_____

COMPUTER CARTOGRAPHY AND GEOGRAPHIC INFORMATION SYSTEM EDIFICATION: A REQUISITE IN INDIAN COLLEGES AND UNIVERSITIES

C. Sujathamma
**Lecturer in Geography, S.P.W. Degree and P.G. College,
Tirupati, Andrapradesh, India.**

ABSTRACT

The art and science of making maps is called cartography that is getting advanced and modernised throughout the world. In recent years, the discipline of cartography has been changed rapidly with the intervention of Computers and automation. With the emphasis focus on use of Computers for geospatial data handling at India's leading mapping agencies and governance, planning and decision-making, a great number of qualified computer Cartographers and GIS specialists will be needed. How can we respond to such rapid discipline changes and to the need for qualified Geography and Cartography professionals? In this article an attempt is made to mention the need of computer mapping and GIS courses to be introduced in Indian colleges and Universities at various levels. This computer cartography and GIS contribute to the society to solve spatial problems.

KEYWORDS: art and science , qualified Geography and Cartography professionals.

INTRODUCTION:

We reached to an era where geospatial data is saved on computers from storing spatial information on stones and skins. This marvelous computer has transformed the discipline of Cartography as a sophisticated method for information processing. Spatial data is now collected, stored digitally, and interpreted and maps drawn by a computer through Geo informatics technology. Eventually our Indian Survey maps will be circulated in the National Museums on the basis of magnetic strips and diskettes and replace the old maps as a treasure.

Cartography is a discipline that is still neglected in most of the Indian Colleges and Universities. While Computers are used in Cartography in the1960s at Harvard University and at many other Universities, we in India seem to have turned a complete eye to huge advances and developments of this fast-growing discipline, even after three decades. Even now, many Universities in India still consider that Cartography as synonymous with Practical Geography and as an optional subject at Post graduation. Cartography course was started at Sri Padmavathi Mahila Viswa Vidyalayam, Tirupati in 1984 and closed within Two Years due to lack of Professionals in this subject. Because of this we cannot cope up with the technological development and to produce students in the subjects where they are supposed to be masters. It focuses the need for trained professionals required by different professional institutions. These professionals are also required in related areas like remote sensing, photogrammetry, spatial analysis, surveying, GPS, Geodesy, etc. Therefore, this is the time to think of to introduce this quickly growing discipline in our Indian Colleges and Universities and entering the International level.

BACKGROUND

Tradition of map making is old one. In ancient India Aryabhatta, Varahamihira, Bhaskaracharya and Bramhaguptha were eminent cartographers and, Chinese and Arabs are next contributors. East India company did survey and prepare map for India, and George Everest did triangulation survey during 19th century and mapped India at various scales. Then Areal photography was used in India in 1920. After independence the new techniques in surveying and mapping were place in the cartographic history of India. The launch of satellites Aryabhatta Bhaskara-I, Bhaskara-II,IRS-1A and IRS-

P2   increased the availability of satellite data in digital form, there was a shift from aerial photo interpretation to satellite image interpretation. This is the major mile stone in Digital cartography.

Since 1983 IIRS, at Deharadune ,System Research Institute,at Pune and some institutions started its activities of map making. a research group has been involved in computer mapping and GIS. The group made significant improvements in the development of a software system called MIDS for machine assisted thematic mapping and a Geographic Information Software system named CMAPS, funded by the Department of Electronics, Government of India. The development of those systems has focused mainly on promoting computer cartography education in India and on their use in the real time sector, but this cannot be done mainly because software cannot be distributed on popular and widely accessible microcomputers. Therefore, a THEMAPS microcomputer mapping system was developed and is available for distribution. The THEMAPS is a mapping system.

In this area, the SRI Computer Cartography Group collects state of the art literature and has a very strong collection of articles, books, papers, guides, journals and training programs. In particular, the group consists of specialists who can teach computer cartography and GIS in different aspects. Contacts were also established with the founders and experts in this area, with International organizations and Universities.

SRI's own experience in this field and experience gained from other well known universities of the United States and of Europe that have begun these courses for a long time has drawn the following curriculum. The training courses are designed to meet Indian standards and slowly establish foreign skills after studying the courses curriculum of various Western universities.

COURSE DESCRIPTION

Taking account of the fact that we do not have qualified personnel and hard-ware or software, we developed a plan to allow computer mapping and GIS courses at Three Levels. In order to give teachers the time to master the new subject by means of external training courses, we propose to start the department with level I and slowly gradient into level III. Those universities which have already offered postgraduate cartography courses (for example Osmania University) may directly add levels II or even some Level III subjects, or change their content or adapt it to LEVEL I needs.

LEVEL I. Introductory Computer Mapping (Under-graduate level).

The goal is to bring students into the use of microcomputers to generate maps and to provide students with the basis for automated mapping. The course provides the students with principles of digital imaging, data processing techniques and computer thematic charts. Students will work with different mapping software to gain practical experience in mapping.

Course Outline:
a) Introduction to the course.
b) Hardware and software concepts.
c) Map components.
d) Automated mapping process
e) Creation of digital cartographic data.
f) Map encoding and digitization of boundary, / point and line features
g) Microcomputer mapping.
h) Point, line and area related thematic data! / presentation
i) Outputting of maps.
j) Advances in computer cartography.

LEVEL II. Computer Cartography (Postgraduate level).

The aim of this course is to provide a thoroughness of theory and practice on computer mapping and spatial data. The course will guide students to digital data collection, storage, processing and the implementation of technical data collection. The focus is put on the co-ordinate capture of the data, mapping of databases, manipulating storage, display and output. Studious work is stressed on leading mapping systems.

At the end of the course, the students should be able to build the cartographic database

in automated map-to-environment, perform data organization tasks and control them and produce the high quality map production.

Course Outline:
a) Introduction
* Development of computer cartography,
* Historical Background,
* Feasibility of using computers,
* Concepts of an automated cartographic system;
b) Digital cartographic data capture:
* Definition of digitization,
* Map encoding,
* Feature and attribute data encoding,
* Editing and updating of cartographic data,
* Automatic digitizers and scanners;
c) Cartographic data base structures
* Definition of data structures,
* Types of spatial data structures,
* Vector and reastar data structures;
d) Thematic Data creation and manipulation
* Creation of thematic data base,
* Linking of cartographic and thematic data files,
* Spatial analysis;
e) Data presentation:
* Output devices,
* Use of data presentation techniques,
* Appropriate data presentation,
* Map outputting in different scales and sizes;
f) Computer cartographic software system:
* Analyzing the software capabilities,
* Selection a appropriate software systems suiting the user needs;
g) Managing computer cartography systems.

LEVEL III. One Year M. Phil. Course In Computer Cartography And GIS:
Course objectives:
The objective of this discussion is to develop the capacity of students to design, create and manage Geographical Information Systems in India for various fields of application. It is planned to satisfy the needs of GIS experts in leading mapping agencies, urban and regional planning, agricultural, irrigation and rural development departments etc.

The course is focused on practical computer experience in the data compilation, digital data creation, analysis of real world problems, user interface design and final maps. The research and analysis of two operating GISs emphasize an appreciation of the nature of the current GIS systems. Students would also build modules that are suitable for their field of interest for different applications.

Course plan:
First term.:
1. Mapping and semiology of graphics,
2. Principles of computer programming,
3. Data processing and DBMS,
4. Computer cartography and GIS;

Second term
1. Information systems,
2. GIS software design and development,
3. Spatial analysis and presentation,
4. GIS application areas,
5. *THREE months project work* on any systems or application oriented areas in Geographic Information systems.

Course Contents.
Course I. Mapping and Semiology of Graphics.
This course is aimed at reviewing the concepts of cartography and the languages of graphical presentation of information. Students will study the underlying principles involved in various components of geographical data representation, and advanced spatial data collection methods.
a) Map components: detailed study of point, line, and area based cartographic data.
b) Topological relationships.
c) Compilation of Cartographic data: identifying sources, compilation, cartographic data generalization, and accuracy.
d) Properties of graphics system: Scope, the plane, retinal variable; its organization and properties.
e) Rules of graphic system: the basic graphic problems, functions, and general rules of construction and legibility.
f) Advanced spatial data capturing methods: Remote sensing.

Course 2. Principles of computer programming:

The objective of this is to learn the principles of programming and to become proficient in two languages, preferably in BASIC and 'C'. This will enable the students to appreciate and evaluate software systems and also to be able to write application modules in their working environment. The course will also expose the students to some of the other graphic packages. The topics covered are:

a) Principles of programming,

b) Programming in BASIC,

c) Programming in 'C',

d) The graphics Kernel system (GKS) standards;

COURSE 3. Data processing and data base management systems:

The course will introduce files, data structures, and DBMS from the point of view of a user or an information analyst (rather than a programmer). The major emphasis will be placed on actual experience with standard microcomputer DBMS. Topics to be covered include:

a) File structures,

b) Types of data organization,

c) properties of DBMS,

d) consideration in selecting DBMS,

e) Statistical data bases,

f) Linking DBMS and spreadsheet,

g) Studio work on DBASE III;

Course 4. Principles of computer cartography and GIS

This course will provide a sound knowledge of computer cartography and geographic information systems. The creation of digital-data, analysis and presentation is dealt through practical and hands-on experience on an operational software system. The students will review and critically evaluate two operational GIS. Finally the course gives a sound knowledge on the USGS, OS, and other digital data organization and standards.

a) Introduction: Development of computer cartography, reasons for automating hardware and software, and concepts of an automated cartography system.

b) Components of a GIS: Digital representation of spatial data, analytical capabilities, user interface and presentation.

c) Studio work on a training mapping system to an operational GISS,

d) Review and evaluation of any two operational GIS,

e) Review of USGS and OS activities, cartographic data standards and transfer.

Course 5. Information systems

This course is oriented towards understanding the concepts of information systems, assessing to the requirements for, and design and management of information system. Emphasis is laid on study of the spatially oriented information. This will also give the necessary skill to do the next course of GIS software design and development

a) Conceptual foundation of information systems: Concepts of information system, organization, and value of information to decision makers.

b) Identifying information requirements and data needs with particular reference to the Indian situations

c) Structure of an information system: structure, transaction processing system, and information system support for planning, control and decision making.

d) Information system development and management: Design, organisation, creation, evaluation and management.

Course 6. GIS software design and development

This is an advanced course that looks into the design aspects of a GIS such As : Data structure, efficient algorithms, data storage, data transfer, and user interface. Emphasis is laid on design considerations, evaluating the above aspects and how to choose the appropriate design elements for specific application areas:

a) GIS data base structure: definition of data structure, types of spatial data structures, coordinate systems, and coordinate storage schemes,

b) Data generlization, rotation, map merging, translation, and scaling,

c) Vector and raster data structures,

d) other data structures such as quadtress,

e) Geographic data encoding: feature classes,

groups and elements updation and distribution of geographic data and exchange formats.

f) Associated and non-geographic data manipulation: Nature of non-geographic data, its creation and management.

g) Creation of relational data base and management.

h) Data storage and memory management

i) Microcomputer based GIS, a detailed study.

Course 7. Spatial analysis and presentation

This course is focused on acquiring specialized skills on the spatial analysis techniques needed in various GIS application areas. Emphasis is laid on knowing the primary manipulation, and analysis such as location-allocation modeling, shortest path and flow analysis, surface area modeling and overlaying of maps are dealt with separately. The course also aims at knowing the appropriate techniques to present the final results on maps.

a) Introductory spatial analysis: Points, lines, and areas on maps. Topology and primary analysis,

b) Point data analysis: Location-allocation modeling, nearest neighborhood analysis, and presentation,

c) Network data analysis: Accessibility and connectivity, shortest path on networks, flow analysis buffer generation and its presentation

d) Surface area analysis: Isolines, trend surface analysis, slope analysis, area calculations, redistricting, centroids, etc.

e) Overlaying of maps.

f) Queries on features and its presentation on maps

Course 8. GIS Applications

This course looks into the potential application areas of GIS. Specific application 'areas are chosen to study and review the require-ments, design and organization of spatial in-formation, and also the hardware and software requirements. The application areas include:

a) Urban Information system

b) Land record and land-use information system

c) District information system

d) Traffic and transportation information system

e) Agriculture information system

f) Forest information system

g) Public utilities information system

Hardware And Software Requirements For Computer Cartographic Laboratory:

To start with, a Microcomputer configuration with minimum requirements are outlined below:

1. A PC-AT with 80287 arithmetic co-processor and EGA card
2. Additional 1 MB OF RAM.
3. USB port
4. 20MB of Hard disk
5. Laser Jet Printer with graphic capabilities
6. A small Digitizer (Optional)
7. A Plotter (optional).

The above configuration (without a digitizer and plotter), with the necessary software will cost approximately 1.2 lakh rupees, which the Departments could afford easily at initial stage. Later, more Microcomputers and peripherals could be added depending upon the financial position.

As for the Cartography software, training of teachers and acquisitions of literature, journals about 25% of the above cost should be allocated.

University Grants Commission can assist the Departments in providing Labs, software, training of staff, and in acquiring literature and Journals.

FUTURE SCENARIO

The art and science of cartography has now advanced as geographers, researchers, software companies, and various user organisations have realised the importance of Information Technology. The advantages offered by computers in this field of geography are numerous and find useful application in a number of areas like mining, earthquake zone detection, defense, cultivation, roads construction, town planning, under water exploration and mountain expeditions. Yet another career prospect awaits you even though you may not be a student of science or mathematics. At present, most map makers and map users in India start using computers because of their speed at which data

technology has developed and the application areas. In addition, numerous new areas will be in use for computerized spatial information systems. The experts in this field develop maps and images with the help of specific software and hardware. Let's seek a look into the future by assessing the current situation.

The price of computer hardware, software and accessories has drastically come down and one can easily establish Digital cartographic lab. As far as software is concerned, import systems are expensive. The departments should therefore first use free software, such as the GRASS, ILWISS etc. In the case of software purchasing, preference should be given to indigenous system due to easy approach for training and maintenance. (Please note that in the schools computers are being used under the CLASS initiative).

A Study of papers presented and the discussions at the VII Annual Conference of the Indian National Cartographical Association, 1984 reveal that the spatial data processing technology in India is going to have a drastic change.

The comprehensive plans for the Indian Survey to set up modern cartographic centers and digital mapping centers show that digital mapping data is available to Indian users in mobiles also for final user processing and analysis in the near future. This ensures that the management of digital map data should be understood to our students.

With computerised spatial information systems, there will be a need for qualified computer mappers and Geoinformatics analysts in important application areas such as Urban and regional planning, Forestry, Irrigation, Rural development, disaster management etc. SOI, the Naval Hydrographic Office, NRSA and other agencies have already experienced the necessity. And finally, as the discipline extremely established worldwide, we must make significant contributions and achieve more things in digital cartography.

REFERENCES:

1. Indian National Cartographic Association; Abstracts of VII Annual conference held at Ahmedabad, in November 1987

2. Institute for Spatial Organization, TNO Netherlands: course details of computer Cartography and GIS., 1987

3. Sharma L P and Datta PR ; Proposed Intergrated Cartographic systems for Survey of India, paper presented in VII INCA conference, November, 1987.

4. Systems Research Institute, Pune; Internal Course documents on M.Phil in Geographic Information system, August, 1987.

5. Univerisity of Maryland, Department of Geography; Course details of Computer Cartography and GIS.1987

6. Ummer Sahib S, et al; from Computer Cartography to Microcomputer based GIS; The Evolution of an Operational GIS. Paper presented in VII INCA Conference, November 1987.