Geographic Information Systems 2018/19
Week 12, Topic 2

Mark Foley
School of Computing
DIT, Kevin Street

mark.foley@dit.ie

In this session...

Review and wrap up

Introduction

What is GIS?

Why is it interesting?

What is spatial data? - Basic data structures

Getting the World into a computer

Maps and mapping

Map as "database"

What sort of problems can I solve with GIS?

Module content

Introduction to GIS

Spatial data and coordinate systems

Vector data

Raster data

Data acquisition, accuracy and quality

Display and cartography

Attribute data management and data exploration

Vector data analysis

Raster data analysis

Terrain mapping and analysis

Spatial interpolation

GIS modeling

Projections and coordinate systems

The shape of the Earth

From an approximate sphere to flat maps

Geographic Coordinate Systems

Map Projections in general

So, why is all of this important?

Datasets in different coordinate systems cannot be used together or displayed on the same map

You need to normalise to a consistent choice for this

You might need to convert data from one coordinate system to another

GIS software comes pre-loaded with the necessary parameters to convert between systems

The EPSG (European Petroleum Survey Group) publishes a database of coordinate system information plus some very good related documents on map projections and datums

Each coordinate system has a code number assigned by EPSG. The most common ones you're likely to encounter in Ireland are

- WGS84 → EPSG:4326
- Web Mercator (aka Spherical Mercator) → EPSG:3857
- TM75/Irish Grid → EPSG:29903
- Irish Transverse Mercator (ITM) → EPSG:2157

Representation of spatial features

- Representation of spatial features
  - “Simple features” model
- Geometry: points, lines and polygons
- Data structures: shapefile, spatialite, PostGIS, etc.
- Interchange formats: JSON/GeoJSON, WKT, GML etc.
- Topology
  - Topological data structures - general overview
  - Advantages/disadvantages vis a vis simple features
- Attribute data
- Symbology
- Classification

Symbology

The symbology of a layer is its visual appearance on the map. The basic strength of GIS over other ways of representing data with spatial aspects is that with GIS, you have a dynamic visual representation of the data you're working with.

Therefore, the visual appearance of the map (which depends on the symbology of the individual layers) is very important. The end user of the maps you produce will need to be able to easily see what the map represents. Equally as important, you need to be able to explore the data as you're working with it, and good symbology helps a lot.

Values in your attributes can dynamically determine the displayed symbology. For example, a mpa that shades areas by some attribute of eacfh area is known as a choropleth map.

Raster Data

Raster Data

Idea of continuous data

Raster types

Cell values

Resolution

Digital Elevation Model (DEM)

Example representation

Encoding & compression

Quadtree

Other raster types

Data display and cartography

Cartographic representations

Types of quantitative maps

Map design

Typography

Map production

Data acquisition, transformation & accuracy

- Acquisition
  - Sources of spatial data
- Transformation
  - Line simplification
  - Vector to/from Raster
- Accuracy
  - Standards
  - Error handling

Data transformation & accuracy

- Transformation
  - Geometric transformation
  - Root mean square (RMS) error
  - Line simplification
  - Vector to/from Raster
- Accuracy
  - Standards
  - Error handling

Data Quality Issues

Explain the key concepts and terminology associated with data error and quality

Describe errors in spatial data

List types of error that arise in GIS

Outline typical ssources of error in a GIS project

Explain how GIS errors can be modelled and traced

Describe how errors in GIS can be managed

Vector Data Analysis

Data Exploration

Distance measurement

Map-based data manipulation

Spatial data query

Buffering

Overlay

Raster Data Analysis

Data Analysis Environment

Local Operations

Neighbourhood Operations

Zonal Operations

Physical Distance Measure Operations

Other Raster Data Operations

Comparison of Vector- and Raster-Based Data Analysis

Terrain Mapping and Analysis

Data for Terrain Mapping and Analysis

Terrain Mapping

Slope and Aspect

Surface Curvature

Raster Versus TIN

Interpolation

Multi-criteria Evaluation

Modeling

Worked Example

A somewhat silly project (based on last week's example):

"Grape growing in the Gaeltacht"

Scenario

1. You have been awarded a grant (funding) to determine suitable areas for growing grapes in the Gaeltacht (Irish-speaking) regions of Ireland
2. You must ignore the obvious climatic challenges (you're an optimist and your funder is naive)
3. The suitable areas must be
    1. Inside the Gaeltacht areas
    2. On South-facing slopes
    3. Not too flat (to allow for drainage)
    4. Not too steep (to allow for machine access)

Coming next...

And finally...

... the exam