# GIS Data Topology

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Definition of Map Topology

- Chang text defines topology as the study of properties of geometric objects that remain invariant under certain transformations. (Chang)
- **A** major area of mathematics concerned with spatial properties that are preserved under continuous deformations of objects. (Wikipedia)
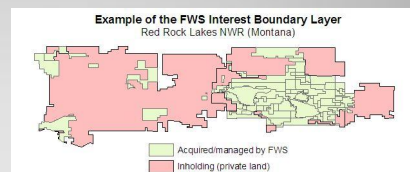
Example of Topology

- The Rubber Band example
  - ➢ A rubber band can be stretched and twisted, but as a result of it being a closed circuit the rubber band demonstrates aspects of topology in the sense that it well stay a closed circuit even when its shape is transformed or manipulated.
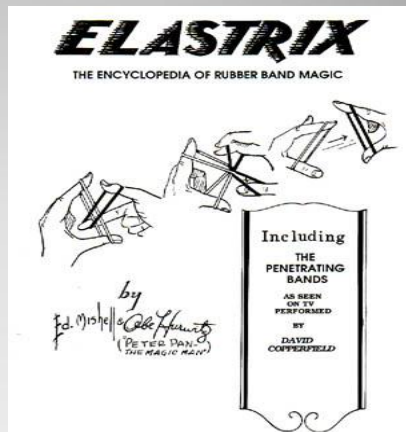

My Experience with Topology

- Mapping tract boundaries of USFWS lands
- Topology was used to insure correct property boundaries
- Restricted certain analysis of properties that included easements

Example of the FWS Interest Boundary Layer
Red Rock Lakes NWR (Montana)

Acquired/managed by FWS
Inholding (private land)

Graph Theory

- A field of mathematics that uses diagrams or graphs to study the arrangements of geometric objects and how they are related.
- Digraphs (Directed Graphs)
- Arc- Line connected with two points
- Node- The beginning or end point on a line
- Vertices- Points that fall between Nodes on Arcs
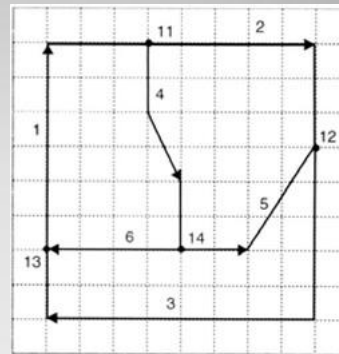
Adjacency

• **A Matrix or Matrices are used to show relationships**
•**1 and 0 are used to define characteristics of adjacency**
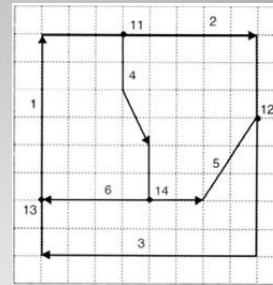•**Direction of an Arc is used to determine value**
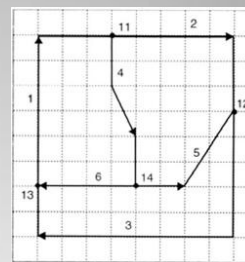
Adjacency matrix

	11	12	13	14
11	0	1	0	1
12	0	0	1	0
13	1	0	0	0
14	0	1	1	0

Incidence

•**A Matrix or Matrices are used to show relationships**
•**1, -1, and 0 are used to define characteristics of Incidence**
•**Nodes are used to define connectivity of Arcs**

Incidence matrix

	1	2	3	4	5	6
11	-1	1	0	1	0	0
12	0	-1	1	0	-1	0
13	1	0	-1	0	0	-1
14	0	0	0	-1	1	1

Benefits of Topology

- Insure Data Quality
1. Shared lines can restrict boundary discrepancies
2. Gaps in line segments can restrict aspects of connectivity to a network
3. Defined areas can insure land use restrictions
- Enhances GIS Analysis
1. Attribute rules benefit address locating by reducing attributes to be searched
2. Transit directions benefit route finding by depicting realistic transportation options
3. Housing needs assessments are benefited through restrictions in property uses.

Sources

- Chang, Kang-tsung. "Introduction to GIS 5th Edition" Chang 2009, 5th Edition
- Viro, Ivanov, Netsvetaev, Kharlamov. "Topology" Wikipedia. 2009 <http://en.wikipedia.org/wiki/Topology>
- Magic Shop. "Elastrix" How Do Tricks: Elastrix Book Image <http://www.howtodotricks.com/Books.html>
- USFWS. "**FWS National Cadastral Data**" Branch of Data and System Services. <http://www.fws.gov/data/Cadastral.htm>

Questions

1. What values and how are those values used in matrices to define Adjacency?
2. What values and how are those values used in matrices to define Incidence?
3. Name two important digraphs related to map topology of the Vector Data Model?
4. How can topology insure the integrity and quality of spatial data?