GIS Applications to City Planning Engineering

Balqies Sadoun
Al-Balqa' Applied University, Jordan

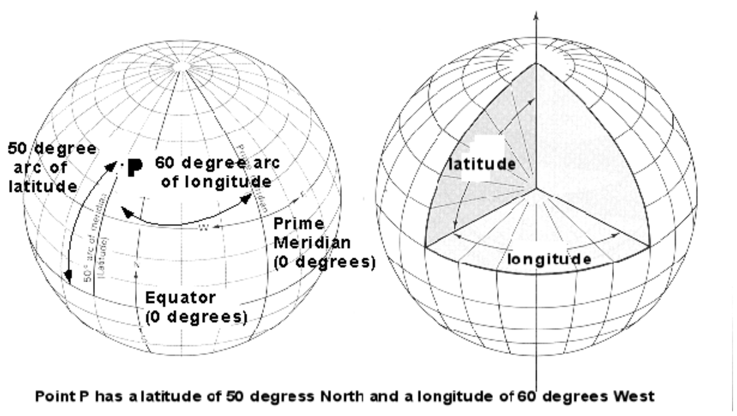
INTRODUCTION

The rapid progress in information technology (IT) has moved computing and the Internet to the mainstream. Today's personal laptop computer has computational power and performance equal to 10 times that of the mainframe computer. Information technology has become essential to numerous fields, including city and regional planning engineering. Moreover, IT and computing are no longer exclusive to computer scientists/engineers. There are many new disciplines that have been initiated recently based on the cross fertilization of IT and traditional fields. Examples include geographical information systems (GIS), computer simulation, e-commerce, and e-business. The arrival of affordable and powerful computer systems over the past few decades has facilitated the growth of pioneering software applications for the storage, analysis, and display of geographic data and information. The majority of these belong to GIS (Batty et al., 1994; Burrough et al., 1980; Choi & Usery, 2004; Clapp et al., 1997; GIS@Purdue, 2003; Golay et al., 2000; Goodchild et al., 1999; IFFD, 1998; Jankowski, 1995; Joerin et al., 2001; Kohsaka, 2001; Korte, 2001; McDonnell & Kemp, 1995; Mohan, 2001; Ralston, 2004; Sadoun, 2003; Saleh & Sadoun, 2004).

GIS is used for a wide variety of tasks, including planning store locations, managing land use, planning and designing good transportation systems, and aiding law enforcement agencies. GIS systems are basically ubiquitous computerized mapping programs that help corporations, private groups, and governments to make decisions in an economical manner. A GIS program works by connecting information/data stored in a computer database system to points on a map. Information is displayed in layers, with each succeeding layer laid over the preceding ones. The resulting maps and diagrams can reveal trends or patterns that might be missed if the same information was presented in a traditional spreadsheet or plot.

A GIS is a computer system capable of capturing, managing, integrating, manipulating, analyzing, and displaying geographically referenced information. GIS deals with spatial information that uses location within a coordinate system as its reference base (see Figure 1). It integrates common database operations such as query and statistical analysis with the unique visualization and geographic analysis benefits offered by maps. These abilities distinguish GIS from other information systems and make it valuable to a wide range of public and private enterprises for explaining events, predicting out-

Figure 1. A coordinate system (GIS@Purdue 2003)

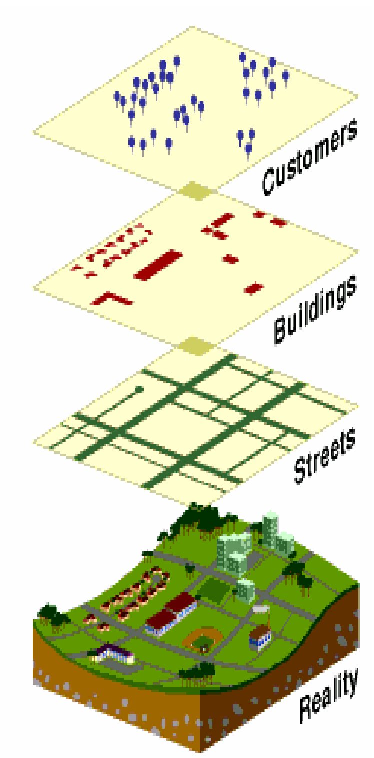


comes, and planning strategies (Batty et al., 1994; Burrough et al, 1980; Choi & Usery, 2004; Clapp et al., 1997; GIS@Purdue, 2003; Golay et al., 2000; Goodchild et al., 1999; IFFD, 1998; Jankowski, 1995; Joerin et al., 2001; Kohsaka, 2001; Korte, 2001; McDonnell & Kemp, 1995; Mohan, 2001; Ralston, 2004; Sadoun, 2003; Saleh & Sadoun, 2004).

BACKGROUND

A working GIS integrates five key components: hardware, software, data, people, and methods. GIS stores information about the world as a collection of thematic layers that can be linked together by geography. GIS data usually is stored in more than one layer in order to overcome technical problems caused by handling very large amounts of information at once (Figure 2). This simple but extremely powerful and versatile concept has proved invaluable for solving many real-world problems, such as tracking delivery vehicles, recording details of planning applications, and modeling global atmospheric circulation. GIS technology, as a human-computer interaction (HCI) tool, can provide an efficient platform that is easy to customize and rich enough to support a vector-raster integration environment beyond the traditional visualization.

Figure 2. Illustration of GIS data layers (GIS@Purdue, 2003)



A GIS has four main functional subsystems: (1) data input, (2) data storage and retrieval, (3) data manipulation and analysis, and (4) data output and display subsystem. A data input subsystem allows the user to capture, collect, and transform spatial and thematic data into digital form. The data inputs usually are derived from a combination of hard copy maps, aerial photographs, remotely sensed images, reports, survey documents, and so forth. Maps can be digitized to collect the coordinates of the map features. Electronic scanning devices also can be used to convert map lines and points to digital information (see Figure 3).

The data storage and retrieval subsystem organizes the data, spatial and attribute, in a form that permits them to be retrieved quickly by the user for analysis and permits rapid and accurate updates to be made to the database. This component usually involves use of a database management system (DBMS) for maintaining attribute data. Spatial data usually is encoded and maintained in a proprietary file format.

The data manipulation and analysis subsystem allows the user to define and execute spatial and

Figure 3. A digitizing board with an input device to capture data from a source map (GIS@Purdue, 2003)