

GIS
LECTURE 3
GIS DATA SOURCES

META-DATA

DATA ABOUT DATA-

- Metadata or data about data is intended to provide sufficient information that a potential user of the data can make an informed decision about the application and use of the data set.
- **Data Quality Information**
 - lineage
 - logical consistency and
 - completeness of the data

MORE ON DATA-META-DATA

- **Identification Information**
 - This section describes the intended use of the data set and any known limitations
 - cite information and other documents related to the data set
- **Entity and Attribute Information**
 - This section provides a description of the entity and attribute structure of the data set
 - the range of known or permitted values
 - the source of the definitions for the attributes

EXAMPLE META DATA- USING XML

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<?xml version="1.0" encoding="ISO-8859-1" ?>
<metadata>
  <info>
    <citation>
      <citeinfo>
        <origin>Environmental Systems Research Institute Inc.</origin>
        <pubdate>January 2001</pubdate>
        <pubtime>Unknown</pubtime>
        <title Sync="TRUE">buildingshp</title>
        <geofrm Sync="TRUE">vector digital data</geofrm>
        <onlink />
        <fname Sync="TRUE">buildingshp</fname>
      </citeinfo>
    </citation>
  </info>
  <descript>
    <abstract>This Data is a simulated data set. It was created for instructional use with ESRI software training modules or for
    not be used for any purpose other than, for which it was intended.</abstract>
    <purpose>This Data is produced for users of ESRI software products and should be used for training, demonstration, and
    aggregated Data has been derived from actual statistical information. ESRI has manipulated and applied certain assumptions
    the Data solely for educational training purposes. Assumptions, analyses, opinions applied and actual outcomes may vary
    on this Data, and the user should always verify actual Data and exercise their own professional judgment when interpreting
    <suppln>For further information about GIS and ESRI software, visit the ESRI Website at: www.esri.com. For more information
    the ESRI Virtual Campus at: campus.esri.com. For more information about instructor-led training visit: www.esri.com/
    <langdata Sync="TRUE">en</langdata>
  </descript>
</metadata>
```

VECTOR AND RASTER ARE THE BASIC CONCEPT OF GIS

- Vector- model real world by points, lines and polygons
- Raster- model real world representation by pixels

Now TOPOLOGY....



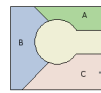
Lines/arcs, nodes

polygons

"Between coverage features"

Now TOPOLOGY....

- What is Topology in GIS?
- Topology refers to the spatial relationships between geographic features.
- It describes the relationships between connecting or adjacent coverage features.
- GIS that supports topology allows the setting of topology rules



PARCEL.PAT			
Polygon	Area	Parcel Number	Land Use
A	12,001	11-115-001	R1
B	15,775	11-115-002	R1
C	19,136	11-115-003	R3

OWNER	
Parcel Number	Owner
11-115-001	Brown, C.
11-115-002	Green, J.
11-115-003	Smith, I.

CONCEPTS OF GIS- TOPOLOGY

- Topology has three basic components:
- Connectivity (Arc – Node Topology):
- Area Definition / Containment (Polygon – Arc Topology):
- Contiguity:

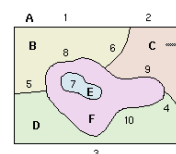
CONCEPTS OF GIS- TOPOLOGY

- I. Connectivity (Arc – Node Topology):
- Points along an arc that define its shape are called Vertices.
- Endpoints of the arc are called Nodes.
- Arcs join only at the Nodes!



CONCEPTS OF GIS- TOPOLOGY

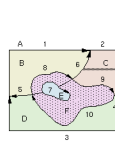
- II. Area Definition / Containment (Polygon – Arc Topology):
- An enclosed polygon has a measurable area.
- Lists of arcs define boundaries and closed areas are maintained.
- Polygons are represented as a series of (x , y) coordinates that connect to define an area.



Polygon-Arc Topology	
Polygon	Arc List
B	1, 6, 8, 5
C	2, 4, 9, 6
D	3, 5, 10, 4
E	7
F	8, 9, 10, 0, 7

CONCEPTS OF GIS- TOPOLOGY

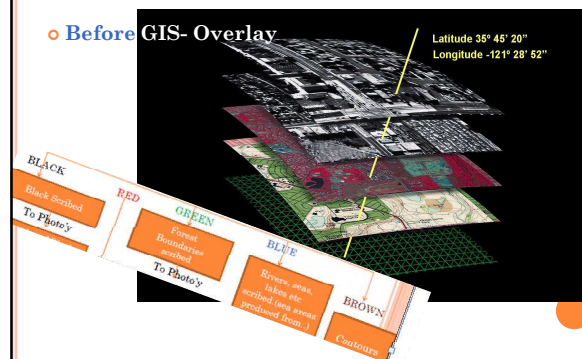
- III. Contiguity:
- Every arc has a direction
- A GIS maintains a list of Polygons on the left and right side of each arc.
- The computer then uses this information to determine which features are next to one another.



Left-Right Topology			
Arc	Left Polygon	Right Polygon	
1	A	B	
2	A	C	
3	A	D	
4	C	D	
5	D	B	
6	B	C	
7	F	E	
8	B	F	
9	C	F	
10	D	F	

LAYERS- MAP OVERLAY IN GIS

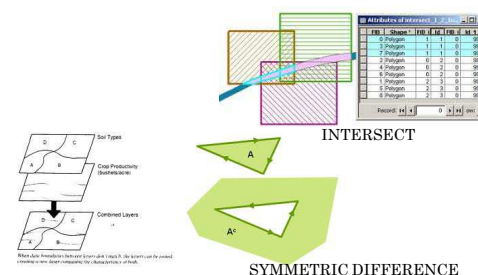
- Before GIS- Overlay



LAYERS- MAP OVERLAY IN GIS

- The combination of several spatial datasets (points, lines or polygons) creates a new output vector dataset
- **Union** overlay- combines inputs single new output
- **Intersect** overlay defines- Find inputs' overlap and retains it
- **Symmetric difference** overlay- keep area of both inputs except for the overlapping area

OVERLAY IN GIS

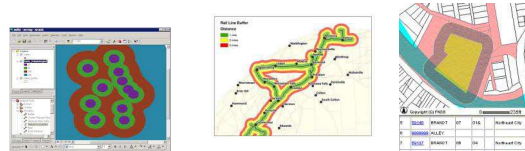


DATA EXTRACTION

- A GIS process similar to vector overlay, though it can be used in either vector or raster data analysis.
- Rather than combining the properties and features of both datasets,
- data extraction involves using a "clip" or "mask" to extract the features of one data set that fall within the spatial extent of another dataset.
- Map algebra- raster analysis

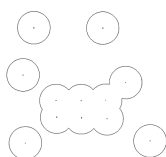
BUFFER OPERATIONS

- Buffering is used to constrain space around individual land features.
- It is generally used for defining all of the spaces within a certain distance of a type of feature
- A subset of features that are selected according to an attribute value.



BUFFER OPERATIONS

- Points, lines and polygons can be buffered
- Raster pixels or groups of pixels
- Buffering points:
- circular polygon
- The radius of this circular polygon is called the buffer distance.



BUFFERING LINES:

- Line segments are handled independently of each other.
- We can represent two parallel lines at a distance of m (buffer distance) from L1.
- We then add the bounds to the parallel buffers by capping the start point and end point of the line with half circular polygons of radius m or bounding rectangles.



BUFFER OPERATIONS

1000	BRANDY	07	016	NorthEast City
2000	ALLEY			
3000	BRANDY	08	04	NorthEast City

POLYGON BUFFER

- Buffering of polygonal surfaces uses most of the same concepts used for line buffering. The only significant change is that the polygon buffer is created on only one side of the line that defines the polygon.
- Applications of buffering in wireless coverage

CO-ORDINATES AND DISTANCES

- The concept of coordinates and distances pertain to the Cartesian coordinates.
- Generally, pairs of numbers expressing horizontal distances along orthogonal axes, or
- triplets of numbers measuring horizontal and vertical distances, or n-numbers along n-axes expressing a precise location in n-dimensional space make up a well-defined set of coordinate.
- Co-ordinates generally represent locations on the earth's surface relative to other locations.

Distance Formula: Given the two points with coordinates (x_1, y_1) and (x_2, y_2) , the distance between these points is given by the formula:

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

2-Dimensional
3-D?

GIS DATA SOURCES

- Surveying
- Photogrammetry
- Remote Sensing
- Gps Or Satellite Surveying
- Existing Data(Analogue and Digital)
- *These are only summaries! Don't be scared.....☺*

DATA SOURCES- SURVEYING

- **Surveying** is the technique and science of accurately determining the terrestrial or three-dimensional position of points and the distances and angles between them.
 - These points are usually on the surface of the **Earth**, and the coordinates thus obtained are often used to draw plans or maps showing boundaries for **ownership** or governmental purposes (via GIS).

DATA SOURCES- SURVEYING

- as "land surveying" is the detailed study or inspection, as by gathering information through observations, measurements in the field, questionnaires, or research of legal instruments, and data analysis in the support of planning, designing, and establishing of property boundaries.
- LIS

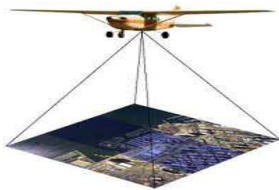
DATA SOURCES- SURVEYING

- Precision measurements of length, angle, elevation, area, and volume, as well as horizontal and vertical control surveys



DATA SOURCES- PHOTOGRAMMETRY

- Aerial **photogrammetry** is a technique for creating two dimensional (2D) or three dimensional (3D) models from aerial photographs, which are pictures of the Earth from a high point, usually an airplane.



DATA SOURCES- PHOTOGRAMMETRY

- Overlapping or non- overlapping Photographs
- Models can be formed with two Overlapping photos
- Orthophotographs- Photos that are corrected of error due to tilt and relief.
 - Can be oriented planimetrically
- Ground control points need to be established on the ground and marked prior to flight.
- Digital elevation data can be acquired from stereo photogrammetry which can be a great source of information to a GIS.

DATA SOURCES- PHOTOGRAMMETRY

- The final product of a photogrammetric survey can be an input into a GIS as an image background in a vector GIS
 - which is good as a reference over which a vector layer can be overlaid.
- Can be digitized as it represents reality in pictorial form

GLOBAL POSITIONING SYSTEMS

- Navigation and precise-positioning tool
- Was originally designed to assist soldiers

- ✦ Systems
 - + GPS (USA)
 - + GLONASS (Russia)
 - + GALILEO (Europe)
 - + COMPASS, BEIDOU (China)
 - + IRNSS (India)
 - + QZSS (Japan)

GLOBAL POSITIONING SYSTEMS

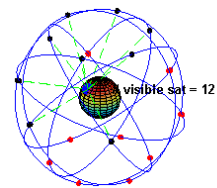
- Satellite constellation sending info. to receivers on earth



GPS-



GLOBAL POSITIONING SYSTEMS



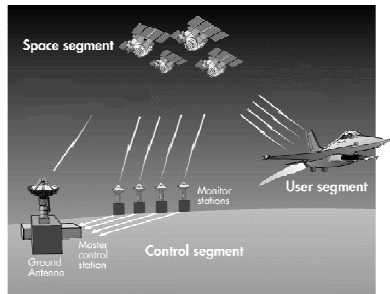
GLOBAL POSITIONING SYSTEMS

- Uses of GPS (commercial and scientific)
- positioning tool in airplanes, boats, cars, and for almost all outdoor recreational activities such as hiking, fishing, and kayaking.
- weather forecasting
- global climate studies
- accurate method of surveying (precision of measurement cm)
- earthquake studies to measure tectonic motions
- We can do all this because of GIS.

GPS OR SATELLITE SURVEYING

- **User Segment**
- **Control Segment**
- **Space Segment**
- The space segment consists of a constellation of 24 satellites or more, each in its own orbit 11,000 nautical miles above Earth
- (1 nautical mile=1.85200 kilometers)
- 11,000 nautical miles =20 000km

GPS OR SATELLITE SURVEYING



GLOBAL POSITIONING SYSTEMS

- Accurately determining their locations (Longitudes, Latitudes or X and Y coordinates) world-wide-> Hence **Global**
- Today, the uses of GPS have extended
 - commercial and scientific worlds
 - Meteorologists use it for weather forecasting
- The output from a GPS device is a set of **coordinates** based on a particular coordinate system (Map Projections – this topic will be introduced soon).



REMOTE SENSING

GEOEYE 1



Imaging Mode	Panchromatic	Multispectral
Spatial Resolution	41 meter	1.65 meters
Spectral Range	450-900 nm	450-520 nm (blue) 520-800 nm (green) 625-885 nm (red) 760-900 nm (near IR)

Swath Width	15.2 km
Off-Nadir Imaging	Up to 60 degrees
Dynamic Range	11 bits per pixel
Mission Life	Expected > 10 years
Revisit Time	Less than 3 days
Orbital Altitude	681 km
Nodal Crossing	10:30 am



© GeosEye

DATA SOURCES- FOR GIS REMOTE SENSING SYSTEMS

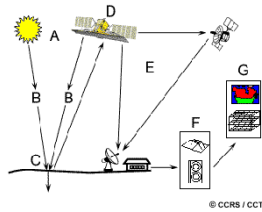
- Remote sensing can be broadly defined as the collection and interpretation of information about an object, area, or event without being in physical contact with the object
- Target
- Sensor
- Source of radiation
- Atmosphere in between Target and Sensor

REMOTE SENSING

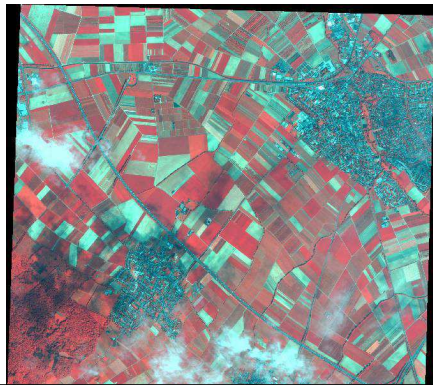
- Collection of data over large numbers of wavelength bands are referred to as multispectral or hyperspectral data
- This is an inexpensive way to obtain spatial information over large areas

REMOTE SENSING

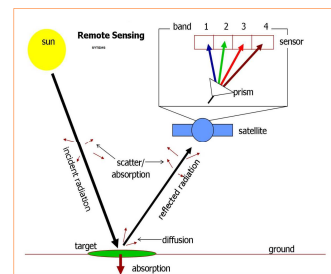
- Seven processes involved
- Energy Source, Radiation and atmosphere, Interaction with target, Recording of energy, Transmission Reception and Processing,
- Interpretation and Analysis, Application (Mem->ERiRTIA)



SITE-SPECIFIC IDENTIFICATION OF PATHOGEN INFESTATION



DATA ACQUISITION -REMOTE SENSING SYSTEMS



REMOTE SENSING SYSTEMS

- Aircraft and satellites are the common platforms
- The platform houses a sensor
- Scanners in the case of Satellites and
- Cameras in the case of Aircrafts (photogrammetry in this case)

DATA ACQUISITION -REMOTE SENSING SYSTEMS

- Original form of remote sensing



REMOTE SENSING SYSTEMS

- Satellites

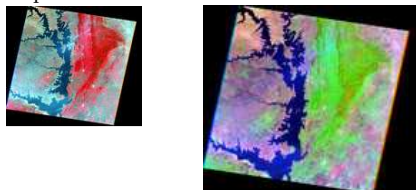


DATA ACQUISITION -REMOTE SENSING SYSTEMS

- Information collected on- EMR is a form of energy- at other wavelengths including
 - near infrared,
 - thermal infrared
 - and microwave
- Seven Processes involved
 1. Energy Source/Illumination
 2. Radiation from source and atmosphere(Interactn)
 3. Interaction between target and radiation
 4. Recording of energy by sensor
 5. Transmission, Reception and Processing (On earth)
 6. Interpretation and Analysis (Visual or Via Software)
 7. Application

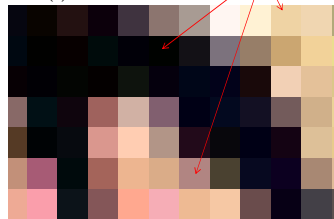
R.S. SATELLITE IMAGES

- Which part of the earth is this?



REMOTE SENSING IMAGE- PIXELLATED

- Images are represented as pixels- Raster Model(?)



GLOBAL POSITIONING SYSTEMS

- Global Positioning System (**GPS**) is a navigation and precise-positioning tool.
- Positions are defined by X,Y, Z coordinates (remember?)
 - X,Y
 - Longitudes, Latitudes
 - Eastings, Northings
- Developed by the Department of Defense in 1973

EXISTING DATA

- Hard copy maps
- Digital sources/Internet (www)
- Government agencies and
- the UN publish GIS data that can be used for free- USGS.

EXISTING DATA

File type is indicated by its extension

Extension	Description
.dbf	dBase database file, accompanies shapefiles; by ESRI
.gz	compressed using Gzip, by GNU Zip
.jpg	Joint Photographic Experts Group image file
.png	Portable Network Graphics image file
.prj	text file, with projection details
.shx	spatial index file, accompanies shapefiles; by ESRI
.sbx	spatial index file, accompanies shapefiles; by ESRI
.sbn	spatial index file, accompanies shapefiles; by ESRI
.sid	Mr.Sid compressed image file, an option with Landsat mosaics
.tfw	world file, sometimes accompanies GeoTIFF

EXISTING DATA