

Geographic Information Systems Course

Duration: 55 h

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1. Course objectives

Provide practice in design and development of cartographical skills with spatial analysis tools. Understand the main features of Arcview Gis through practice.

The first objective of this course is to help students become familiar with the basics of mapping and its main applications.

The second objective is to provide expected knowledge and skills as well as the expertise and independence necessary for management of projects in Geographic Information Systems.

Specific Objectives

In order to achieve these overall objectives, it is necessary to know the following objectives as well:

1. Know why and how to establish a GIS: "What is GIS?"
2. Master the terminology and acquire general knowledge base necessary for the establishment of a GIS and GIS manipulation tool: "Geographic Information"
3. Acquire, manipulate, save the data sources in a GIS
4. Become familiar with specific functionality to the GIS: "Spatial Analysis"
5. Mastering the output and dissemination of results of a GIS project.
6. Develop and implement a GIS project
7. Present the software and data sources available on the current GIS market
8. Master a tool for creating databases, i.e. DBMS Microsoft Access
9. Discover and use the internet for GIS resources

Software

Training in the GIS software will be done on a version of Arc GIS, in this case Arc GIS 9.2. This software is a product of ESRI. It is currently one of the most commonly used worldwide by professionals within the public and private sectors, universities, researchers, local authorities and development officials. It has the advantage of having an easy to use user interface. It is therefore just as simple to a GIS user as it is to someone interested in more sophisticated applications. It is open to application development (ArcView Avenue Script example).

Its import-export capabilities have earned him an ideal bridge to other GIS software (MapInfo, GeoConcept, and image processing software, GRASS, ENVI, IDRISI), but also Computer Aided Design (CAD), Computer Aided Mapping (CAM), databases (Excel., Dbase, etc.).

Students will also be familiar with surveys by Global System Positioning (GPS) and location data integration into GIS.

Required Texts

- ArcView users manual
- Ormsby Tim & Alvi Jonell, *Extending ArcView GIS. Teach yourself to use ArcView GIS extensions*. ESRI Press, 1999, 527 p. + CD-ROM.
- www.esri.com
- Aerial and satellite images, thematic cartographic database of the Laboratory of the Directorate of Geographic and Cartographic Works and State Services of Senegal.

Schedule and Spirit

The course of "Geographic Information Systems" is 55 hours: 20 hours of theory and 35 hours of practice and personal work on projects. The details on date and time of courses will follow.

It will be sometimes asked of students to read or comment on a number of documents (articles, book chapters) or do some exercises to prepare before a class. Group work is strongly encouraged. Students should be able to read and understand French and English. They will be asked to participate in class and encouraged to ask questions, share knowledge and discuss their particular problems.

2. Course Format

Training takes place in three hour sessions (morning and afternoon), mixing concepts and definitions, supervised hands-on work, case studies, etc.)

3. Course Contents

The course will be taught according to the follow outline:

Detailed Course Information

Day 1

Introduction: The State of Geomatics in Senegal

This introductory chapter aims to present the state of geomatics in Senegal, with particular emphasis on continuity and the methodological renewal of this discipline, strengthening mapping science through new techniques in a multi-disciplinary fashion. Points of specific retail developments will be broken down as follows:

- Historical foundations of cartography in Senegal;
- Development of remote sensing and GIS implementation;
- Geomatics authorities in Senegal;
- Conclusion on geomatics and future needs.

Day 1

“What is GIS and Why Implement a GIS?”

General Objectives

Present the course objectives related to GIS and to introduce GIS

Specific Objectives

More specifically:

- Assess student understanding of GIS
- Assess student familiarity with GIS
- Assess the needs of students related to GIS
- Define the concept of GIS

Section 1: Presentations of the instructor and the student

Students will be asked to fill out a form with their name, date and place of birth, their level of English and French, the level of their computer skills, the level of their GIS knowledge, title, subject and the name of their Director de Mémoire to understand the specific interests and needs of each student.

An open discussion about GIS will follow with questions about:

- Students' knowledge of GIS,
 - If the students have knowledge of GIS, they will be asked the extent of their experience with GIS, i.e. theoretical or hands on, software used, the project they used it for, etc.
 - The ideas that students have about GIS, what it can be used for and what distinguishes it from classical cartography
- Students will then be asked to clarify their expectations for the course, their current and future needs and any foreseen problems

Section 2: Structure of the Section

As the title suggests, the overall purpose, specific objectives and the lesson plan with details on the breakdown between theory and practice will be presented to students. Necessary

modifications will be made from suggestions from students during discussions. The timing and types of exams (quizzes, book report, oral presentation, written test, practical work) will be announced in class. Students will be reminded of a few simple rules for proper conduct in class (tardiness, attendance, etc.) but the main emphasis will be placed on the need for active participation of students. Students will be encouraged to work in groups on specific topics, with a bibliography or works cited handed in and discussed. Students are requested to speak in class, ask questions, and to let the instructor know when they do not understand something. Books, articles, software and reference materials will be used as course material.

Section 3: “What is a GIS and why implement one?”

Themes:

- GIS: Definitions
- History: birth of GIS and today’s sophistication
- Terminology: comparison in the international community
- Similarities and differences between SIG, DAO and CAO
- Features
- In the interest of SIG.

Day 2

Geographic Data, Maps and SIG: “Geographic Information”

General Objectives

The purpose of this chapter is to review some basic principles necessary for the implementation of GIS. We will also state the importance of geographic information and the issue of associating phenomena or objects through spatial dimensions.

Specific Objectives

More precisely, we will discuss or review:

- Basic skills in spatial analysis
- Representing the real world with SIG
- Data structures in SIG: the Conceptual data model

Section 1: Spatial analysis, enhanced by modern geography

Section 2: The issue of representation of SIG

Section 3: Organization of data in SIG

Day 3

Sources of data acquisition, manipulated and stored in SIG

Objectives

The purpose of this chapter is to review the different types of data in the GIS, input them, handle and store them. Depending on the equipment available (table scanner, scanner, digital databases), we will focus on practicing data manipulation and creating databases.

Specific Objectives

Specifically, we will:

- Present different types of data: vector, raster, alphanumeric or attribute data
- Know the equipment necessary for the integration of data and learn the operating procedures for the equipment
- Present satellite images
- Acquire external databases
- Learn to manipulate and save data in SIG

Section 1: Data sources

Section 2: Hardware and operating procedures

Section 3: Special case of satellite imagery and external databases

Section 4: Handling and saving data in SIG

Day 4 Data analysis in SIG

General objectives

This chapter will be entirely dedicated to the proper use of SIG: spatial analysis. The objective of this class is to give the students basic knowledge to prepare them for more complex applications of SIG. Emphasis will be placed on practice.

Specific Objectives

To familiarize students with a couple basic principles of station analysis including:

- Location and information search by spatial query
- Spatial characteristics of geographic objects
- Querying spatial database with an SQL query
- Measures
- Classification: close, adjacent or buffer zones
- Analysis of surfaces with the Digital Terrain Model (MNT) or Digital Elevation Model (DEM), raster surfaces and interpolation
- Spatial distribution
- Analysis by superposition and intersection (intersection-union-merger) of layers
- Cartographic Modeling: definition, models in geography, types of cartographic models, examples, setting up the model and verification

Section 1: Spatial analysis, basic elements

Section 2: Measures

Section 3: Classification

Section 4: Analysis of surfaces

Section 5: Spatial distribution

Section 6: Data analysis by layering

Section 7: Cartographic modeling

Day 5

Presentation of the Results of Analysis

General Objectives

Tout résultat d'analyse spatiale, aussi pertinent soit-il, doit pouvoir être présenté de manière claire, simple et attrayante. La force du SIG est de pouvoir utiliser le graphisme, et notamment la carte, pour communiquer un résultat, une idée, d'où souvent un grand impact du SIG chez les décideurs. L'objectif de ce cours est par conséquent d'enseigner aux étudiants comment utiliser le SIG pour présenter ces résultats mais aussi donner des éléments de base pour la production de résultats de bonne qualité. En fonction du matériel à disposition, nous verrons dans quelle mesure il est possible d'utiliser différents supports de communication comme le support papier (imprimer ses résultats sous forme de carte unique mais aussi de poster), le projecteur PowerPoint, les transparents...

All results of spatial analysis, relevant or not, must be presented in a clear, simple and attractive manner. The strength of GIS is using graphics, notably maps, for communicating a result or an idea, which often has a big impact on policymakers. The objective of this course is therefore to teach students how to use GIS to present these results but also to provide basic skills for producing quality results. Depending on the materials available, we'll see how it is possible to use different communication media such as hard copy (printing results on one side of the paper and in poster form), the PowerPoint projector and transparencies.

The part of the course includes an important part, which is an introduction to semiotics (graphical language mapping); the concepts of semiotics allow us to make maps clear and effective.

Specific Objectives

At the end of this chapter, the student will be able to:

- Develop a map in GIS with the integration of map elements and symbols
- Present results in a non-map cartogram, graph and table
- Use and maximize a special presentation of the results in SIG: the possibility to use results
- Save the results in SIG
- Use various media of communication materials

Section 1: Presentation of the results map

Section 2: The non-cartographic result

Section 3: Protection and communications

Day 6

Case Studies

General objectives

To enable students to see the relevance of GIS tools through case studies. The cases to be examined are listed below:

- 1st case:** Use of vegetation indices for estimation available agricultural land.
- 2nd case:** Stacks of charcoal as marker sites for exploitation.
- 3rd case:** Temperature analysis of marine surface data using the MSG satellite.
- 4th case:** Study of brushfires in Senegal
- 5th case:** Air pollution and urban mobility in Dakar
- 6th case:** Mapping the spatial evolution of Dakar
- 7th case:** The evolution of mangrove formation in the Saloum Delta and Joal-Fadiouth

Day 7

The GIS project design and implementation

General Objectives

It is not enough just to know how to integrate, manipulate, analyze and present data. We still need to know where we implement GIS, what problem to analyze, what to apply it to and what lens to view it through? Students should be able to identify and know the steps in the design and establishment of GIS.

Specific Objectives

At the end of this chapter, the student will be able to:

- Explain the design of a GIS
- Recognize the steps necessary to design
- Recognize different approaches

Section 1: How does one design a GIS?

Section 2: What are the needs associated with this design

Section 3: Approaches to design

Section 4: Model design and implementation

Day 8

Software, data sources and the web

General Objectives

This chapter is intended to provide students with some basic information on software and data sources available, particularly data available in digital format. The web being a mine of essential information, the students will receive and use a list of websites to find highly useful data and implementation of GIS projects in general (software, examples, etc.)

Section 1: Software and data sources

Section 2: Using the web and GIS

Synthesis

Day 9

Management System Database

Course structure (Theory and tutorials):

- Introduction to databases and modeling
- Data manipulation
- Queries and optimization
- Creation of states and integration of graphics
- Macro
- Tutorial

Jour 10

Global Positioning System (GPS)

Course structure (Theory and tutorials)

- What is GPS ? The reference coordinates
- Technical evolution of positioning systems
- How does GPS work?
- Error sources
- Using the Garmin receiver
- Collection of data on a map and on a Garmin receiver
- Integration of GPS data in SIG
- Application areas (cadastre, geography, traffic management, guiding trucks, topography, geographical location, etc.)

4. Final Summary

There will be an evaluation of the knowledge and skills acquired through the course. Groups of students will be formed and asked to chose a “real world” application and to develop and implement a GIS project (students will select the best tools, define geographic objects and their spatial relationships, chose a study area, scale in time and space, examine the available data all within the constraints of time and money). The project will be presented in a written report with charts or a PowerPoint presentation.

The assessment should reflect that the key concepts and skills are well understood.