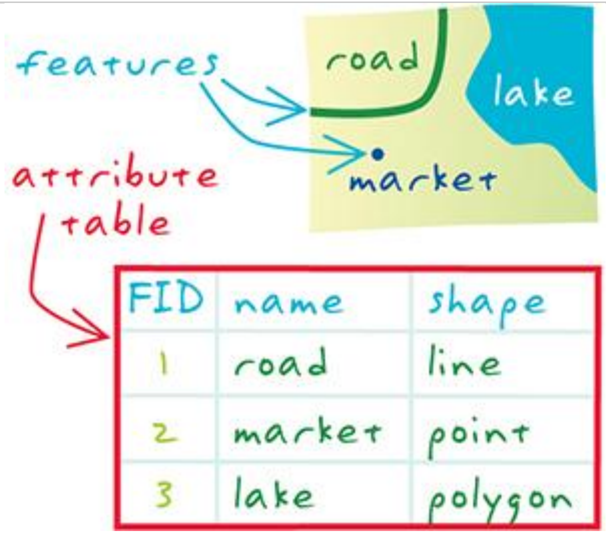
ATTRIBUTE TABLE

Attribute Data Attribute data are the information linked to the geographic features (spatial data) that describe them. That is, attribute data are the “[n]on-graphic information associated with a point, line, or area elements in a GIS.”

1. 

[data structures] A database or tabular file containing information about a set of geographic features, usually arranged so that each row represents a feature and each column represents one feature attribute. In raster datasets, each row of an attribute table corresponds to a certain zone of cells having the same value. In a GIS, attribute tables are often joined or related to spatial data layers, and the attribute values they contain can be used to find, query, and symbolize features or raster cells.

GEOREFERENCING

Georeferencing is the process of taking a digital image, it could be an airphoto, a scanned geologic map, or a picture of a topographic map, and adding geographic information to the image so that GIS or mapping software can 'place' the image in its appropriate real world location. This process is completed by selecting pixels in the digital image and assigning them geographic coordinates. In rare instances, one may already know the geographic coordinates of certain pixels in an image; more frequently, a non-georeferenced image is georeferenced to an existing image that already has embedded geographic information, such as a DRG, DLG, or DEM (see Data Resources).

Specialized software is generally necessary to complete the process of geocoding. ArcGIS has functionality for this procedure, as do many remote sensing software packages, such as ENVI. For the purposes of GeoPads, the most pressing need for georeferencing are the digital images of geologic maps available from the National Geologic Map Database. The USGS provides a comprehensive tutorial on georeferencing in ArcGIS. Other programs will follow a similar procedure.

Georeferencing means that the internal coordinate system of a map or aerial photo image can be related to a ground system of geographic coordinates. The relevant coordinate transforms are typically stored within the image file (GeoPDF and GeoTIFF are examples), though there are many possible mechanisms for implementing georeferencing. The most visible effect of georeferencing is that display software can show ground coordinates (such as latitude/longitude or UTM coordinates) and also measure ground distances and areas. In other words, Georeferencing means to associate something with locations in physical space. The term is commonly used in the geographic information systems field to describe the process of associating a physical map or raster image of a map with spatial locations. Georeferencing may be applied to any kind of object or structure that can be related to a geographical location, such as points of interest, roads, places, bridges, or buildings.[1]

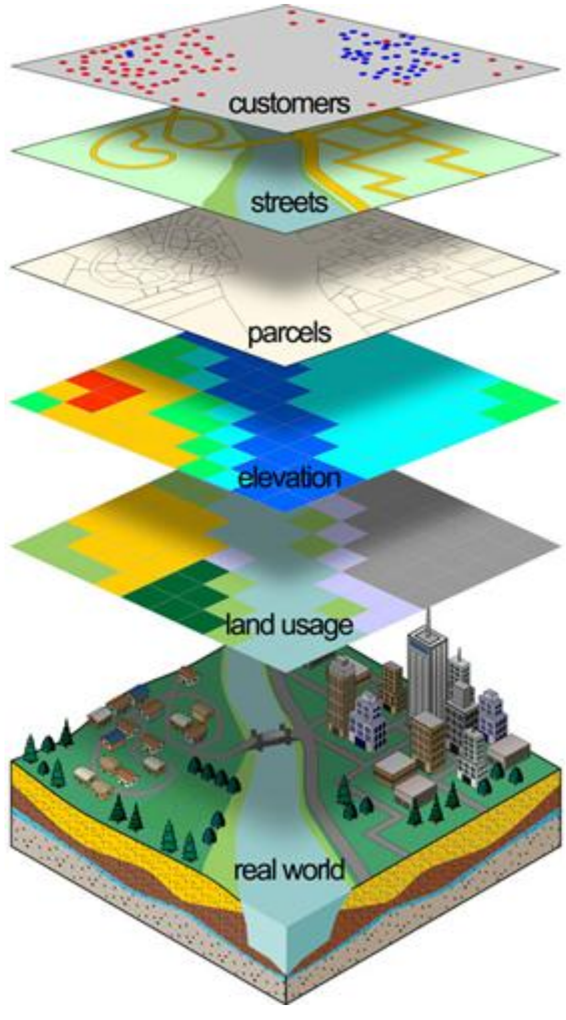
Geographic locations are most commonly represented using a coordinate reference system, which in turn can be related to a geodetic reference system such as WGS-84.

Examples include establishing the correct position of an aerial photograph within a map or finding the geographical coordinates of a place name or street address (Geocoding).

Image enhancement is the process of adjusting digital images so that the results are more suitable for display or further image analysis. For example, you can remove noise, sharpen, or brighten an image, making it easier to identify key features.

OVERLAY is a GIS operation that superimposes multiple data sets (representing different themes) together for the purpose of identifying relationships between them.[2]. An overlay creates a composite map by combining the geometry and attributes of the input data sets. Tools are available in most GIS software for overlaying both Vector or raster data.

Before the use of computers, a similar effect was develioped by Ian McHarg and others by drawing maps of the same area at the same scale on clear plastic and actually laying them on top of each other.



Overlay with Vector Data

Feature overlays from vector data are created when one vector layer (points, lines, or polygons) is merged with one or more other vector layers covering the same area with points, lines, and/or polygons. A resultant new layer is created that combines the geometry and the attributes of the input layers.

An example of overlay with vector data would be taking a watershed layer and laying over it a layer of counties. The result would show which parts of each watershed are in each county

Polygon Overlay Functions

Various GIS software packages offer a variety of polygon overlay tools, often with differing names. Of these, the following three are used most commonly for the widest variety of purposes:

- Intersection, where the result includes all those polygon parts that occur in both input layers and all other parts are excluded. It is roughly analogous to AND in logic and multiplication in arithmetic.
- Union, where the result includes all those polygon parts that occur in either A or B (or both), so is the sum of all the parts of both A and B. Different from identify in that individual layers are no longer identifiable. It is roughly analogous to OR in logic and addition in arithmetic.
- Subtract, also known as Difference or Erase, where the result includes only those polygon parts that occur in one layer but not in another. It is roughly analogous to AND NOT in logic and subtraction in arithmetic.

The remainder are used less often, and in a narrower range of applications. If a tool is not available, all of these could be derived from the first three in two or three steps.

- Symmetric Difference, also known as Exclusive Or, which includes polygons that occur in one of the layers but not both. It can be derived as either (A union B) subtract (A intersect B), or (A subtract B) union (B subtract A). It is roughly analogous to XOR in logic.
- Identity covers the extent of one of the two layers, with the geometery and attributes merged in the area where they overlap. It can be derived as (A subtract B) union (A intersect B).
- Cover, also known as Update, is similar to union in extent, but in the area where the two layers overlap, only the geometry and attributes of one of the layers is retained. It is called "cover" because it looks like one layer is covering the other; it is called "update" because its most common usage is when the covering layer represents recent changes that need to replace polygons in the original layer, such as new zoning districts. It can be derived as A union (B subtract A).
- Clip contains the same overall extent as the intersection, but only retains the geometry and attributes of one of the input layers. It is most commonly used to trim one layer by a polygon represent an area of interest for the task. It can be derived as A subtract (A subtract B).

It is important to note that these functions can change the original polygons and lines into new polygons and lines and their attribute

Overlay with Raster Data

Raster overlay involves two or more different sets of data that derive from a common grid. The separate sets of data are usually given numerical values. These values then are mathematically merged together to create a new set of values for a single output layer [4]. Raster overlay is often used to create risk surfaces, sustainability assessments, value assessments, and other procedures. An example of raster overlay would be to divide the habitat of an endangered species into a grid, and then getting data for multiple factors that have an effect on the habitat and then creating a risk surface to illustrate what sections of the habitat need protecting mos

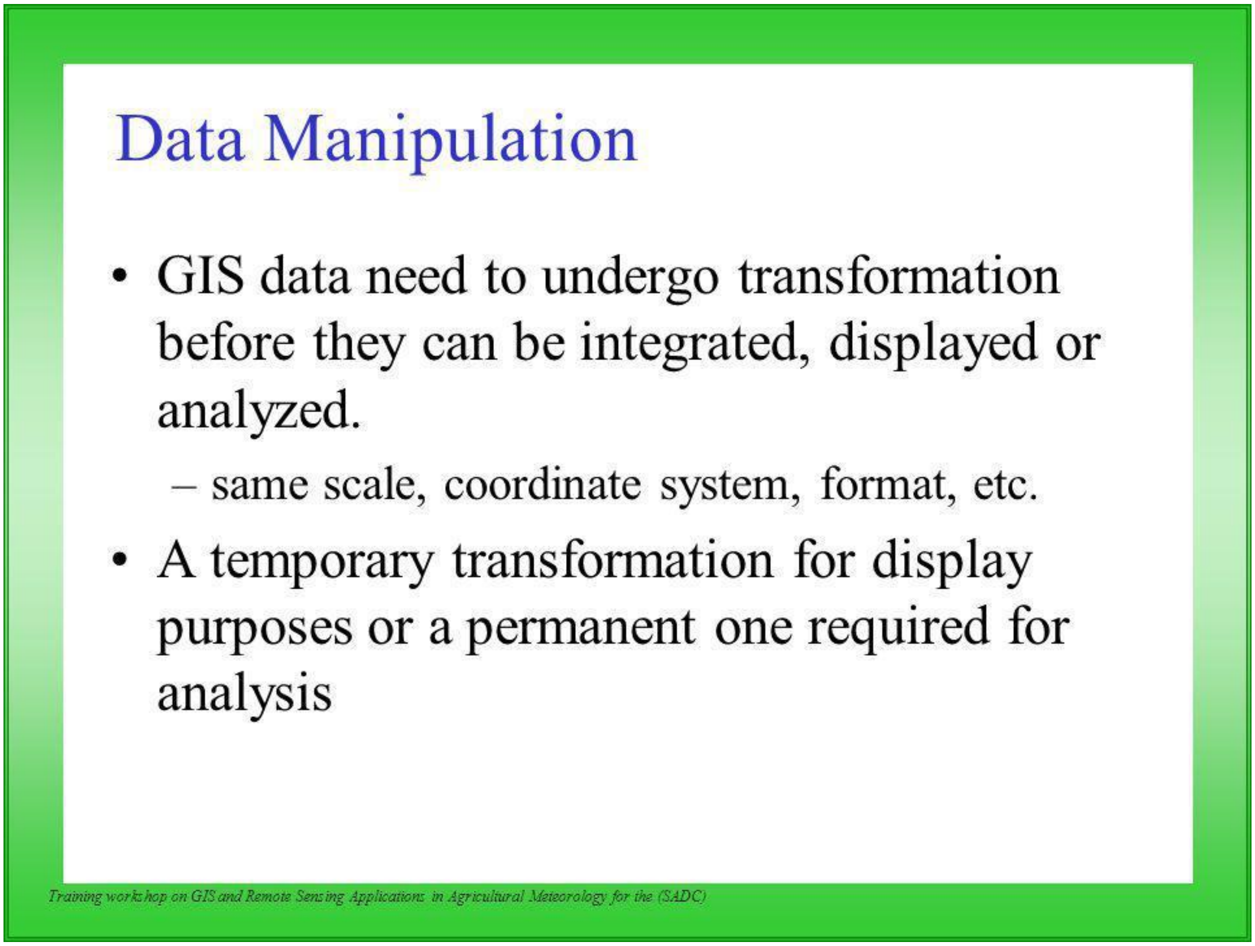


IMAGE ENHANCEMENT is the process of adjusting digital images so that the results are more suitable for display or further image analysis. For example, you can remove noise, sharpen, or brighten an image, making it easier to identify key features.

Image enhancement techniques are mathematical techniques that are aimed at realizing improvement in the quality of a given image. The result is another image that demonstrates certain features in a manner that is better in some sense as compared to their appearance in the original image. One may also derive or compute multiple processed versions of the original image, each presenting a selected feature in an enhanced appearance. Simple image enhancement techniques are developed and applied in an ad hoc manner.

Image enhancement techniques have been widely used in many applications of image processing where the subjective quality of images is important for human interpretation

Here are some useful examples and methods of image enhancement:

- Filtering with morphological operators
- Histogram equalization
- Noise removal using a Wiener filter
- Linear contrast adjustment
- Median filtering
- Unsharp mask filtering
- Contrast-limited adaptive histogram equalization (CLAHE)
- Decorrelation stretch

The following images illustrate a few of these examples

IMAGE CLASSIFICATION

Image classification refers to the task of extracting information classes from a multiband raster image. The resulting raster from image classification can be used to create thematic maps. Depending on the interaction between the analyst and the computer during classification, there are two types of classification: supervised and unsupervised.

With the ArcGIS Spatial Analyst extension, there is a full suite of tools in the Multivariate toolset to perform supervised and unsupervised classification (see An overview of the Multivariate toolset). The classification process is a multi-step workflow, therefore, the **Image Classification** toolbar has been developed to provided an integrated environment to perform classifications with the tools. Not only does the toolbar help with the workflow for performing unsupervised and supervised classification, it also contains additional functionality for analyzing input data, creating training samples and signature files, and determining the quality of the training samples and signature files. The recommended way to perform classification and multivariate analysis is through the **Image Classification** toolbar.

Supervised classification

Supervised classification uses the spectral signatures obtained from training samples to classify an image. With the assistance of the **Image Classification** toolbar, you can easily create training samples to represent the classes you want to extract. You can also easily create a signature file from the training samples, which is then used by the multivariate classification tools to classify the image.

Unsupervised classification

Unsupervised classification finds spectral classes (or clusters) in a multiband image without the analyst’s intervention. The **Image Classification** toolbar aids in unsupervised classification by providing access to the tools to create the clusters, capability to analyze the quality of the clusters, and access to classification tools.

Example

In the following example, the **Image Classification** toolbar was used to classify a Landsat TM satellite image.

Post-classification

In the classified output, some misclassified isolated pixels or small regions of pixels may exist. This gives the output a "salt and pepper" or speckled appearance. Post-classification processing refers to the process of removing the noise and improving the quality of the classified output.

The ArcGIS Spatial Analyst extension provides a set of generalization tools for the post-classification processing task. This task involves three steps. Each step is based on a Spatial Analyst tool from the Generalization toolset.

1. Filtering the classified output.

   This step removes the isolated pixels or noise from the classified output. The Majority Filter tool is used.

2. Smoothing class boundaries and clumping classified output.

   This step smooths the ragged class boundaries and clumps the classes. The Boundary Clean tool is used.

3. Generalizing classified output by removing small isolated regions.

   This step reclassifies small isolated regions of pixels to the nearest classes. The Region Group, Set Null and Nibble tools are used.

IMAGE EDITING

Image editing refers to modifying or improving digital or traditional photographic images using different techniques, tools or software. Images produced by scanners, digital cameras or other image-capturing devices may be good, but not perfect. Image editing is done to create the best possible look for the images and also to improve the overall quality of the image according to different parameters.

Image editing is considered a creative, artistic act. Image editing is done for removing unwanted elements such as dust specks and scratches, adjusting the geometry of the image like rotating and cropping, correcting for lens aberrations, sharpening or softening the image, making color changes or adding special effects to the image. Often the tasks involved in image editing are repetitive and need intense processing. Manual image editing done on traditional analog photographs requires a high level of expertise and attention to detail. Image editing software applications are also available for editing images. Unlike other conventional methods, these tools provide advanced image editing operations like data compression, photo organization and selection of image properties.

In digital image processing, image editing is basically categorized into pixel editing and parametric image editing. Pixel editing focuses on altering the image by working at the pixel level. Parametric image editing, on other hand, focuses on changing the appearance of the image without altering the original image.

There are benefits associated with image editing. It enhances the original images in accordance to the user's requirements. They can bring more color and life to the image. It helps in bringing the best possible image in the interests of the viewers.

There are a few drawbacks for image editing. Advanced software for image editing is expensive and often requires time for an individual to understand and become familiarized with its features. Furthermore, some consider edited images to be false or misleading, causing a negative reputation for some people toward image editing.

Thematic map

A **thematic map** is a type of map specifically designed to show a particular theme connected with a specific geographic area, such as temperature variation, rainfall distribution or population density.

A **thematic map** is a specialized map made to visualize a particular subject or theme about a geographic area. Thematic maps can portray physical, social, political, cultural, economic, sociological, or any other aspects of a city, state, region, nation, continent, or the entire globe.[1] A thematic map is designed to serve a special purpose or to illustrate a particular subject, in contrast to a general map, on which a variety of phenomena appear together, such as landforms, lines of transportation, settlements, and political boundaries.[2] This is in direct contrast to a reference map or Topographic map, which are designed to show the location of visible features of the landscape with minimal interpretation and intended to be used for a wide variety of purposes. Thematic maps also portray basic features such as coastlines, boundaries and places, but they are only used as a point of locational reference for the phenomenon being mapped.[2]

Thematic maps also emphasize spatial variation of one or a number of geographic distributions. These distributions may be physical phenomena such as climate or human characteristics such as population density and health issues. Barbara Petchenik described the difference as "in place, about space."[3] While general reference maps show where something is in space, thematic maps tell a story about that place based on spatial patterns.[4] Thematic maps are sometimes referred to as graphic essays because they display spatial variations and interrelationships of geographical distributions that can be interpreted

Uses

Thematic maps serve three primary purposes.

1. They provide specific information about particular locations.
2. They provide general information about spatial patterns.
3. They can be used to compare patterns on two or more maps.

Common examples are maps of demographic data such as population density. When designing a thematic map, cartographers must balance a number of factors in order to effectively represent the data. Besides spatial accuracy, and aesthetics, quirks of human visual perception and the presentation format must be taken into account.