**GIS Notes**

Everything you experience from day to day happens somewhere in geographic space. As a result, you can represent your world and your experiences in it by using maps. You use those maps to find places, save time while traveling, decide where to locate a new store, plan cities, guide the development of wildlife preserves, and satisfy hundreds of other applications.

The computer systems that enable you to store and access all this information are collectively called geographic information systems (GIS).

Examples of people that may use GIS:

* Business owners and marketers
* Urban planners
* Merchandise distributors

Using GIS software, you can put maps and other geographic data into the computer. After you have the data in the computer, you can store, retrieve, and edit that data. You can analyze it (for example, find geographic features, measure distances, or compare patterns) and produce output from it (create new maps from what you find).

A GIS system is comprised of:

* Data
* Computers and software
* Geographic concepts that drive the analysis of data
* People that operate the GIS
* The organizations within which the GIS exists

Primary data are collected firsthand by you, for a particular project. Primary data are usually the best data for the job because you collect them with your specific goals in mind. Secondary data come from others who collect the data for unrelated tasks or gather it with remote sensors.

The process of entering data into a GIS system can be summed up as:

1. Define where, how, and what kind of data to sample
2. Collect that data directly or indirectly
3. Use the software to transform that data

You may need to change some data from hard copy to digital forms; you may need to convert some from uncategorized to categorized data (for example, aerial photo interpretation); and you may need to attach coordinates to digital data so that you can find them in your digital maps.

Hardware used to collect GIS data includes:

* Devices to collect information
* Devices to enter information
* Storage and analysis devices
* Output devices

Grid cells: one method of storing data in squared boxes, that may be utilized by a GIS system.

Organizations that use GIS work best when the organization adapts itself to the technology. If GIS helps the organization perform its tasks, if the employees are adapting to and benefitting from the changes, if the organization provides training, and if GIS enhances the organization's overall goals, that organization can likely incorporate GIS successfully, long-term.

A system designer reviews an organization's structure, products, workflow, and needs. He or she then determines the costs and benefits of GIS for that organization, as well as how the organization might best include GIS in critical operations.

Geographers know that all things are related in geographic space, but close things are more related than far things. This statement describes one aspect of geographic space — closeness — that makes space so important to you as a geographic decision-maker. Listed below are some terms that also relate to geographical space as it is used in GIS.

Density: refers to the measure of how concentrated or dispersed a phenomenon is within a specific geographic area.

Sinuosity: refers to the degree of curvature or winding of a linear feature, such as a river, road, or coastline. Sinuosity is a measure of how much a linear feature deviates from a straight line.

Connectivity: refers to the degree to which geographic features or locations are linked or able to interact with each other. Connectivity can be evaluated in terms of physical connections, such as roads or transportation networks, as well as conceptual connections, such as social or economic linkages between places.

Pattern Change: refers to the observed modifications or transformations in the spatial distribution, arrangement, or characteristics of geographic features over time

Movement: refers to the study and analysis of the spatial trajectories, patterns, and dynamics of objects, people, or phenomena as they change location over time.

Shape: refers to the geometric properties and configuration of geographic features and objects.

Size: refers to the physical dimensions and measurement of geographic features and objects.

Isolation: refers to the degree to which a geographic feature or location is physically or functionally separated from its surrounding environment or other features.

Adjacency: refers to the spatial relationship between geographic features or locations that are next to or bordering one another.

Geographic data come in four basic forms: points, lines, polygons (or areas), and surfaces. A fifth form, related to surfaces, is volumes.

* Points: refer to the simplest form of geographic feature, represented by a single x,y coordinate location on a map or in a spatial dataset.
* Lines: refer to linear geographic features represented by a series of connected x,y coordinate points.
* Polygons: refer to geographic features that are represented by enclosed two-dimensional areas defined by a series of connected x,y coordinate points.
* Surfaces: refer to continuous geographic features or phenomena that can be represented and analyzed as three-dimensional spatial data.
* Volumes: refer to the three-dimensional representation and analysis of geographic features and phenomena that have measurable depth or thickness, not just length and width.

Most GIS systems contain database tables that allow you to store all sorts of descriptive information about the points, lines, areas, and surfaces that you're depicting in your GIS. The nature of database tables requires you to be just as picky about assigning descriptive information to your objects as you are about choosing the right graphics to depict the objects themselves.

Nominal information: Geographic features that have names only. So, you can't compare their descriptive information to any other.

Ordinal information: Geographic features that you can compare by rank. You could have short, medium, and tall trees; dirt roads, paved roads, highways, and superhighways; or large, medium, and small chemical spills.

Interval information: Geographic features that have detailed increments (intervals) that you can measure. One limiting characteristic of interval data is that, although you can get very accurate measurements, you can't form ratios because the starting point is arbitrary.

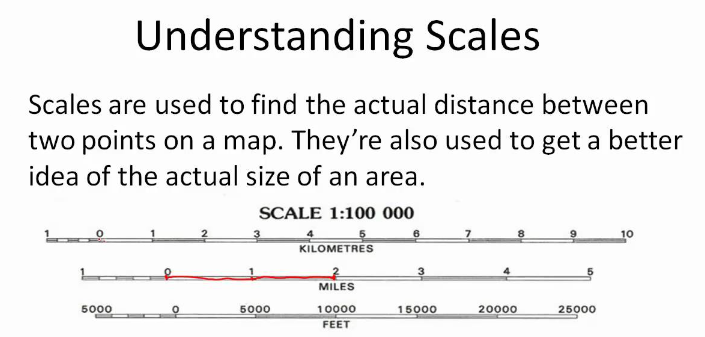
Ratio information: Geographic data that have measurable units, like interval data, but also allow you to make the ratio comparisons that interval data won't. If you own a parcel of land that's worth $20,000 and your neighbor has a parcel worth $10,000, then your parcel isn't just worth $10,000 more, it's also twice as expensive. The key point is that ratio data have an absolute 0.

Scalar information: data are a bit difficult to define, but here's my take: Scalar data have a proprietary measurement system. That is, you create your own scale that applies to only a particular set of data. So, if you're ranking the beauty of a scenic overlook on a scale of 1 to 10, you first have to decide what each number in the scale means. GIS allows you to establish a scalar description for features that you can't really measure any other way.

Map Extent: refers to the geographic area or region that is visible and displayed within the current map view or window.

Map scale refers to the relationship between the distance on a map and the corresponding distance on the earth's surface. Specifically, map scale is the ratio or proportion that expresses how much the map has been reduced or enlarged compared to the actual geographic space it represents.

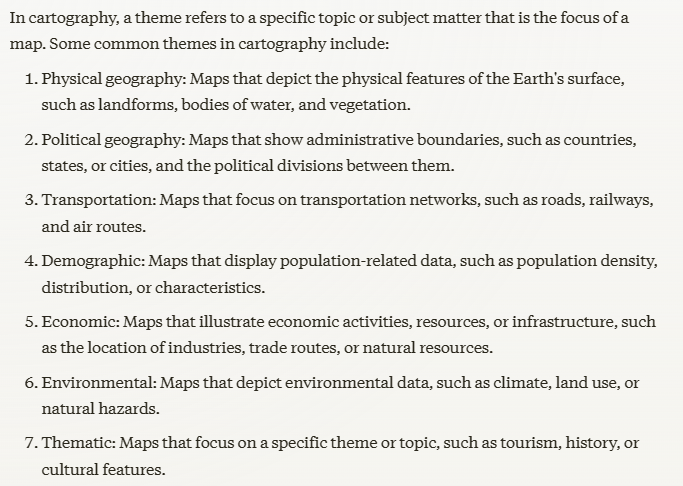
You can often find a map's scale represented by a graphic bar and a fraction that shows the relationship between the size of the map in the numerator (the fraction's top part) and the size of the Earth in the denominator (the fraction's bottom part). Using this mathematical approach, the smaller the fraction (one with a small numerator and a large denominator), the smaller the scale.



Cartographers use symbols that represent point features (such as towns), symbols that represent linear features (such as roads and rivers), and symbols that represent area features (such as lakes and towns).

Cartographers have to carefully consider certain things when they create a map:

* Scale: Determines how many geographic features can be symbolized on a map.
* Data availability: Determines what type of information can be put on the map.
* Limitations of output devices: The cartographer also has to consider how symbols will print.
* Reader characteristics: Not all readers have 20/20 vision, color vision, or any vision at all.



Reference maps offer a great deal of information on a single document. Atlases generally contain reference maps so that many related maps can be contained in the same place. Reference maps often cover very large portions of the Earth.

A thematic map provides as much accurate, detailed information as possible about a particular subject, such as roads or hills, as compared to a reference map, which tries to select the most important information about several subjects.

A road map is one example of a thematic map because it focuses on communicating information about roads.

Thematic maps are the primary kind of maps that you use in your GIS activities.

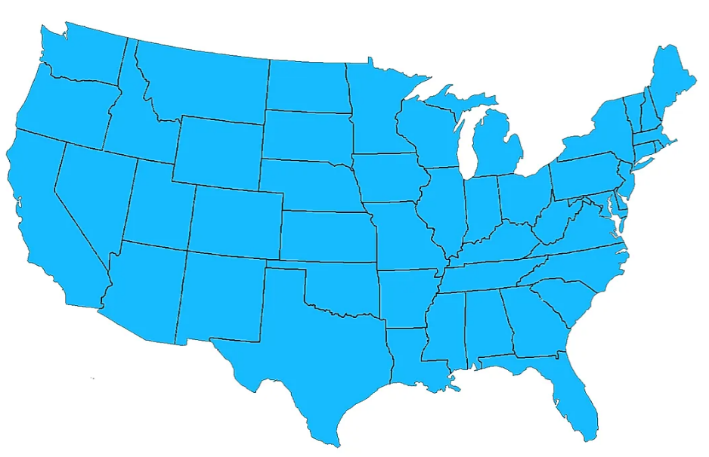
A good rule of thumb is that the larger the map scale, the smaller the area covered and the greater the detail. Larger scale maps are generally better for your GIS activities because they provide the largest amount of detail.

The “weakest link” hypothesis: the success or failure of a complex production process or system depends on the performance of the weakest component or link in the chain. This is mentioned in GIS as a way to remind the GIS operator that quality of a geographic product depends on it’s worst/lowest quality input.

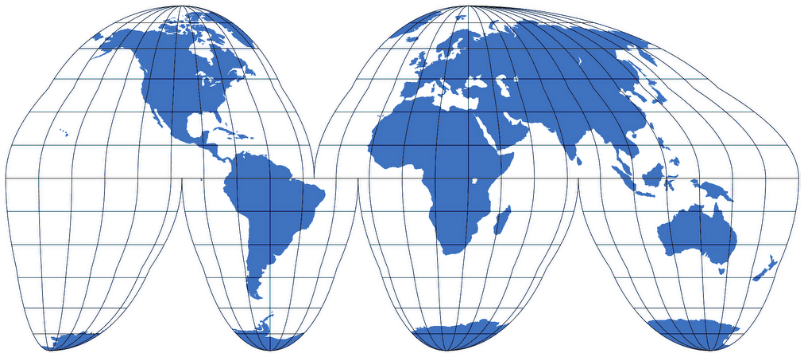
The earth’s spherical shape has some major drawbacks for the mapmaker who's faced with producing a flat map that correctly represents the shapes, angles, distances, and sizes of objects on the Earth. It is expected that some distortion will occur when translating a round object to a flat object.

Map projections —the process of converting the spherical Earth to a flat surface — come in many different types, from contiguous to interrupted, from those that look like photographs of the Earth to those placed on cones or cylinders.

Contiguous map: a type of map in which all the geographic areas or units depicted are connected to each other, with no gaps or disconnected regions. Example shown below:

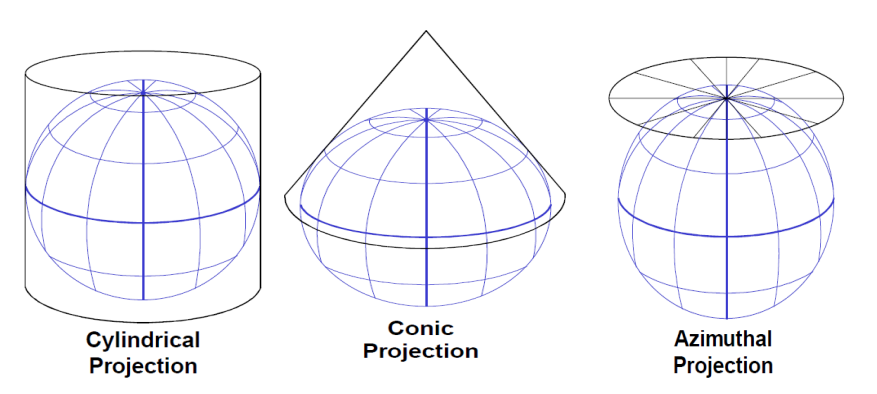


Interrupted map: a type of cartographic projection that intentionally breaks or interrupts the continuity of the map in order to better display certain geographical features or regions. Example shown below:



Another way to describe map projections is:

* Planar or Azimuthal
* Conical
* Cylindrical



When working with GIS, pick the map projection that best represents the properties you want preserved when you create output maps from your analysis. Most high-end GIS software has the capability to convert back and forth from one projection to another. Most have more map projections than you'll ever use.

Having an accurate representation of distance and area measurements in any projected map depends on having accurate measurements of the spherical Earth. The science of geodesy deals specifically with these measurements.

Geodesy is the scientific discipline focused on the measurement and representation of the Earth, including its gravitational field and geometric shape. It encompasses a range of activities and techniques related to accurately determining the size, shape, and position of the Earth.

A datum is a set of parameters and control points that define the size, shape, and orientation of the Earth's surface within a particular coordinate system. It provides a frame of reference for accurately locating and positioning geographic features and coordinates.

Your GIS software needs to know what datum you're using for each set of map data that you put into your database. Attaching your coordinates to the wrong datum can result in location and measurement errors.

When loading up your GIS, be sure to use the correct datum for each map source as you add it. Also, convert all your map data to a common datum when you work with more than one source map at a time.

Coordinate systems in GIS (Geographic Information Systems) are reference frameworks used to define and represent the location of geographic features and data on a map or within a digital mapping environment.

One of the many possible coordinate systems that you may encounter in GIS is called the UTM system. UTM stands for Universal Transverse Mercator, which is the most commonly used system. This system divides the Earth from latitude 84° north and 80° south into 60 numbered vertical zones, each 6 degrees of longitude wide.

