GIS Data in ArcGIS

Pay Attention to Data!!!

GIS Data Models

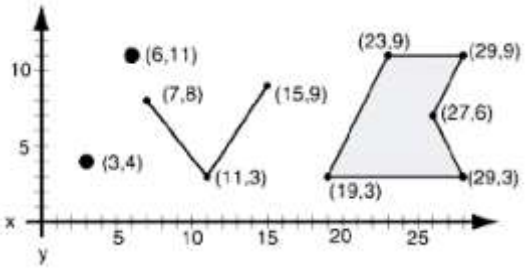
- Vector
  - Points, lines, polygons, multi-part, multi-patch
  - Composite & secondary features
    - Regions, dynamic segmentation (routes)
- Raster
  - Grids, images
  - Nominal, ordinal, interval, ratio measures
- Triangulated Irregular Network (TIN)
- Tabular
- Terrain dataset (ArcGIS 9.2 and later)
- Network dataset (ArcGIS 9.X)

GIS Data Structures

- Coverage
- File-based
  - Shapefiles (.shp, .dbf, …)
  - File-based Geodatabase (ArcGIS 9.2 and later)
- DBMS-based
  - Personal Geodatabase – MS Access
  - ArcSDE

Vector Data Model

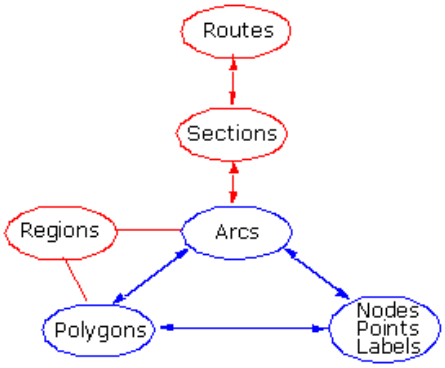
Geometry



Attributes
(PAT, AAT, PAT)

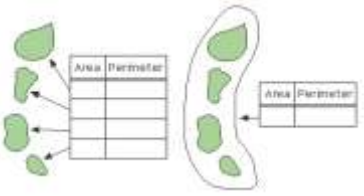
TRACT	POP1990	AREA	PERIMETER
0056	3433	5205890	9508.022
0057	1775	17330714	17017.602
001102	1331	13391034	15832.158
001202	3245	10129278	12933.502
001302	2839	8228478	11483.996

Composition Features (Coverage)

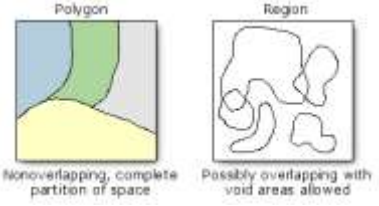


Regions (Coverage) / Multipart Features

- Disjoint polygons



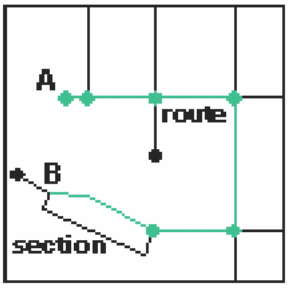
- Overlapped polygons



Multipatch

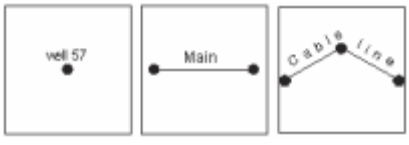
- Its geometry type can contain 3D models with vertical and overhanging faces.
- These faces may contain texture information.
- Multipatch data is stored in the same manner as point, line, and polygon data in GDB or shapefiles.
- It can have attributes and can be used with the standard tools, such as the Identify tool.
- Use 3D Analyst tools to manage multipatch features.

Routes

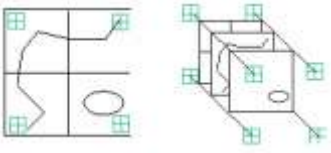


Secondary Features

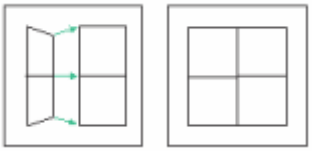
Annotations



Tics



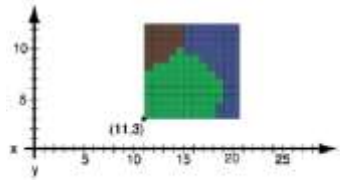
Links



Raster Data Model

- Cells (Pixels)
- Cell value

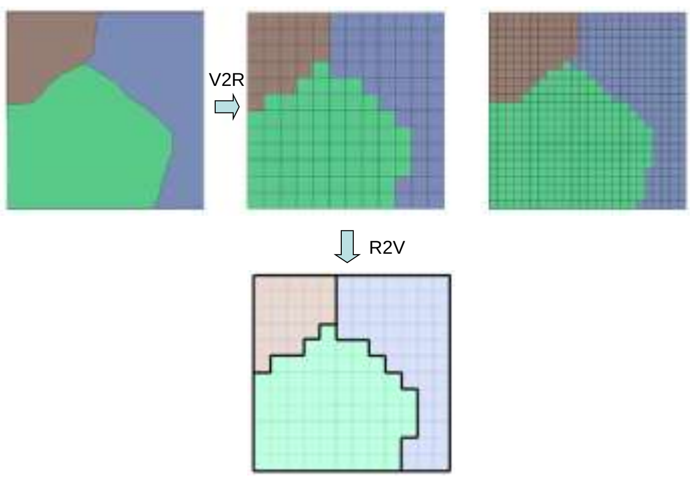
- x, y cell sizes
- Geographic coordinates



Attributes

Value	Count	Name	Suitability	Type
2	[illegible]	Cropland and pastureland	5	Agriculture
3	[illegible]	Urban and industrial	5	Urban
16	212	[illegible]	5	Cleared
27	1383	Cottonwood	4	Riparian
463	142	Ash-Cottonwood	3	Woodland
476	[illegible]	Oak	3	Woodland
506	[illegible]	Douglas fir	2	Forest
518	8557	Mixed evergreen-broadleaf	3	Forest
512	7940	Douglas fir-Hemlock-Cedar	1	Forest

Raster to Vector / Vector to Raster

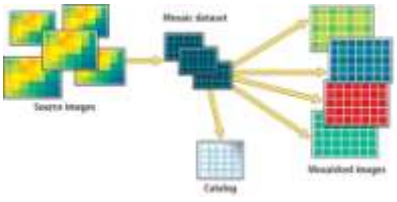


ArcGIS Mosaic Dataset (first released in ArcGIS 10)

- A Mosaic Dataset is an ESRI geodatabase model that is used to store and manage collections of raster datasets.

- Created to help streamline raster data management over varying spatial, spectral, temporal and radiometric resolutions between raster datasets.

A mosaic dataset in ArcMap



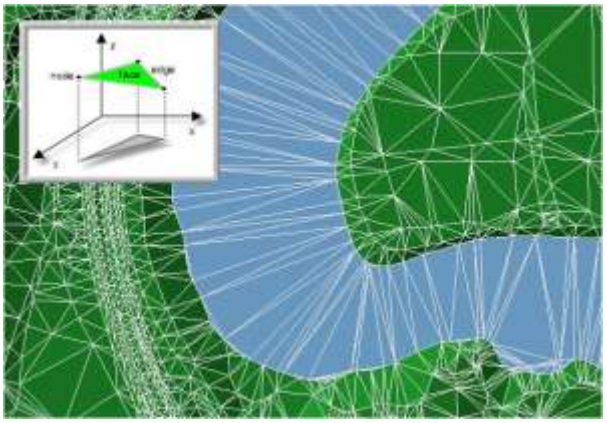
The mosaic dataset structure

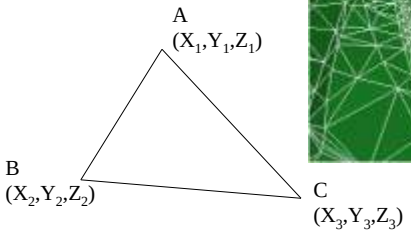
Viewing and Querying Capabilities of Mosaic Dataset

- Dynamic mosaicking
- On-the-fly processing (slope, aspect, hillshade, orthorectification)
- Temporal querying
- Catalog view of footprints with associated attributes and metadata

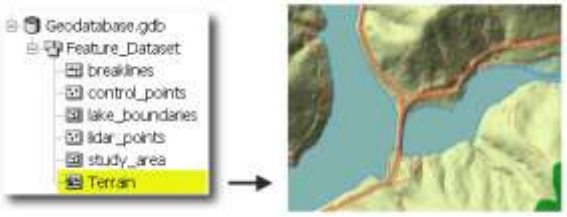
TIN

- Node (x, y, z)
- Edge
- Triangles

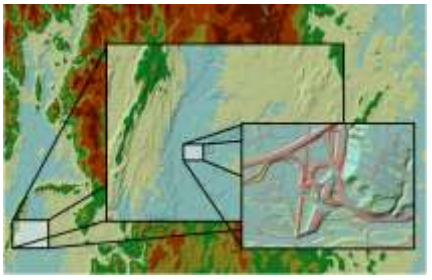




ArcGIS Terrain Dataset (first released in ArcGIS 9.2)



A terrain dataset is a multi-level (pyramid-level) TIN

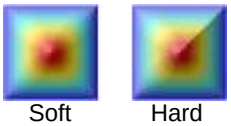


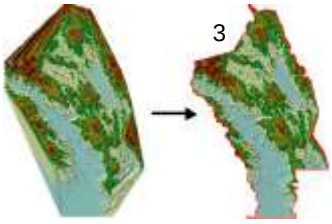
Surface Feature Types (SFTypes) of Terrain Dataset

1. Mass points (x,y,z locations)
2. Breaklines (hard or soft)
3. Clipping polygons (hard or soft)
4. Erase polygons (hard or soft)
5. Replace polygons (hard or soft)

1

2





Network

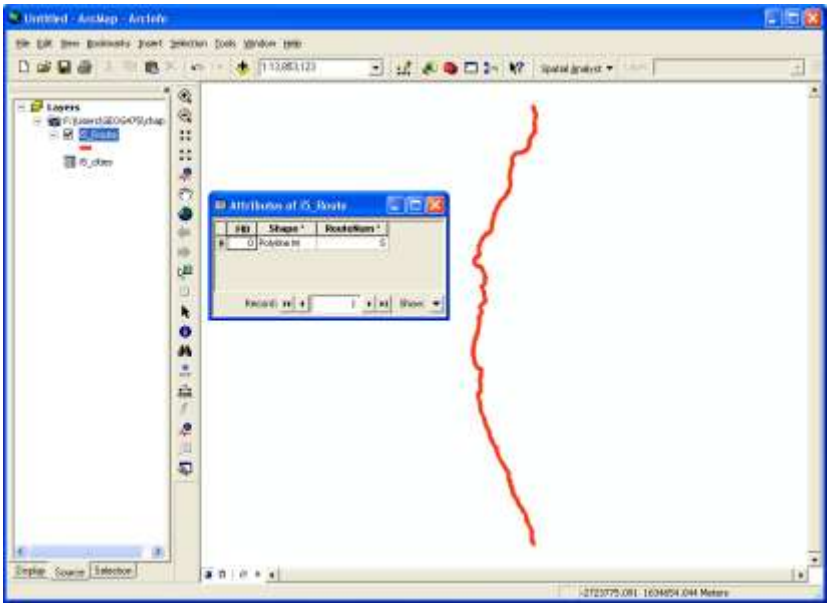
- Geocoding
  - Address
  - Intersection
- Dynamic segmentation
  - Sections and routes (for linear referencing)
  - Events
- Network connective
  - Geometric network and transportation network
  - Edge + junctions (geodatabase)
  - Turn tables associated with junctions.

Network

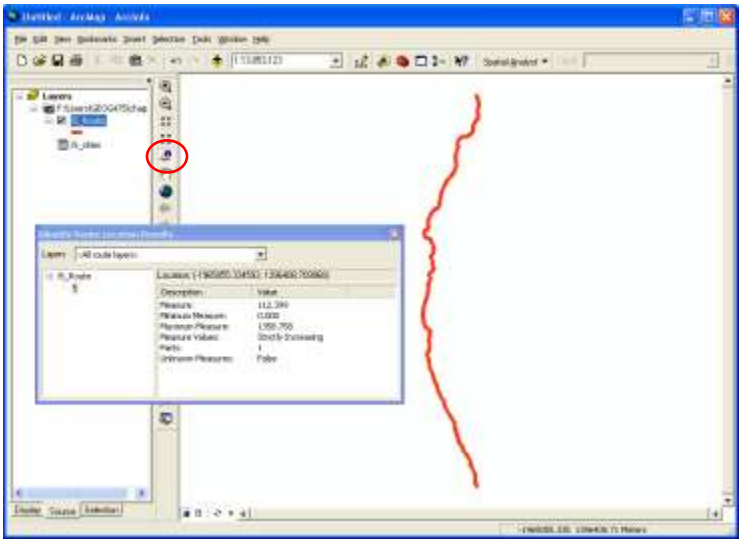
- Topology-based features – connectivity
  - Intersections (junctions)
    - Junctions
    - Sources and sinks
    - Turns, Turn impedance
    - Overpasses and underpasses
  - Links (edges)
    - Directions
    - Impedance (length, travel time, flow volume)
    - Directional impedance

Street Layer for Geocoding

Polylines for Dynamic Segmentation - Routes



Linear Referencing - Identify Route Locations Tool

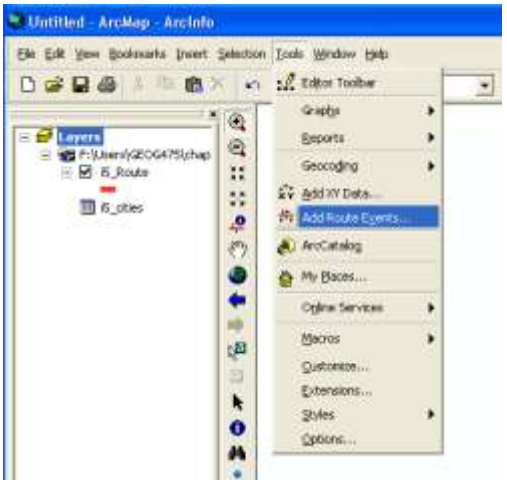


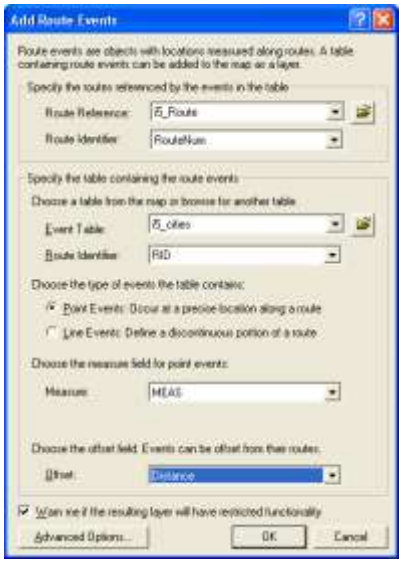
- The tool needs to be added to ArcMap manually using the customize interface.

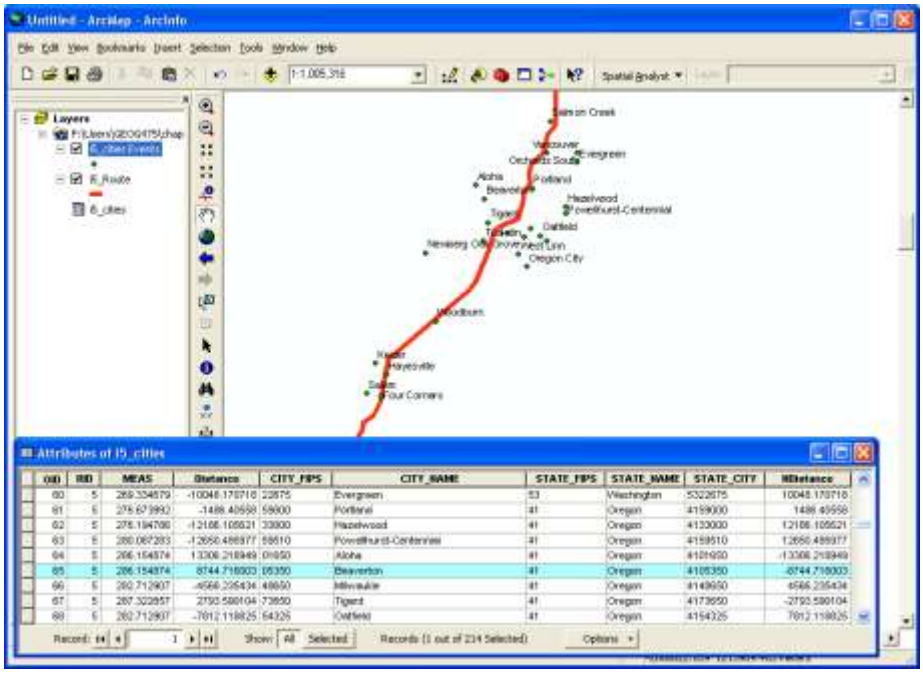
Event Table – Point & Line Events

- Offset: A value indicating how far the events are from the route – the sign of the value indicates the direction of the offset – right or left.

Add Route Events



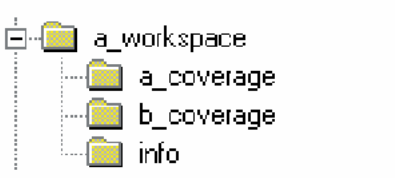




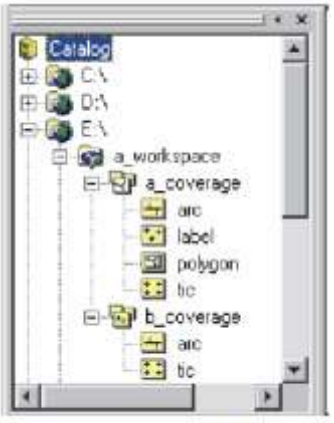
GIS Data Structures

- Geometry & attributes
- File-based
  - ArcInfo: Coverages + Info tables
  - ArcView: Shapefiles + dbf tables
  - ArcGIS: File geodatabase (since 9.2)
- DBMS-based
  - ArcGIS: Personal Geodatabase (mdb) & Geodatabase (SDE)

ArcInfo Coverage Data Structure



Workspace in the file system



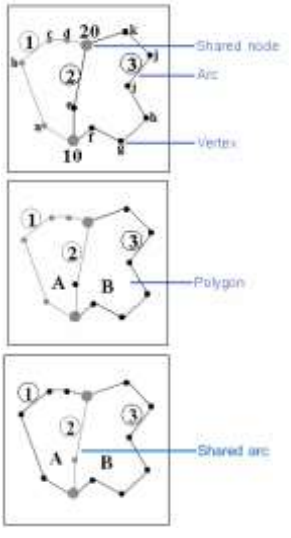
Workspace in ArcCatalog

Coverage Topology

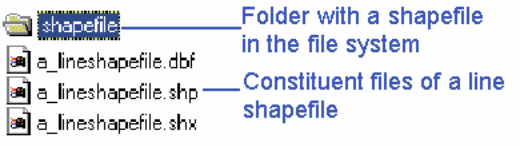
Connectivity: Arcs that share a node are Connected (arc-node topology)

Area definition: An area is defined by a series of connected arcs (polygon-arc topology)

Contiguity: Arcs have directions and left and right polygons (left-right topology)

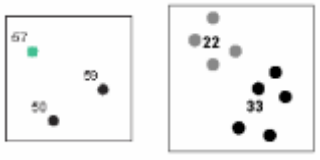


ArcView Shapefile Data Structure



Shapefile (No Topology!)

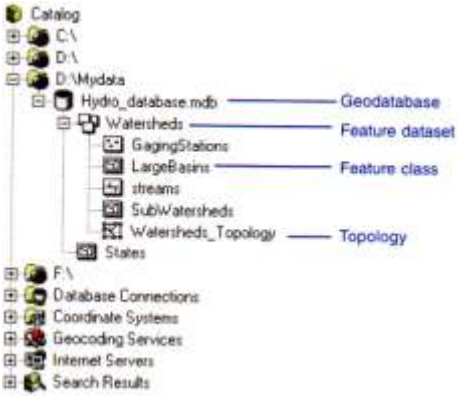
Point, multipoint



Line

Polygon

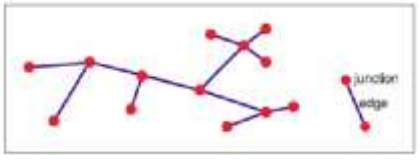
ArcGIS Geodatabase Data Structure



Features / Feature Classes

- All point, line, and polygon features can:
  - Be multipart
  - Have x,y; x,y,z; or x,y,z,m coordinates
    - (m-coordinates store distance measurement values, a line with m-coordinates becomes a route)
  - Be stored as continuous layers instead of tiled
  - Lines are built from line segments, circular arcs, and splines.

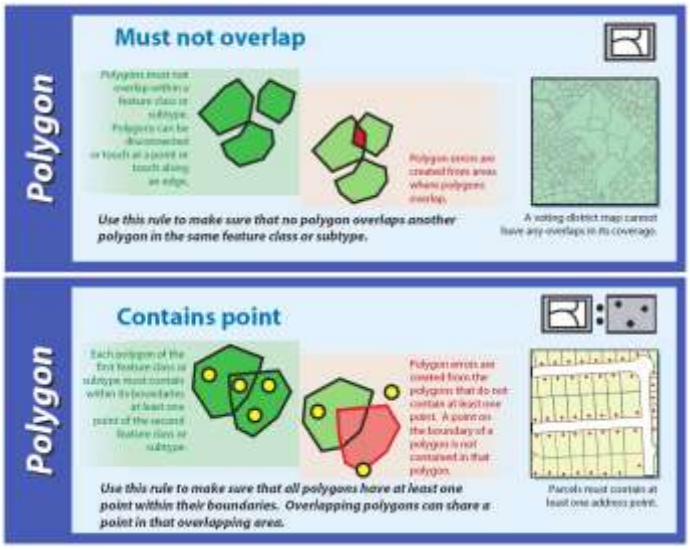
- Network dataset
  - Junctions, edges



- Terrain dataset

Geodatabase Topology (Optional)

ArcGIS topology defines the spatial relationships between geometries



25 Geodatabase Topology Rules (in 9.x)

… aren't automatically applied; need to be selected by database designer or user

Line or Polygon

- (Distance b/t vertices) Must be larger then cluster tolerance

Point Rules

- Point must be covered by line
- Must be properly inside (polygons)
- Must be covered by endpoint of
- Must be covered by boundary of

Line Rules

- Must not overlap
- Must be single part
- Must not self overlap
- Must not overlap with
- Must not have dangles
- Must not have pseudo-nodes (pseudos)
- Must not intersect
- Must not self intersect
- Endpoint must be covered by
- Must be covered by boundary of
- Must not intersect or touch interior
- Must be covered by feature class of

Polygon Rules

- Contains points
- Must not overlap
- Must not have gaps
- Must not overlap with
- Must be covered by
- Must cover each other
- Boundary must be covered by
- Must be covered by feature class of
- Area boundary must be covered by boundary of

Six New Rules in ArcGIS 10

- Polygon: Contains One Point
- Line: Must Not Intersect With
- Line: Must Not Intersect or Touch Interior With
- Line: Must Be Inside
- Point: Must Be Coincident With
- Point: Must Be Disjoint

http://help.arcgis.com/en/arcgisdesktop/10.0/help/index.html#//001t000000sp000000.htm

Why do we need topology in GIS?

- Enforce geometric rules for spatial representation and maintain data integrity
- Reduce data redundancy
- Improve data access/update efficiency

Summary

Data Structure	***Type***	***Topology***	***Portability***	***Spatial Integrity***
Coverage	File-based	Required	Low	High
Shapefile	File-based	None	High	None
Geodatabase	DBMS	Optional	High	High (if topology rules are defined)
8.X & 9.1 Personal Geodatabase	DBMS (MS Access)	Optional	High	High (if topology rules are defined)
9.2 File-based Geodatabase	File-based	Optional	High	High (if topology rules are defined)

ESRI keeps adding new features to its geodatabase DBMS. Most of the GDB are backward-compatible. Make sure you have the latest service pack or patches to ensure trouble-free access to GDB created in different versions of ArcGIS.