Chapter VIII
Geographical Information Systems (GIS) and Learning Applications in Archaeology

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INTRODUCTION

Progress made in the fields of designing and geometrically analyzing earth maps, has lead to the development of automatic techniques which are applied in collecting analyzing and representing any information relevant to geographical interest. Such a collection of techniques sets the frame of what we call geographical information system (GIS).

GIS is a well organized collection of computer hardware and software along with the appropriate human resources that stores, updates, process, analyzes, and displays spatial data from a variety of sources. Two very popular definitions of GIS are:

…a powerful set of tools for collecting, storing, retrieving at will, transforming, and displaying spatial data from the real world for a particular set of purposes. (Burrough, 1986)

…an information system that is designed to work with data referenced by spatial or geographic co-ordinates. In other words a GIS is both a database system with specific capabilities for spatially-referenced data as well as a set of operations for working (analysis) with the data. (Star & Estes, 1990)

With a GIS, we can link information to location data, such as time to archaeological places, different earth surface levels to excavation periods, or different border lines within eras. We can then layer that information to give a better understanding of how it all works together. This is done by choosing what layers to combine based on what questions we need to answer. ArcGIS (which is the approach of the leading ESRI corporation to the field of GIS) is presented later in the chapter. A GIS module of SeeArchWEB can be found and used in the Web site www.seearchweb.net.

There are 2 basic types of geographic information:

- **Spatial information** (topologies and networks)**:** By the term spatial information we mean the determination of the position of different geographical data on a map, according to a reference system. Spatial relationships, such as topologies and networks, are also crucial parts of a GIS database. Topology is employed to manage common boundaries between features, define and enforce data integrity rules, and support topological queries and navigation. Topology also is used to support sophisticated editing and construct features from unstructured geometry. Much, if not all, of the data that archaeologists recover is spatial in nature, or has an important spatial component (Wheatley & Gillings, 2002).
- **Descriptive information:** On the other hand, descriptive information is the term used to handle the quantitative and qualitative attributes of a specific geographical space. In addition to geographic representations, GIS data sets include traditional tabular attributes that describe the geographic objects. Many tables can be linked to the geographic objects by common fields (keys). These tabular information sets and relationships play a key role in GIS data models, just as they do in traditional database applications.

A major change which derived from GIS implementation is that for the first time spatial information is linked with non-graphical one and in addition to that, logical and arithmetical operations are made possible between them.

Apart from the above change, a GIS is most often associated with maps. However, a map is only one type of product produced by a GIS. This product provides one way to work with geographic data in a GIS. As it can be easily understood, a GIS can provide more problem-solving capabilities than using a simple mapping program or adding data to an online mapping tool.

According to Marble (1990) GIS comprise four major subsystems:

- The Data Entry subsystem
- The Spatial Database
- The Manipulation and Analysis subsystem
- The Visualisation and Reporting subsystem.

A GIS can be viewed in three ways:

- **The database view:** A GIS is a new kind of database—a geographic database (geodatabase). A GIS is based on a relational database that includes information for the world in geographic terms. This can be considered as the IS (information system) of geography.
- **The map view:** A GIS can produce and manipulate maps enriched with artificial intelligence, so that by changing views they can show different perspectives of the earth's objects and the relationships between them. These different perspectives support what is called geovisualization, which is the term to describe the ability to form queries, and analyze and edit information in a user friendly way.
- **The model view:** Finally, a GIS can be used as a tool to transform existing geographic information into new one by implementing a model on pre-existing datasets. This is done by using geoprocessing functions made to correspond with the needs of the desired model.

By implementing the above three ways, we are able to pass from the simplicity of a single map to the interactivity of GIS information. So, every time we are ready to answer the following question about the objects in which we are interested:

- What is it?
- Where is it?
- How it relates with other objects?