1 Systems, Science, and Study

The chapter introduces the conceptual framework for the book, by addressing several major questions:

- What exactly is geographic information, and why is it important? What is special about it?
- What is information generally, and how does it relate to data, evidence, knowledge, wisdom, and understanding?
- What kinds of decisions make use of geographic information?
- What is a geographic information system (GIS)?
- What is geographic information science, and how does it relate to the use of GIS for scientific purposes?
- How do companies make money from GIS?

LEARNING OBJECTIVES

- **Know definitions of the terms used throughout the book, including GIS itself;**
- **Be familiar with a brief history of GIS;**
- **Recognize the sometimes invisible roles of GIS in everyday life, and the roles of GIS in business;**
- **Understand the significance of geographic information science, and how it relates to geographic information systems;**
- **Understand the many impacts GIS is having on society, and the need to study those impacts.**

KEY WORDS AND CONCEPTS

Knowing about ‘where’; geographic problems; scale/detail; science and practical problem solving; spatial is special; the sequence data/information/evidence/knowledge/wisdom; knowing how; GIS roles; GIS history; Internet and GIS; GIS as several businesses; ‘systems’, ‘science’ and ‘studies’

OUTLINE

CHAPTER SUMMARY

1.1 Introduction: Why does GIS matter?

- GIS are a special class of information systems that keep track not only of events, activities, and things, but also of *where* these events, activities, and things happen or exist.
- Knowing where something happens is of critical importance
- Geographic location is an important attribute of activities, policies, strategies, and plans.
- *Geographic problems*. involve an aspect of location, either in the information used to solve them, or in the solutions themselves
- Three bases for classifying geographic problems

- the scale or level of geographic detail
- the intent or purpose
    - practical problem-solving or *normative* applications, such as finding new locations
    - curiosity driven or *positive* uses that advance science, such as predicting behavior based on location
- the timescale
    - *operational* decisions required for smooth functioning of an operations
    - *tactical* decisions which are medium-term
    - *strategic* decision for long-term direction
    - *transactional* timescales at which databases are updated

- Applications Box 1.1 Hurricane Katrina, August 29, 2005, discusses how location was crucial in the emergency responses to Hurricane Katrina.
- Applications Box 1.2 Where did your ancestors come from? Illustrates curiosity driven research.

1.1.1 Spatial is Special

- The basic terms need clarification
    - *Geographic* refers to the Earth's surface and near-surface
    - *Spatial* refers to any space, often used in place of geographic
    - *Geospatial* implies a subset of spatial applied to the Earth's surface and near-surface
- Spatial is special because
    - almost all human activities and decisions involve a geographic component
    - working with geographic information involves unique, complex and difficult choices
- technical reasons are summarized in Technical Box 1.3

1.2 Data, Information, Evidence, Knowledge, Wisdom

- No universally agreed definition of these terms, however,

- *Data* are raw facts, neutral and context-free, internal meaning is irrelevant
- *Information* is data refined for some purpose or that have been given some degree of interpretation, often costly to produce but easy to add value to through processing.
- *Knowledge* is information to which value has been added by interpretation based on a particular context, experience, and purpose; it is often acquired over substantial periods and involvement in many projects.
    - *Codified* – can be written and transferred easily to others
    - *Tacit* – is slow to acquire and difficult to transfer accurately

- *Evidence* – is halfway between information and knowledge, a multiplicity of information from different sources whose selection and analysis is focused on specific problems

- *Wisdom* – used in the context of decisions made or advice given

- Table 1.2 compares and illustrates these terms

1.3 Systems and Science

- GIS are computer-based systems for storing and processing geographic information.
- GI Science (GISc) is the scientific context and underpinnings of geographic information systems

1.3.1 The science of problem solving

- Knowledge about how the world works (*process*) is more valuable than knowledge about how it looks (*form*), because such knowledge can be used to predict

    - *Idiographic* geography focuses on the description of form and emphasizes the unique characteristics of places

    - *Nomothetic* geography seeks to discover general processes

- GIS is useful as a tool for problem solving because it combines the general with the specific

- Software captures and implements general knowledge

- The database represents specific information

- General knowledge for problem solving comes in many forms
    - Classifications
    - Rule sets, some based on statistical generalisations
    - Laws
- Solving problems needs *objectives* which can be expressed in *tangible* (measured on some well-defined scales) and/or *intangible* ways. There may be multiple objectives.

1.3.2 The technology of problem solving

- Table 1.3 lists several definitions of GIS and the groups who find them useful

1.4 A brief history of GIS

- This section mentions several milestones including
    - The Canada Geographic Information System or CGIS, designed in the mid-1960s as a computerized map measuring system
    - The US Bureau of the Census and the DIME program for the 1970 census
    - Harvard University's Laboratory for Computer Graphics and Spatial Analysis which developed ODYSSEY GIS in the late 1970s
    - UK Experimental Cartography Unit pioneered high quality computer mapping from 1968 up to the mid-1970s
    - Computer mapping at the national mapping agencies
    - Remote sensing developments including military satellites, Landsat and GPS
- "The modern history of GIS dates from the early 1980s, when the price of sufficiently powerful computers fell below a critical threshold."
- Table 1.4 summarizes the major events

1.5 Views of GIS

- There are many different perspectives on GIS
    - It is clearly too much for any one software package to handle
- GIS has grown from its initial commercial beginnings as a simple off-the-shelf package to a complex of software, hardware, people, institutions, networks, and activities that can appear very confusing to the novice.

1.5.1 Anatomy of a GIS

1.5.1.1 The network

- This section offers a brief history of the Internet and its impacts
- The links between GIS and the Internet are described, as a vehicle for delivering information, applications and services (including location-based services)

1.5.1.2 The other five components of GIS

- Figure 1.16 illustrates the six component parts of a GIS
- Hardware, software, procedures, data, people and network

1.6 The business of GIS

- Includes:
    - The software industry
    - The data industry
    - The GIService industry
    - The GeoWeb Service industry
    - The publishing Industry
    - GIS education
- Technical Box 1.4 lists magazines and websites offering GIS news and related services
- Technical Box 1.5 lists scholarly GIS journals
- Technical Box 1.6 lists sites offering Web-based education and training in GIS

1.7 GISystems, GIScience and GIStudies

- The term *geographic information science* was coined in a paper by Michael Goodchild published in 1992.
- Related terms include geomatics, geoinformatics, spatial information science, geoinformation engineering.

- All suggest a scientific approach to the fundamental issues raised by the use of GIS and related technologies
- Technical Box 1.7 shows the UCGIS GIScience research agenda and ties it to the chapters in the book
- *GIStudies* can be defined as the systematic study of society's use of geographic information, including its institutions, standards, and procedures

1.8 GIS and the Study of Geography

- This section explores this relationship and its sometimes tense characteristics.
- While spatial analysis has a long history, new data handling techniques and rich data sources are moving it strongly to new frontiers
- However, there is enduring unease in some academic quarters about GIS applications and their social implications, including
    - GIS favors certain phenomena and perspectives
        - Often used for purposes that may be ethically questionable or invade individual privacy
        - Concern about a field led by the technology and the marketplace rather than human need (as articulated by academics)
        - GIS as a tool in the hands of the already powerful
    - An absence of critical research in GIS
    - 'Guilt by implied association' – the uninformed bind GIS to logical positivism, with its restrictive assumptions.

ESSAY TOPICS

Generally speaking, these get more searching as one progresses down the list:

1. List and outline any four geographical problems to which GIS might be applied.
2. What are the three characteristics that enable distinctions to be made between different geographical problems?
3. The authors state that 'spatial is special'. List seven reasons why this is true.
4. Figure 1.6 shows the 'geography' of the family names of the authors in 1881 and in 1998. What processes over the Twentieth Century do you think account for the similarities and differences between the maps?
5. If you (or any of your classmates) have a fairly common Anglo Saxon family name, visit gbnames.publicprofiler.org and worldnames.publicpfofiler.org and investigate (a) the