# Beyond Mapping: Concepts, Algorithms and Issues in GIS

### by Joseph K. Berry (1993, John Wiley Publishers)

*…available for purchase online from Wiley.com and Amazon.com (about $95)*

*<click here> for printer-friendly version (.pdf) ; posted online line at www.innovativegis.com/basis/Books/bm_des.htm*

*Most desktop mapping and GIS applications have focused on mapping and spatial data management for viewing and geo-query of mapped data.  Map analysis and GIS modeling involve entirely new spatial reasoning concepts and procedures that are not reflected in our paper map legacy.  This book and its companion book, Spatial Reasoning for Effective GIS (Berry, 1995), are based on Joe Berry's popular "Beyond Mapping" columns in GIS World magazine and, discusses the new breed of map analysis tools and how they can be used to better characterize and communicate spatial relationships.  Both books are written for GIS professionals, as well as novices, in a witty style that entertains as well as informs.*

*Beyond Mapping explores the basic concepts of Geographic Information Systems (GIS) technology and discusses the issues involved as GIS moves from the researcher to the general user.  The emerging technology goes beyond traditional mapping and spatial data management to new concepts and procedures for modeling the complex interrelationships among spatial data of all kinds.  Beyond Mapping is designed so the general user can read about broad issues and then delve into more detail, even at the algorithm level.*

*The book also contains an extensive resource appendix and a stimulating discussion of "The Ten Most Beautiful Formulae in GIS," by Nigel Waters.*

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*The MapCalc software by BASIS provides hands-on exercises supporting the topics in this book.  Professional and Developer versions of the software are in development.  The Educational version, MapCalc Learner and support materials are available for free download from www.innovativegis.com, see "Software" item.*

**Evaluation Version**
**MapCalc Tutorials**
**MapCalc Data Sets**
**MapCalc User's Manual**

*— MapCalc Learner with MapCalc and Surfer\* tutorial systems, exercises/databases, and application examples; constrained 100 x 100 analysis frame; licensed for educational use.* Free download.

*— Instructor Materials containing lecture PowerPoint's, additional exercises and exam questions/answers; multiple seat license for single computer lab; educational use only; two CD set; US$45.00 plus shipping and handling.*

*\*Surfer is a popular surface modeling and 3D display package by Golden Software, Inc.  It is bundled with the educational version of MapCalc and provides complementary exercises.  For more information on Surfer, link to  http://www.goldensoftware.com/frames/surferframe.htm*

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## Beyond Mapping: Concepts, Algorithms and Issues in GIS

*This is a collection of Joe Berry's popular "Beyond mapping" columns published in GeoWorld from 1989 to 1993.  In this compilation, Berry explores the concepts of geographic information systems (GIS) technology and discusses the issues involved as GIS moves from the researcher to the general user.   This emerging technology goes beyond traditional mapping and spatial database management to new concepts and procedures for modeling the complex interrelations among spatial data of all kinds.  Beyond Mapping is designed so the general user can read about broad issues then delve into more detail, even to the algorithm level.   The material presented in Beyond Mapping is cross-referenced to the companion GIS Concepts Digital Slide Shows (gCON) and Tutorial Map Analysis Package (tMAP) software.  The gCON system is designed for self-learning map analysis concepts through slide sets demonstrating GIS procedures and applications.  The tMAP software program is designed for self-learning map analysis concepts through "hands-on" experience.*

*Note: The original gCON Digital Slides Shows have been replaced by the online MapCalc Description and Examples document and the tMAP software has been replaced by the MapCalc Learner software (free download at www.innovativegis.com, under "Software").*

- **Introduction —** There are some similarities, but many differences, between traditional and GIS maps. This section describes the conceptual differences and terminology used in vector and raster map formats and an overall organizational structure for GIS databases.

- **Topic 1 Maps As Data and Data Structure Implications —** The full impact of numerical representation of spatial data in GIS is just beginning to be recognized.  In this section the implications of vector

and raster data models on encoding, storage, and analysis are discussed. The inherent statistical characterizations of mapped data and their implications in map analysis are described.

- **Topic 2 Measuring Effective Distance and Connectivity** — Before GIS technology, the concept of distance was as simple and straightforward as a ruler. Now the traditional concept of distance is first extended to one of proximity, then to one of actual movement in geographic space, around and through barriers. Procedures and applications of optimal path analysis over continuous map surfaces also are presented.

- **Topic 3 Roving Windows: Assessment of Neighborhood Characteristics** — The information surrounding a point often provides insight into spatial problem solving. Neighborhood summaries can be derived from surface configuration to produce slope, aspect and profile maps. Or, the summaries can relate to the context of the neighborhood for such procedures as spatial interpolation, smoothing, and diversity analysis. More than any other class of operations, roving windows provide entirely new applications for map analysis.

- **Topic 4 What GIS Is and Isn't: Spatial Data Mapping, Management, Modeling and More** — Most initial applications of GIS automate current cartographic practices. However, the greatest return on investment in GIS technology is realized through entirely new applications inspired by the new set of map analysis tools. This section develops an awareness of the considerations and conditions that move user perspective from computer mapping to spatial database management to application modeling and beyond.

- **Topic 5 Assessing Variability, Shape, and Pattern of Map Features** — The shape and pattern of landscape features are readily apparent to the eye but historically difficult to quantify. This section describes several indices used in characterizing the configuration and arrangement of features.

- **Topic 6 Overlaying Maps and Characterizing Error Propagation** — Overlaying maps is at the heart of most GIS applications. However, the propagation of errors needs to be characterized and included with the overlay results. This section describes approaches used in establishing map uncertainty and assessing error propagation.

- **Topic 7 Overlaying Maps and Summarizing the Results** — In GIS overlaying maps goes beyond traditional procedures of "sandwiching" map sheets on a light-table. In this section, procedures for point-by-point, region-wide, and map-wide overlay summaries are described. Numerous applications and the underlying concepts are presented.

- **Topic 8 Scoping GIS: What to Consider** — GIS technology is a radical departure from traditional map processing; therefore, assessing its potential within an organization needs to go beyond traditional cost-benefit analysis. This section describes the major organizational, social, and personal ramifications of implementing GIS.

- **Topic 9 Slope, Distance and Connectivity: Their Algorithms** — At first encounter, many of the advanced GIS analytical operations are intimidating. However, a basic understanding of the computer's procedures is needed to assess the potential and limitations of the new tools. This section describes various approaches used in computing slope, effective distance, optimal paths and visual connectivity.

- **Topic 10 Cartographic and Spatial Modeling** — Many GIS applications take the technology well beyond mapping and into the larger field of mathematical modeling. This section discusses command "macro" construction, the mathematical implications, and the use of GIS models in consensus building and conflict resolution.

- **Epilog** — We have been creating and using mapped for thousands of years. This section looks at GIS's history, current trends and probable future.

- **Appendices** — Appendices are included that describe the companion software for self-learning GIS concepts and applications, a listing of GIS resources, and a glossary of terms by Bruce L. Kessler.

*The **Spatial Reasoning for Effective GIS** book can be purchased online from Wiley.com and Amazon.com.*

*For more information about the Spatial Reasoning book and supporting materials, contact:*

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