UNIT V

IMPLEMENTING A GIS AND APPLICATIONS

Implementing a GIS

AWARENESS

A geographic information system (GIS) is a system that creates, manages, analyzes, and maps all types of data. GIS connects data to a map, integrating location data (where things are) with all types of descriptive information (what things are like there). This provides a foundation for mapping and analysis that is used in science and almost every industry. GIS helps users understand patterns, relationships, and geographic context. The benefits include improved communication and efficiency as well as better management and decision making.

GIS technology applies geographic science with tools for understanding and collaboration. It helps people reach a common goal: to gain actionable intelligence from all types of data.

Hundreds of thousands of organizations in virtually every field are using GIS to make maps that communicate, perform analysis, share information, and solve complex problems around the world. This is changing the way the world works.

GIS technology applies geographic science with tools for understanding and collaboration. It helps people reach a common goal: to gain actionable intelligence from all types of data.

Participate in the international celebration of GIS technology. GIS is a scientific framework for gathering, analyzing, and visualizing geographic data to help us make better decisions. On GIS Day, help others learn about geography and the real-world applications of GIS that are making a difference in our society. It's a chance for you to share your accomplishments and inspire others to discover and use GIS. Even though celebrating may look a little different this year, sharing GIS is more important than ever.

GIS SYSTEM REQUIREMENTS

To run intensive GIS data processes or complex spatial analysis, it is important for your computer to have an adequate amount of RAM. For running ArcGIS software, make sure you have at least 8GB of RAM but preferably 16GB or higher.

Hardware (computers and peripherals to store the GIS data) VCU has a license server running so that faculty, staff, and students can connect and run ESRI's ArcGIS suite.

This license is restricted to on-campus use by VCU students, faculty, and staff. The license server is running FlexLM software with codes to allow a user to retrieve a license and actually 'run' ArcGIS.

If the server or network goes down, so does the ability for anyone to run ArcGIS. The local user MUST be connected to the server at all times.

VCU also has an ArcIMS server that is managed by Technology Services. This service allows users to perform GIS analyses and functions without installing software on a user's computer.

Software (to access, query, manage, present and analyze GIS data) All ArcGIS products (ArcView, ArcEditor, and ArcInfo) are comprised of the ArcMap, ArcCatalog, and ArcToolbox applications.

These products can be thought of at different levels:

ArcView level allows editing of personal geodatabases and shapefile, where you can: Create high-quality maps, graphs, and reports.

Perform geographic queries and analysis.

ArcEditor level allows a user to create, edit and manage ArcInfo coverages and ArcSDE geodatabases, where you can

Create and edit geometric networks.

Create and edit custom features.

ArcInfo level allows a user to create, edit, and analyze coverages using ArcInfo Workstation. This is the most powerful level of ArcGIS. For this to run ArcInfo workstation must be loaded on the machine. This is the foundation of ArcGIS.

Run AML (Arc Macro Language) programs from ArcToolbox.

Convert from multiple GIS data formats into ArcInfo coverage formats.

Use the geoprocessing server to perform ArcToolbox operations on a designated computer (a remote server).

Note: A user can change the 'level' of the software by using the desktop administrator.

ArcMap is the primary ArcGIS application for displaying, querying, editing, creating, and analyzing data.

This application provides tools for creating visual displays of your data, querying, and creating presentation-quality maps.

ArcMap makes it easy to layout your maps for printing, embedding in other documents, or electronic publishing.

It also includes analysis, charting, and reporting functions and a comprehensive suite of editing tools for creating and editing geographic data.

When you save a map, all of your layout work, symbols, text, and graphics are automatically preserved.

ArcCatalog is a tool for accessing and managing your data.

This application helps you organize and manage all your GIS data.

It includes tools for browsing and finding geographic information, recording and viewing metadata, quickly viewing any dataset, and defining the schema structure for your geographic data layers.

ArcToolbox contains tools for data conversion and management.

This application provides you with tools for data conversion, managing coordinate systems, and changing map projections.

It supports user-friendly drag-and-drop operations from Arc Catalog.

For Arc Info users, Arc Toolbox provides additional and more sophisticated data conversion and spatial analysis tools.

Data such as standard map and graphics file formats, images, CAD files, spreadsheets, relational databases, and census data.

GIS stores information about the world as a collection of themed layers that can be used together. A layer can be anything that contains similar features such as customers, buildings, streets, lakes, or postal codes.

This data includes either an explicit geographic reference, such as a latitude and longitude coordinate, or an implicit reference such as an address, postal code, census tract name, forest stand identifier, or road name.

Data can be free or fee-based. The source of this data comes from a variety of places.

Link to potential data sources.

Data types supported in ArcGIS.

People (to collect, manage and analyze data)

Several VCU individuals are active in GIS projects. Some are in the system management role, keeping the GIS servers running; some collect data and create the layers to specific geographic areas, while others provide training on using GIS.

DECISION MAKING USING GIS (GIS AS DECISION-SUPPORT SYSTEM)

A GIS aids the decision-making process by integrating and displaying data in an understandable form. Furthermore, a GIS is used to analyze relationships among different kinds of data (e.g., environmental and health data). The fundamental analytical functions of a GIS-based spatial decision-support system include

(1) Query analysis,

(2) Proximity or buffer analysis,

(3) Overlay analysis,

(4) Neighborhood analysis,

(5) network analysis, and

(6) modeling. Various combinations of these functions are commonly used during the geographic data analysis process.

GIS is not an end in itself, however, but provides a valuable foundation for further analysis. A spatial decision-support system can be based on the primary functions of a GIS, but these basic functions need enhancements for analysis and modeling. For instance, for food-security analysis it is possible to link a GIS to a model that predicts grain yields from a range of spatial input data, such as soils, climate, and topography. This model can be linked to economic and demographic models showing where people live and the grain demand from these settlements. The combination of basic data, yield modeling, and human demand and location analysis provides a way to evaluate food security. Hence, using a spatial decision-support system is not simply a descriptive exercise. The desired outcome is not how the world looks, but instead how the world works.

A critical feature of a spatial decision-support system is its emphasis on linking data with analysis tools. Some analyses use spatial analysis functions often referred to as GIS modeling in which several data layers are merged to create a new synthetic layer. This is often the approach for risk assessment. For example, various habitat, human population, and climate data layers can be merged to provide a vector-borne disease risk map as a product this product can be updated rapidly and often is a means to marshal scarce resources.

Spatial decision-support systems also can involve numerical models, including forecast models that evaluate through simulation in map form various alternative scenarios based on different policy options. This type of decision-support usually is deployed for planning purposes. It can be useful as a way to integrate multiple planning objectives, or competing options for the use of a specific natural resource, such as land, or particular location, such as a watershed.

GIS BASED ROAD NETWORK PLANNING

Geographical Information System (GIS) software is used to determine the quickest way or the shortest way between those locations. The attribute data of the road network is collected to develop the database of road network and an optimum route. An optimal route representing the total cost of route in meters as well as in minutes are developed.

Geographic Information System (GIS) technology is one of the hottest research tools in the world recently and one of the fastest growing high technology of monitoring.

It has been proven to be valid and efficient to solve real-life problems, such as responding and resolving emergency situations . A geographic information system is a computerized system that is designed to capture, store, manipulate, analyze, manage, visualize, and present all types of geographical data associated with geographical locations. GIS can bring all that data together quickly and enable users to analyze and visualize information in an efficient way. It has been used in several fields such as transportation management, emergency services, gas station mapping, and healthcare planning . The shortest path between two vertices in a network is defined as the directed simple path from with the property that no other such path has a lower weight . Most applications solve the shortest path problem based on the distance as a weight. In this paper, we used the time parameter instead of the distance which calculated the path between two points that takes minimum time based on one or more parameters other than the distance.

Examples of these parameters are road width, average speed, waiting time, etc. In emergency situations, the best path is preferred, that it takes the minimum time to reach a destination which helps to save people life. The main objective of this research is to find the best path and representing this valuable spatial information to end-users in an efficient way using GIS software.

MINERAL MAPPING USING GIS

GIS is ideal for integrating various exploration datasets such as geophysical images, geochemistry, geologic maps, radiometric surveys, boreholes, and mineral deposits. GIS gives the explorations tools to manage, display, and analyze data, resulting in successful, cost-effective discovery of new mineral deposits.

The process of mineral exploration composed of several stages which starts with small scale and develops into larger scale. In every stage, geological, topographical, geophysical, geochemical data are collected, processed and integrated. Then, after finishing every stage produced mineral potential map and the study area becomes smaller. Mineral exploration companies deal with various types of data sources to explore for minerals deposits. The types of data vary from geological maps, multispectral satellite images, and geophysical images to databases in different formats. The best platform to bring all these data together and get a precious result is GIS.

GIS also can be used to generate a mineral potential map, in the absence of comprehensive systematic mineral exploration programs, it is important to develop alternative methodologies of mineral potential classification. Then, it's possible to use spatial data that are relevant to mineral potential such as; lithology and topography, which are available for most areas. The importance of such data can be realized by their incorporation in GIS. Then it is important to add exploration criteria. Those criteria provided by conceptual mineral deposit models are invaluable bases for the generation of mineral potential information. GIS can be useful in many stages of mineral exploration processes: data acquisition, storage, manipulate, and reporting. It's possible now to the geologists gain the field data electronically that by using Global Positioning System (GPS) receivers. The Internet also can be act as a source of data sets which can be downloaded directly from it. All these data types can be combined, integrated, and analyzed using GIS. GIS can easily integrate with other specific programs for image and geophysical data processing. So, Raster images such as satellite imagery or geophysical images can be displayed in GIS and overlaid with vector data such as geology, faults, and geochemical samples.

SHORTEST PATH DETECTION USING GIS

The Network Analysis tool for QGIS is a useful utility for solving any cost-distance query that one might have. The tool itself is very user-friendly and intuitive and can really help in finding the best route using whichever criteria designated. One could verify that they set up the tool properly by checking if the outputs for the fastest and shortest path are the same, indicating that the SPEED field wasn't created properly. This tool is slightly limited in the sense that if we would like to calculate the distance between two points in miles or the speed field is in miles/hour, the tool will not give us solution, because by default it supports only kilometers and meters. One way to solve this would be to convert miles to meters or km through another field calculator expression.

The Network Analysis tool for QGIS calculates the shortest path between two points on any polyline layer and plots this path over the road network.

Network Analysis tool

- Select "Fastest" in the path to calculate
- Select your start and end point it could be the same two again
- Enter the same direction information for the shortest path
- Now under the speed field, select the "SPEED" field
- You can keep the average speed from earlier and the topographic tolerance as well

If you run this, you should get the fastest path

You can switch back and forth between these criteria, recalculating each shortest and fastest path, and note the changes in cost taken. In this particular example, the only difference between the shortest and fastest route is a single right turn.

The last operation is to export the output as a shape file, by clicking the Export button on the shortest path panel.

HAZARD ZONATION USING REMOTE SENSING AND GIS

Landslides are among the most costly and damaging natural hazards in mountainous regions, triggered mainly under the influence of earthquakes and/or rainfall. In the present study, Landslide Hazard Zonation (LHZ) of Dikrong river basin of Arunachal Pradesh was carried out using Remote Sensing and Geographic Information System (GIS). Various thematic layers namely slope, photo-lineament buffer, thrust buffer, relative relief map, geology and land use / land cover map were generated using remote sensing data and GIS. The weighting-rating system based on the relative importance of various causative factors as derived from remotely sensed data and other thematic maps were used for the LHZ. The different classes of thematic

Geographic Information System (GIS) techniques have large capabilities for analyzing very complex factors. Remote sensing techniques are useful in preparing necessary data in landslide hazard zonation. There are several landslide hazard assessment studies inliterature. They can be divided into three categories according to the application techniques:

1- Traditional techniques, 2- Remote sensing techniques (satellite and air photo), 3- GIS

techniques (generaly integrated remote sensing techniques in data preparation).

LANDSLIDE HAZARD ZONATION After the reclassification of these maps into relevant classes, the quantitative weighting values were assigned to each of the parameter classes on a scale of 1 to 10. Then, the weighting values were assigned to each of the parameter maps and at last, the weights of each pixel and new class values were calculated to get the hazard classes and the map. There are generally 3 to 6 classes in landslide hazard zonation maps. In this study, five classes were obtained according to the knowledge based properties:

1 No hazard (or very low)

2 2- Low

3 3- Moderate

4 4- High

5 5- Very high

GIS FOR SOLVING MULTI CRITERIA PROBLEMS

Lots of the problems people have are of a geographic nature and hence coupling GIS with MCDA is impactful. Spatial problems typically involve a large set of feasible alternatives and multiple, conflicting and incommensurate evaluation criteria. Using a GIS-MCDA can is a process that transforms and combines geographical data and value judgments to solve spatial problems. To do this it considers geographical data models, the spatial dimension of the evaluation criteria and decision alternatives in evaluating the criteria.

Some examples of GIS-MCDA applications include vehicle routing, site selection, scenario evaluation, land suitability, transportation scheduling, impact assessment, location-allocation to a variety of sectors.

GIS-MCDA steps

1. Define you problem, goal or objective. Try to understand and define the problem as comprehensively as possible.
2. Determine the criteria and the constraints. Using a combination of experts' opinions and information from various sources. This could be acquired from discussions with experts of relevant fields, surveying of literature and analysis of historical data.
3. Transform the values onto a relative scale. This allows for comparison between each of the criteria, and for us to represent the judgments and expert knowledge with meaningful numbers.
4. Weight the importance of each criterion in regards to the objective, and in respect to each other.
5. Combine, synthesize and aggregate the layers/criteria together.
6. Analyze and then validate your results

GIS FOR BUSINESS APPLICATIONS

Information is the key factor to success. Business information parameters, including sales, customer inventory, potential market segmentation, and demographic profile, form the defining factors for all industrial segments, such as retail, real estate, insurance, and pharmaceuticals. Since most of this business information has geographical location, it becomes important to use GIS to analyze them spatially. Business GIS and mapping have evolved into a formidable tool by which the corporate world can use spatial information to manage its business. Especially for companies trying to identify uncovered markets, GIS would support business decision-making by adding a spatial component to the decision process. With GIS, businesses make judgments based not only on the attributes of business entities, but on their spatial properties: location, overlaps, proximities, zones of influence, scale, distances. This leads to better-informed decisions. GIS is an integrated collection of computer software and data used to view and manage information about geographic places, analyze spatial relationships, and model spatial processes. A GIS provides a framework for gathering and organizing spatial data and related information so that it can be displayed and analyzed [2]. GIS can be used as a computer system capable of capturing, storing, analyzing, and displaying geographically referenced information—that is, data identified according to location. Furthermore, GIS helps produce software that enables the geographic mapping of information such as the locations of customers, competitors, suppliers, sales prospects, suppliers, and partners. GIS can be used for site selection, trade area analysis, environmental analysis, sales territory design, and the targeting of marketing. Impacts of GIS on business organizations mean that all types of companies choose GIS to quickly assess real-estate values and market viability. GIS helps business performance in a variety of tasks, including site selection by defining of consumer spending patterns, reallocation of franchise trade areas from the acquisition of new retail outlets, relocation of existing stores based on changing demographic patterns, visualization of market penetration and share of market, mapping of existing customers through address matching, target marketing using lifestyle segmentation statistics, definition of trade areas through drive time analysis, planning for store access by mapping average daily traffic [4]. In this paper the main objective is to design, build, and analyze a geospatial database to help in the use of the place strategy to select the most perfect or the most profitable locations in the city of Alexandria in Egypt to open a new branch for a virtual X restaurant