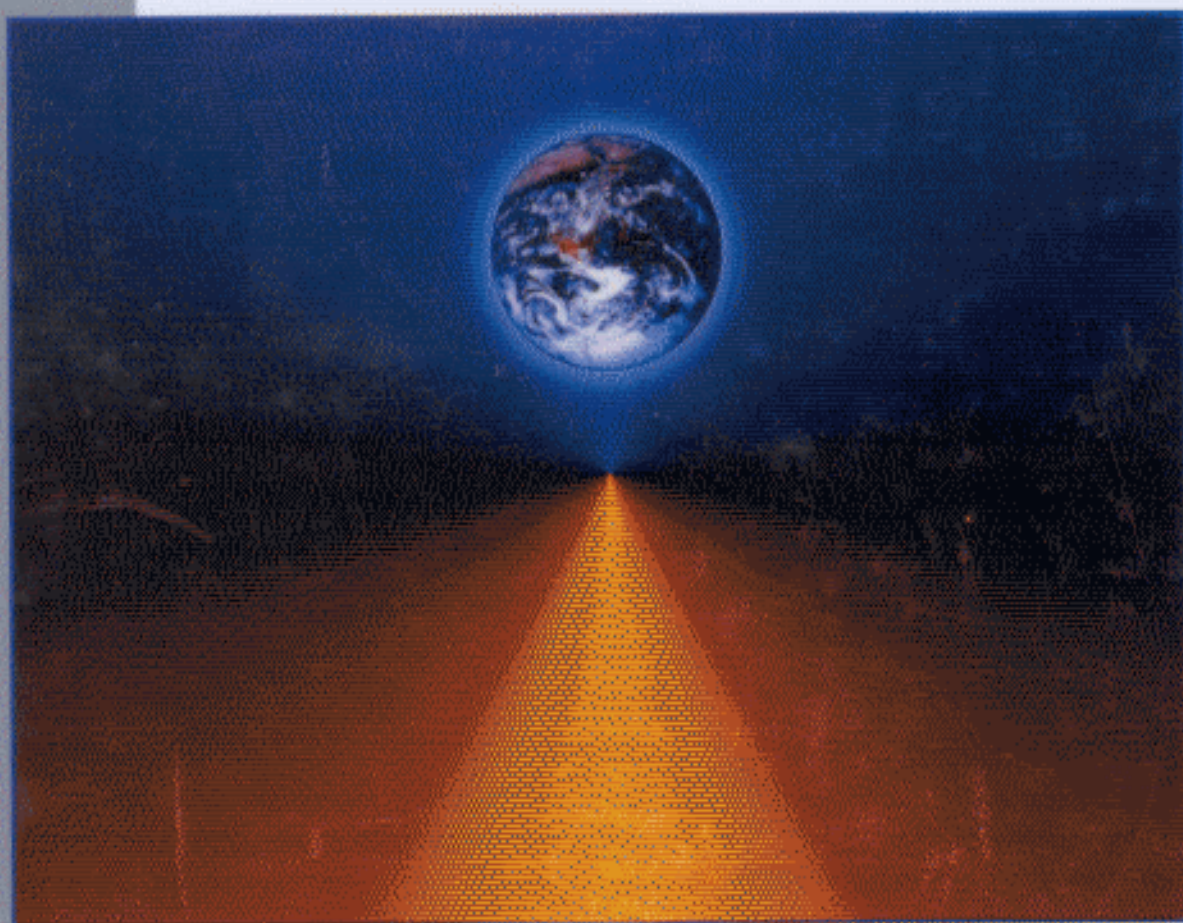




Prentice Hall Series
in Geographic
Information Science

KEITH C. CLARKE,
Series Editor

Concepts and Techniques of Geographic Information Systems



C. P. Lo • Albert K. W. Yeung

CONTENTS

Preface xi

1 Introduction to Geographic Information Systems (GIS) 1

- 1.1 Introduction 2
- 1.2 Definitions of GIS and Related Terminology 2
- 1.3 The Evolution of GIS 5
- 1.4 Components of GIS 9
- 1.5 Approaches to the Study of GIS 14
- 1.6 Summary 17
- References 18

2 Maps and GIS 19

- 2.1 Introduction 20
- 2.2 Map Scale 20
- 2.3 Classes of Maps 21
- 2.4 The Mapping Process 22
- 2.5 Plane Coordinate Systems and Transformations 24
- 2.6 Geographic Coordinate System of Earth 26
- 2.7 Map Projection 27
- 2.8 Establishing a Spatial Framework for Mapping Locations on Earth: Georeferencing 32
- 2.9 Acquisition of Spatial Data for the Terrain: Topographic Mapping 48
- 2.10 Attribute Data for Thematic Mapping 54
- 2.11 Summary 60
- References 60

3 Digital Representation of Geographic Data 63

- 3.1 Introduction 64
- 3.2 Technical Issues Pertaining to Digital Representation of Geographic Data 69
- 3.3 Database and Database Management Systems 75
- 3.4 Raster Geographic Data Representation 80
- 3.5 Vector Data Representation 84
- 3.6 Object-Oriented Geographic Data Representation 92
- 3.7 The Relationship Between Data Representation and Data Analysis in GIS 99
- 3.8 Summary 100
- References 101

4 Data Quality and Data Standards 103

- 4.1 Introduction 104
- 4.2 Concepts and Definitions of Data Quality 104
- 4.3 Components of Geographic Data Quality 108
- 4.4 Assessment of Data Quality 112
- 4.5 Managing Spatial Data Errors 119
- 4.6 Geographic Data Standards 123
- 4.7 Geographic Data Standards and GIS Development 130
- 4.8 Summary 131
- References 132

5 Raster-Based GIS Data Processing 135

- 5.1 Introduction 136
- 5.2 Acquiring and Handling Raster Geographic Data 143
- 5.3 Raster-Based GIS Data Analysis 152
- 5.4 Output Functions of Raster Data Processing 168
- 5.5 Cartographic Modeling 175
- 5.6 Summary 181
- References 182

6 Vector-Based GIS Data Processing 184

- 6.1 Introduction 185
- 6.2 Characteristics of Vector-Based GIS Data Processing 185
- 6.3 Vector Data Input Functions 189
- 6.4 Nontopological GIS Analysis Functions 201
- 6.5 Feature-Based Topological Functions 206
- 6.6 Layer-Based Topological Functions 208
- 6.7 Vector-Based Output Functions 216
- 6.8 Application Programming 219
- 6.9 Summary 222
- References 224

7 Visualization of Geographic Information and Generation of Information Products 225

- 7.1 Introduction 226
- 7.2 Cartography in the Context of GIS 226
- 7.3 Human-Computer Interaction and GIS 228
- 7.4 Visualization of Geographic Information 233
- 7.5 Principles of Cartographic Design in GIS 242

- 7.6 Generation of Information Products 248
- 7.7 Summary 261
- References 262

8 Remote Sensing and GIS Integration 265

- 8.1 Introduction 266
- 8.2 Principles of Electromagnetic Remote Sensing 266
- 8.3 Remote Sensing System Classifications 269
- 8.4 Imaging Characteristics of Remote Sensing Systems 270
- 8.5 Extraction of Metric Information from Remotely Sensed Images 274
- 8.6 Extraction of Thematic (Descriptive or Attribute) Information from Remotely Sensed Images 287
- 8.7 Integration of Remote Sensing and GIS 297
- 8.8 Summary 301
- References 302

9 Digital Terrain Modeling 305

- 9.1 Introduction 306
- 9.2 Definitions and Terminology 306
- 9.3 Approaches to Digital Terrain Data Sampling 307
- 9.4 Acquisition of Digital Terrain Data 312
- 9.5 Data Processing, Analysis, and Visualization 322
- 9.6 Applications of Digital Terrain Models 340
- 9.7 Summary 345
- References 346

10 Spatial Analysis and Modeling 349

- 10.1 Introduction 350
- 10.2 Descriptive Statistics 350
- 10.3 Spatial Autocorrelation 351
- 10.4 Quadrat Counts and Nearest-Neighbor Analysis 353
- 10.5 Trend Surface Analysis 358
- 10.6 Gravity Models 358
- 10.7 Network Analysis 361
- 10.8 GIS Modeling 365
- 10.9 Summary 372
- References 374

11 GIS Implementation and Project Management 376

- 11.1 Introduction 377
- 11.2 Software Engineering as Applied to GIS 377
- 11.3 GIS Project Planning 380
- 11.4 Systems Analysis and User Requirements Studies 383
- 11.5 Geographic Database Design Methodology 392
- 11.6 GIS Application Software Design Methodology 405
- 11.7 Systems Implementation and Technology Rollout 409
- 11.8 Systems Maintenance and Technical Support 414
- 11.9 Summary 417
- References 418

12 GIS Issues and Prospects 419

- 12.1 Introduction 420
- 12.2 Issues of Implementing GIS 420
- 12.3 The Trend of GIS Development 426
- 12.4 Frontiers of GIS Research 439
- 12.5 Conclusions 443
- References 444

APPENDIX A Internet Resources for GIS 447

- A.1 Introduction 448
- A.2 Where to Start the Search? 448
- A.3 Pointers to Information Resources 449
- A.4 Pointers to Data Resources 451
- A.5 Pointers to Product Information 453
- A.6 Examples of Internet-Based GIS Applications 455
- A.7 Major GIS, Cartography, Remote Sensing, Photogrammetry, and Surveying Journals 456
- References 456

APPENDIX B Glossary of GIS Terms 457

Photo and Figure Credits 475

Index 477