INTRODUCTION TO GEOGRAPHIC INFORMATION SYSTEMS (GIS)

WHAT IS GIS?

GIS can be defined in a number of ways:

- Tools allowing for the processing of spatial data into information, which is used to make decisions.
- A tool kit for answering geographic questions
- “ A computer system for collecting, checking, integrating and analyzing information related to the surface of the earth” David Rhind, 1988

- An organized collection of computer hardware, software, geographic data. And personnel designed to efficiently capture, store, update, manipulate, analyze, and display all forms of geographically referenced information.
- A computer system capable of holding and using data describing places on the earth’s surface (real world).

GIS IS NOT

- **Computer Assisted Cartography**

  - CAC allows the user to create maps, however it lacks analytical capabilities

- **Computer Assisted Design**

  - CAD was designed to create buildings, thus its mapping abilities are limited.

  - CAD also lacks analytical capabilities

HISTORY OF GIS

- **Canada GIS**

- Earliest GIS developed

- Started in the mid 1960's

- It is dynamic enough that it is still being used today

- **US Bureau of the Census**

- Needed a methodology to organize and manipulate census data

- The census was geocoded for the first time in 1970
- Started with DIME files and progressed to TIGER files
- DIME Files
- Urban areas were given Ids of right and left blocks
- To and from ID codes
- X, Y coordinates

Address ranges on each side of the street

- Forms the basis of modern geocoding of addresses

- **Brief History of ESRI**

- Environmental Systems Research Institute was created in 1969

- Jack Dangermond founded ESRI

- ARC/INFO was released in the 1980's

- ArcView was released in the 1990's

- **Difficulties in Early Development**

- Computers took up whole rooms
- Computers were expensive
- Memory, data storage, analysis graphical input capabilities were limited
- Graphics were of poor quality

- **Why GIS?**

- Need for large scale mapping and spatial analysis
- Up to Date inventory of resources
- Manage day to day operations
- Tool to market ideas

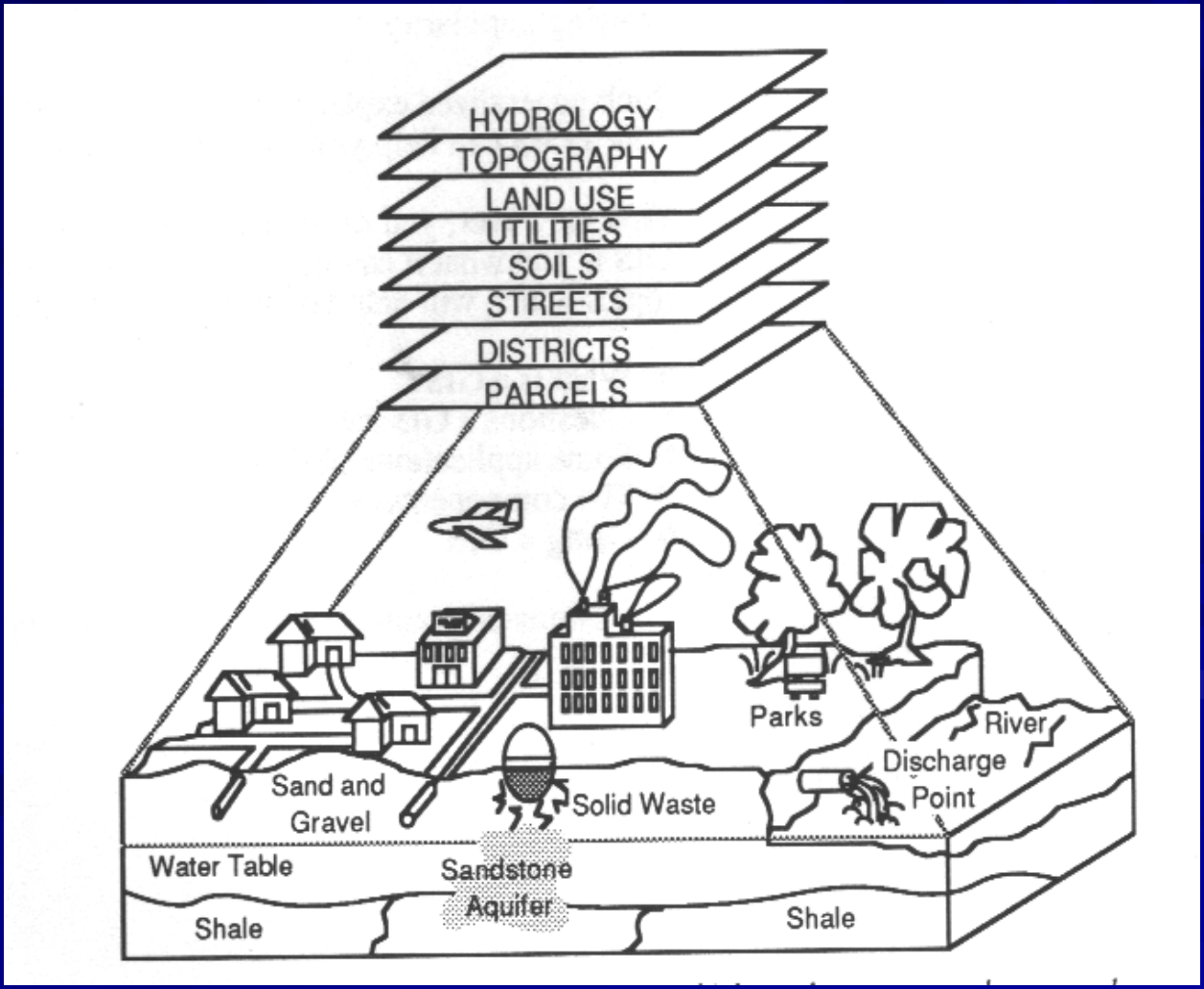
HOW DOES GIS WORK?

- A GIS stores information about the world as a collection of thematic layers that can be linked together by geography

- **What questions can a GIS answer?**

- Location – What is at ….?
- Condition – Where is it?
- Trends – What has changed since ….?
- Patterns – What spatial patterns exist?
- Modeling – What if ….?

- The **real world** consists of many geographies which in a GIS can be represented as a number of related data layers.

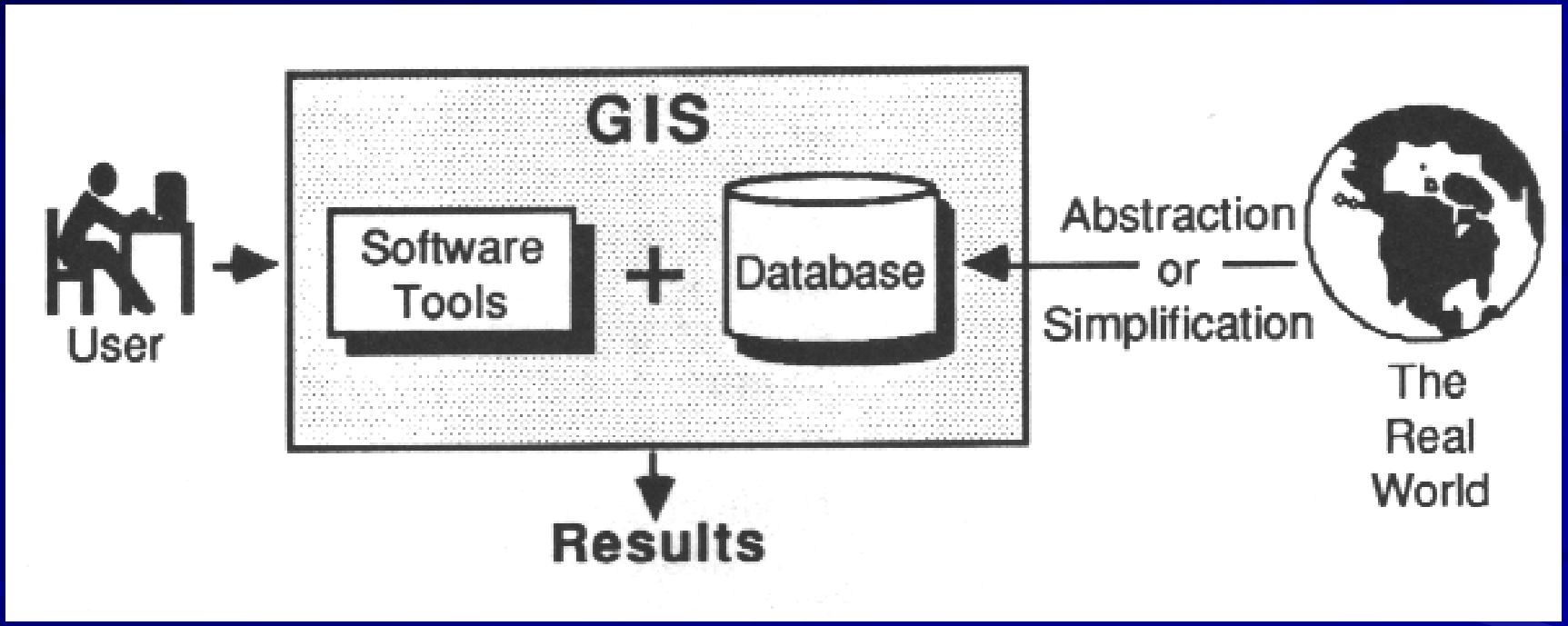


GIS SUBSYSTEMS

- **Data Processing**
- Data Input
- Data Storage
- Data Analysis
- Run Queries
- Display Results
- **Information System**
- Many groups can use information
- GIS department will need to acquire information to serve a large audience

- **Management System**
- Manage resources
- **GIS Analytical Capabilities**
- GIS provides access to raw data
- Data can be aggregated or reclassified

Components of a GIS



The user becomes part of the GIS whenever complicated analyses, such as spatial analyses and modeling, have to be carried out. These require skills in selecting and using tools from the GIS toolbox and intimate knowledge of the data being used.

- GIS technology integrates common database operations such as query and statistical analysis with the unique visualization and geographic analysis benefits offered by maps.
- A GIS does not hold maps or pictures, it holds a database. The database concept is central to a GIS and is the main difference between a GIS and a simple drafting or computing mapping system which can only produce good graphic output.

TYPES OF DATA

- Raster Data

-

- Vector Data

A GIS permits **spatial** operations on data.

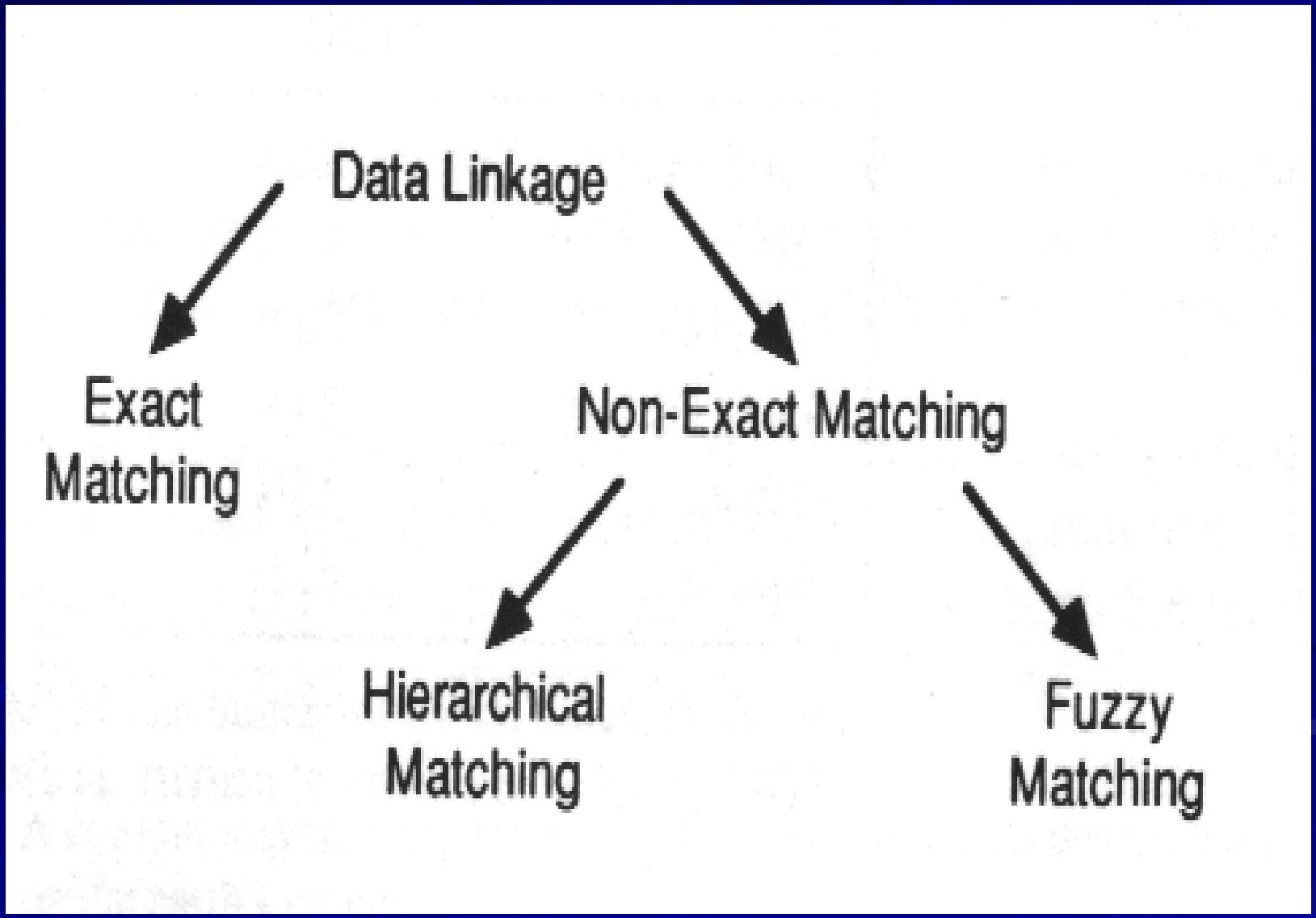
Name	Latitude	Longitude	GIS Population
London	51N	0	80
Zurich	47N	8E	25
Utrecht	52N	5E	40
Santa Barbara	34N	119W	50
Orono	45N	69W	30
Buffalo	42N	78W	30

Aspatial query – What is the average number of people working with GIS?

Spatial query – How many people work in GIS in the major centers of Western Europe? Which centres lie within, 1000 miles of each other?

Answered using latitude and longitude data & other information such as the radius of the earth.

Data Linkage



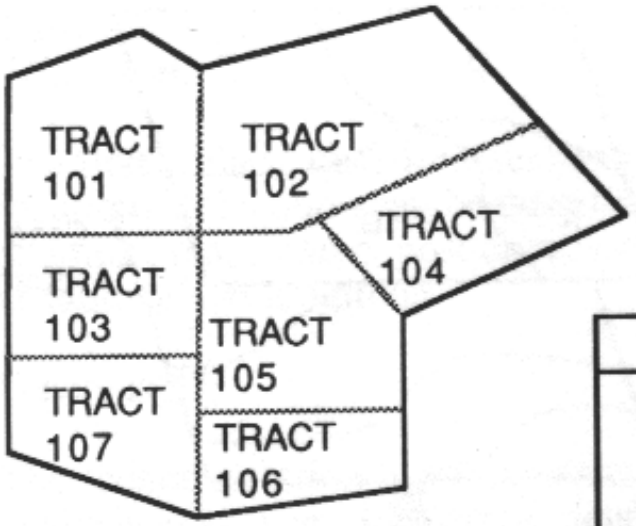
Exact matching – This occurs when there is information in one computer file about many geographic features and additional information in another file about the same features. A key common to both is used to bring them together (county).

COUNTY	POPULATION
LAKE	108,000
LINCOLN	45,000
MADISON	213,000
ORANGE	1,145,000
PENN	22,000

COUNTY	AVG. HOUSING COST
LAKE	89,000
LINCOLN	77,000
MADISON	104,000
ORANGE	167,000
PENN	75,000

COUNTY	POPULATION	AVG. HOUSING COST
LAKE	108,000	89,000
LINCOLN	45,000	77,000
MADISON	213,000	104,000
ORANGE	1,145,000	167,000
PENN	22,000	75,000

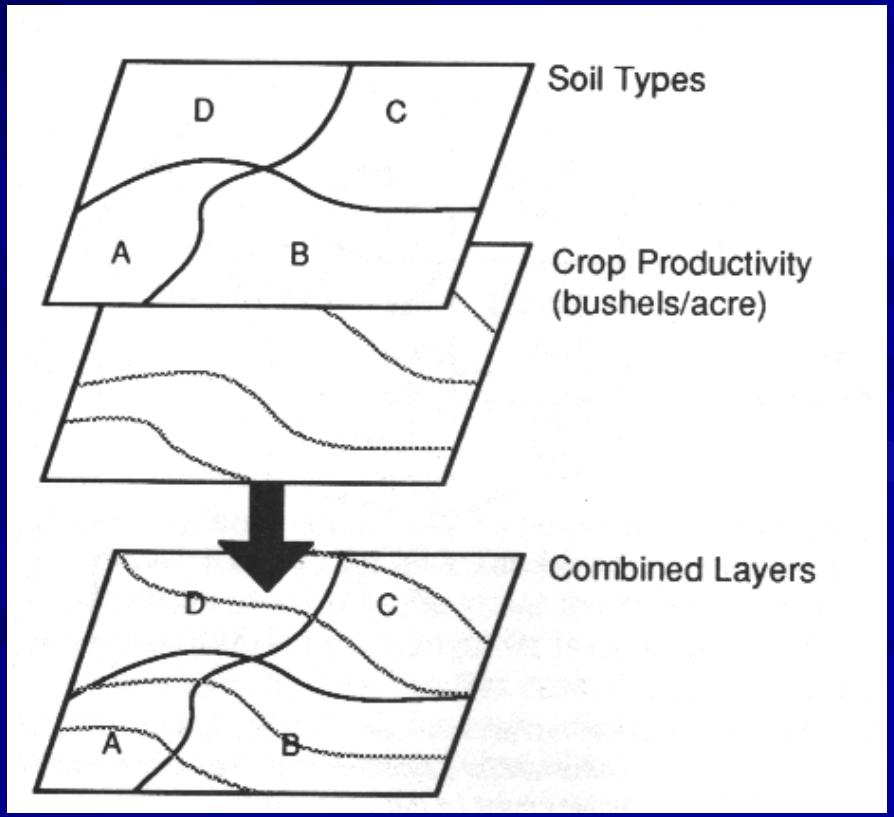
Hierarchical matching – Some data is collected in more detail or less frequently than other forms of information. If smaller areas nest the larger ones, then the solution for making the data match the same area is to use hierarchical matching.



LAKE COUNTY

TRACT	COUNTY	POPULATION
101	LAKE	14,000
102	LAKE	20,000
103	LAKE	5,000
104	LAKE	20,000
105	LAKE	16,000
106	LAKE	22,000
107	LAKE	78,000

Fuzzy matching – Sometimes the boundaries of the smaller areas do not match those of the larger ones e.g. environmental data. When data boundaries don't match, the layers can be joined, creating a new layer containing both characteristics. A GIS can do this as it uses geography or space as the common key between data sets.



WHO USES GIS

- a) Natural Resource Professionals (Forestry and Wildlife Inventories)
- b) Public Safety Departments (Identifying unsafe areas)
- c) Marketing and Business Professionals (Marketing)
- d) Etc..