

utilize a user-oriented study to compare manual and computer generated cartograms in regards to cartogram accuracy, the time it takes to complete a cartogram, and perhaps even cartogram aesthetics. Note that Visual Basic is becoming an increasingly popular programming language in both commercial mapping and educational environments (Slocum and Yoder, 1996). Cartographers and software developers using Visual Basic could benefit from user interface studies, because there are scores of possible menu, icon, and interactive/dynamic map display combinations which can lead to a potentially non-intuitive user interface.

DiBiase et. al. (1992) have suggested that with a quarter century of experience with perception testing, cartographers may now be more prepared than ever to study map animation communication. And with the acceleration of interactive virtual map use and the proliferation of such mapmaking software, user-oriented testing can also apply to electronic atlases and encyclopedias, scripted and menu driven software packages that are increasingly being used by non-cartographers, and new software programs that are being developed by the cartographic community. Obviously, we need to know much more about how interactive electronic media and animated map environments influence the communication of cartographic information.

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reviews

Exploring Geographic Information Systems, Nicholas Chrisman. New York, John Wiley & Sons, Inc., 1997. 298 pages, maps, diagrams, equations, 12 page index. \$49.95, softcover. ISBN 0-471-10842-1.

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The organizing framework for *Exploring Geographic Information Systems* by Nicholas Chrisman looks at the subject in five ways simultaneously: as a technical problem, an empowering application, a scientific endeavor, an academic pursuit, and as a social necessity. Chrisman suggests that a GIS can be approached from any one of these, but one by itself is not adequate. He presents the diversity of GIS with a nested scheme of 6 rings, grouped into 3 parts of the book. Part 1 covers Measurement (chapters 1 and 2), and Representation (chapter 3). Part 2 covers Operations (chapters 4 through 8) and Transformations (chapter 9). Part 3 looks at the broader context of GIS, from the Institutional (chapter 10)

and the Social and Cultural Context (chapter 11). As mentioned in the preface, the author has over 12 years of teaching experience in the subject area and believes it is important to focus on critical thinking in his courses, "confronting real dilemmas, not simplified examples or abstract theories." This is definitely the case in this book. The examples, and the technical descriptions, are both very thorough. The book has many references to prior methods of cartography, as well as suggestions for the user about conversions, databases, and cartographic representation of data.

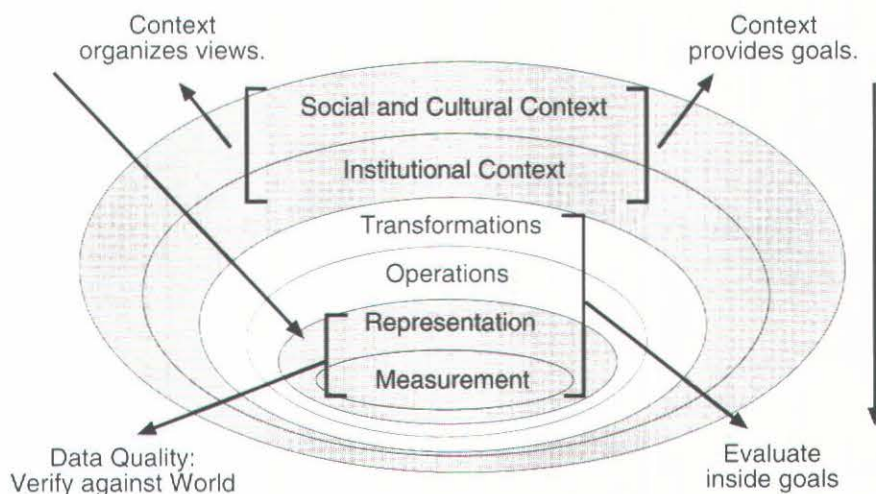
Part 1: Building Blocks of Geographic Information

In Part 1 the author covers measurement and representation. He suggests that the process of geographic measurement (the first ring) requires choices that can be organized as measurement frameworks. The measurement framework differences best explain, he says, the technical choices of representation (the second ring). Measurement and representation strongly influence operations (third ring). Transformations, the fourth ring, is the conversion from one measurement framework to

another. With this hierarchy of rings, Chrisman shows that each ring builds on decisions made at the lower or "simpler" levels. He also shows that GIS is more than just vectors, rasters, and linkages to attributes and promotes the critical details of Stevens' scheme of nominal, ordinal, interval and ratio measurements. Chrisman points to gaps in Stevens' scheme when applied to GIS and provides three reference systems as examples: Temporal (has an origin-time to call zero), Spatial (the brief introduction brings out the complexity of this level of measurement), and attribute (includes Stevens' plus several more).

Chapter 1 starts with the innermost ring in the 6-ring diagram of GIS-Measurement. Chrisman defines geographic information (Chrisman rarely uses GIS, rather the reference "geographic information"), reviews the conventional approach to measurement, and introduces reference systems for measurements of time, space, and attributes. He starts the chapter with a good description of map use including: civil engineering, cartography, surveying and the introduction of global positioning systems (GPS). An important point is made about the tendency to cling to the printed map as a model for digital development. This, Chrisman points out, has been a large barrier to GIS progress. He goes on to provide a definition for GIS and cites the general definition widely accepted by Dueker and Kjerne 1989. However, he adopts the following definition for the perspective of this book: GIS-The organized activity by which people: measure, represent, operate, and transform geographic phenomena. Each of these activities is expanded upon in the book. The conventional view of measurement is also detailed.

Chapter 2 deals extensively with Measurement Frameworks, which are the set of rules for measure-



ment. An example, taken from the book, is that of the geographical matrix. Basically a geographic object such as a city or state, has attributes. Chrisman then goes on to examine the three components of geographic information: time, space and attribute. He describes each as they serve as control, while one of the others (e.g. space) can be measured. Additionally, he suggests that, in geographic relationships, there are composites, indirect measurements, choropleth, and temporal that are all measurements frameworks for geographic information.

Chapter 3 describes the translation of measurement schemes into practical systems of representation. Substantial treatment of the conversion from paper maps to digital form (e.g. hardcopy maps into the computer-digitizing/scanning) is given. Chrisman discusses the details of representations of geographic information. Not just vector and raster differences and digitizing, but also computer storage explained with bits, bytes, integers, floating point, and double precision representation. However technical this may be to the reader, it provides a very good understanding of data representation. For example, a remotely sensed image, which is a continuous measurement, may be rescaled into a range from 0 to 255 to be coded as an integer, thus possibly losing data. Chrisman gives a very good description for vector and reintroduces the notion that the geographic information and decisions regarding the system should be tailored to the purpose of the project or enterprise. The chapter includes an in-depth discussion on digitizing including the pitfalls especially with accuracy variations. To help avert this, quality control and data checks are explained in regard to topology and digitizing.

Part 2: Operations and Transformations

Part 2 tackles the next two rings, operations and transformations, which comprise the majority of the book. Chrisman defines an operation, the third ring, as "the procedures that manipulate the information to construct new relationships or to make new measurements" the analytical basis of GIS. When an operation converts the information into a new measurement framework, it is called a transformation, the fourth ring. The final chapter of this section presents transformations as the culmination of the operations from chapters 4 through 8. The first two rings, measurement and representation, occur in a specific order. However, in operations and transformations, there is not as clear of a boundary. The 3rd ring, operations, takes 5 chapters discussing groups of tools in increasing complexity. Operations are the procedures that manipulate the information to construct new relationships or to make new measurements. Special operations convert the information into a new measurement framework, so they are termed transformations. The reader must get the measurement framework reference that Chrisman is making, since it is referred to throughout the book, starting with chapter 2. The definition given for measurement frameworks is "rules for control of other components of a phenomenon that permit measurement of one component - GIS has 3 components: time, space and attribute."

Chapter 4 starts with the manipulation of attributes within one geographic entity (i.e. cities). For example, reducing and increasing information content. Chrisman points out the different affects, and possibly additional data needed, between decreasing and increasing information content. Chapter 4 ends with a discussion of the interaction between attributes and spa-

tial components. An example is given in converting detailed land use categories to more generalized urban/rural categories. From this simple example Chrisman sheds light on the uses of aggregation and isolation and how certain categories can cause problems by not falling neatly into two categories.

Chapter 5 discusses overlay of different geographic data sets, in contrast to chapter 4, which deals with analysis within a geographic theme. The origins of the map overlay procedure are described in detail and the actual overlay operation is explained for both raster and vector mapping. Some history on the debate between vector and raster is also provided. Various uses of overlay are presented such as detecting differences in land use change over time. Chapter 5 details taxonomy of overlay combinations, which are broken into three groups: dominance rules, contributory rules, and interaction rules. This is a good description of the process and the rules used to accomplish various overlays. Several very good examples are given to help the reader tackle overlay problems.

Chapter 6 covers distance relationships such as vector buffers, and distance fields for rasters. The processes of how the buffers and distance fields are created are explained and comparisons are given for both. Voronoi diagrams, or as many geographers are familiar with-Thiessen polygons, are introduced at the end of the chapter. This method is introduced as a form of control through relationships, rather than control by attribute or space as in vectors and rasters respectively.

Chapter 7 describes neighborhood construction and the topology of surfaces. A challenge for the student of geographic information is given to ensure they understand what and how to use the term: topology of the topography. In this chapter Chrisman provides a de-

scription of how to compute relationships on a surface. Also, neighborhood operations are described and compared to overlay procedures. The complexity of neighborhood operations is discussed leading to the construction of neighborhoods. This is followed by a comparison of vector and raster neighbors, and finally we get taxonomy of neighborhood operations.

Chapter 8 deals with the last set of operations: comprehensive operations. This includes neighborhoods, location-allocation methods, and statistical analysis and GIS. This chapter deals with the complex operations a GIS undertakes, taking into account not only the surroundings, but also what is going on elsewhere. The author covers this complexity in three parts in this chapter: first with iterative operations, where the result at one place can propagate to influence the results elsewhere. The second group deals with location-allocation models, where the strategy is to find the most practical solution, possibly not the optimal one. The chapter concludes with a summary of the whole distribution with statistical models.

Chapter 9, covers the 4th ring, transformations of information from one form to another. This chapter looks at past approaches to transformations in analytical cartography, operations to transform surface information, and develops taxonomy for transformations. Chrisman admits that many of the operations presented in the book to this point could be considered transformations, but this chapter focuses on conversions between measurement. Chrisman calculates there are 144 transformations for the operations introduced in his book. Because of the large number, and mostly to make a point, he only deals with surface transformations in this chapter—a total of 16 transformations. A few good examples of transformations are given at the end of the chapter to

help the reader understand the utility.

Part 3: The Broader Context

Part 3 suggests evaluating a GIS not only on technical merit but also how it meets the goals for the project. This section covers the measures of evaluation and the procedures to implement a GIS. Part 3 tries to focus on the purpose behind doing a GIS in the first place. The final 2 rings are explained to the reader by covering the broader context of institutional, social and cultural issues with regard to geographic information. First, in Chapter 10 the author looks at the process of evaluating the operation of a system and its implementation. Measures that are used to evaluate geographic information systems are reviewed, and a description of database design procedures in implementing geographic information systems is given.

The goal of Chapter 11 - Social and Institutional Context is to examine how the social and institutional context shapes and constrains the use of geographic information. Chrisman starts the chapter with a discussion on mapmaking throughout history, followed by a section on the "geography of geographic information". A discussion of how the needs for geographic information arose is covered. Basic political problems are covered in this chapter since GIS often affect many departments. Information equity, access and balance of competing concerns are addressed from this social context with references to GIS.

The author's goal is to have the reader examine, and explore GIS based on a nested scheme of 6 rings. These progress from measurement, to representation to operations & transformations, to an institutional, social & cultural context. He definitely covers these rings and how they interrelate. He shows their importance and uses

their hierarchical structure for the book's foundation. The technical aspects of GIS are covered very well, in order for the reader to "master this powerful new technology". However, the book does not give as much depth to the final two rings, Institutional, Social and Cultural Context, which is misleading when viewing these two large rings in the nested scheme of rings diagram. Chrisman does inform the reader in the preface that the organizational views are missing from most technical literature on GIS, and that view is needed since a GIS is developed and maintained for a reason. So to that end, even though it is sparse, it is at least included. To the author's credit, the brevity does not take away from the content; Chrisman packs a lot of information in the last part of the book.

Chrisman does a good job of covering the breadth of GIS while also providing the user with plenty of references and technical descriptions of GIS. The author does admit early on that this is a book to begin exploration of GIS, not to cover all aspects. However, this book is not meant for users starting out with new desktop GIS software. Even though the suggestions in it are very useful, the level of technical knowledge is well beyond a business executive, or a crime analyst who may be using GIS occasionally to answer spatial questions. This book would better serve a GIS analyst, student of geographic information, or anyone charged with implementing or maintaining a GIS.

This book is unlike many other GIS books that focus on the people, data, software, hardware, and processes, or those that discuss the potential uses of GIS. This book starts with a detailed description of measurements. The author gives a very good description of the vector model as it relates to GIS. He also, again, contrasts with cartography as well as drafting or illustration

software. The book does a very good job at discussing measurements, and operations on data sets (the first 4 rings), but just a small portion of the book is spent on people, and the social context required for a GIS. Chrisman wants to get across the notion of exploring GIS in his nested 6-ring context. The concept seems very valid, however, the book seemed a little off balance with the highly technical sections on surfaces, and levels of measurement, and then the very light touch on the institutional, social and cultural context. I agree with the author that many GIS books are very technically slanted. However, I doubt this book will be read, if not only understood, by those other than technically literate GIS/computer/geography users.

As I have mentioned, there are extensive references to the cartographic processes, as well as several references to surfaces, which help to make several key points in the book. However, again the level of detail and amount of information on the technical side seems to make the final two chapters out of place. For example, Chrisman spends a lot of space, relative to other topics, on compression for raster images such as the TIFF standard and quadtrees.

The order of the material was also presented slightly different than other GIS books. The very technical topics first and then the broad approach of GIS, where it fits, evaluation, etc. are at the end. Even in chapter 10: which covers evaluation and implementation, Chrisman has a list of steps to implement a GIS, and construction is of course last, with assessment and analysis for a system listed first.

I think the GIS terminology is very well explained and many examples are given. In addition, the comparison to cartography is helpful to many geographers and cartographers. However, the connection to the decision-makers interested in the "broader context" may

not be appropriate. This book is heavily focused on surfaces, cartographic background, which may not be suitable for many desktop GIS users. However, I don't think Chrisman intended it for the masses of GIS users. It is a wonderful book for someone involved with GIS, or intends on learning more about geographic information.

The author has a web site encouraging continued exploration. The web site is <http://www.wiley.com/college/chrisman>. It is a great site full of content. It includes the book's table of contents, a definition of GIS, the book's index, and more.

Overall Chrisman meets his goal of starting the reader on an exploration of GIS. Very good examples are given as well as problems to look for during the implementation and technical phases of a GIS. In addition, he makes connection from GIS to other fields, or past processes to help the user understand a concept. Some examples of how he does this are provided here. A simple example, a reminder is given to the reader regarding "standardizing" a ranking from say 1 to 9. An assignment of numbers, Chrisman reminds the reader, does not automatically construct valid arithmetical relationships. Pitfalls with digitizing are highlighted. For example, taking the digitizing tablet's resolution as a measure of accuracy. Projections and classification reductions are other examples Chrisman uses to get the reader on this exploration. Many links are made to other technologies, or just older methods of doing the same thing. Such as the overlay method taken from photo-mechanical reproduction, seeing through multiple layers. In addition to uses and specific technological tools, the author also gave specific examples from real-world projects such as the Pennsylvania project to site a disposal for radioactive waste. He used this project in

the example of overlay. Other operations are detailed, such as raster overlays to get a cost surface. A good example is given in the transformation section of the book. Chrisman explains the process of Dasymetric mapping of population density. Showing population density after taking out uninhabited areas from the pre-defined set boundaries, in this case the census tracts-also called controlled guesswork. The importance of a good cultural context is explained with the backdrop of systems that chose the hardware and software on technical merit, not the purpose of the organization.

I think current "power" users of GIS will learn interesting details and further their understanding of GIS. One of Chrisman's underlying goals, I believe, is to have the reader question some of the data or processes currently in place in a GIS department.

Shapes of Ireland: Maps and Their Makers, 1564-1839, J. H. Andrews Geography Publications, Dublin, 1997 346 p. Illus. by Sharon Hill, AGS Collection, Univ. of Wisconsin-Milwaukee

"Shapes of Ireland: maps and their makers, 1564-1839", by J. H. Andrews, successfully presents and evaluates the cartographic impacts of the mapping history of Ireland. The early cartographic styles, with both their shortcomings and genius, juxtapose with the territorial and political struggles of the lands of Ireland and Britain that differ culturally and socially. Ireland owes most of its cartographic representation to English mappers, many never having set foot on its green and hilly shore. The story is poignant and true and told with erudition. It is only by reading between the lines that one sees the reasons for its late-blooming cartographic production. From present day evidence, most of Irish carto-