**PDHonline Course L145 (5 PDH)**

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# GIS – Introduction and Sample Uses

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**2020**

**PDH Online | PDH Center**

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Welcome to:

# FEMAs GIS Tutorial Series (Tutorials I, II and III)

## Screen-captures of FEMA's well-thought-out and carefully presented tutorial on:

# GIS

## (Geographic Information Systems)

# TUTORIAL 1 OF 3

**The tutorial series presents an introduction to GIS illustrated with FEMA's application of GIS in their MAP MODERNIZATION OBJECTIVES**

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IMPORTANT:

The **blue-text** links in the course material and the **GLOSSARY** entries accessed through the pull-down menu provide significant benefits to those studying the "live," on-line tutorial.

For this reason, it is suggested that those using this hard-copy version of FEMA's GIS tutorial series make frequent reference to the GLOSSARY section at the end of each portion of the tutorial.

For your convenience and ease of study, each of these three hard-copy files (a separate file covering each session of FEMA's 3-part GIS tutorial series) contains GLOSSARY entries from all three "live" tutorials.

Both the course material and the quiz rely on frequent reference to these GLOSSARY entries.

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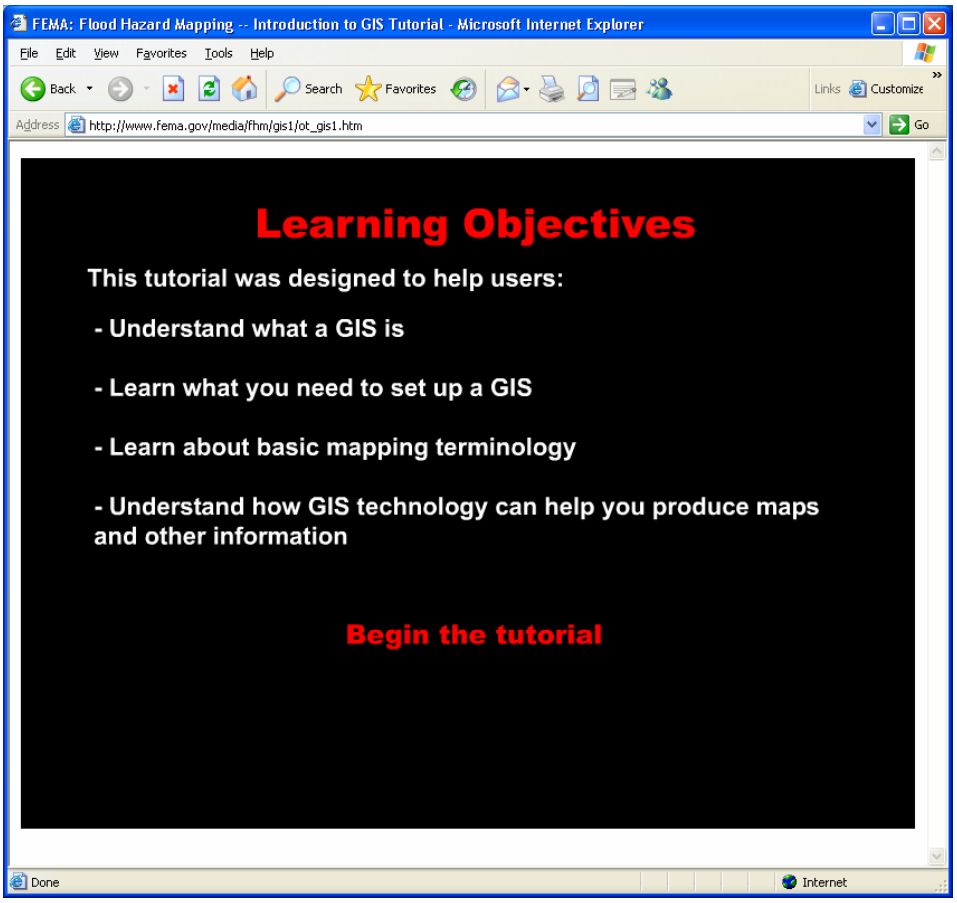
## Interested in viewing the on-line tutorial?

Tutorial system reqmts
http://www.fema.gov/plan/prevent/fhm/ot_gisrq.shtm

This link takes you directly to the tutorial
http://www.fema.gov/media/fhm/gis1/ot_gis1.htm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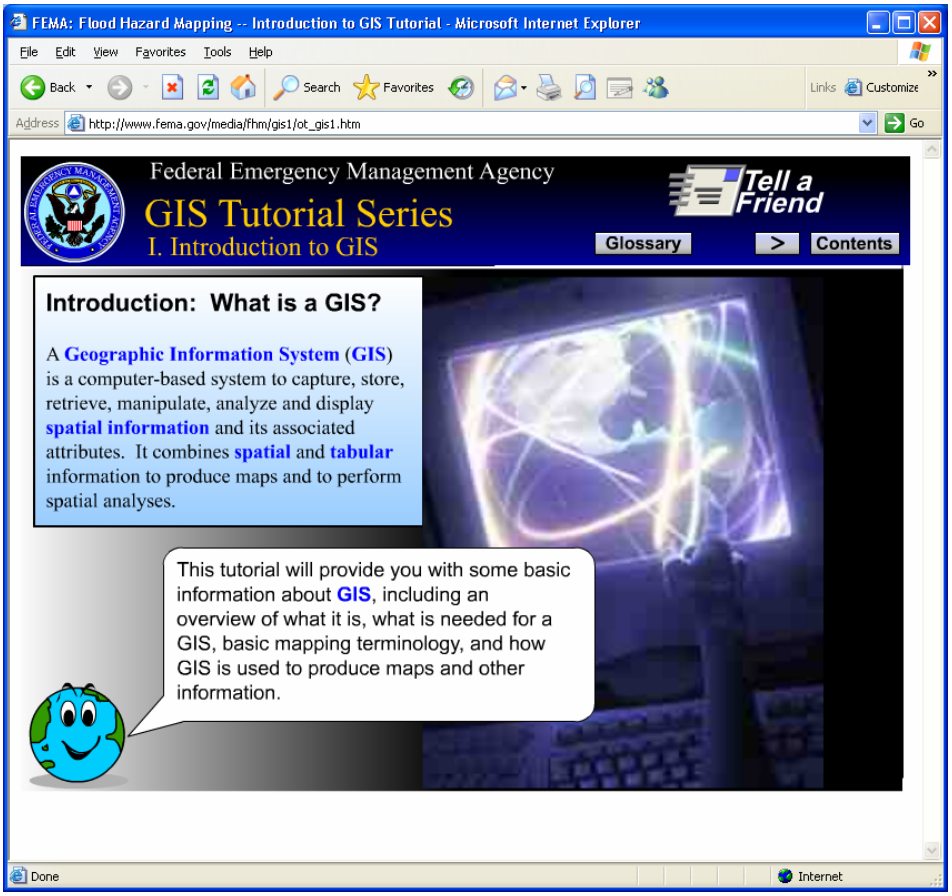
Learning Objectives
This tutorial was designed to help users:
- Understand what a GIS is
- Learn what you need to set up a GIS
- Learn about basic mapping terminology
- Understand how GIS technology can help you produce maps and other information
Begin the tutorial
Done
Internet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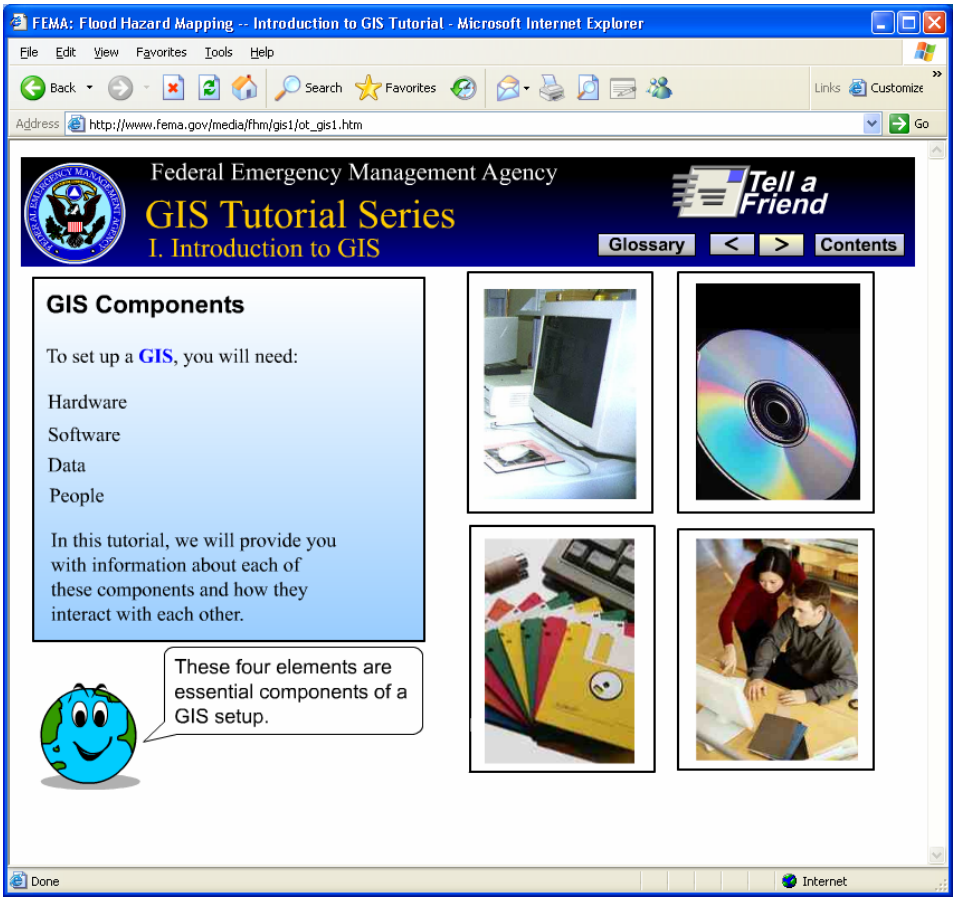
Contents
Introduction: What is a GIS?
A Geographic Information System (GIS) is a computer-based system to capture, store, retrieve, manipulate, analyze and display spatial information and its associated attributes. It combines spatial and tabular information to produce maps and to perform spatial analyses.
This tutorial will provide you with some basic information about GIS, including an overview of what it is, what is needed for a GIS, basic mapping terminology, and how GIS is used to produce maps and other information.
Done
Internet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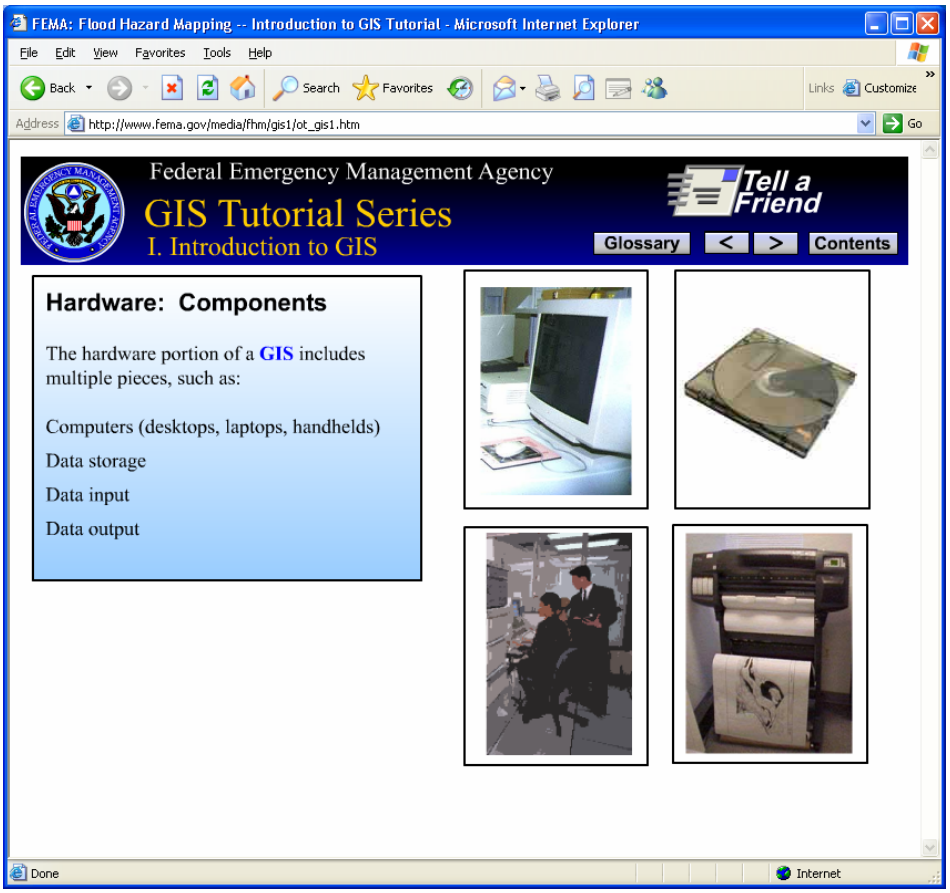
GIS Components
To set up a GIS, you will need:
Hardware
Software
Data
People
In this tutorial, we will provide you with information about each of these components and how they interact with each other.
These four elements are essential components of a GIS setup.
Done
Internet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Hardware: Components
The hardware portion of a GIS includes multiple pieces, such as:
Computers (desktops, laptops, handhelds)
Data storage
Data input
Data output
Done
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Hardware: Computers
Computer hardware used to run a GIS ranges from low-end desktop computers and laptops to high-end servers.
The type(s) of hardware and software required to set up a GIS depend on the needs of the user (i.e., GIS software processing requirements, data storage requirements).
Done
Internet


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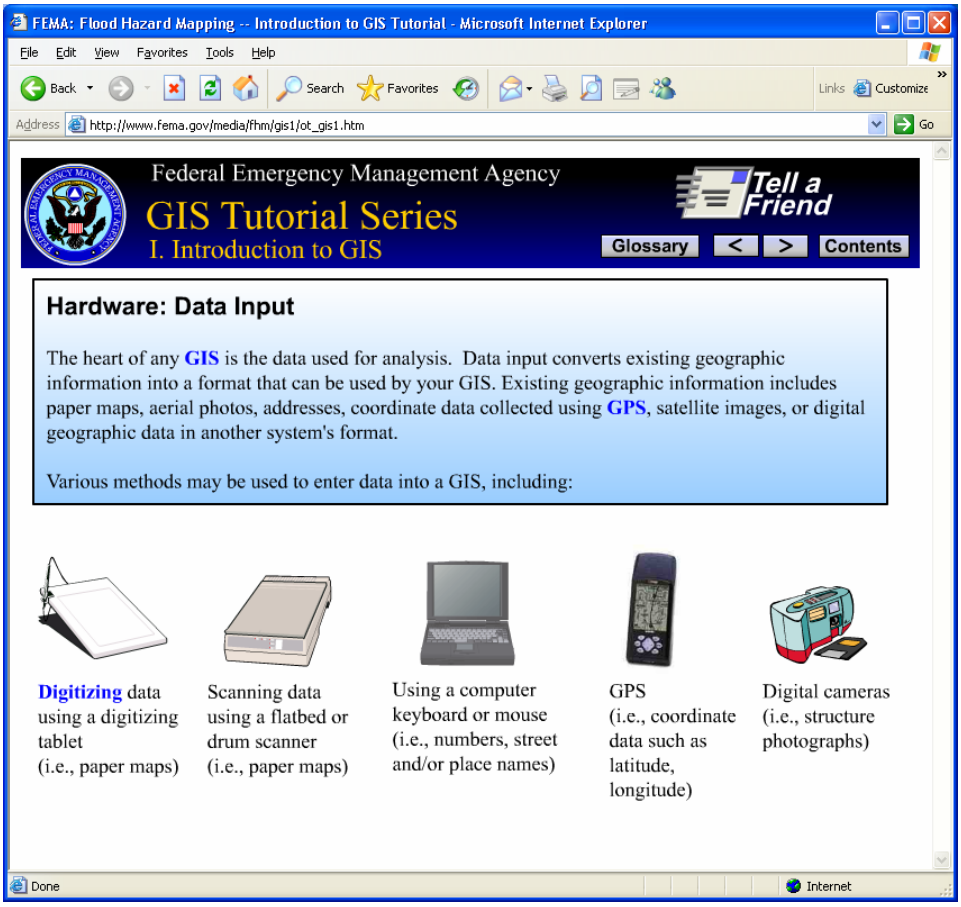
Hardware: Data Storage
GIS data can include fairly large files. Data storage devices available include local hard disks, network storage, CDs, high-volume portable disks and tapes.
The type of data storage device selected will depend on the size of the data sets and whether immediate access to the files is necessary. Data storage requirements depend on the combined size of the data sets.
Done
Internet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Hardware: Data Input
The heart of any GIS is the data used for analysis. Data input converts existing geographic information into a format that can be used by your GIS. Existing geographic information includes paper maps, aerial photos, addresses, coordinate data collected using GPS, satellite images, or digital geographic data in another system's format.
Various methods may be used to enter data into a GIS, including:
Digitizing data using a digitizing tablet (i.e., paper maps)
Scanning data using a flatbed or drum scanner (i.e., paper maps)
Using a computer keyboard or mouse (i.e., numbers, street and/or place names)
GPS (i.e., coordinate data such as latitude, longitude)
Digital cameras (i.e., structure photographs)
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Internet


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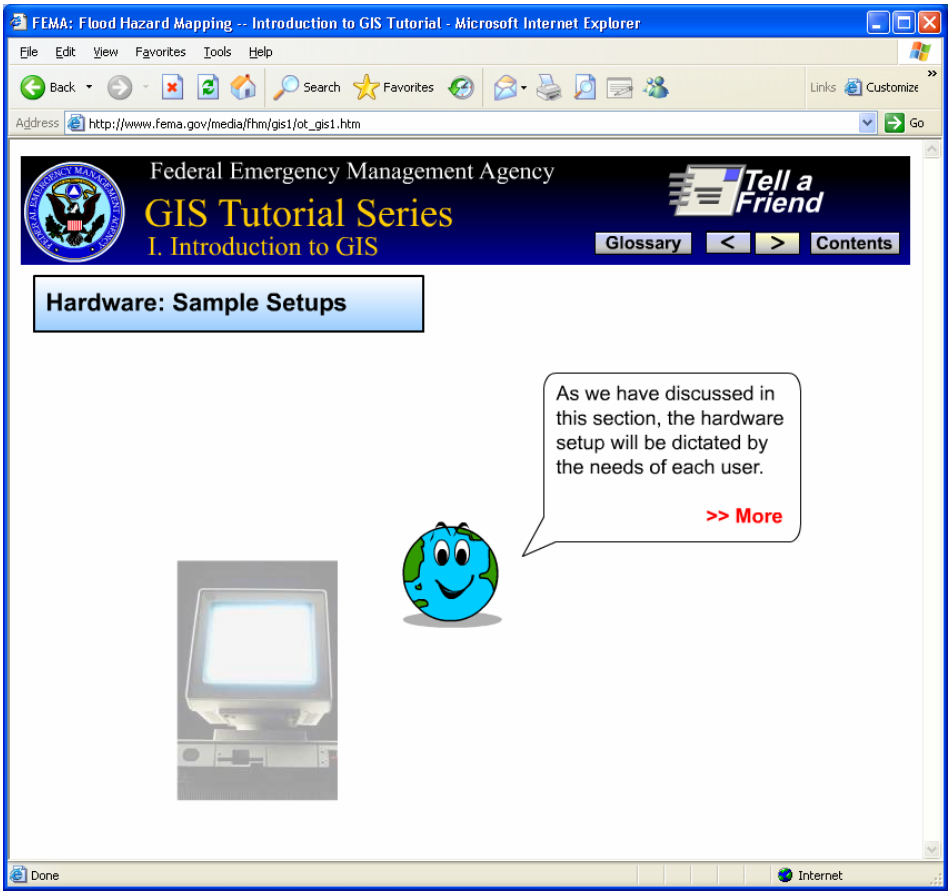
Hardware: Data Output
As is the case with any system, the data and analysis are only good if the information obtained can be communicated effectively.
Output devices such as printers and plotters are needed when planning for a GIS so that maps, charts, graphs, and tabular information can be printed. Additional output may include files that can be distributed via the Web and other media.
Done
Internet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Hardware: Sample Setups
As we have discussed in this section, the hardware setup will be dictated by the needs of each user.
>> More
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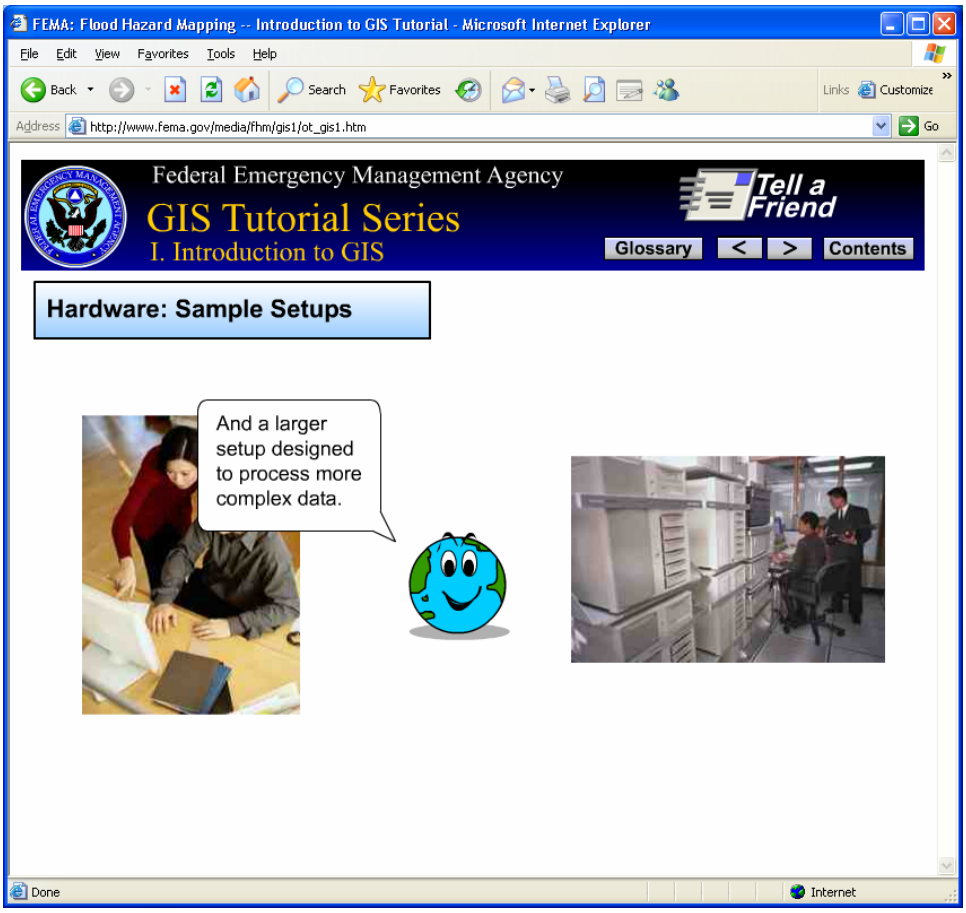
Hardware: Sample Setups
The following examples are provided to show a basic setup designed to handle simple data operations...
>>More
Done
Internet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Hardware: Sample Setups
And a larger setup designed to process more complex data.
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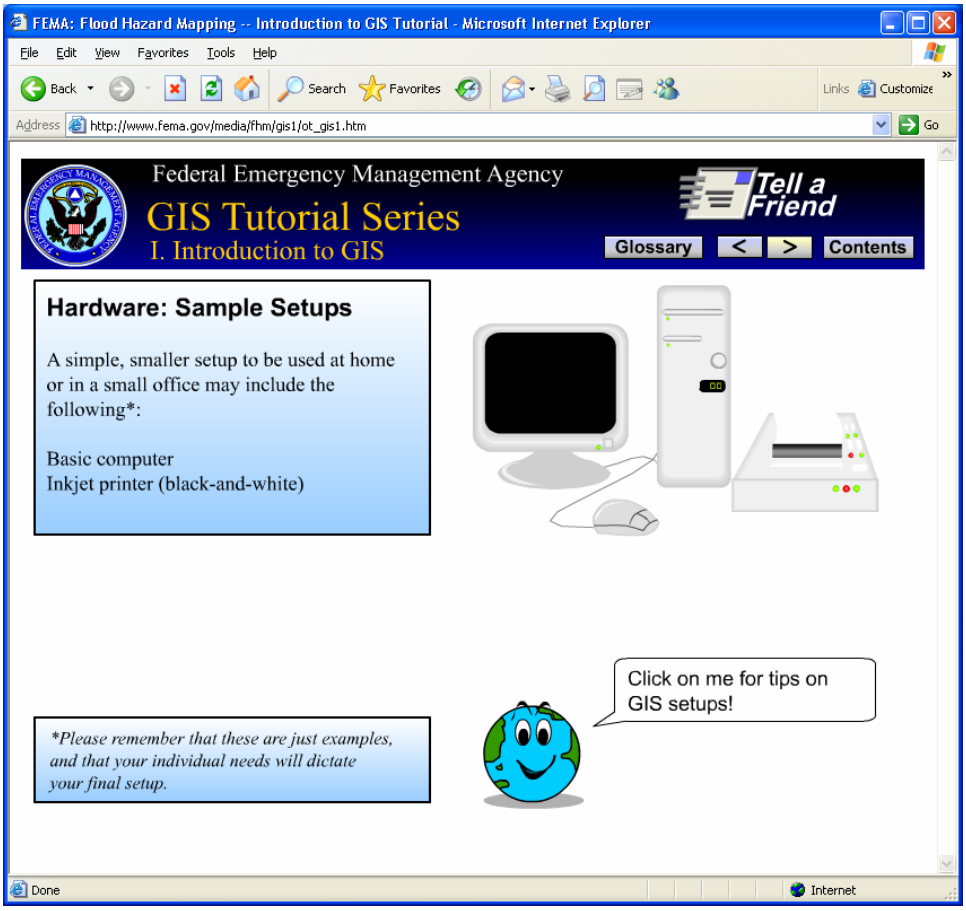
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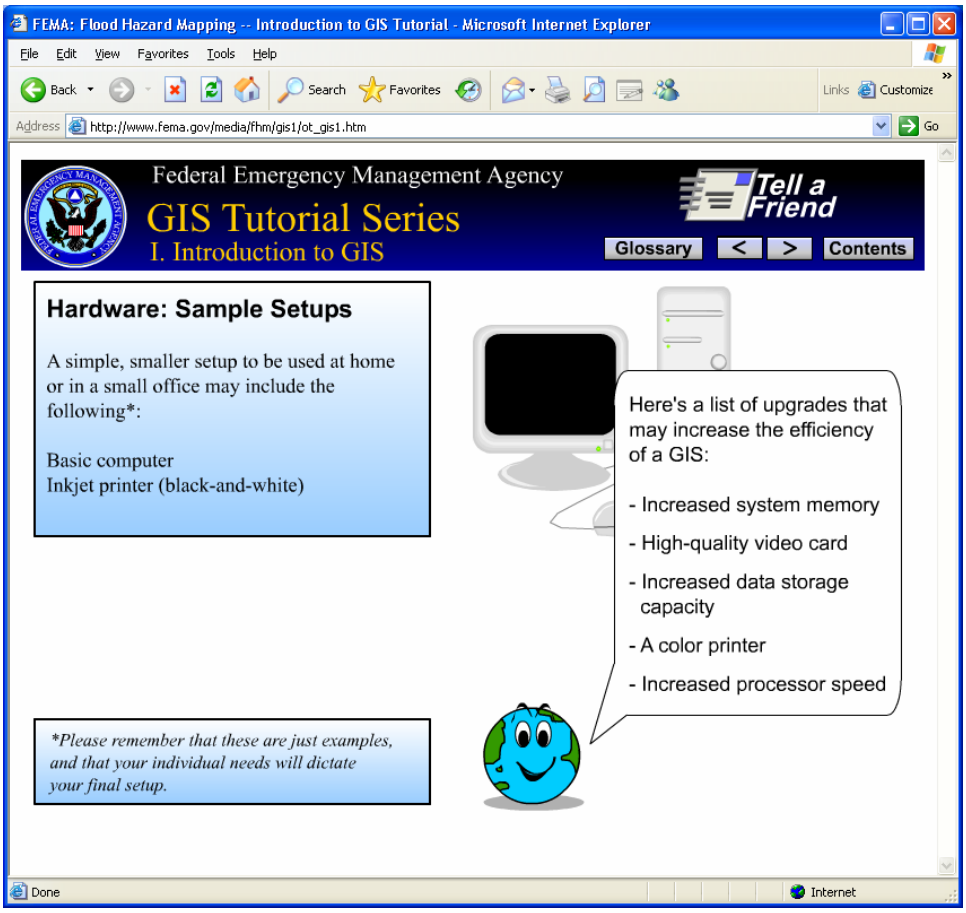
Hardware: Sample Setups
A simple, smaller setup to be used at home or in a small office may include the following*:
Basic computer
Inkjet printer (black-and-white)
*Please remember that these are just examples, and that your individual needs will dictate your final setup.
Click on me for tips on GIS setups!
Done
Internet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Hardware: Sample Setups
A simple, smaller setup to be used at home or in a small office may include the following*:
Basic computer
Inkjet printer (black-and-white)
*Please remember that these are just examples, and that your individual needs will dictate your final setup.
Here's a list of upgrades that may increase the efficiency of a GIS:
- Increased system memory
- High-quality video card
- Increased data storage capacity
- A color printer
- Increased processor speed
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Hardware: Sample Setups
A larger, more sophisticated setup like the one described below is typical of systems used to create Digital Flood Insurance Rate Maps (DFIRMs).*
High-end computer
Large server
Digitizing tablet
Color laser printers and plotters (large format printer)
*Please remember that these are just examples, and that your individual needs will dictate your final setup.
Done
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## Software

Although most **GIS** software packages share similar features (i.e., **thematic mapping**, **labeling**, **geocoding**, finding what's inside an area, determining quantities, etc.), programs vary in price and functionality.

Some have a number of built-in functions and others have additional modules that can be purchased separately to do specific types of analyses, such as flood hazard mapping and disaster planning.

The choice of software depends on the needs of each user. For your reference, we have provided a partial list of GIS software firms and their products. You may follow the links for each company for additional information.*

### Selection of GIS Software Companies and Programs

ESRI (ArcView, Arc/INFO)

MapInfo (MapInfo)

Caliper (Maptitude)

Intergraph (GeoMedia)

Tactician (Tactician)

**Note: This is not a comprehensive list of the types of GIS software packages available and does not constitute FEMA's endorsement of any of these companies and/or their products.*

Done Internet

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## Software: Sample Setups

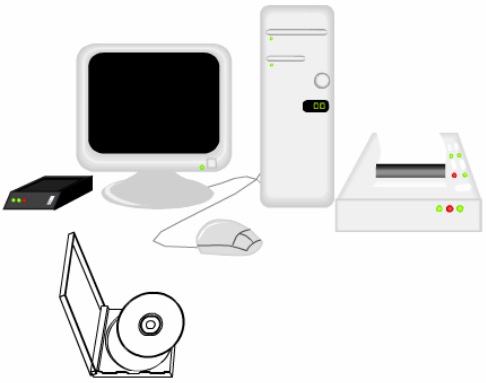
A simple, small setup like the one described below is typical of software packages used in a home or small office setting where users are making their initial forays into **GIS**.*

Basic computer

Inkjet printer (black-and-white)

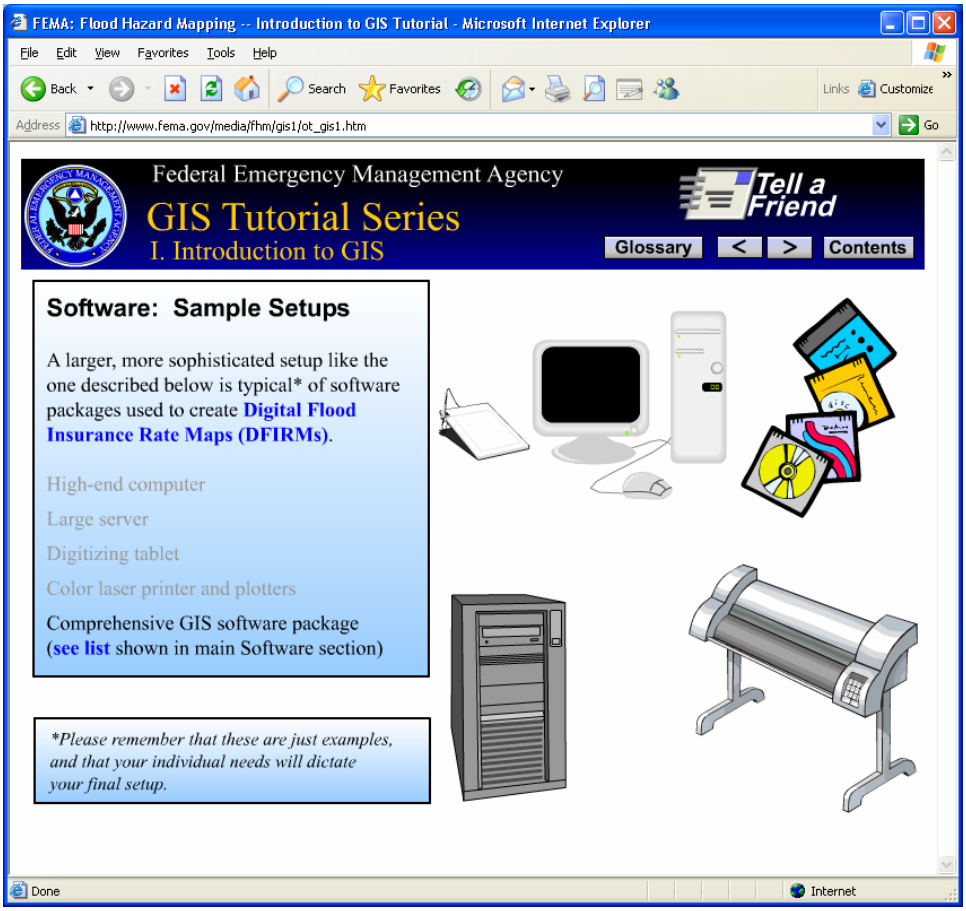
Publicly available geographic data downloaded from the Web

Public domain software



**Please remember that these are just examples, and that your individual needs will dictate your final setup.*

Done Internet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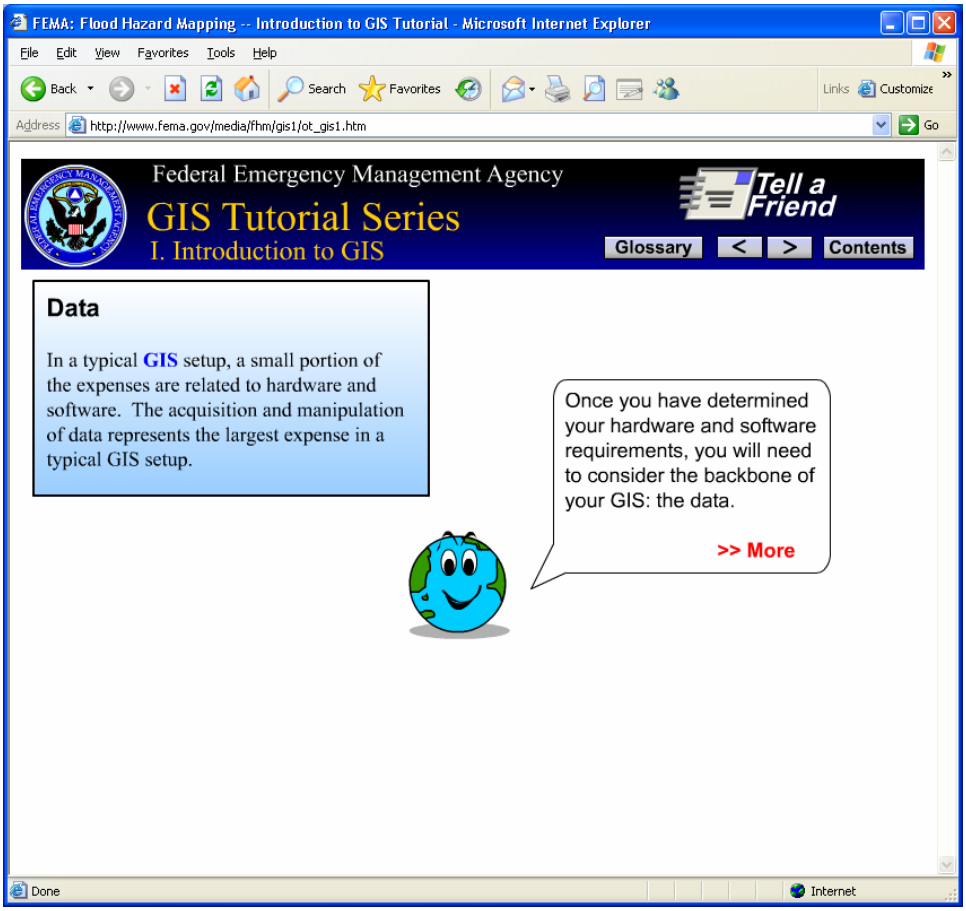
Software: Sample Setups
A larger, more sophisticated setup like the one described below is typical* of software packages used to create Digital Flood Insurance Rate Maps (DFIRMs).
High-end computer
Large server
Digitizing tablet
Color laser printer and plotters
Comprehensive GIS software package (see list shown in main Software section)
*Please remember that these are just examples, and that your individual needs will dictate your final setup.
Done
Internet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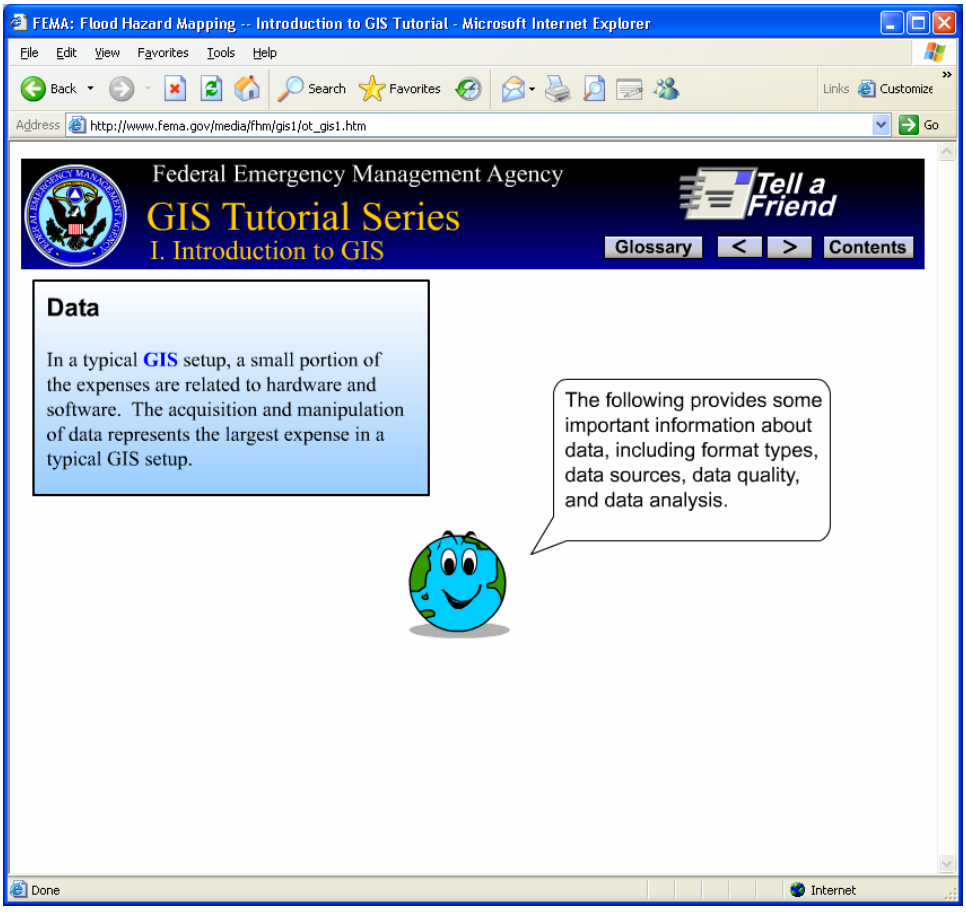
Data
In a typical GIS setup, a small portion of the expenses are related to hardware and software. The acquisition and manipulation of data represents the largest expense in a typical GIS setup.
Once you have determined your hardware and software requirements, you will need to consider the backbone of your GIS: the data.
>> More
Done
Internet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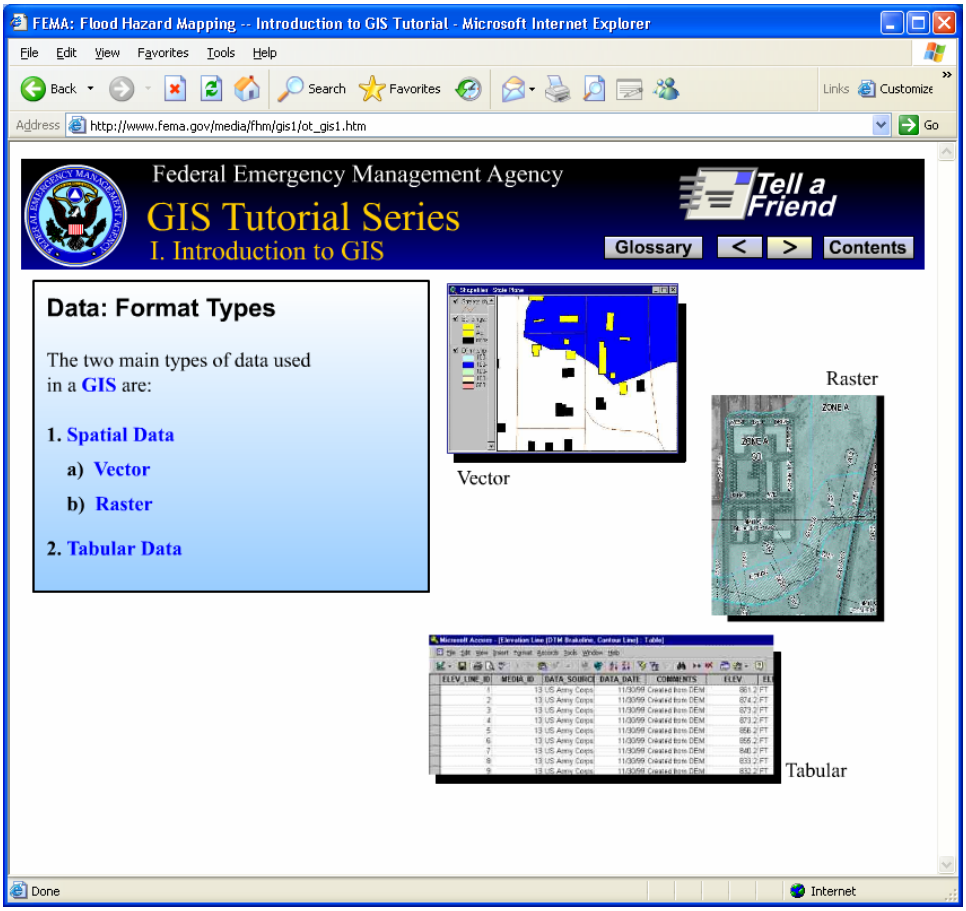
Data
In a typical GIS setup, a small portion of the expenses are related to hardware and software. The acquisition and manipulation of data represents the largest expense in a typical GIS setup.
The following provides some important information about data, including format types, data sources, data quality, and data analysis.
Done
Internet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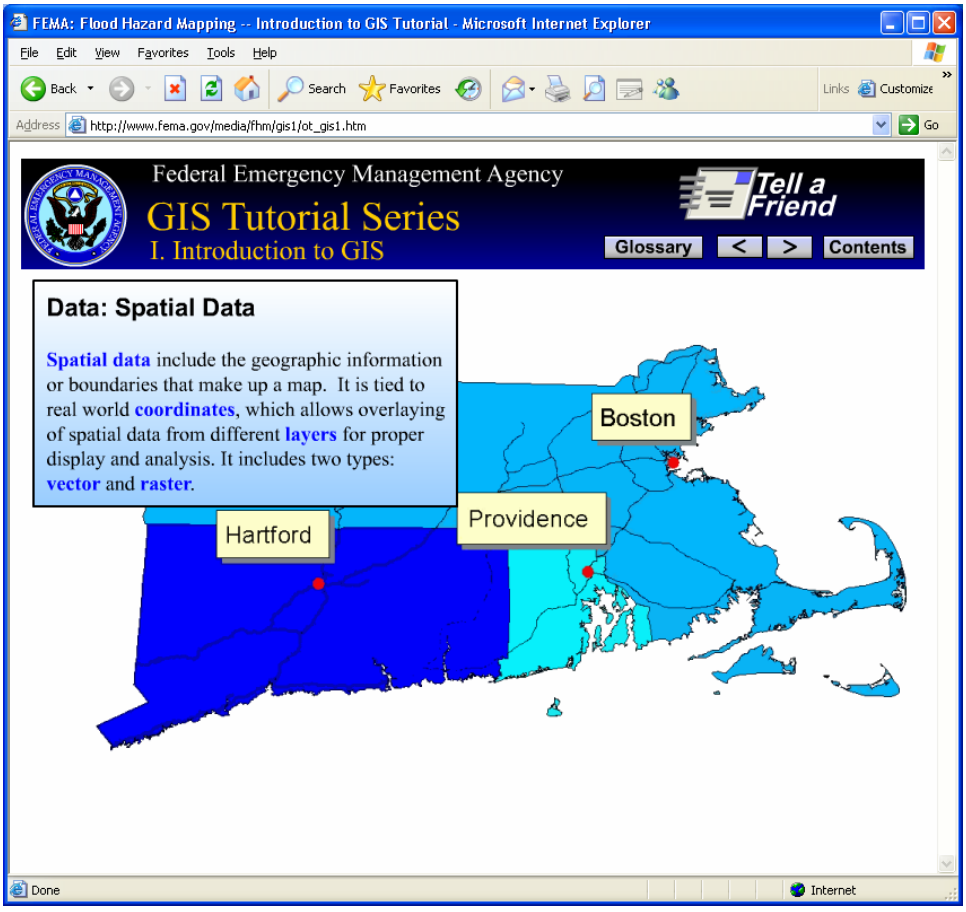
Data: Format Types
The two main types of data used in a GIS are:
1. Spatial Data
a) Vector
b) Raster
2. Tabular Data
Vector
Raster
Tabular
Done
Internet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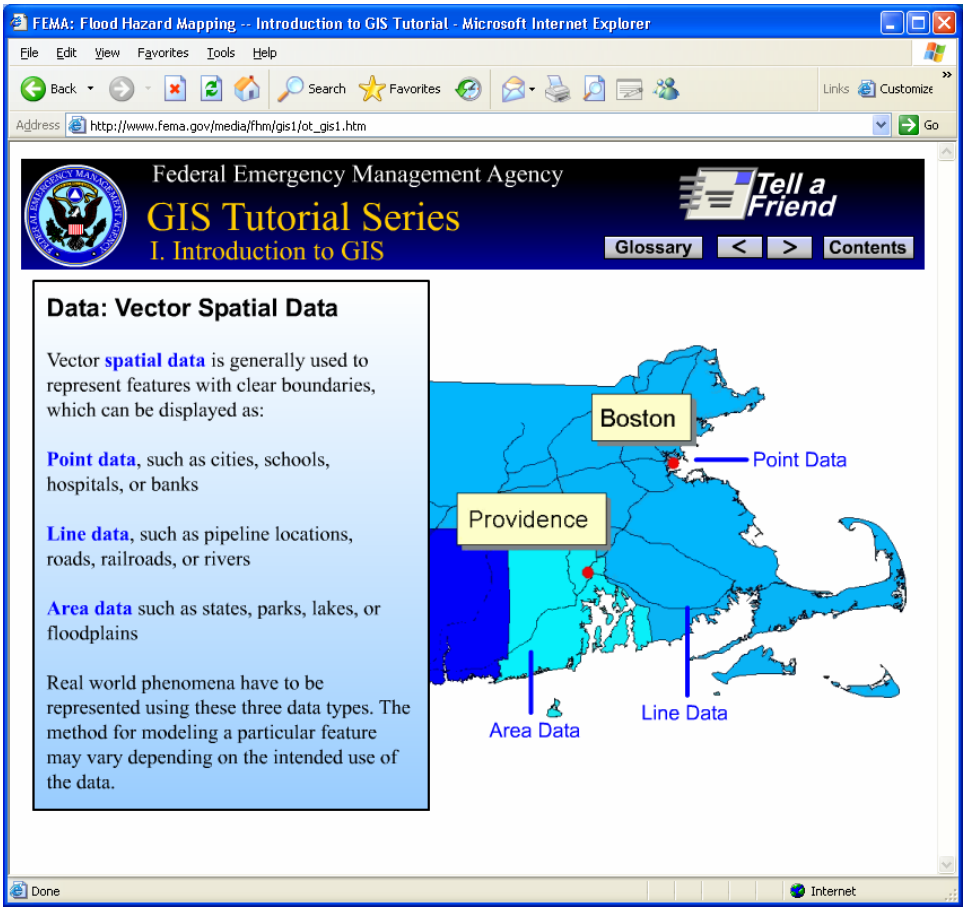
Data: Spatial Data
Spatial data include the geographic information or boundaries that make up a map. It is tied to real world coordinates, which allows overlaying of spatial data from different layers for proper display and analysis. It includes two types: vector and raster.
Boston
Providence
Hartford
Done
Internet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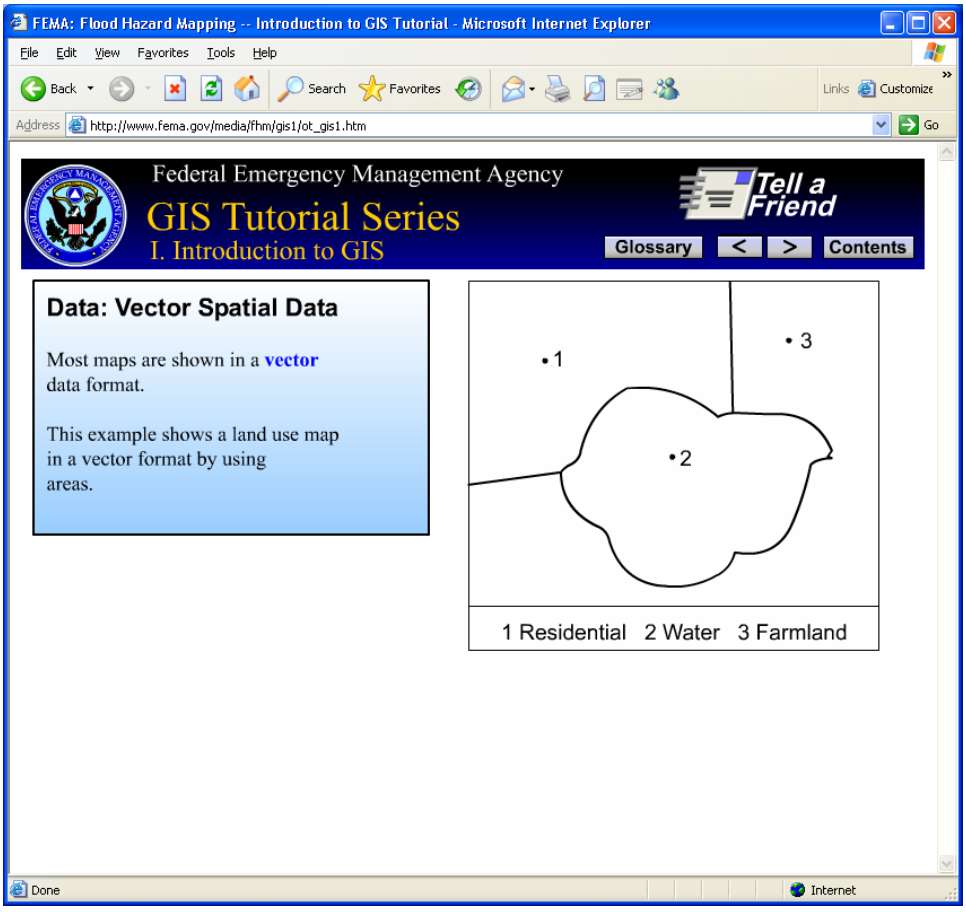
Data: Vector Spatial Data
Vector spatial data is generally used to represent features with clear boundaries, which can be displayed as:
Point data, such as cities, schools, hospitals, or banks
Line data, such as pipeline locations, roads, railroads, or rivers
Area data such as states, parks, lakes, or floodplains
Real world phenomena have to be represented using these three data types. The method for modeling a particular feature may vary depending on the intended use of the data.
Boston
Point Data
Providence
Area Data
Line Data
Done
Internet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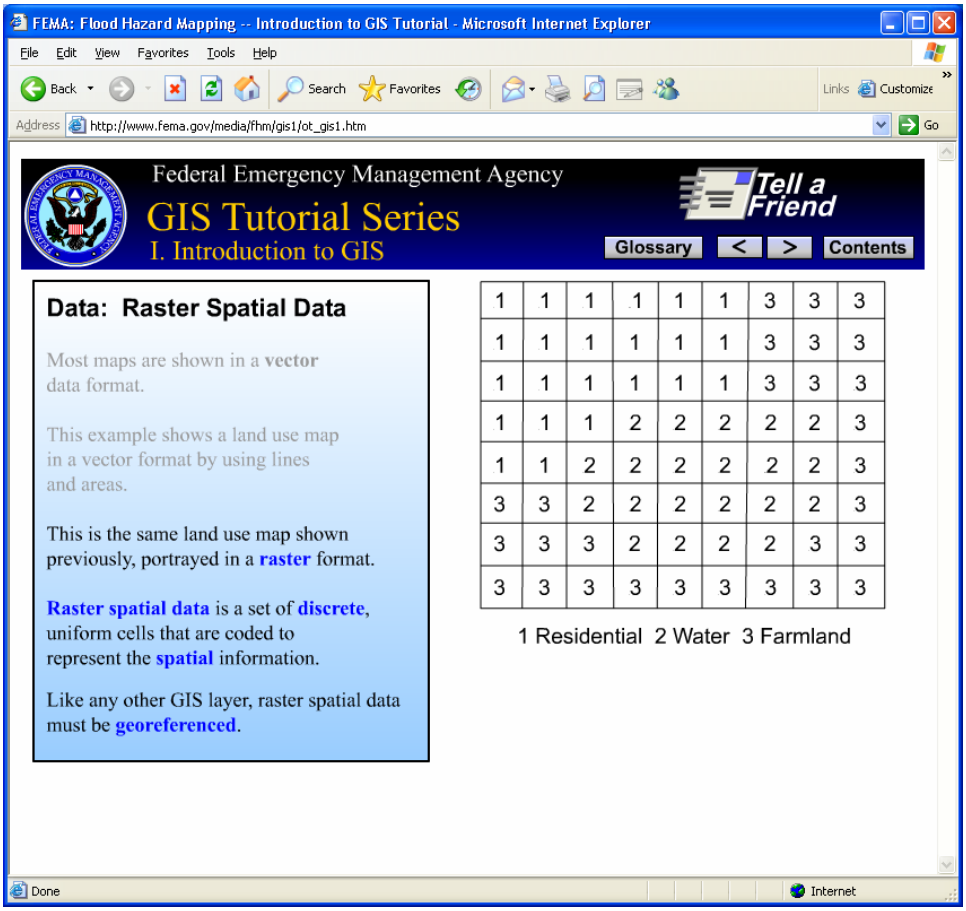
Data: Vector Spatial Data
Most maps are shown in a vector data format.
This example shows a land use map in a vector format by using areas.
1
2
3
1 Residential 2 Water 3 Farmland
Done
Internet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Data: Raster Spatial Data
Most maps are shown in a vector data format.
This example shows a land use map in a vector format by using lines and areas.
This is the same land use map shown previously, portrayed in a raster format.
Raster spatial data is a set of discrete, uniform cells that are coded to represent the spatial information.
Like any other GIS layer, raster spatial data must be georeferenced.
1 1 1 1 1 1 3 3 3
1 1 1 1 1 1 3 3 3
1 1 1 1 1 1 3 3 3
1 1 1 2 2 2 2 2 3
1 1 2 2 2 2 2 2 3
3 3 2 2 2 2 2 2 3
3 3 3 2 2 2 2 3 3
3 3 3 3 3 3 3 3 3
1 Residential 2 Water 3 Farmland
Done
Internet


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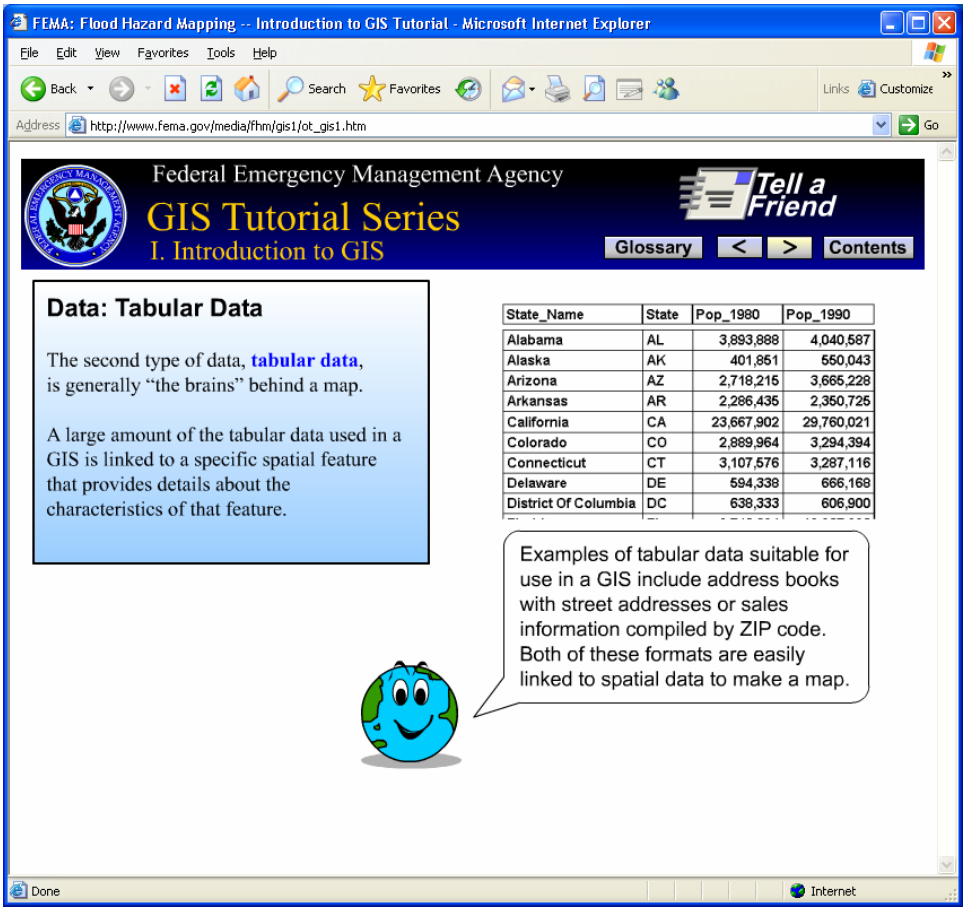
Data: Raster Spatial Data
Raster spatial data may include satellite images, aerial photographs, and other related products. LIDAR and IFSAR data can be used to create raster spatial data.
GIS software allows users to link photos and other graphics to spatial data.
FEMA uses primarily vector-style GIS software packages that are usually capable of importing raster data as a visual backdrop to vector data.
Done
Internet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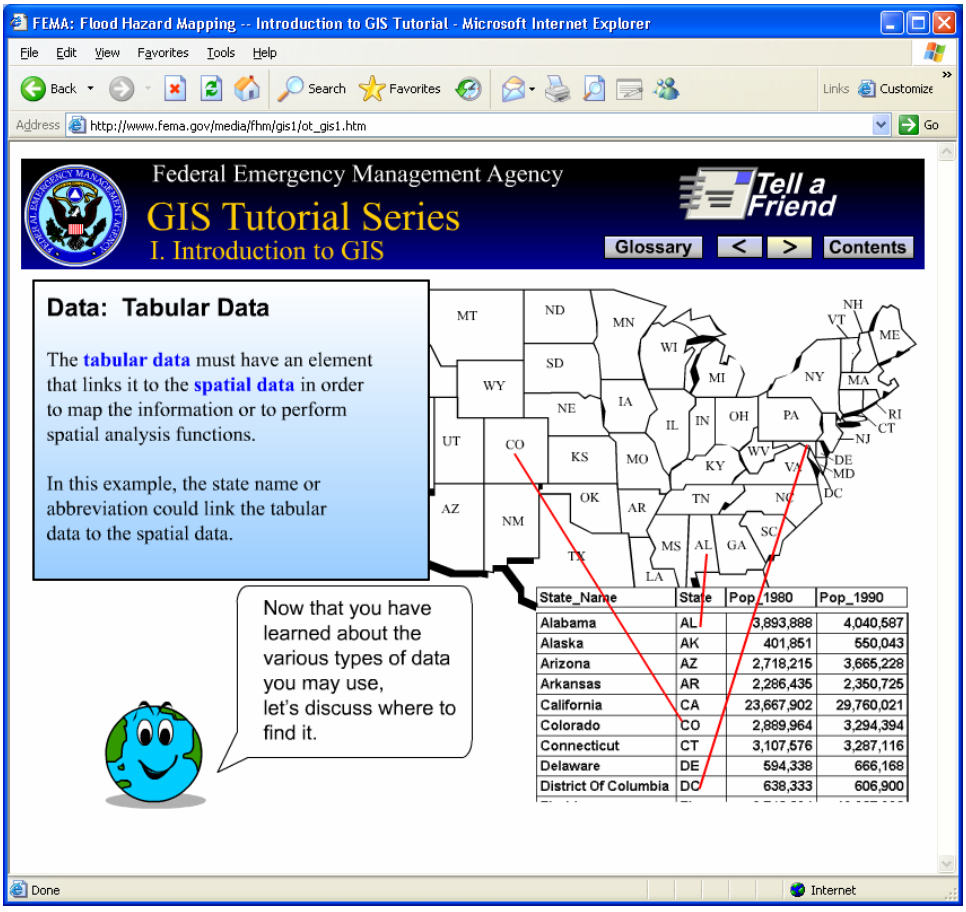
Data: Tabular Data
The second type of data, tabular data, is generally "the brains" behind a map.
A large amount of the tabular data used in a GIS is linked to a specific spatial feature that provides details about the characteristics of that feature.
State_Name | State | Pop_1980 | Pop_1990
Alabama | AL | 3,893,888 | 4,040,587
Alaska | AK | 401,851 | 550,043
Arizona | AZ | 2,718,215 | 3,665,228
Arkansas | AR | 2,286,435 | 2,350,725
California | CA | 23,667,902 | 29,760,021
Colorado | CO | 2,889,964 | 3,294,394
Connecticut | CT | 3,107,576 | 3,287,116
Delaware | DE | 594,338 | 666,168
District Of Columbia | DC | 638,333 | 606,900
Examples of tabular data suitable for use in a GIS include address books with street addresses or sales information compiled by ZIP code. Both of these formats are easily linked to spatial data to make a map.
Done
Internet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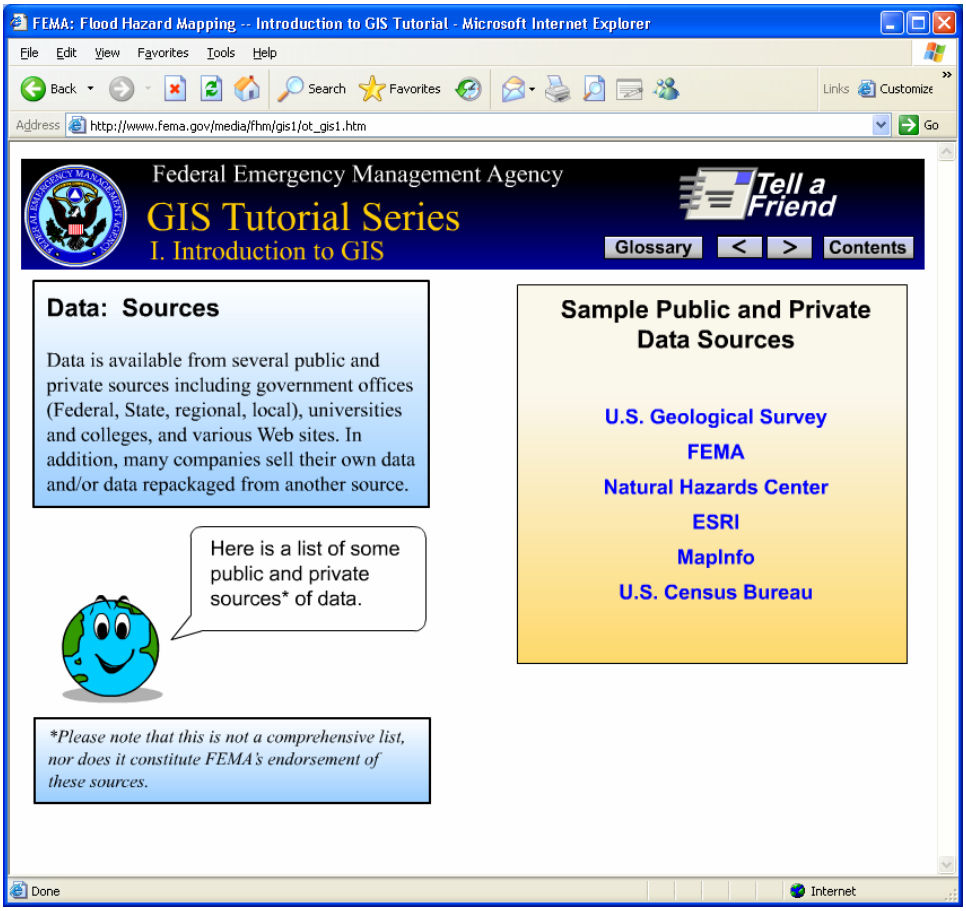
Data: Tabular Data
The tabular data must have an element that links it to the spatial data in order to map the information or to perform spatial analysis functions.
In this example, the state name or abbreviation could link the tabular data to the spatial data.
MT ND MN WI MI NY VT NH ME MA RI CT NJ SD WY NE IA IL IN OH PA UT CO KS MO KY WV VA DE MD DC AZ NM OK AR TN NC SC MS AL GA TX LA
State_Name | State | Pop_1980 | Pop_1990
Alabama | AL | 3,893,888 | 4,040,587
Alaska | AK | 401,851 | 550,043
Arizona | AZ | 2,718,215 | 3,665,228
Arkansas | AR | 2,286,435 | 2,350,725
California | CA | 23,667,902 | 29,760,021
Colorado | CO | 2,889,964 | 3,294,394
Connecticut | CT | 3,107,576 | 3,287,116
Delaware | DE | 594,338 | 666,168
District Of Columbia | DC | 638,333 | 606,900
Now that you have learned about the various types of data you may use, let's discuss where to find it.
Done
Internet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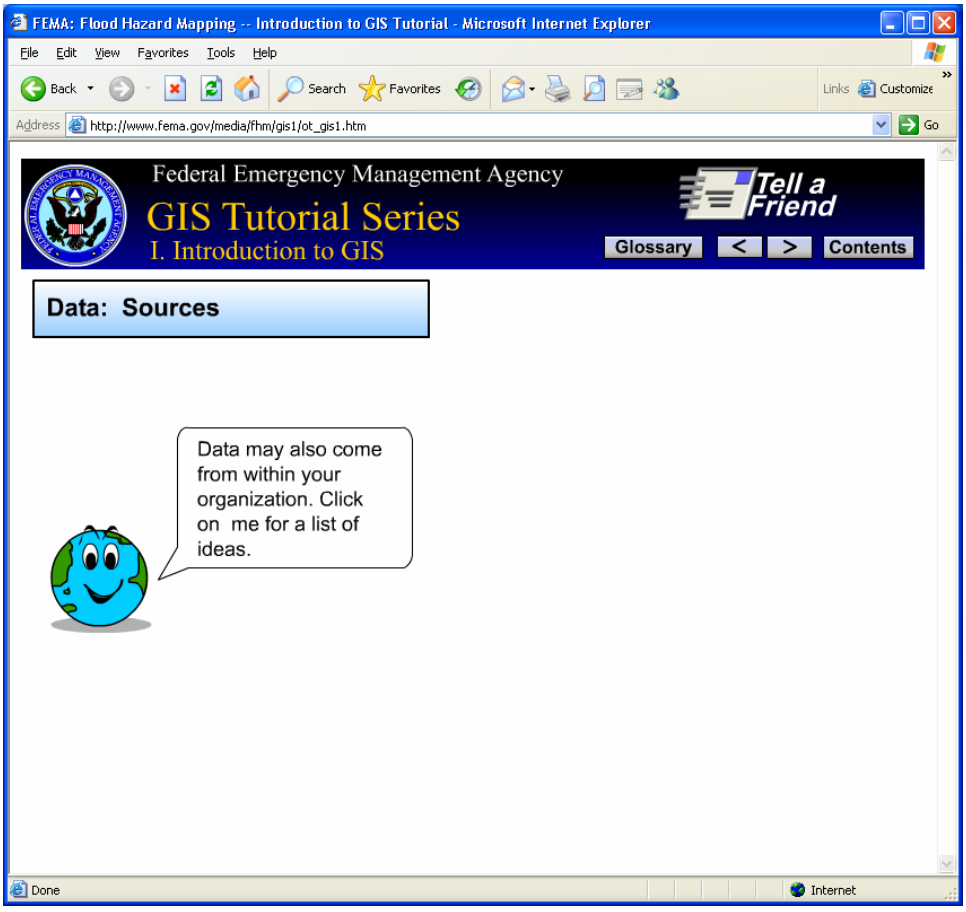
Data: Sources
Data is available from several public and private sources including government offices (Federal, State, regional, local), universities and colleges, and various Web sites. In addition, many companies sell their own data and/or data repackaged from another source.
Here is a list of some public and private sources* of data.
*Please note that this is not a comprehensive list, nor does it constitute FEMA's endorsement of these sources.
Sample Public and Private Data Sources
U.S. Geological Survey
FEMA
Natural Hazards Center
ESRI
MapInfo
U.S. Census Bureau
Done
Internet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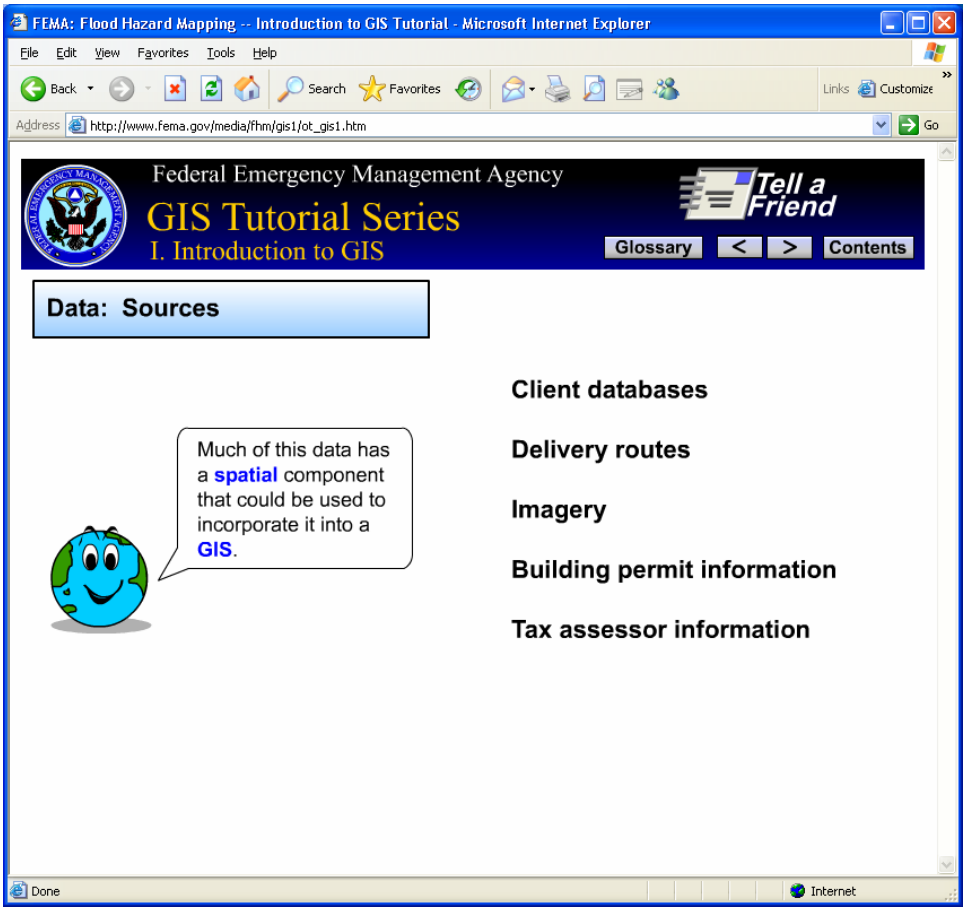
Data: Sources
Data may also come from within your organization. Click on me for a list of ideas.
Done
Internet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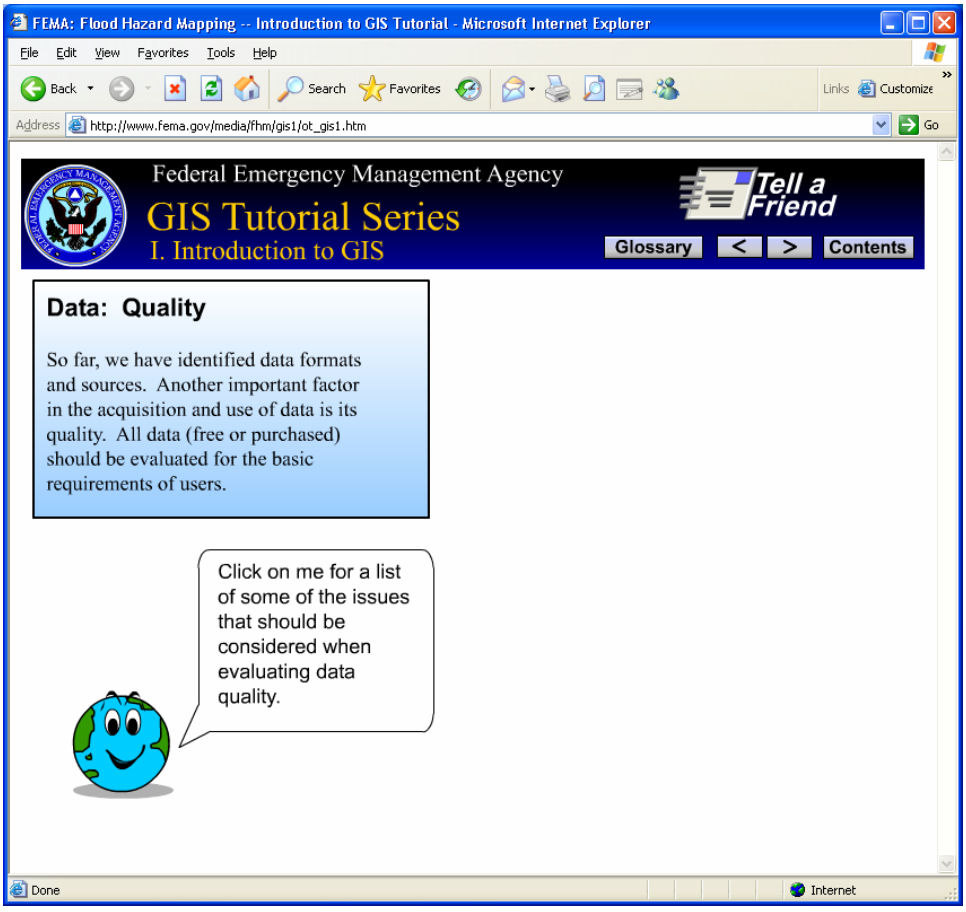
Data: Sources
Much of this data has a spatial component that could be used to incorporate it into a GIS.
Client databases
Delivery routes
Imagery
Building permit information
Tax assessor information
Done
Internet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Data: Quality
So far, we have identified data formats and sources. Another important factor in the acquisition and use of data is its quality. All data (free or purchased) should be evaluated for the basic requirements of users.
Click on me for a list of some of the issues that should be considered when evaluating data quality.
Done
Internet


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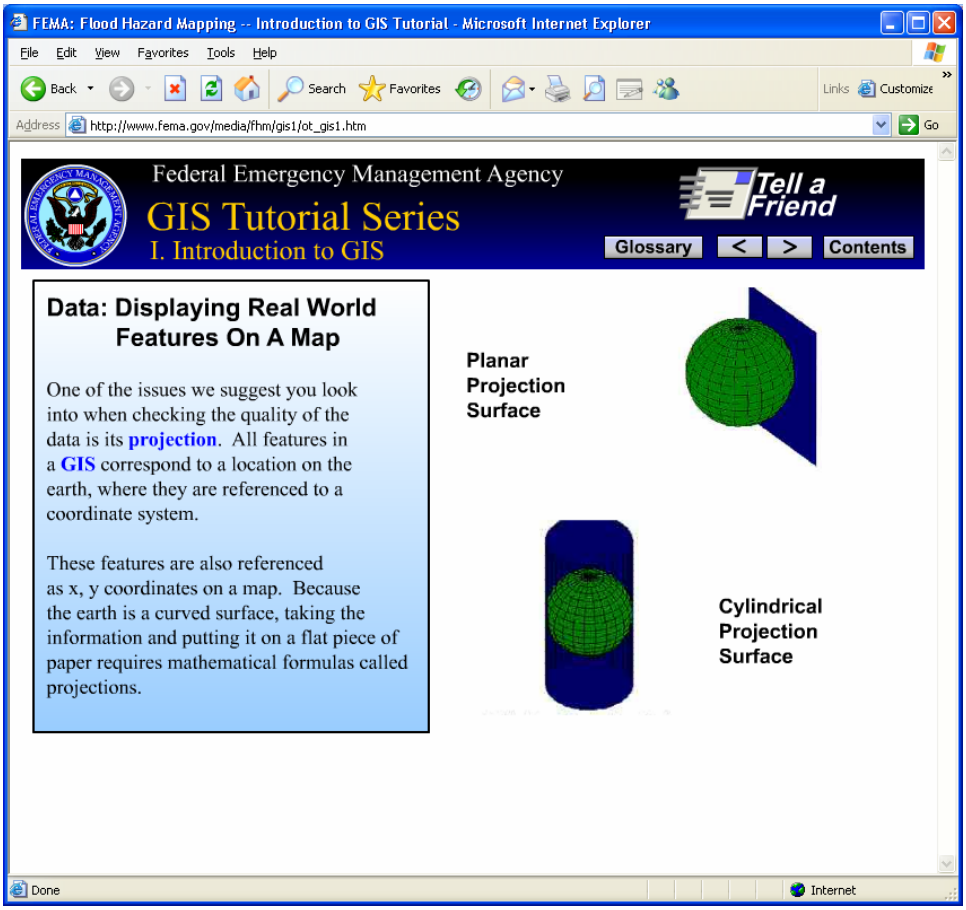
Data: Quality
So far, we have identified data formats and sources. Another important factor in the acquisition and use of data is its quality. All data (free or purchased) should be evaluated for the basic requirements of users.
Does it cover the geographic area of interest?
Does the level of accuracy meet the user's needs?
Does it meet the user's needs?
Does the production date meet the user's needs?
Is it in a format that can be transferred easily into your GIS?
What are the projection and datum?
Done
Internet
100%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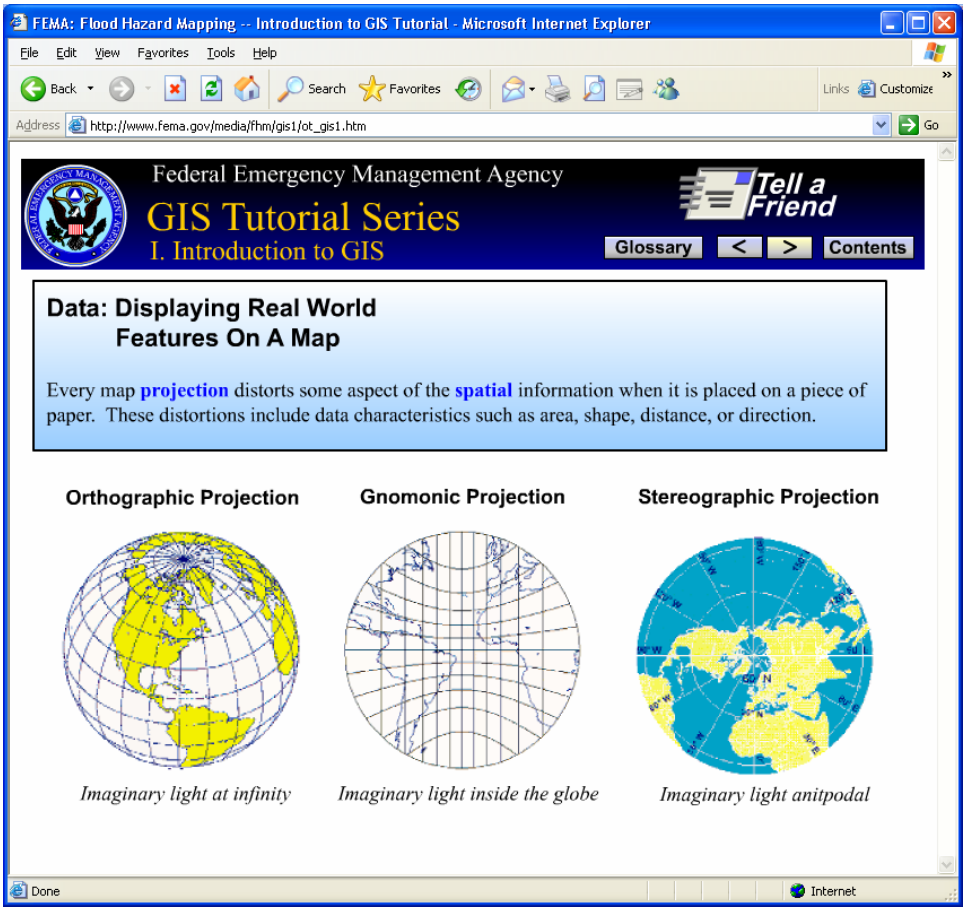
Data: Displaying Real World Features On A Map
One of the issues we suggest you look into when checking the quality of the data is its projection. All features in a GIS correspond to a location on the earth, where they are referenced to a coordinate system.
These features are also referenced as x, y coordinates on a map. Because the earth is a curved surface, taking the information and putting it on a flat piece of paper requires mathematical formulas called projections.
Planar Projection Surface
Cylindrical Projection Surface
Done
Internet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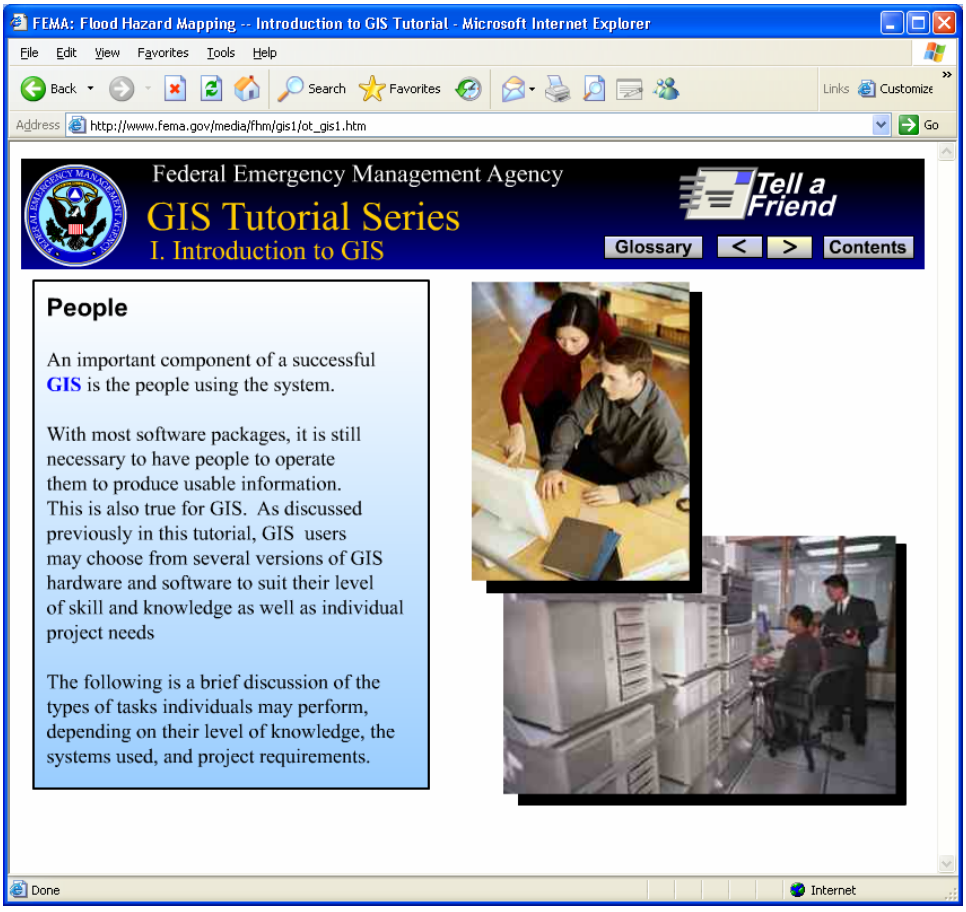
Data: Displaying Real World Features On A Map
Every map projection distorts some aspect of the spatial information when it is placed on a piece of paper. These distortions include data characteristics such as area, shape, distance, or direction.
Orthographic Projection
Gnomonic Projection
Stereographic Projection
Imaginary light at infinity
Imaginary light inside the globe
Imaginary light anitpodal
Done
Internet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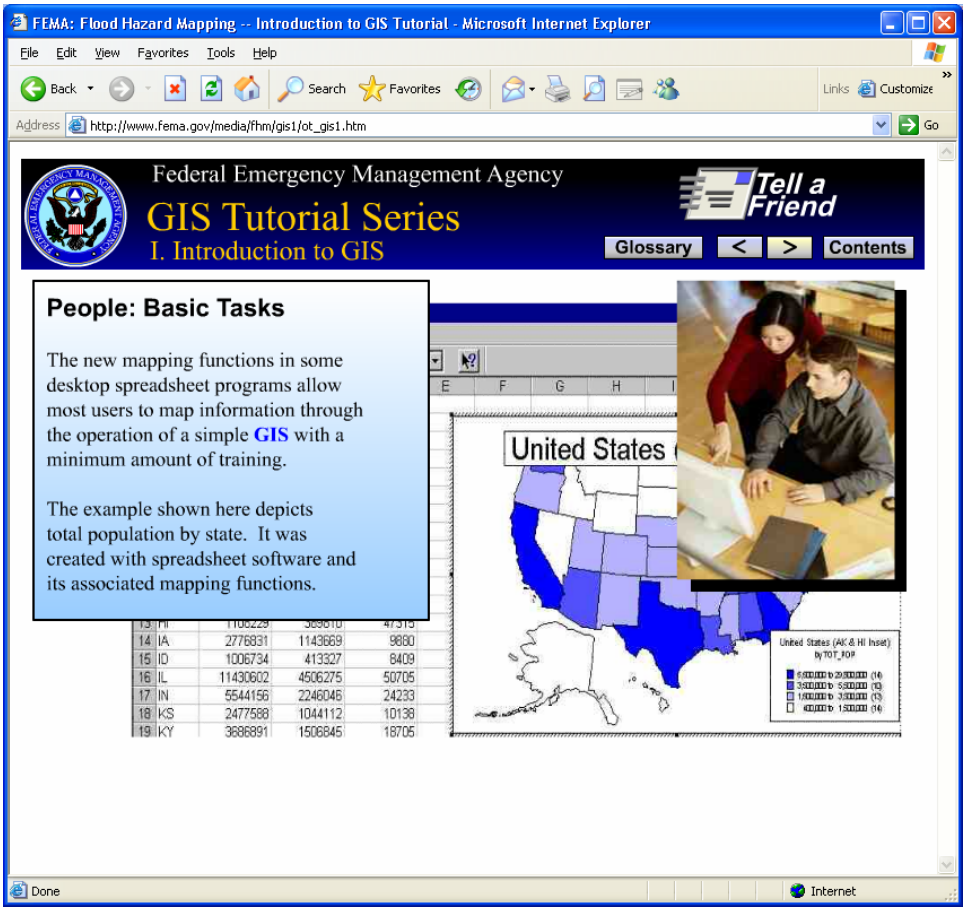
People
An important component of a successful GIS is the people using the system.
With most software packages, it is still necessary to have people to operate them to produce usable information. This is also true for GIS. As discussed previously in this tutorial, GIS users may choose from several versions of GIS hardware and software to suit their level of skill and knowledge as well as individual project needs
The following is a brief discussion of the types of tasks individuals may perform, depending on their level of knowledge, the systems used, and project requirements.
Done
Internet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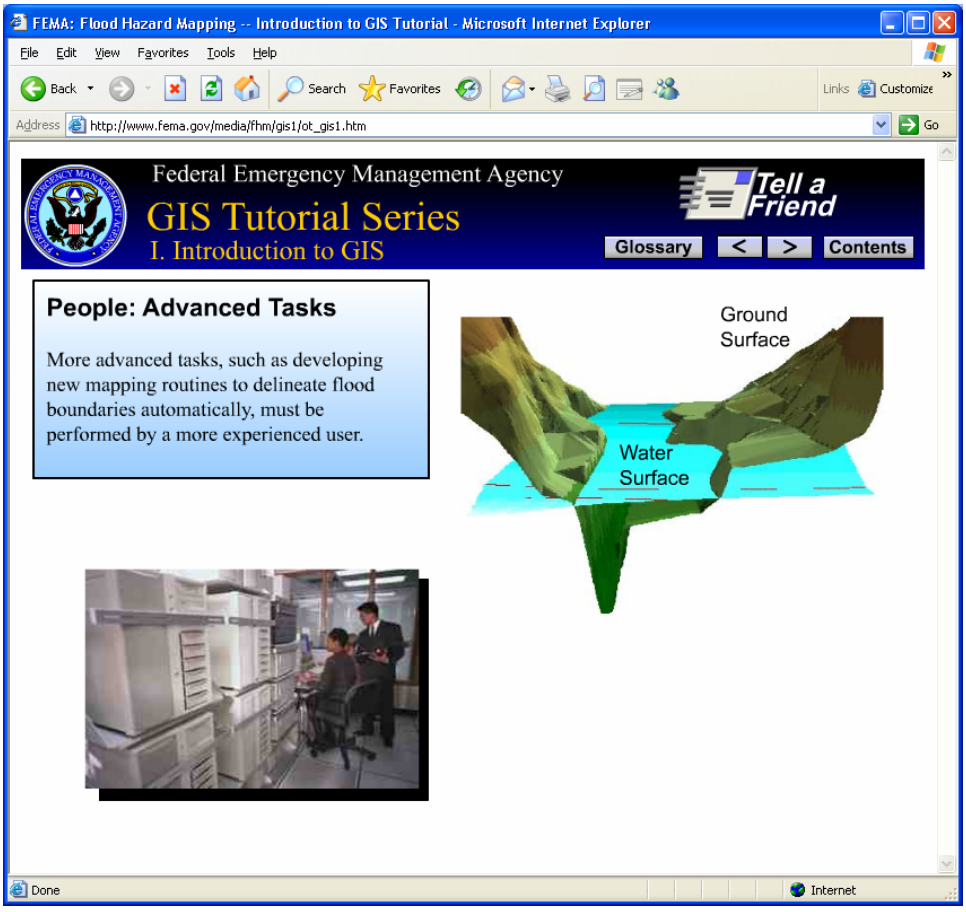
People: Basic Tasks
The new mapping functions in some desktop spreadsheet programs allow most users to map information through the operation of a simple GIS with a minimum amount of training.
The example shown here depicts total population by state. It was created with spreadsheet software and its associated mapping functions.
United States
14 IA 2776831 1143669 9880
15 ID 1006734 413327 8409
16 IL 11430602 4506275 50705
17 IN 5544156 2246046 24233
18 KS 2477588 1044112 10138
19 KY 3686891 1506845 18705
Done
Internet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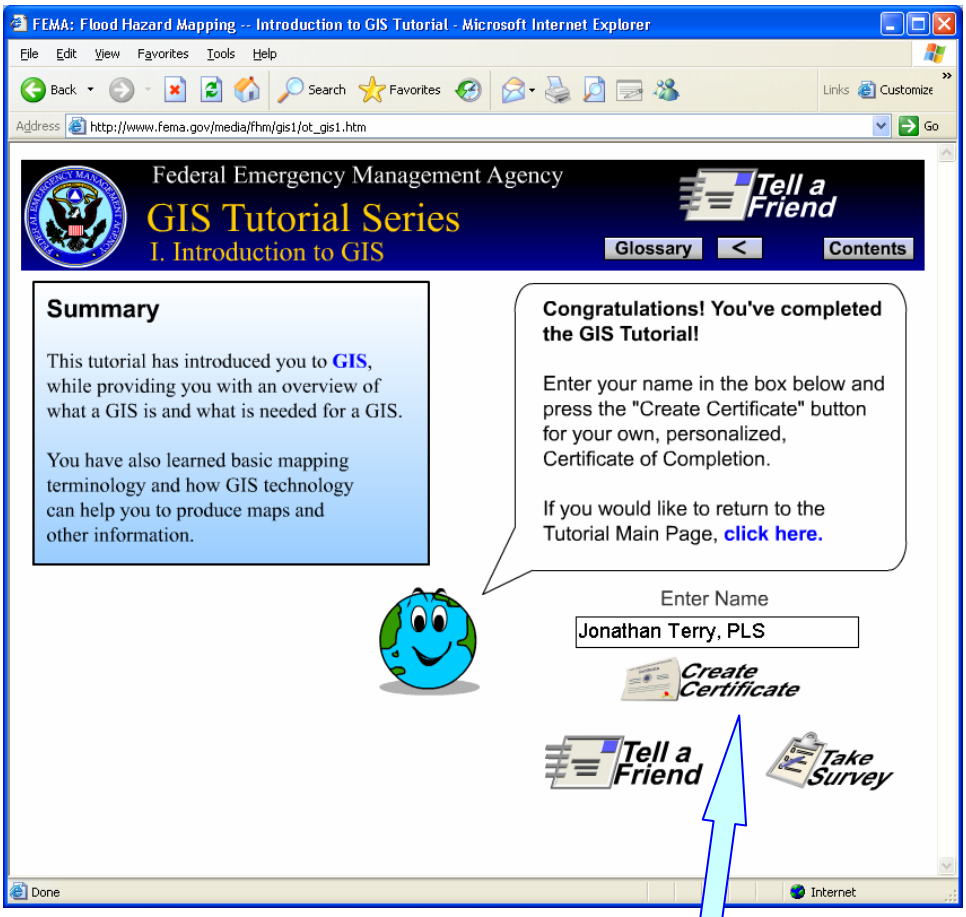
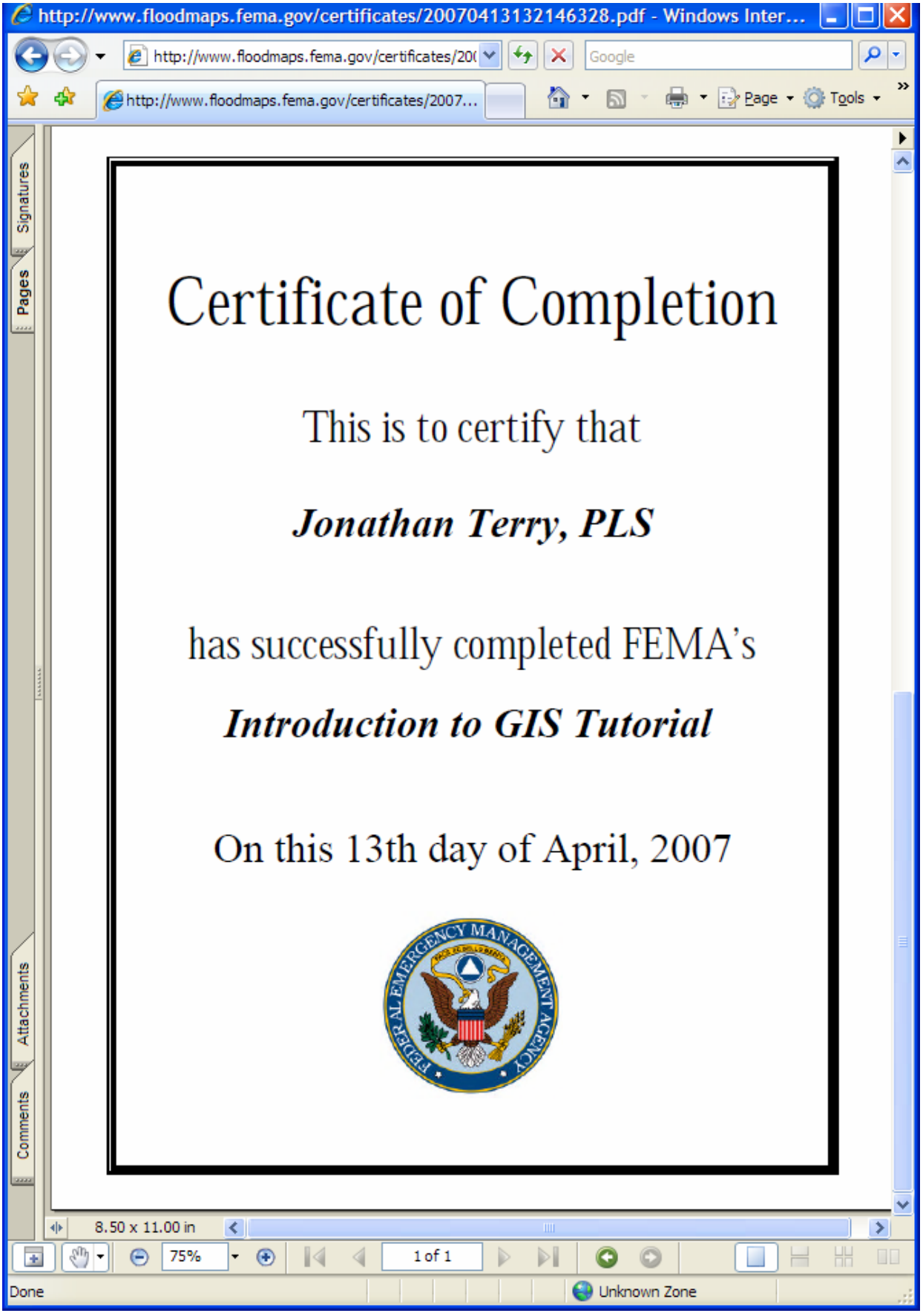
People: Advanced Tasks
More advanced tasks, such as developing new mapping routines to delineate flood boundaries automatically, must be performed by a more experienced user.
Ground Surface
Water Surface
Done
Internet




At the conclusion of the tutorial, you can create an attractive **Certificate of Completion**

Enter your name as you want it to appear on the certificate and click on "Create Certificate."

The certificate looks most impressive if plotted in color as the screen-capture on the following page illustrates.


http://www.floodmaps.fema.gov/certificates/20070413132146328.pdf - Windows Inter...
http://www.floodmaps.fema.gov/certificates/2007...
Page
Tools
Signatures
Pages
Attachments
Comments
Certificate of Completion
This is to certify that
Jonathan Terry, PLS
has successfully completed FEMA's
Introduction to GIS Tutorial
On this 13th day of April, 2007
FEDERAL EMERGENCY MANAGEMENT AGENCY
8.50 x 11.00 in
75%
1 of 1
Done
Unknown Zone

# GLOSSARY

(Terms found in FEMA's three GIS tutorials)

**100-Year Flood**

The flood having a 1-percent chance of being equaled or exceeded in any given year, also known as the base flood. The 1-percent annual chance flood, which is the standard used by most Federal and state agencies, is used by the National Flood Insurance Program (NFIP) as the standard for floodplain management and to determine the need for flood insurance. A structure located within a flood hazard area shown on an NFIP map has a 26 percent chance of suffering flood damage during the term of a 30-year mortgage.

**1-percent annual chance floodplain**

This is the boundary of the flood that has a 1-percent chance of being equaled or exceeded in any given year. Also known as, "the 100-year floodplain."

**500-Year Floodplain**

This is the boundary of the flood that has a 0.2-percent chance of being equaled or exceeded in any given year. Officially termed "the 0.2-percent annual chance floodplain."

**Accuracy**

This term refers to the conformance to a reasonable standard. The statistical meaning of accuracy is the degree with which an estimated mean differs from the true mean.

Different projects require different levels of data accuracy than others. The National Standard for Spatial Data Accuracy (NSSDA) has implemented a well-defined statistical and testing methodology for the positional accuracy of maps and geospatial data derived from sources such as aerial photographs, satellite imagery, or maps. Accuracy specifications for data collection during a FEMA Flood Insurance Study are outlined in several FEMA-authored guidance documents.

**Area Data**

A fundamental unit of geographic information; it is a measure of a particular extent of the earth’s surface.

**Automated Floodplain Mapping**

The use of digital elevation models (DEMs) or digital terrain models with digital water surface elevation data in the GIS environment to define the limits of the floodplain.

**Base Flood**

The flood having a 1-percent chance of being equaled or exceeded in any given year, also known as the 100-year flood. The base flood, which is the standard used by most Federal and state agencies, is used by the National Flood Insurance Program (NFIP) as the standard for floodplain management and to determine the need for flood insurance. A structure located within a special flood hazard area on a NFIP map has a 26-percent chance of suffering flood damage during the term of a 30-year mortgage.

**Block Group (data)**

A geographical area bounded on all sides by visible or nonvisible features shown on Census maps. A block group is the third smallest geographic entity for which the Census Bureau collects and tabulates decennial Census information.

**Buffers**

A zone of a specified distance around spatial features. Both constant- and variable-width buffers can be generated for a set of spatial features based on each feature's attribute values. The resulting buffer zones form polygons-areas that are either inside or outside the specified buffer distance from each feature. Buffers are useful for proximity analysis (e.g., find all stream segments within 300 feet of a proposed logging area).

**Coordinate System**

A reference system used to measure horizontal and vertical distances on a planimetric map. A coordinate system is usually defined by a map projection, a spheroid of reference, a datum, one or more standard parallels, a central meridian, and possible shifts in the x- and y-directions to locate x,y positions of point, line, and area features. In some software packages, it is used to refer to a system with units and characteristics defined by a map projection. A common coordinate system is used to spatially register geographic data for the same area.

**Data Sets**

A collection of related records.

**Datum**

A fixed starting point of a scale.

**Density (Population Density Data)**

The number of inhabitants per unit ia a geographic region.

**Digital Flood Insurance Rate Map (DFIRM)**

A FIRM is a map produced by FEMA that shows flood hazard information and is used to rate flood insurance. A DFIRM is a FIRM that was produced suing digital technology.

As part of FEMA's Map Modernization Objectives, a new Digital Flood Insurance Rate Map (DFIRM) product is being developed. The new DFIRM product will include a spatial database with options that can be invoked depending on the available data. The DFIRM spatial database will include certain standard features and meet minimum mapping requirements. Additional enhancements will be included depending on community needs, available data, and funding. A review of needs and available data will lead to recommendations concerning which options to exercise.

**Digitizing**

The process of converting map data from their original visual form (i.e., a paper map) to a digital format that can be handled by a computer.

**Discrete (cells)**

Self-contained, distinct units.

**Flood (also Flooding)**

A general and temporary condition of partial or complete inundation of normally dry land areas. For flood insurance claim purposes, two or more structures must be inundated before flood damage will be covered.

**Flood Hazard Data**

Information about a community's flooding hazards used to prepare Flood Insurance Rate Maps and Flood Insurance Study reports. It may include information such as statistical analyses of records of river-flow, storm tides, and rainfall; information obtained through consultation with the community; floodplain topographic surveys; and hydrologic and hydraulic analyses.

**Flood Insurance Rate Map (FIRM)**

A map on which the 100-year (1% annual chance) and the 500-year (0.2% annual chance) floodplains, Base Flood Elevations, and risk premium zones (and floodway information on Map Initiatives FIRMs) are delineated to enable insurance agents to issue an accurate flood insurance policies to homeowners in communities participating in the National Flood Insurance Program.

**Floodplain or Flood-Prone Area**

Any land area susceptible to inundation by water from any source.

**Floodplain Management**

The operation of the program of corrective and preventive measures for mitigating flood damage, including, but not limited to, emergency preparedness plans, flood-control works, and floodplain management regulations.

**Floodway**

Channel of the stream plus any adjacent floodplain areas that must be kept free of encroachment so that a 100-year flood discharge can be conveyed without increasing the elevation of the 100-year flood by more than a specified amount (1 foot in most states).

**Geocoding**

Assigning locational coordinates, such as longitude/latitude, to map features (i.e., assigning a point location on the earth for a mailing address.

**Georeference**

To establish the relationship between page coordinates on a planar map and known real-world coordinates.

**GIS (Geographic Information System)**

A Geographic Information System (GIS) is a computer-based system to capture, store, retrieve, manipulate, analyze and display spatial information and its associated attributes. It combines spatial and tabular information to produce maps and to perform spatial analyses.

**GPS**

The Global Positioning System (GPS) is a satellite-based radio navigation system developed and operated by the U.S. Department of Defense (DOD). It allows land, sea, and airborne users to determine their three-dimensional position, velocity and time precisely and accurately, 24 hours a day, in all weather, anywhere in the world. Each GPS satellite transmits an accurate position and time signal. GPS receivers collect signals from satellites and display the user's position, velocity, and time is needed for their marine, terrestrial, or aeronautical applications.

**HAZUZ**

PC-based GIS software used to implement a standardized, nationally applicable earthquake loss estimation method. The HAZUZ software is being expanded to perform similar loss evaluations for wind (hurricanes, thunderstorms, tornadoes, extra tropical cyclones and hail) and flood (riverine and coastal) hazards. HAZUZ Development Is Being Funded by FEMA through a Cooperative Agreement with the National Institute of Building Sciences.

**Housing Unit (Data)**

A house, an apartment or other group of rooms, or a single room, is regarded as a housing unit when it is occupied or intended for occupancy as separate living quarters; that is, when the occupants do not live and eat with any other persons in the structure and there is direct access from the outside or through a common hall.

**IFSAR**

InterFerometric Synthetic Aperture Radar. It uses airborne or space-born radar antennae to obtain highly accurate terrain data over a larger geographical areas.

**LIDAR**

Light Detection And Ranging. Airborne laser system that combines a pulsing laser with a positioning system consisting of a Global Positioning System (GPS) receiver and an Inertial Measuring Unit (IMU) to measure the elevation of ground points on the earth's surface.

**Labeling**

The process of attaching identification codes to map features (i.e., attaching city names to city point locations.

**Layer**

A layer is a logical separation of mapped information according to theme. Many Geographic Information Systems and CAD/CAM systems allow the user to choose and work on a single layer or any combination of layers at a time.

**Line Data**

One of the basic geographical primitives. It is defined by at least two pairs of XY coordinates.

**National Flood Insurance Program (NFIP)**

Federal insurance program under which flood-prone areas are identified and flood insurance is made available to residents of participating communities that agree to adopt and enforce floodplain management ordinances to reduce future flood damage.

**Point Data**

A position, place or locality.

**Polygon**

A multi-sited figure representing an area on a map; a geographic primitive.

**Projection**

A mathematical model the transforms the locations of features on the Earth's surface to locations on a two-dimensional surface. Because the Earth is three-dimensional, some methods must be used to depict a map in two dimensions. Some projections preserve shape; others preserve accuracy of area, distance, or direction. See also coordinates or coordinate system.

Map projections project the earth's surface onto a flat plane. However, any such representation distorts some parameter of the earth's surface be it distance, area, shape, or direction.

**Q3 Data**

A digital representation of certain features of FEMA's Flood Insurance Rate Map (FIRM) product, intended for use with desktop mapping and GIS technology. Because of the scale of the digital Q3 Flood Data, it cannot be used to determine absolute delineations of flood risk boundaries.

**Raster**

A regular grid of cells covering an area.

**Raster Spatial Data**

A discrete set of uniform cells are coded to represent spatial information.

**Remote Sensing**

Acquiring information about an object without contacting it physically. Methods include aerial photography, radar, and satellite imaging. For example, when responding to a disaster, FEMA's Mapping and Analysis Center (MAC) may receive remote sensing data that indicates areas affected by the disaster, as derived from various imagery products. Typical examples include flooded, saturated and/or damaged areas.

**Special Flood Hazard Area (SFHA)**

Area inundated by the base (1-percent annual chance) flood, identified on the Flood Insurance Rate Map as Zones A, AE, AH, AO, AR, V, VE, or A99.

**Saturated**

Soaked with moisture.

**Spatial Data (or Spacial Information)**

Includes the geographic information of boundaries that make up a map; also known as georeferenced data.

**Tabular Data (or Tabular Information)**

Data organized in a table format.

**Thematic Map**

A map showing information about a particular topic, often statistical in nature (i.e., population per state).

**Vector**

The representation of spatial data by points, lines and polygons.

---

## Below are Zones found on Flood Insurance Rate Maps (FIRMs):

**Zone A**

The flood insurance rate zone that corresponds to the 100-your floodplains that is determined in the Flood Insurance Study by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no Base Flood Elevations or depths are shown within this zone. Mandatory flood insurance purchase requirements apply.

**Zone A99**

The flood insurance rate zone that corresponds to areas of the 100-year floodplains that will be protected by a Federal flood protection system where construction has reached specified statutory milestones. No Base Flood Elevations or depths are shown within the zone. Mandatory flood insurance purchase requirements apply.

**Zone AE**

[Note: In the tutorial, the following definition for Zone AE is accessed through clicking a link titled, "Zone AE and A1-A30.]

The flood insurance rate zone that corresponds to the 100-year floodplains that is determined in the Flood Insurance Study by detailed methods. In most instances, Base Flood Elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone. Mandatory flood insurance purchase requirements apply.

**Zone AH**

The flood insurance rate zone that corresponds to the areas of the 100-year shallow flooding with a constant water-surface elevation (usually areas of ponding) where average depths are between 1 and 3 feet. The Base Flood Elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone. Mandatory flood insurance purchase requirements apply.

**Zone AO**

The flood insurance rate zone that corresponds to the area of 100-year shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet. The depth should be averaged along the cross-section and then along the direction of flow to determine the extent of the zone. Average flood depths derived from the detailed hydraulic analyses are shown within this zone. In addition, alluvial fan flood hazards are shown as Zone AO on the Flood Insurance Rate Map. Mandatory flood insurance purchase requirements apply.

**Zone AR**

The flood insurance rate zone that results from the decertification of a previously accepted flood protection system that is being restored to provide protection from the 100-year or greater flood event.

**Zone D**

Designation on National Flood Insurance Program maps used for areas where there are possible, but undetermined, flood hazards. In areas designated as Zone D, no analysis of flood hazards has been conducted. Mandatory flood insurance purchase requirements do not apply, but coverage is available. The flood insurance rates for properties in Zone D are commensurate with the uncertainty of the flood risk.

**Zone V**

The flood insurance rates zone that corresponds to the 100-year coastal floodplains that have additional hazards associated with storm waves. Because approximate hydraulic analyses are performed for such areas, no Base Flood Elevations are shown within this zone. Mandatory flood insurance purchase requirements apply.

**Zone VE**

The flood insurance rates zone that corresponds to the 100-year coastal floodplains that have additional hazards associated with storm waves. Base Flood Elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone. Mandatory flood insurance purchase requirements apply.

**Zones B, C and X**

The flood insurance rates zone that corresponds to areas outside the 100-year floodplains, areas of 100-year sheet flow flooding where average depths are less than 1 foot, areas of 100-years stream flooding where the contributing drainage area is less than 1 square mile, or areas protected from the 100-year flood by levees. No Based Flood Elevations or depths are shown within this zone.