

CHAPTER 25 INTRODUCTION TO GEOGRAPHIC INFORMATION SYSTEMS

Objectives

At the end of this chapter, students should be able to;

- i. Define Geographical Information Systems.
- ii. Describe geographic data and enumerate the importance of georeferencing them.
- iii. Mention examples of spatial data and attribute data
- iv. Enumerate sources of geographic data
- v. State components of GIS.
- vi. State the importance and problems of GIS.

Introduction

Geographical information system is a relatively new tool of understanding the distribution, trend and pattern of geographical phenomenon on the earth surface. It is a new method of investigating and solving various human and environment related problems. It was first conceived and developed in Canada in the 1960s. Since then it has experienced rapid progress both in its methods and applications.

19.1 What is Geographic Information Systems?

Geographical Information Systems (GIS) is a system of computer hardware, software, data, people, organizations, and institutional arrangements for collecting, storing, analyzing, and disseminating information about areas of the earth. It is a computer based information system which attempts to capture, store, manipulate and display spatially referenced data for solving complex human and environmental problems.

19.1.1 The Nature of Geographic Data

Geographical Information Systems deals with two types of data, namely;

- i. **Spatial data - This is any data that occupies space in terms of having a specific location based on some geographic referencing system: (Latitude and longitude and Natural grid system).** Hence, they are called geographic data. Spatial data can be in form of point, line and polygon.

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Figure 19.1: Geographic data

Source: Ayeni, 2003

Usually spatial data are in the form of a set of x , y coordinates indicating the latitudinal and longitudinal position of a geographic object in space. Example of point data are water well, spot height, towns etc. Lines data examples are rivers, stream, road network, railway lines etc. Polygon data include Plot of land, football field, stadium etc.

Specific data can be positional data or relational data: (i) **Positional data:** These are locational data. They are raw facts about objects or places on the earth surface. Examples of locational data is latitude and longitude.

(ii) **Relational Data:** These are topological data. Topological data show spatial relationship among objects on the earth surface. Examples include boundary, share note, etc.

ii. **Non-spatial Data** – This refers to non-locational data, attributes data or attributes of spatial entities. They vary over space and time, hence they are called *variables*. They are descriptions of spatial data that are normally found in the database and map legend and includes information like colour, ownership, magnitude, classifications, etc. They may also be qualitative attributes such as names, labels, codes etc. or quantitative attributes like population size, class, cubic data etc.

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Figure 19.2: The nature of attribute data.

Source: Ayeni, 2003

19.2 Sources of Geographic Data

There are two major sources of geographic data, these are; 1. *Primary Sources*- These include; i. Land surveying ii. Photogrammetry iii. Remote Sensing iv. GPS (Global Positioning System).

2. *Secondary Sources*- These include data that have been collected by established private individuals, organizations, government ministries, parastatals and institutions. It may also be data from non-profit organizations. For example topographical maps from Federal Survey, Lagos are example of secondary geographical data.

19.3 Georeferencing Spatial Data

Georeferencing of spatial data concerns situating spatial data correctly in the GIS environment. It is making sure that spatial data obtain in the field is correctly and accurately positioned in GIS environment.

Importance of georeferencing spatial data

1. It builds confidence in data obtained out the field.
2. It encourages accuracy and efficiency in data management.
3. It is a means of achieving data quality control.
4. It enables proper analysis in GIS environment.

19.4 Components of GIS

Five components of GIS can be identified namely; i. Computer Hardware – Hardware serves as mechanism for data processing and data storage. Hardware for data capture and processing include; desktop computer, Laptop, palm top, personal digital assistant (PDAs), notebook, workstation, micro computer, digitizer, digital camera, GPS, etc. Hardware for data storage includes; flash drive, Compact disc, DVD, diskette etc.

Figure 19.3a: Laptop

Figure 19.3b: Computer System.

- ii. Software – A set of written programs that gives intelligence to computer to perform GIS operations, such as buffering overlay, network analysis, etc. Examples of GIS software are ARCAIS, ARCVIEW, ERDAS, IMAGINE, etc
- iii. Data – Set of raw facts to be processed. They constitute the core of any information system.
- iv. People – These are personnel involved in GIS operations
- v. Procedures – Consist of the steps utilized to gather, store and keep information and those used in its upkeep and management and also for conducting various types of analyses on the data.
- vi. Peripherals – Include all other equipment that work with computer to make it highly functional such as mouse, printer, plotter, projector etc.

Figure 19.4a: INK JET Printer

Figure 19.4b: Laser Jet Printer

Figure 19.4c: Plotter

Figure 19.4d: Scanner

19.5 Applications of Geographic Information Systems

Geographical Information Systems is a versatile field and is applicable in many areas of human endeavour. For example it is applicable in the areas of;

- 1. Monitoring of land use and land cover change.

- 2. Forecasting of changes in environmental parameters.
- 3. Infrastructural services planning.
- 4. Natural resources management.
- 5. Transport network management.
- 6. Public protection and security systems.

7. Property development and investment.
8. Urban planning and management.
9. Establishing cadastral records and development of land information systems.
10. Hazard and disaster management.

19.6 Importance of Geographic Information Systems

1. It is useful for storing, manipulating and managing data.
2. GIS is a very useful tool in research.
3. It is useful in solving many environment related problems. For example it can be used to solve the problem of waste disposal and management in urban areas.
4. It can be combined with other technologies to provide platform addressing human pressing problems.
5. It is a good means of self employment and a good source of income for many practitioners in the field.
6. It makes the process and art map making simple.

19.7 Problems of GIS

There are number of problems facing GIS, particularly in Nigeria. These are enumerated below;

1. It is highly costly to establish a GIS organization due to cost of hardware, software and peripherals.

2. Lack of adequately trained expert in GIS who could handle GIS operations and train others adequately.
3. There is still poor awareness on the part of the public about the capabilities and the relevance of GIS
4. Some professionals and academic feel GIS will throw them out of business as a result of this fear they vehemently oppose the establishment of GIS in their organization or corporations.
5. Poor infrastructural facilities, especially electricity which makes GIS operations difficult and very costly.
6. Discrepancies in payment to Nigerian trained experts and the foreign trained experts.

Summary

In this chapter you have learnt that;

- Geographical Information Systems (GIS) is a system of computer hardware, software, data, people, organizations, and institutional arrangements for collecting, storing, analyzing, and disseminating information about areas of the earth.

- That geographic data is any data that occupies space in terms of having a specific location based on some geographic referencing system.
- Non-spatial Data refers to non-locational data attributes data or attributes of spatial entities. They vary over space and time, hence they are called *variables*.

- Primary Sources of geographic data include; i. Land surveying ii. Photogrammetry iii. Remote Sensing iv. GPS (Global Positioning System).
- Components of GIS are hardware, software, peopleware, procedure, institution and peripheral.
- GIS is applicable to all areas of human endeavour.

Revision Questions

1. The acronym GIS stands for; A. Geotechnical Information Systems B. Geological Information Systems C. Geographical Information Systems D. General Information Systems
2. Example of spatial data is; A. River B. Name of a place C. Population size D. Colour of a building
3. These are sources of primary data in GIS except; A. Land survey B. Remote sensing C. GPS
- D. Interview
4. The followings are components of GIS except; A. Computer Hardware B. Computer Software C. Peopleware D. Transport
5. Software can be described as; A. A set of written programs that gives intelligence to computer.
- B. A set of written instructions for computer to perform.
- C. A set of written laws guiding operations of computer.
- D. A set of ideas to run GIS firm.
6. Data can be defined as; A. Set of raw facts to be processed.
- B. Set of information to be displayed.
- C. Set of figures.
- D. None of the above.
7. Plotter is an example of hardware for A. Data processing B. Information display C. Analysis of data D. Drawing.
8. Scanner is a computer hardware for; A. Capturing digital data B. Capturing remote objects C. Analyzing data D. Processing data
9. A variable is an; A. Attribute data that varies over time and space.
- B. Spatial data that varies over time and space
- C. Data that is collected once in a year
- D. None of the above.
10. One important problem of GIS is; A. High cost of establishing a GIS organization due to cost of hardware, software and peripherals.
- B. It is difficult to understand.
- C. It is limited to the domain of Geographers.
- D. It is applicable to any field making it jack of all trade.

Answer

1. C
2. A
3. D
4. D
5. A
6. A
7. B
8. A
9. A
10. A

Essay Questions

1. What is GIS?
2. Differentiate between spatial and non-spatial data
3. List ten areas of application of GIS
4. Discuss problems confronting GIS in Nigeria.
5. (a) Mention five examples of computer hardware for capturing and processing spatial data.
(b) Discuss four sources of spatial data.