GIS Introduction & Overview

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GIS is BIG Business Now

- GIS is the primary driver for its very own, ever greater, acceptability and use.
- Everyone likes maps and graphics and the computer makes it easier for you to visualize your data.
- GIS growth feeds on its own successes and builds new and more complex applications as it permeates society.
- It is projected that $75 to $95 BILLION dollars will be spent in the United States alone on GIS implementations through the year 2000.
- The market has grown over 40% per year with no stopping for several years now.

Most common practical applications:

- Analyze how the environment is affected by man
- Mapping out environmental layers to characterize a site and predict site potential
- Routing of roads, transmission lines, pipelines, sewer, and network analysis / flow analysis through these ‘transportation’ routes.
- Mapping and managing urban infrastructure including base maps, tax, curbs, water supply, drainage, electricity, telephone, and gas.
- Spatially examining socio and economic indicators of the population and their use in planning and growth management.

There are literally thousands of applications of GIS!!

Why?

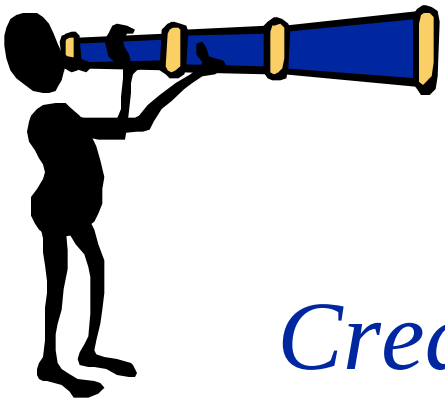
Because no project is ever started without first asking:

Where??

Who benefits from the GIS Application?

- People responsible for the infrastructure - whether you watch it, study it, design it, repair it, sell it, own it, manage it, defend it, or just use it.

- GIS, once installed to serve a local government, can act as a magnet pulling local citizens back to an appreciation of local political leadership.



VISION

Create and promote an efficient GIS environment that fosters cooperation and data sharing.

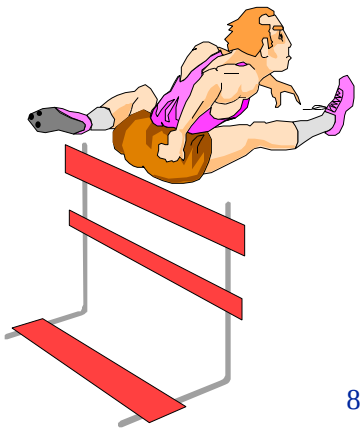
GOALS

- Provide access to documented GIS data (base, current, and historical) while ensuring privacy.
- Provide GIS training and education across all levels of users and management.
- Provide access to and information on GIS technology (hardware and software).
- Facilitate coordination of GIS technology efforts to eliminate redundancy.

Goal ➡ **Provide access to documented GIS data (base, current, and historical) while ensuring privacy.**

Potential Problems:

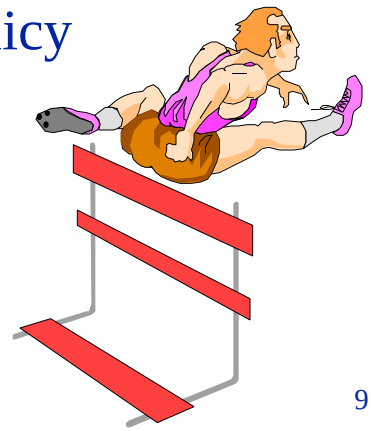
- ➡ Conversion of existing data is labor-intensive.
- ➡ Undefined accuracies and extents of data collection and usage.
- ➡ Data transfer standards.
- ➡ Data update.
- ➡ Storage and maintenance planning.
- ➡ Need for technical assistance within their own office.
- ➡ Policies to ensure privacy.
- ➡ GIS law issues.



Goal ➡ **Provide GIS training and education across all levels of users and management.**

Potential Problems:

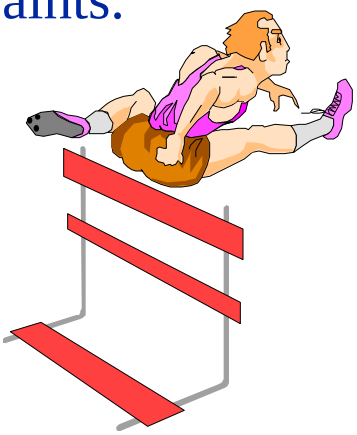
- ➡ Lack of trained personnel.
- ➡ Debate over centralized or decentralized system.
- ➡ Lack of application knowledge.
- ➡ Lack of understanding of importance and usefulness of this technology by policy makers and the general public.



Goal ➡ **Provide access to and information on GIS technology (hardware and software).**

Potential Problems:

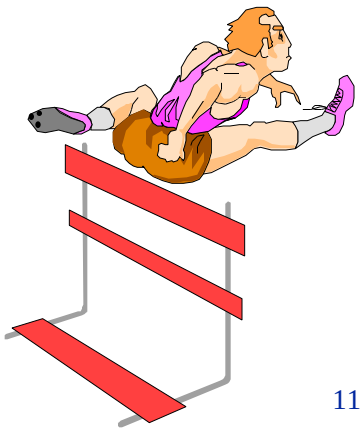
- ➡ Expense of hardware and software.
- ➡ Lack of knowledge about equipment options.
- ➡ Lack of funding.
- ➡ Bandwidth and connectivity restraints.
- ➡ Resistance to change.



Goal ➡ **Facilitate coordination of GIS technology efforts to eliminate redundancy.**

Potential Problems:

- Incompatibility of systems.
- Unwilling to share.
- What is useful/priority is not shared or coordinated.
- No existing GIS entity to address these issues and facilitate cooperation.
- Staff turnover.
- No assigned individual responsible for data.
- Lack of formal, on-going planning.
- Utilization of other agencies' data lacking.



MU Department of Geography
Geographic Resources Center

What is GIS?

A system of hardware, software, and procedures …

designed to support the capture, management, manipulation, analysis, modeling, and display of spatially referenced data …

for solving complex planning and management problems.

While accurate, comprehensive, and widely accepted…

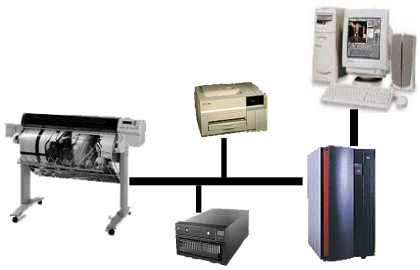
this definition is very cryptic to a GIS newcomer.

A Simpler Definition of GIS

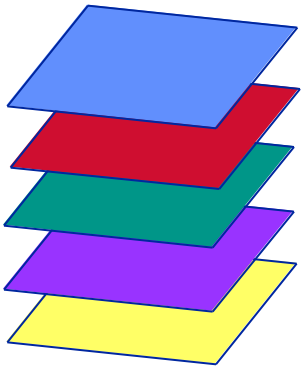
A computer system which can hold and use data describing places on the earth's surface.

This definition also leaves out the most important component of the GIS…the people who administrate, use, and manage the GIS.

Components of GIS



Computer Hardware & Software

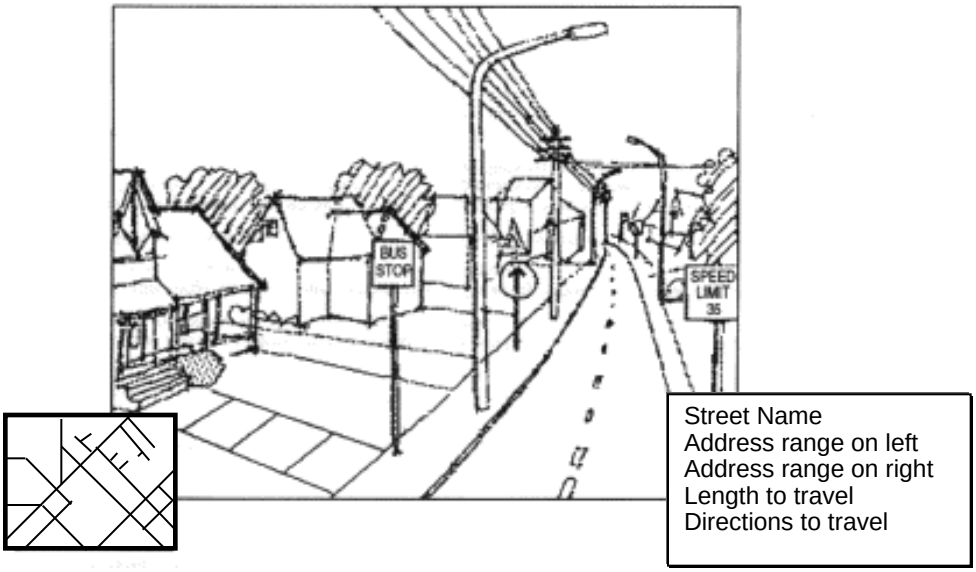


Database

Organizational
Structure & People

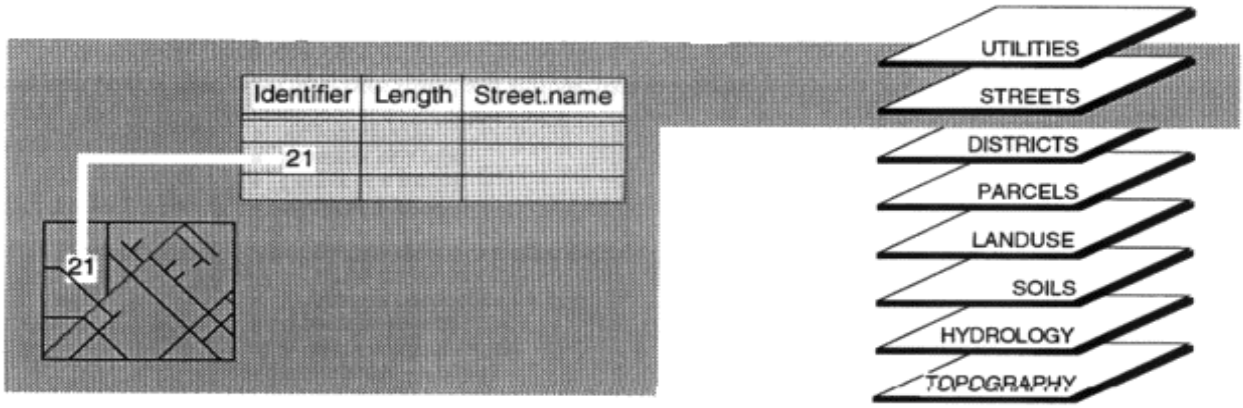
Geographic Features

Geographic features are represented by two types of data.



SPATIAL DATA **ATTRIBUTE DATA**

The Geographic Database



Spatial and attribute data types are linked together by a common identifier.

Geographic Database

Other Terms Used for Geographic Information Systems

- Multipurpose Geographic Data System
- Multipurpose Land Use System
- Computerized GIS
- System for Handling Natural Resources Inventory Data
- Image Based Information System
- Land Resources Information System
- Spatial Data Management & Comprehensive Analysis System
- Planning Information System
- Resource Information System
- Natural Resource Management Information System
- Spatial Data Handling System
- Geographically Referenced Information System
- Geo-Information System
- Spatial Information System
- Environment Information System
- AGIS - Automated GIS
- Multipurpose Cadastre
- Land Information System (LIS)
- AM/FM - Automated Mapping and Facilities Management

Major Areas of Practical Application of GIS Technology

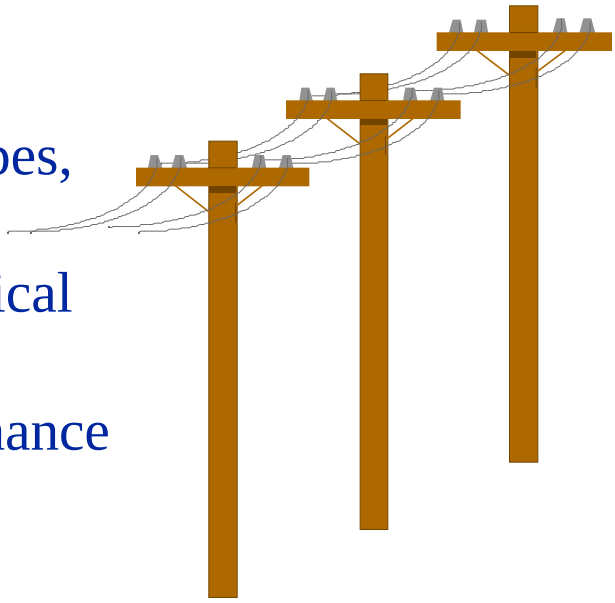
Street Network-Based

- address matching
- vehicle routing and scheduling
- location analysis, site selection
- development of evacuation plans

Major Areas of Practical Application of GIS Technology

Facilities Management

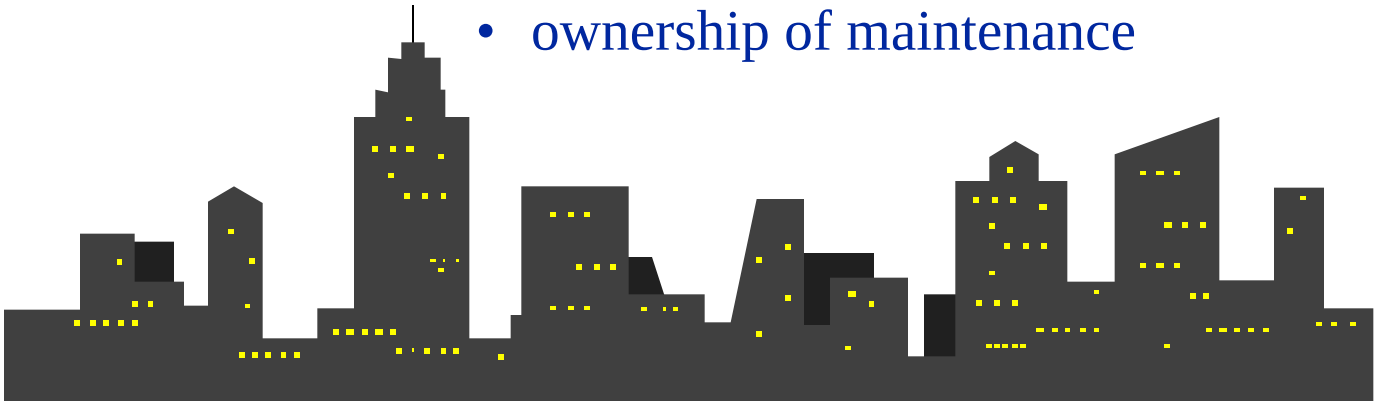
- locating underground pipes, cables
- balancing loads in electrical networks
- planning facility maintenance
- tracking energy use



Major Areas of Practical Application of GIS Technology

Land Parcel-Based

- zoning, subdivision plan review
- land acquisition
- environmental impact statements
- water quality management
- ownership of maintenance



Major Areas of Practical Application of GIS Technology

Natural Resource-Based

- forest management
- wildlife habitat, migration routes management
- wild and scenic rivers preservation
- recreation resources planning
- floodplain management
- wetland preservation
- agricultural lands management
- groundwater modeling and contamination tracking
- environmental impact analysis
- viewshed analysis

Spatial Operations

ASPATIAL QUERIES:

Queries that in being answered do not use the stored X & Y location of the feature, nor does it describe where the places are in relation to each other.

Example:

- How many people are working with GIS in Missouri?

SPATIAL QUERIES:

Queries that can only be answered using the stored X & Y location of the feature and its relationship to other features on the earth's surface. Spatial queries can not be answered without geography and topology.

Examples:

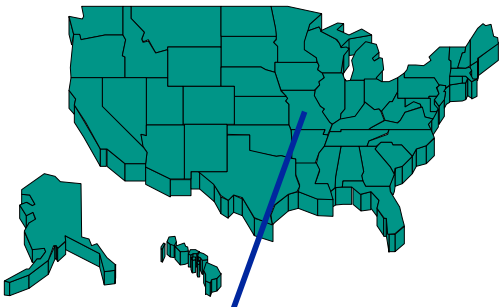
- How many people are working with GIS in the major population centers in Missouri?
- Which centers are within 100 miles of each other?
- What is the shortest route that passes through all of these centers?

Data Linkage

- A GIS typically links different data sets together.
- This may seem trivial but can prove to be the analytical backbone of the GIS as well as its greatest selling point.
- Consider the different ways in which data sets may need to be linked together.

Exact Matching

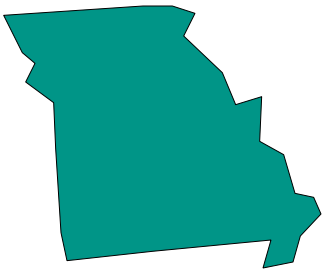
Occurs when you have some information in one file about lots of geographic features (i.e. counties) and additional information in another file about the same set of features.

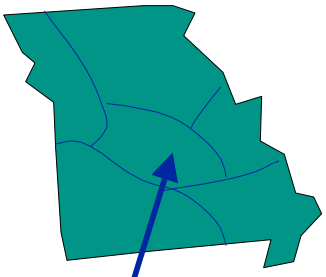


State	Region	Population
…		
Michigan	Midwest	
Mississippi	South	
Missouri	Midwest	
Montana	West	

Hierarchical Matching

Occurs when you have two data sets collected at different levels of detail. If the smaller areas nest (fit exactly) within the larger ones, you can use hierarchical matching to link the two data sets by adding the data for the small areas together until the grouped areas match the bigger ones.

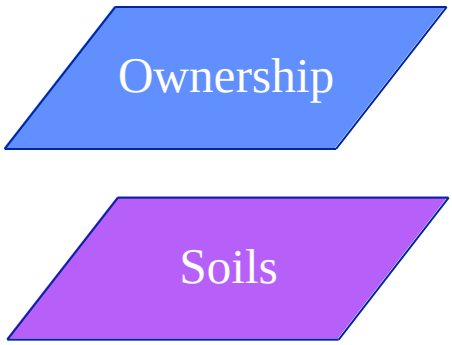




Region	State Park	Area
…		
Ozarks	Lake of the Ozarks	
Ozarks	Ha Ha Tonka	
Ozarks	Bennett Spring	

Fuzzy Matching

On many occasions the small areas do not match the larger ones. This is especially true when dealing with environmental data (i.e.. soil and land cover data sets). If we wanted to determine the soils most productive for each crop, we would need to overlay the 2 data sets & compute crop productivity for each soil type.



Owner	Assessed Value
C. Baker	$200,000
M. Jones	$150,000
E. Smith	$300,000
D. McCarthy	$275,000

Soil ID	Prime Farm Land
01B	Yes
01C	Yes
01C2	No
03A	No

Questions a GIS can Answer

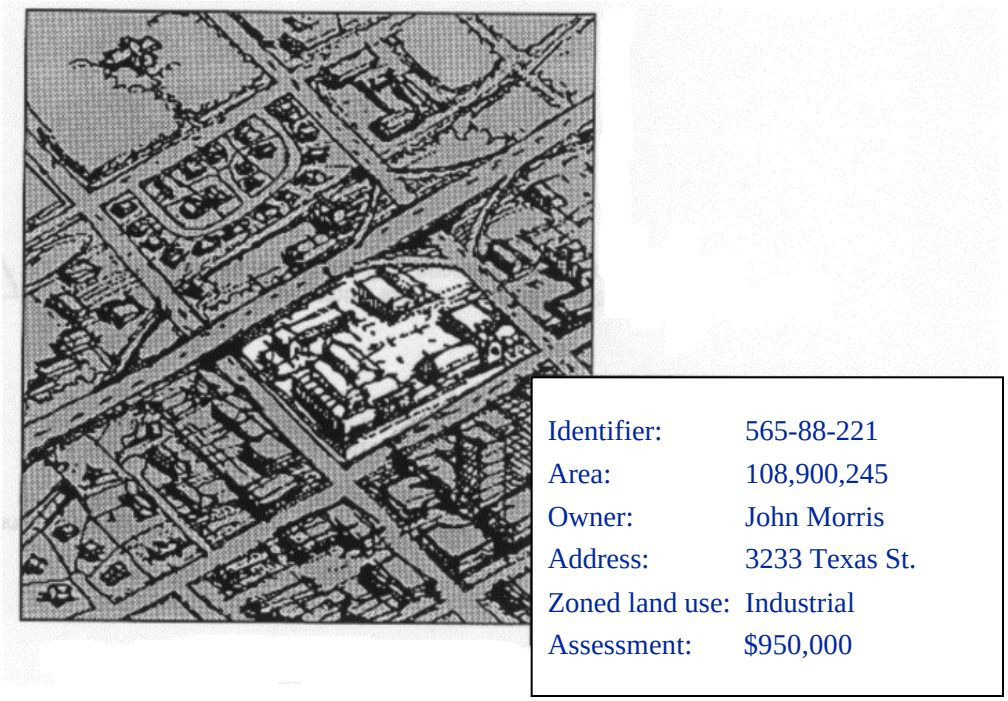
A comprehensive GIS can answer all of the following questions...

LOCATION: What is at...?

Here we are seeking to find out what exists at a particular location.

A location can be described in many different ways using, for example, place name, zip code, or latitude and longitude coordinates.

GIS generations information - locations



Identifier:	565-88-221
Area:	108,900,245
Owner:	John Morris
Address:	3233 Texas St.
Zoned land use:	Industrial
Assessment:	$950,000

Who owns the lot at 3233 Texas Street, and what is it zoned for?

CONDITION: Where is it?

Instead of identifying what exists at a given location, you want to find a location where certain conditions are satisfied.

For example, you wish to find a house assessed at less than $200,000 with 4 bedrooms and made of wood or stucco.

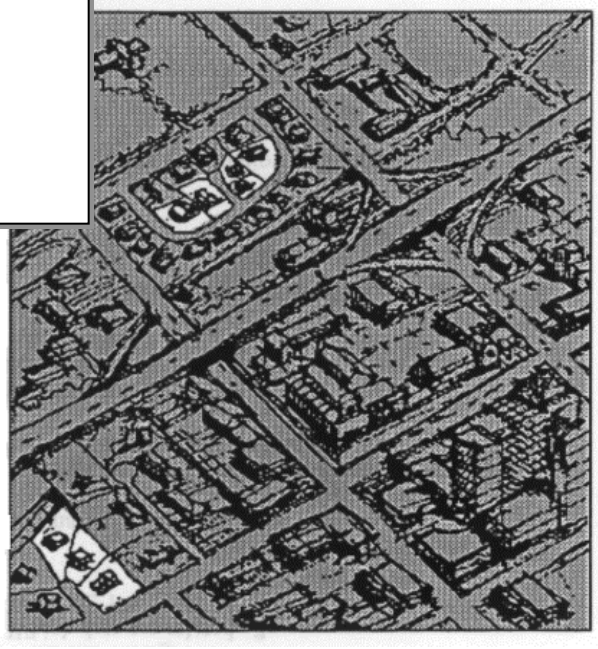
GIS generates information - conditions

Residential land use

Assessed at less than $200,000

4 bedrooms

Made of wood or stucco

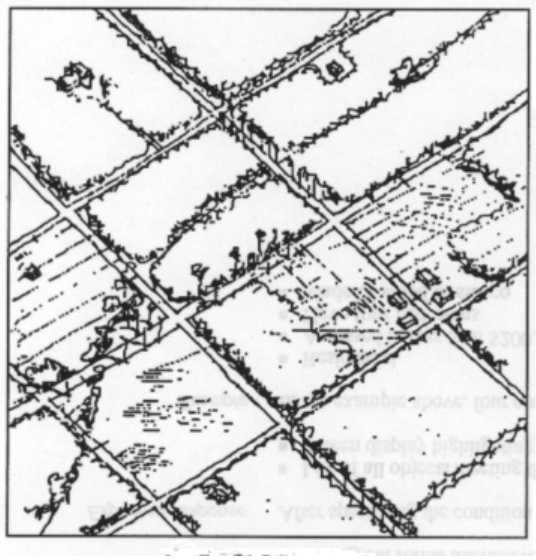


Where are houses located that you might consider buying?

TRENDS:
What has changed since…?

This seeks to discover the differences between an area as the result of the passing of time.

GIS generates information - trends



Smallville in 1950

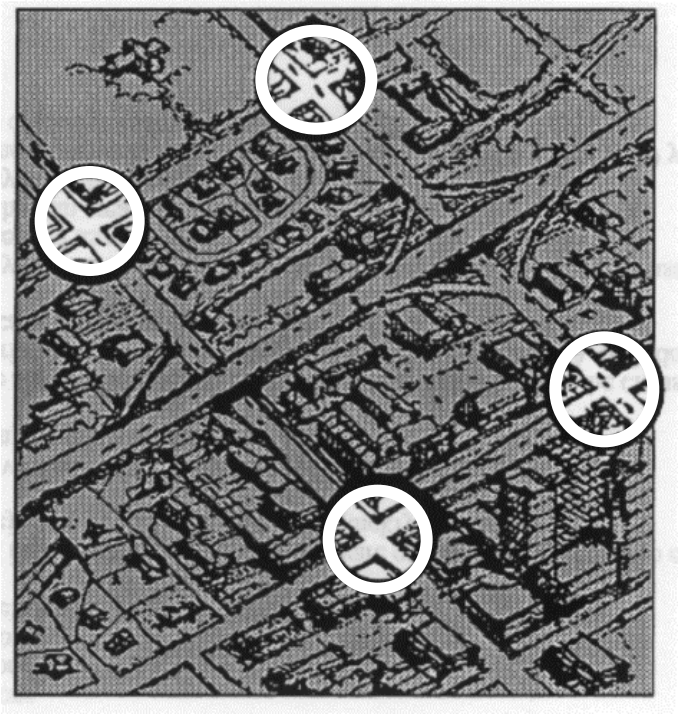
Smallville in 1990

How much land has gone from agriculture to other uses since 1950?

PATTERNS:
What spatial patterns exist?

This seeks to discover what types of patterns may exist in the newly created data file that were not visible before. For example you may wish to know where motor vehicle accidents occur and at what times.

GIS generates information - patterns



What kinds of patterns exist for motor vehicle accidents?
Where do they occur and at what times?

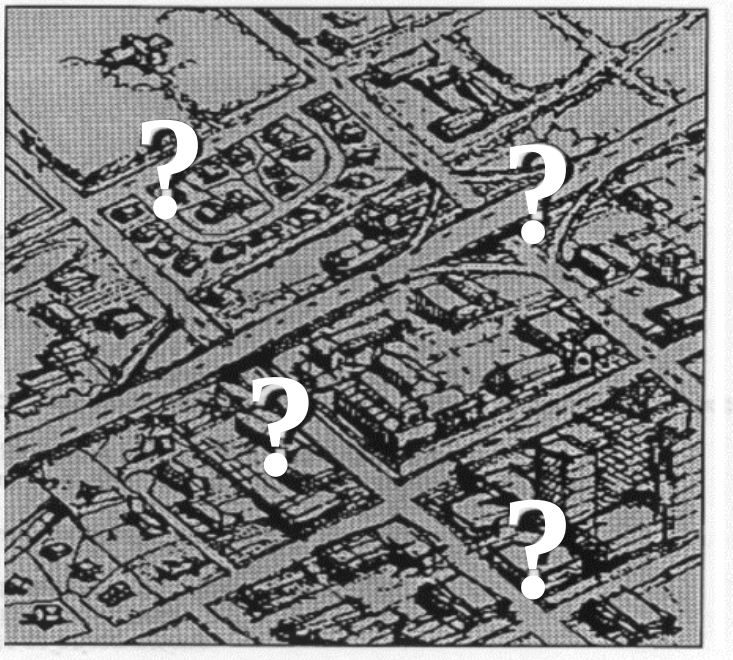
MODELING: What if...?

This seeks to determine what happens if something is changed within an area. For example a new subdivision is added to a school district, or a toxic substance seeps into the local ground water supply, or an earthquake of a given magnitude occurs at a given point, or you want to locate a new business.

GIS generates information - models

School

Hospital



Children's Bookstore

Restaurant

If you wanted to open a new facility, where would you locate it?

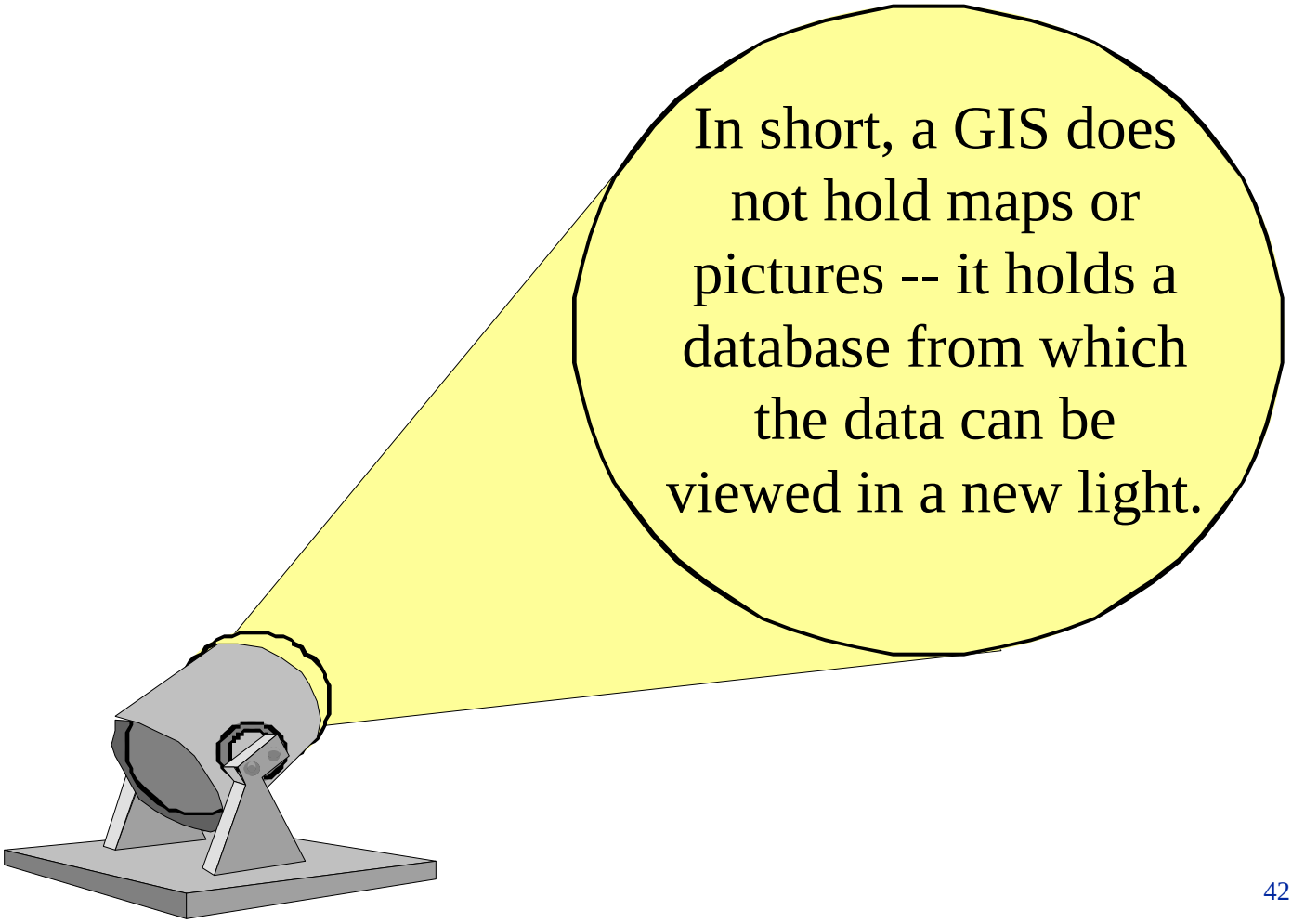
GIS...

A GIS is not simply a computer system for making pretty maps. More importantly a GIS...

...is an **analysis tool**.

...**links** spatial data with geographic information about a particular feature on a map.

...can use the **stored** attributes to compute **new information** about map features.


In short, a GIS does not hold maps or pictures -- it holds a database from which the data can be viewed in a new light.

Beyond Pictures

If you want to go beyond just making pictures, you need to know three pieces of information about every feature stored in the computer.

1. What it is.
2. Where it is.
3. How it relates to other features.