with Java 2D	110
4.9	Exercises	112
5.	Basic principles of three-dimensional graphics	113
5.1	From a 3D world to a model	113
5.2	Geometric transformations	115
5.2.1	Java 3D	118
5.2.2	Geometric transformations in Java 3D	119
5.3	The scenegraph	120
5.4	Elementary geometric objects in Java 3D	123
5.5	The scenegraph in Java 3D	124
5.6	Animation and moving objects	130
5.7	Animation in Java 3D	133
5.8	Projections	139
5.8.1	Projections in Java 3D	146
5.9	Exercises	147

6. Modelling three-dimensional objects	149
6.1 Three-dimensional objects and their surfaces	149
6.2 Topological notions	152
6.3 Modelling techniques	154
6.4 Surface modelling with polygons in Java 3D	159
6.5 Importing geometric objects into Java 3D	162
6.6 Parametric curves and freeform surfaces	163
6.6.1 Parametric curves	164
6.6.2 Efficient computation of polynomials	170
6.6.3 Freeform surfaces	171
6.7 Normal vectors for surfaces	173
6.7.1 Normal vectors in Java 3D	176
6.8 Exercises	178
7. Visible surface determination	179
7.1 The clipping volume	179
7.1.1 Clipping in Java 3D	182
7.2 Principles of algorithms for visible surface determination	183
7.2.1 Image-precision and object-precision algorithms	183
7.2.2 Back-face culling	184
7.2.3 Spatial partitioning	186
7.3 Image-precision techniques	187
7.3.1 The z -buffer algorithm	187
7.3.2 Scan line technique for edges	190
7.3.3 Ray casting	192
7.4 Priority algorithms	195
7.5 Exercises	199
8. Illumination and shading	201
8.1 Light sources	202
8.2 Light sources in Java 3D	206
8.3 Reflection	208
8.4 Shading in Java 3D	216
8.5 Shading	218
8.5.1 Constant and Gouraud shading in Java 3D	222
8.6 Shadows	222
8.7 Transparency	224
8.7.1 Transparency in Java 3D	226
8.8 Textures	227
8.9 Textures in Java 3D	229
8.10 The radiosity model	231
8.11 Ray tracing	236

8.12 Exercises	238
9. Special effects and virtual reality	239
9.1 Fog and particle systems	240
9.2 Fog in Java 3D	242
9.3 Dynamic surfaces	243
9.4 Interaction	245
9.5 Interaction in Java 3D	245
9.6 Collision detection	249
9.7 Collision detection in Java 3D	250
9.8 Sound effects	256
9.9 Sound effects in Java 3D	257
9.10 Stereoscopic viewing	258
9.11 Exercises	263
Appendix: Useful links	264
Appendix: Example programs	266
Appendix: References to Java 2D classes and methods	271
Appendix: References to Java 3D classes and methods	273
Bibliography	275
Index	279