Introduction to GIS

Geol 4048

Geological Applications of Remote Sensing
GIS History:
Before Computers
GIS History

Using maps for a long time
Dr. Roger F. Tomlinson

“Father of GIS”

- He was an English geographer and the primary originator of modern computerized geographic information systems (GIS), and he has been acknowledged as the "father of GIS."
- He was born in 17 November 1933 and died in 9 February 2014.
- After his military service, Dr. Tomlinson attended the University of Nottingham and Acadia University for two separate undergraduate degrees in geography and geology, respectively.
- He received a Masters degree in geography from McGill University where he specialized in the glacial geomorphology of Labrador.
- His Doctoral thesis at University College London was titled: The application of electronic computing methods and techniques to the storage, compilation, and assessment of mapped data.
- Dr. Tomlinson's early career included serving as an assistant professor at Acadia, working as the manager of the computer mapping division at Spartan Air Services in Ottawa, Ontario (following his studies at McGill), and work with the Government of Canada first as a consultant and later as a director of regional planning systems with the Department of Forestry and Rural Development.
- It was during his tenure with the federal government in the 1960s that Dr. Tomlinson initiated, planned and directed the development of the Canada Geographic Information System, the first computerized GIS in the world.
What is GIS

• A geographic information system (GIS) lets us visualize, question, analyze, and interpret data to understand relationships, patterns, and trends.
What is GIS

- A GIS integrates hardware, software, and data for capturing, managing, analyzing, and displaying all forms of geographically referenced information.
- GIS allows us to establish relationships and patterns in the form of maps, reports, and charts.
- A GIS helps you answer questions and solve problems by looking at your data in a way that is quickly understood and easily shared.
- GIS technology can be integrated into any field.
A Geographic Information System (GIS) links locational (spatial) and database (tabular) information and enables a person to visualize patterns, relationships, and trends. This process gives an entirely new perspective to data analysis that cannot be seen in a table or list format. The five components of a GIS are listed below.

**HARDWARE**

The hardware is the computer and peripherals on which the GIS operates. Today, this could be a centralized computer server running the UNIX or Windows NT operating systems, a desktop PC, or an Apple Macintosh. The computer may operate in isolation or in a networked configuration.

- Computers
- Networks
- Peripheral Devices
- Printers
- Plotters
- Digitizers

**SOFTWARE**

GIS software provides the functions and tools users need to store, analyze, and display geographical information. The key software components are:

- GIS Software
- Database Software
- GIS Software
- Network Software

**DATA**

One of the most important components of GIS is the data. It is absolutely essential that data be accurate. The following are different data types:

- Vector Data
- Raster Data
- Image Data
- Attribute Data

**PEOPLE**

GIS technology is clearly of limited value without people to manage the system and to develop plans for applying it. Users of GIS range from highly qualified technical specialists to planners, foresters, and market analysts who use GIS to help with their everyday work.

- Administrators
- Managers
- GIS Technicians
- Application Experts
- End Users
- Consumers

**METHODS**

Methods are well designed plans and application-specific business rules describing how technology is applied. This includes the following:

- Guidelines
- Specifications
- Standards
- Procedures
The Basic Principle

A GIS map contains layers
Layers may contain features or surfaces.

A layer that is not a collection of geographic objects and is considered a single, continuous expanse that change from one location to another like bathymetry and elevation, is called a **surface**.
Features have shape and size

- **Polygons**: objects that are large enough to have boundaries
  - Countries, lakes, and tracks of land
- **Lines**: objects that are relatively too narrow to be polygons
  - Rivers, roads, and pipelines
- **Points**: objects that are relatively too small to be polygons
  - Cities, schools, fire hydrants

These features are collectively called **vector data**.

- Geographic objects have an endless variety of shapes and can be represented as one of three geometric forms:
Surfaces have numeric values rather than shapes.

- Natural phenomena, such as elevation, slope, temperature, rainfall, and wind speed, have no distinct shape.
- They have instead measurable values for any location on the Earth’s surface.
- The most common kind of surface is a **raster**, a matrix of identically sized squared cells. Each cell represents a unit of surface area.
Vector vs. Raster

Which is the best format?
A graticule is a grid over the world map that indicates a certain number of marks up or down from and to the right or left of a given starting point. This kind of grid is called a coordinate system, and it is what a GIS uses to put features in their proper place on a map.
Features can be displayed at different sizes.

**Scale**, commonly expressed as a ratio, is the relationship between the size of the features on a map and the size of the corresponding places in the world.

\[
\frac{\text{Distance on the Map}}{\text{Distance on the Ground}} = \frac{2 \text{ cm}}{1 \text{ km}} = \frac{2 \text{ cm}}{100 000 \text{ cm}} = \frac{\frac{2}{100 000}}{1} = \frac{2}{100 000} = \frac{1}{50 000}
\]

\[= \frac{1}{50 000} \text{ Scale}\]
Features are linked to information.

Attribute table
Features have spatial relationships
New features can be created from areas of overlap.
New features can be created from areas of overlap
Examples of GIS Software

• IDRISI
  ➢ www.clarklabs.org

• MapInfo
  ➢ www.pbinsight.com/welcome/mapinfo/

• GRASS GIS
  ➢ grass.osgeo.org/

• QGIS
  ➢ www.qgis.org/en/site/

• ArcGIS
  ➢ www.esri.com/software/arcgis
ArcGIS from ESRI
Jack and Laura Dangermond founded Environmental Systems Research Institute (ESRI) in 1969 as a small research group focused on land-use planning. The company's early mission was to organize and analyze geographic information to help land planners and land resource managers make well-informed environmental decisions.
1982
Esri enters the software business with ARC/INFO.
1986

Esri releases PC ARC/INFO in response to the proliferation of IBM PCs.
History of ESRI

1991
Esri releases ArcView in response to the popularity of a GUI desktop environment.
2004
ArcGIS 9 builds on desktop success and adds a development framework and server platform.
2012

ArcGIS 10.1 debuts, enabling users to deliver any GIS resource as a web service, putting geographic information in the hands of more people.
2014

ArcGIS 10.3: The Next Generation of GIS Is Here

by Sut Hanna on December 10, 2014

We're excited to announce that ArcGIS 10.3 is now available. ArcGIS 10.3 is a major release that will help you discover, make, use, and share maps from any device, anywhere, at any time.

ArcGIS 10.3 includes new apps and enhancements that will boost your efficiency and extend the impact of your work in your organization. Here are some of the highlights:

ArcGIS Pro – Your New ArcGIS for Desktop App

ArcGIS Pro reinvents desktop GIS. This brand new 64-bit desktop app lets you render and process your data faster than ever. With ArcGIS Pro, you can design and edit in 2D and 3D, work with multiple displays and layouts, and publish maps directly to ArcGIS Online or Portal for ArcGIS, making them available on any device.
2015-2016


Use ArcMap, ArcCatalog, ArcGlobe, or ArcScene, to create maps, perform spatial analysis, manage geographic data, and share your results.

ArcGIS Pro, a new application available to ArcGIS for Desktop users, provides tools to visualize, analyze, compile, and share your data, in both 2D and 3D environments. Go to pro.arcgis.com for information on using ArcGIS Pro.

SIGN UP FOR A FREE TRIAL

Quick Start Guide  |  System Requirements  |  Installation Guide  |  License Manager Guide  |  What’s New

Build Maps  |  Perform Analysis
ArcMap
ArcCatalog
ArcToolbox

3D Analyst Tools
Analysis Tools
Cartography Tools
Conversion Tools
Data Interoperability Tools
Data Management Tools
Editing Tools
Geocoding Tools
Geostatistical Analyst Tools
Linear Referencing Tools
Multidimension Tools
Network Analyst Tools
Parcel Fabric Tools
Schematics Tools
Server Tools
Spatial Analyst Tools
Spatial Statistics Tools
Tracking Analyst Tools
The increasing portability of GPS receivers has enabled laptops, PDAs, and cellular phones to link precise, real-time, locational information to a GIS.

- Enter new data as it directly observed
- Verify or update information already in the system
- Valuable for registering digital images or satellite imagery
- Provides immediate on-site access to spatial data in the field
ArcGIS Server
Online GIS

www.arcgis.com/features/
Any question?