

Contents at a Glance

<i>Introduction</i>	1
<i>Part I: GIS: Geography on Steroids</i>	7
Chapter 1: Seeing the Scope of GIS	9
Chapter 2: Recognizing How Maps Show Information	23
Chapter 3: Reading, Analyzing, and Interpreting Maps	39
<i>Part II: Geography Goes Digital</i>	57
Chapter 4: Creating a Conceptual Model	59
Chapter 5: Understanding the GIS Data Models	73
Chapter 6: Keeping Track of Data Descriptions	93
Chapter 7: Managing Multiple Maps	109
Chapter 8: Gathering and Digitizing Geographic Data	117
<i>Part III: Retrieving, Counting, and Characterizing Geography</i>	135
Chapter 9: Finding Information in Raster Systems	137
Chapter 10: Finding Features in Vector Systems	147
Chapter 11: Searching for Geographic Objects, Distributions, and Groups	165
<i>Part IV: Analyzing Geographic Patterns</i>	181
Chapter 12: Measuring Distance	183
Chapter 13: Working with Statistical Surfaces	199
Chapter 14: Exploring Topographical Surfaces	213
Chapter 15: Working with Networks	225
Chapter 16: Comparing Multiple Maps	239
Chapter 17: Map Algebra and Model Building	253
<i>Part V: GIS Output and Application</i>	277
Chapter 18: Producing Cartographic Output	279
Chapter 19: Generating Non-Cartographic Output	293
Chapter 20: GIS in Organizations	301

<i>Part VI: The Part of Tens</i>	315
Chapter 21: Ten GIS Software Vendors	317
Chapter 22: Ten Questions to Ask Potential Vendors	329
Chapter 23: Ten GIS Data Sources	333
<i>Index</i>	343

Table of Contents

<i>Introduction</i>	1
About This Book	1
Conventions Used in This Book	1
What You're Not to Read	2
Foolish Assumptions	2
How This Book Is Organized	3
Part I: GIS: Geography on Steroids	3
Part II: Geography Goes Digital	3
Part III: Retrieving, Counting, and Characterizing Geography	3
Part IV: Analyzing Geographic Patterns	4
Part V: GIS Output and Application	4
Part VI: The Part of Tens	4
Icons Used in This Book	4
Where to Go from Here	5
<i>Part 1: GIS: Geography on Steroids</i>	7
Chapter 1: Seeing the Scope of GIS	9
Getting a Feel for GIS	10
Meeting the GIS Collective	11
Accumulating geographic data	11
Adding the right computing power	12
Providing display and representation	13
Working with people	14
Knowing How to Think Spatially	15
Recognizing the spatial nature of questions	16
Discovering what's so special about spatial data	17
At Least 101 Uses of GIS	20
Managing business activities	20
Planning city operations and expansion	21
Providing protection and emergency services	21
Land management and conservation	21
Military and defense-related tasks	21
A treasure chest of possibilities	22
Chapter 2: Recognizing How Maps Show Information	23
Knowing How Maps Represent Geography	23
Understanding scale	24
Interpreting symbols	25
Incorporating symbols into your map	26



- Recognizing the Different Types of Maps 27
 - Reading reference maps..... 28
 - Using thematic maps 29
 - Grasping the importance of scale 30
- Working with Projections and Datums 31
 - Picking the right projections 32
 - Good projections depend on accurate datums 33
- Working with Coordinate Systems and Land Subdivisions 34
 - Meeting the Universal Transverse Mercator
(I know you want to)..... 35
 - Measuring the land 36

Chapter 3: Reading, Analyzing, and Interpreting Maps. 39

- Making Sense of Symbols 40
 - Categorizing the space on a map..... 40
 - Understanding levels of measurement 41
 - Understanding the relationship between
symbology and data measurement..... 42
- Recognizing Patterns 44
 - Identifying random distributional patterns 45
 - Finding clustered distributional patterns 46
 - Observing uniform distributional patterns 47
 - Seeing patterns among dissimilar features 47
 - Describing patterns with linear features 48
 - Understanding the repeated sequence of shapes 48
- Analyzing and Quantifying Patterns 50
 - Knowing your geometry and patterns 51
 - Using GIS software for the analysis 52
 - Determining the type of pattern 52
 - Identifying even more patterns 55
- Interpreting the Results and Making Decisions 55

Part II: Geography Goes Digital..... 57

Chapter 4: Creating a Conceptual Model. 59

- Helping Computers Read Maps 60
- Embracing the Model-Creation Process 60
- Defining Your Map’s Contents 61
 - Choosing a theme to map 61
 - Applying the methodology to any GIS project 62
 - Breaking down the data you want to include..... 63
 - Verifying your data’s characteristics 65

Converting from Map to Computer	66
Deciding how to represent your map.....	66
Weighing the benefits: Raster versus vector.....	71
Chapter 5: Understanding the GIS Data Models	73
Examining Raster Models and Structure	73
Representing dimension when everything is square	74
Making a quality difference with resolution.....	75
Finding objects by coordinates	76
Finding grid cells by category	77
Working with map layers	78
Linking objects and descriptions.....	79
Exploring Vector Representation	79
Simple forms of vector representation	79
Complex forms of vector representation.....	81
Dealing with Surfaces	89
Storing surface data in a raster model	89
Representing surfaces in a vector model	90
Chapter 6: Keeping Track of Data Descriptions	93
Knowing the Simple Systems for Tracking Descriptions.....	94
Understanding computer-assisted cartography	94
Using computer-aided design.....	95
Exploring raster systems	96
Working with Tables and Database Management Systems.....	98
Structuring simple relational data.....	98
Getting more complex with relational joins	100
Managing data in Vector GIS	101
Storing data in Raster GIS	102
Searching with SQL in any GIS	103
Understanding Object-Oriented Systems	104
Storing attributes with object-oriented systems	104
Using object orientation to enhance descriptive information.....	105
Knowing the packaging descriptions for different objects	105
Chapter 7: Managing Multiple Maps	109
Layering Data in GIS Models	110
Comparing the Map-Handling Capabilities of GIS System Models	110
Checking out a hybrid system model.....	111
Eliminating pointers with integrated system models	113
Getting better control with object-oriented system models.....	114
Opting for an Object-Oriented Model	115

Chapter 8: Gathering and Digitizing Geographic Data 117

Identifying Quality Data	117
Importing Statistical and Sensory Data	118
Getting information from GPS data.....	119
Using remote sensing to create maps	120
Collecting field data.....	123
Working with census data	124
Getting Existing Map Data into the Computer	125
Forms of digitizing	125
Preparing your map for digitizing.....	129
Deciding what to digitize	130
Cleaning up after digitizing.....	131
Building the metadata	132

Part III: Retrieving, Counting, and Characterizing Geography 135**Chapter 9: Finding Information in Raster Systems 137**

Creating a Search Strategy	138
Locating objects on a map.....	138
Searching for linear features	140
Searching for areas and distributions	140
Using the Software to Perform a Search	141
Searching in simple raster systems	141
Searching DBMS-supported raster systems	143
Counting and Tabulating the Search Results	144
Getting simple statistics.....	144
Interpreting the results	145

Chapter 10: Finding Features in Vector Systems 147

Getting Explicit with Vector Data	148
Seeing How Data Structure Affects Retrieval	149
Deciding How to Search the Systems	151
Targeting the right data source	152
Keeping the expected result in mind	152
Locating Specific Features with SQL	152
Getting to the point(s).....	153
Keeping your searches	157
What's my line?	158
Searching Vector Systems using Geography	160
Counting, Tabulation, and Summary Statistics	161
Validating the Results	162

Chapter 11: Searching for Geographic Objects, Distributions, and Groups 165

Searching Polygons in a GIS	166
Searching for the Right Objects	166
Extracting specific information	167
Knowing the size of each polygon	168
Working with concentrations of point objects	168
Reorganizing data	169
Locating 2-D Map Objects	170
Searching based on category	170
Finding polygons based on level	171
Looking for polygons based on value	173
Locating polygons based on size, shape, and orientation	173
Finding polygons based on location and position	175
Defining the Groups You Want to Find	176
Looking for common properties	176
Looking for common positioning	177
Grouping by what you already know	179

Part IV: Analyzing Geographic Patterns 181

Chapter 12: Measuring Distance 183

Taking Absolute Measurement	183
Finding the shortest straight-line path	184
Measuring Manhattan distance	187
Calculating distance along networks	188
Working with buffers	188
Establishing Relative Measurement	191
Adjacency and nearness	191
Separation and isolation	192
Containment and surroundedness	193
Measuring Functional Distance	194
Anisotropy (whew!) — non-uniformity	195
Accounting for physical parameters	195
Based on intangibles	196
Creating the functional surface	196
Calculating the functional distance	198

Chapter 13: Working with Statistical Surfaces 199

Examining the Character of Statistical Surfaces	199
Understanding discrete and continuous surfaces	201
Exploring rugged and smooth surfaces	201
Climbing steep surfaces	202
Determining slope and orientation	203

Working with Surface Data.....	204
Collecting surface data for entire areas.....	204
Sampling statistical surfaces.....	205
Displaying and analyzing Z values.....	207
Ignoring the rules.....	208
Predicting Values with Interpolation.....	209
Determining values with linear interpolation.....	209
Using non-linear interpolation.....	210
Estimating values with distance-weighted interpolation.....	211
Knowing the other exact interpolation methods.....	212

Chapter 14: Exploring Topographical Surfaces 213

Modeling Visibility with Viewsheds.....	213
The importance of viewshed analysis.....	214
Using ray tracing.....	215
Finding and Using Basins.....	217
Knowing how basins work.....	217
Working with basins in your GIS.....	218
Characterizing Flow.....	219
Knowing the importance of flow.....	219
Modeling and using flow.....	220
Defining Streams.....	222
Finding and quantifying streams.....	222
Identifying methods that work for you.....	224

Chapter 15: Working with Networks 225

Measuring Connectivity.....	225
Recognizing the importance of connectivity.....	226
Measuring and using connectivity.....	226
Working with Impedance Values.....	227
Knowing when your paths are fast or slow.....	227
Modeling impedance for traffic flow.....	228
Working with One-Way Paths.....	229
Understanding unidirectional paths.....	229
Modeling unidirectional paths.....	229
Characterizing Circuitry.....	230
Knowing when lines create circuits.....	230
Measuring and modeling circuits.....	231
Working with Turns and Intersections.....	232
Recognizing the importance of turns and intersections.....	232
Encoding and using turns and intersections.....	232
Directing Traffic and Exploiting Networks.....	234
Finding the shortest path, or route.....	234
Finding the fastest path.....	235
Finding the nicest path.....	237
Finding the service areas.....	237

Chapter 16: Comparing Multiple Maps..... 239

Exploring Methods of Map Overlay.....	240
Finding points in polygons	241
Finding lines on polygons	243
Using Logical Overlay to Compare Polygons.....	245
Searching with union overlay.....	245
Using intersection overlay.....	246
Understanding complement or symmetrical difference overlay	247
Using identity overlay	248
Comparing geometry with clip overlay.....	249
Understanding Raster Overlay.....	250
Comparing Features with Selective Overlay	250

Chapter 17: Map Algebra and Model Building 253

Creating Cartographic Models	253
Understanding Map Algebra	254
The Language of Map Algebra	256
Performing Functions with Map Algebra.....	256
Exercising control.....	257
Using local functions	258
Using focal functions	259
Exploring zonal functions	264
Understanding block functions	268
Using global functions	269
Formulating a Model	270
Making a formulation flowchart.....	271
Basing your database on your flowchart.....	273
Implementing a Model	273
Testing a Model	275
Determining whether the software is working correctly.....	275
Assessing whether the model gives adequate results	276
Gauging whether your model makes sense.....	276
Ensuring that your model satisfies the user.....	276

Part V: GIS Output and Application..... 277**Chapter 18: Producing Cartographic Output 279**

Exploring Traditional Maps	280
Mapping qualitative data	280
Mapping quantitative data.....	281
Creating classes	283
Using map elements	284
Factoring in graphic map design	286

Understanding Cartograms	287
Attracting attention with area cartograms	288
Distorting distance with linear cartograms	290
Mapping sequence with routed line cartograms	290
Chapter 19: Generating Non-Cartographic Output	293
Looking for Routings and Travel Directions	294
Getting Customer Lists and Statistical Data.....	294
Producing Alarms and Signals (Audio and Video).....	297
Benefiting from Virtual Output	297
Animating your maps	297
Getting the most from flythroughs	298
Chapter 20: GIS in Organizations	301
Understanding How Your Organization's Interactions Change.....	301
Categorizing the Types of Organizations That Use GIS.....	302
Private/commercial	303
Government.....	304
Non-profit/educational	305
Designing and Introducing a GIS for Your Organization.....	306
Understanding how technology affects organizations.....	307
Managing people problems	308
Planning for integration	309
Looking Before You Leap (And Afterwards, Too).....	310
Performing needs analysis.....	310
Performing a cost/benefit analysis	311
Understanding initial versus ongoing analysis	313
Using Change Detection.....	313
Technological change	314
Institutional change.....	314
 Part VI: The Part of Tens.....	 315
Chapter 21: Ten GIS Software Vendors	317
Environmental Systems Research Institute	317
PitneyBowes MapInfo Incorporated.....	320
Intergraph.....	321
Clark Laboratories.....	323
Autodesk, Inc.....	324
GE Smallworld	324
PCI Geomatics	325
Leica Geosystems	326
Bentley GIS	327
GRASS GIS	327

Chapter 22: Ten Questions to Ask Potential Vendors	329
What Services Do You Offer?	329
Can You Show How Your Product Will Meet My Needs?	330
What Data Formats Does Your Product Support?.....	330
How Do You Handle Communications and Change Requests?	330
What Hardware Expertise Do You Have?	331
What Does the Price Include?	331
How Long Until the System Is Operational?	331
What Happens If the System Crashes?	332
What Are Your Quality-Control Procedures?.....	332
What Are Your Performance Guarantees?	332
Chapter 23: Ten GIS Data Sources	333
GIS Data Depot	336
Environmental Systems Research Institute	337
National Geospatial Data Clearinghouse	337
Center for International Earth Science Information Network (CIESIN).....	339
Go-Geo!.....	339
Instituto Nacional de Estadística Geografía e Informática (INEGI)	340
CGIAR Consortium for Spatial Information (CGIAR-CSI)	340
Australian Consortium for the Asian Spatial Information and Analysis Network (ACASIAN).....	340
Geoscience Australia.....	341
Canada Geospatial Data Infrastructure	341
<i>Index</i>	343