2009 ESRI Education User Conference
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Topology in ArcGIS

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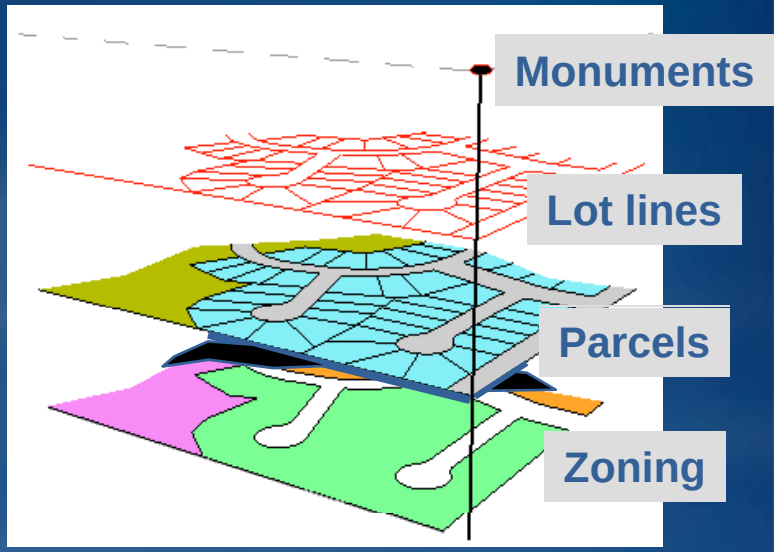
Please!
Turn OFF cell phones
and paging devices

What is Topology

- Process to describe & maintain spatial relationships of map features
  - Adjacency
  - Coincidence
  - Connectivity
  - Containment
  - Others …
- GIS uses
  - Analysis
  - Data integrity

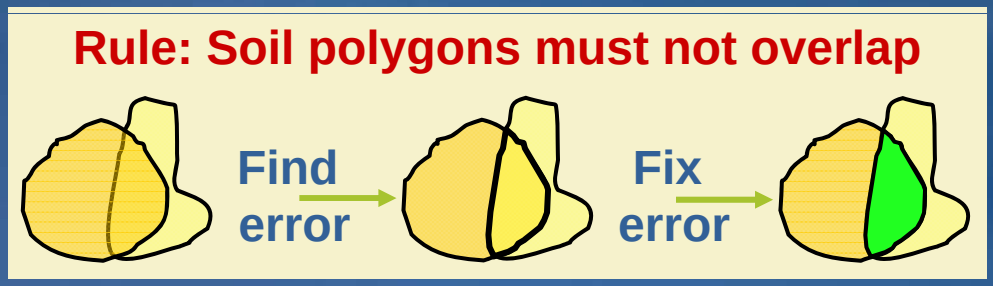
Topology in the geodatabase

- Helps ensure spatial integrity of data
  - Finds errors in data
  - Fix with edit and topology tools
- Relationships not stored
  - Discovered on-the-fly by ArcMap
- Coincidence-based topology
  - Snaps feature vertices (user prioritizes through ranks)
  - Between one or two feature classes
- Requires an ArcEditor or ArcInfo license



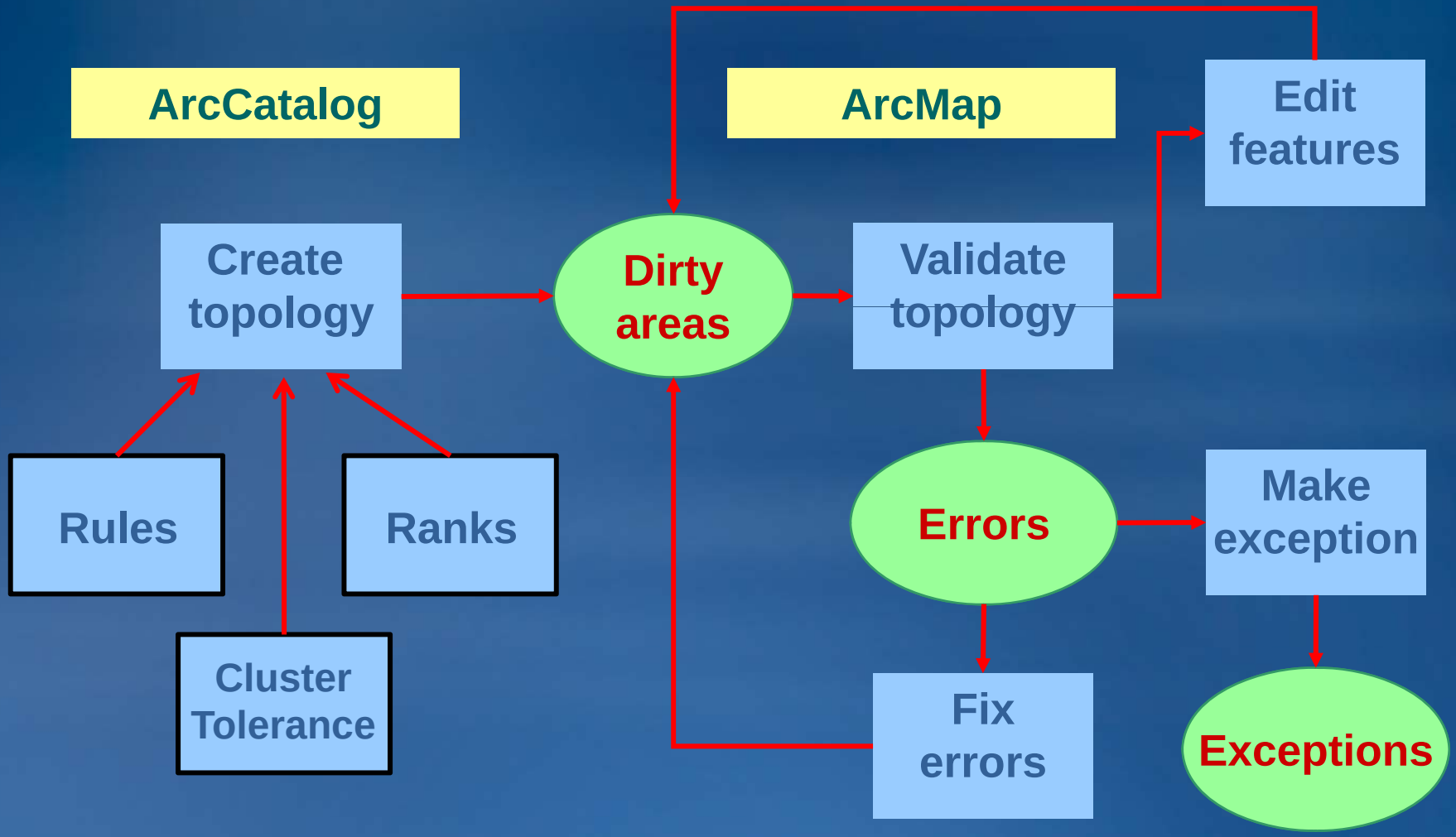
Real-world examples

- Single feature class examples
  - Zip Code boundaries must not overlap
  - Sewer lines must not have dangles
  - Vegetation polygons must not have gaps



- Two feature class examples
  - Parcel boundary must be covered by parcel lines
  - Zoning must not overlap with water
  - Oil well must be in an authorized lease

Topology workflow



Creating a Geodatabase topology

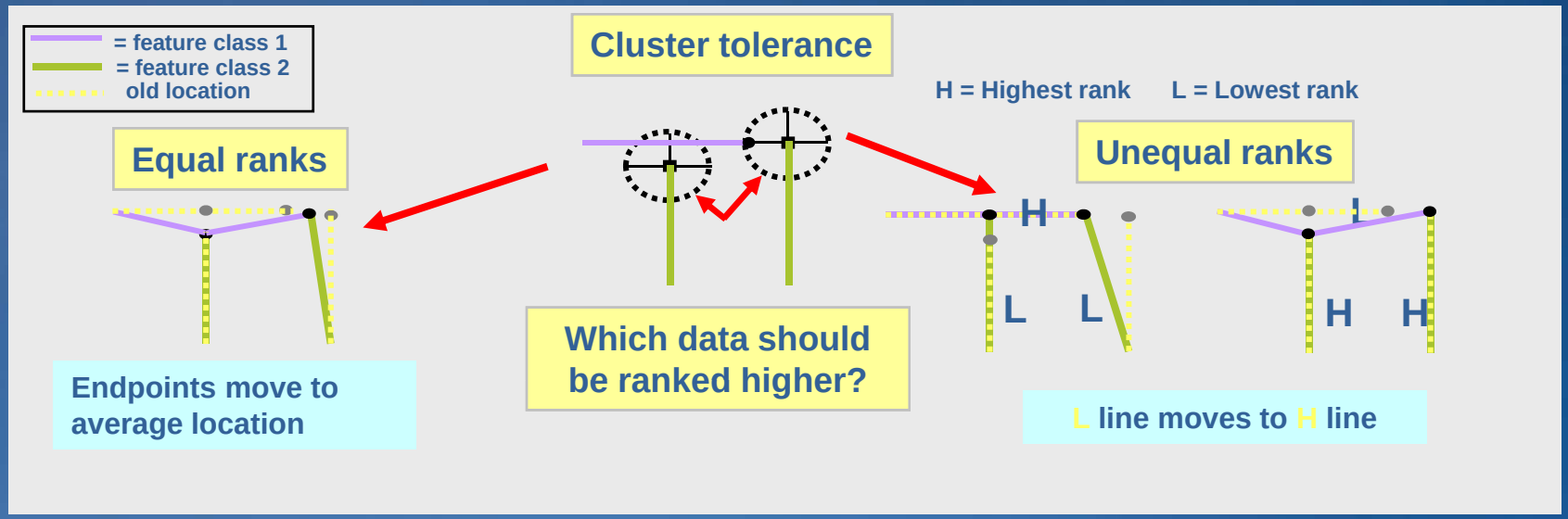
- Created in feature dataset
  - Only “simple” feature classes (no annotation, multi-point, dimensions, etc.)
  - A feature class may be in only one topology at a time
- User specifies topology properties
  - Cluster tolerance
  - Participating feature classes
  - Ranks
  - Topology rules

- Creates and enforces topological relationships
  - Snaps feature vertices during validation
- Edited in ArcMap

Topology properties

- Cluster tolerance
  - A distance within which all geometry is made coincident, or “identical” in location

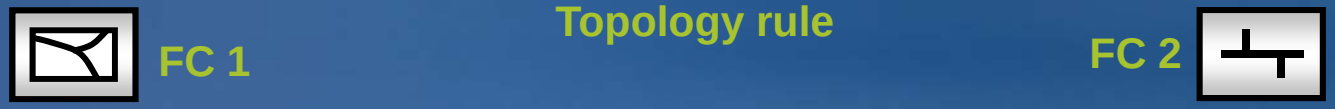
- Ranks
  - Control how vertices move during validation
  - Lower-ranked vertices move to higher-ranked vertices



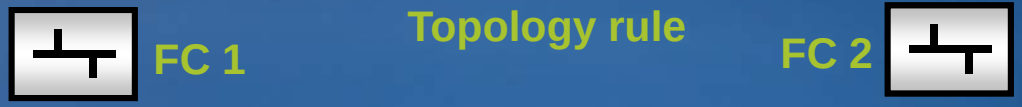
Topology rules(!)

- Define valid spatial relationships
  - Between feature classes or subtypes
- 25 rules available **(C:\Program Files\ArcGIS\Documentation\topology_rules_poster.pdf)**
  - Many rules for each type of feature (point, line, polygon)
- Set when creating topology; tested during validation

"Parcels … *boundary must be covered by* … Parcel Lines"

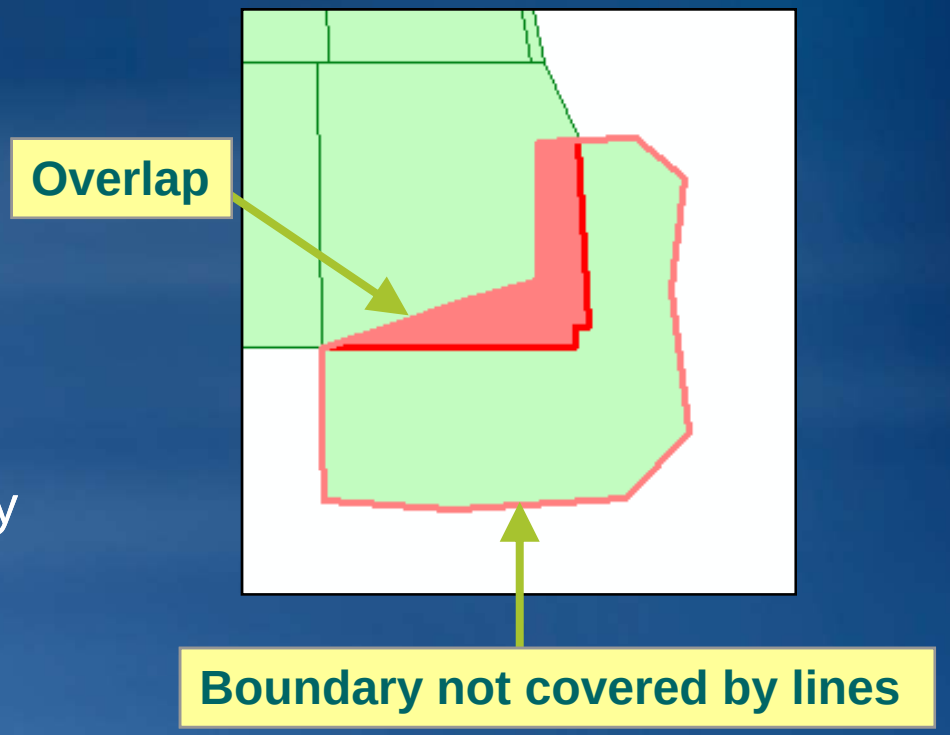


"Roads … *must not overlap with* … Railroads"



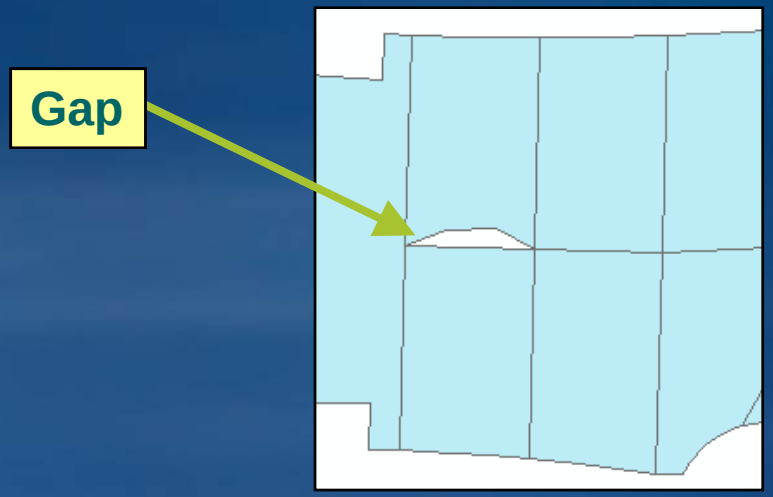
Some commonly used topology rules

- Must not overlap
  - Census blocks cannot overlap
  - Vegetation cannot overlap
  - Zoning cannot overlap
  - Soils cannot overlap
- Boundary must be covered by
  - Parcel boundary must be covered by parcel lines
  - Geologic rock formation boundary must be covered by rock formation line type



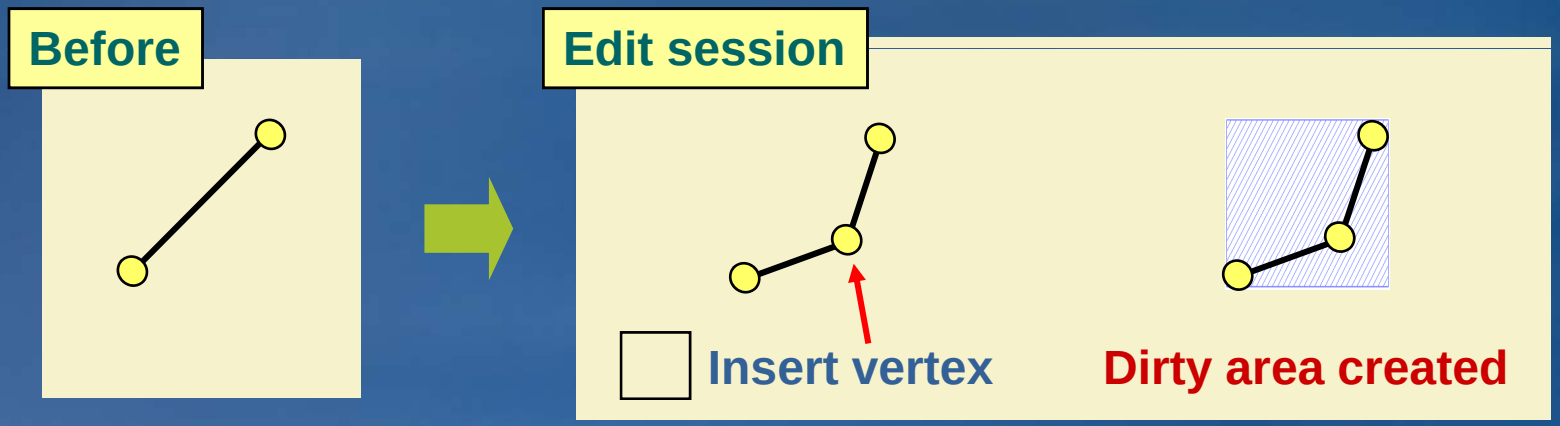
More commonly used topology rules

- Must not have gaps
  - No gaps in vegetation
  - No gaps in soils
  - No gaps in temperature
- Must not have dangles
  - Sewer lines
  - Parcel lines
- Points must be covered by line
  - Monitoring station must fall along streams
  - Monument corners must fall along PLSS corner
  - Manhole covers must fall along storm sewer line



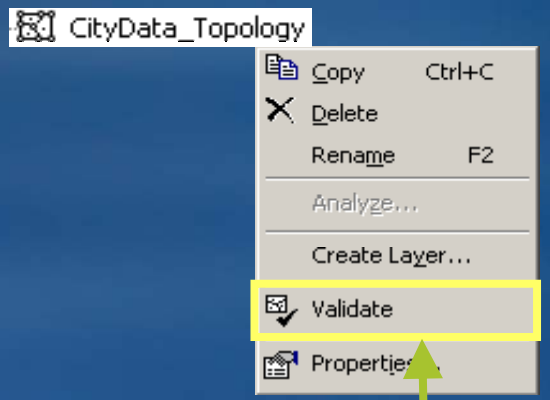
Dirty areas

- Areas in the dataset that have not been validated
  - Entire extent is “dirty” when topology is first created
  - May contain existing or undiscovered errors
  - Edits create dirty areas

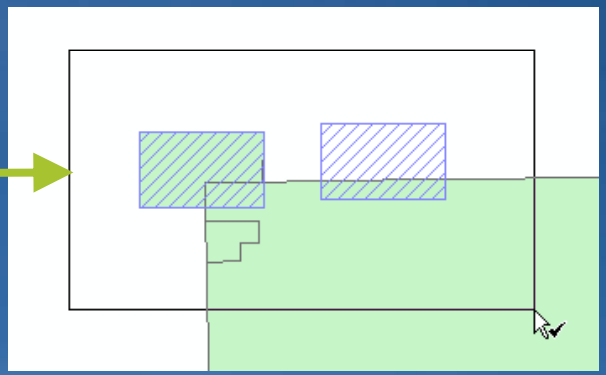


Validating a topology

- Checks dirty areas for errors
- Snaps coordinates using cluster tolerance and ranks
- ArcCatalog Validates entire topology
  - Cannot undo
- ArcMap has additional options
  - Can undo
- No new features are created



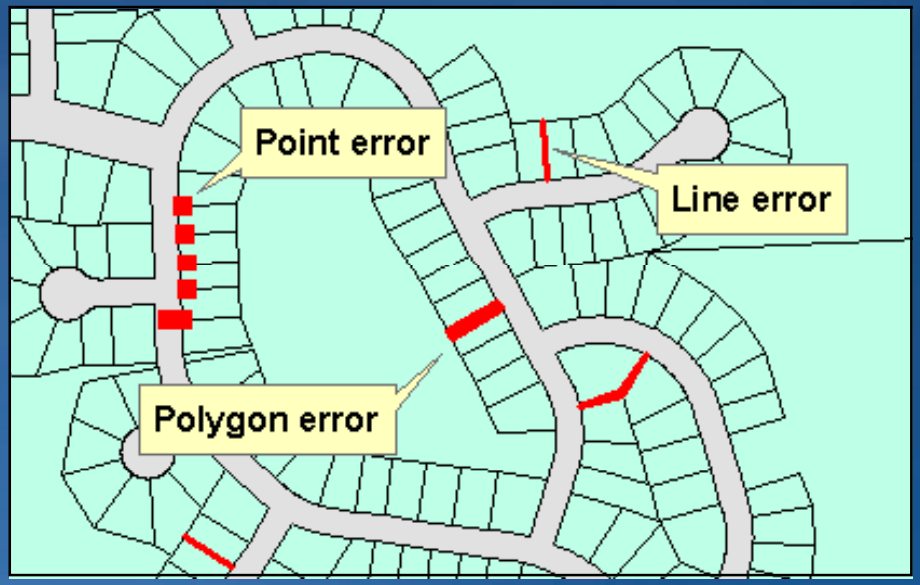
Validating in ArcMap



Validating in ArcCatalog

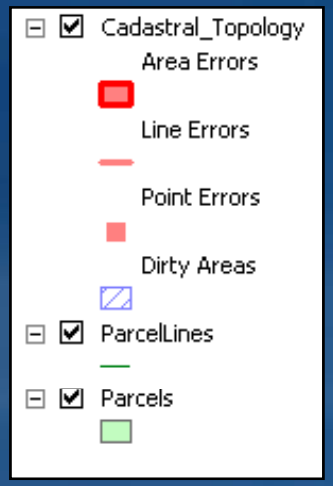
Topology errors

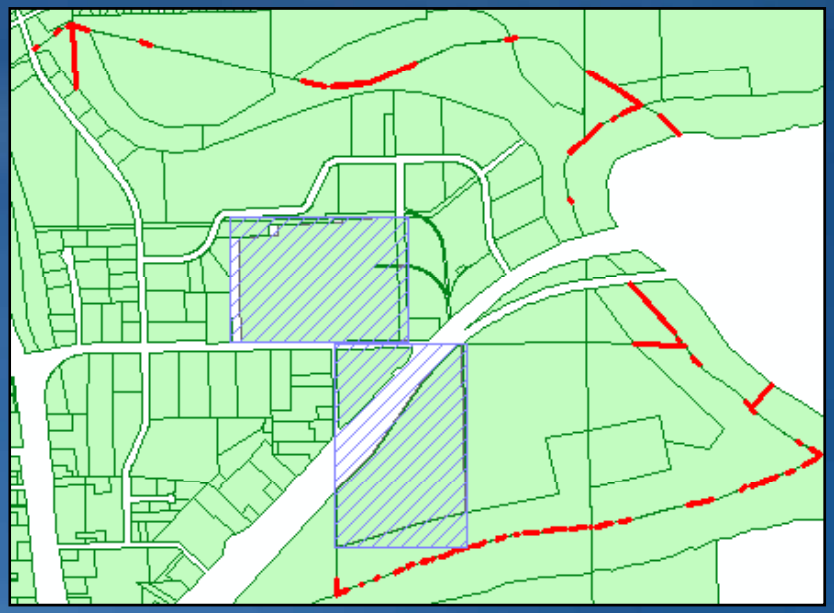
- Found during validation
  - Rule violations: Dangles, overlaps, etc.
  - If there are no rules, there can be no errors
- Stored in topology as specialized geometries
  - Use to locate errors in ArcMap
- Error properties
  - Which rule was violated?
  - Which features caused the error?
  - Where is the error **located?**



Displaying in ArcMap

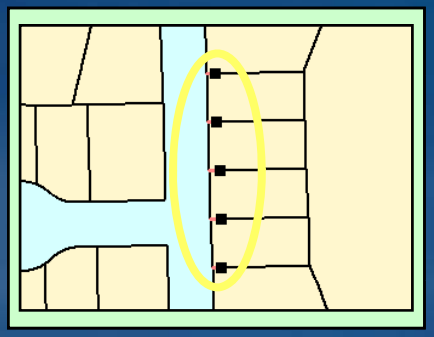
- Topology error symbology
  - Red is default, can change
- Dirty areas
  - Not shown by default
- Draw participating feature classes
  - Required for feature editing
- Display exceptions
  - Area, line, point

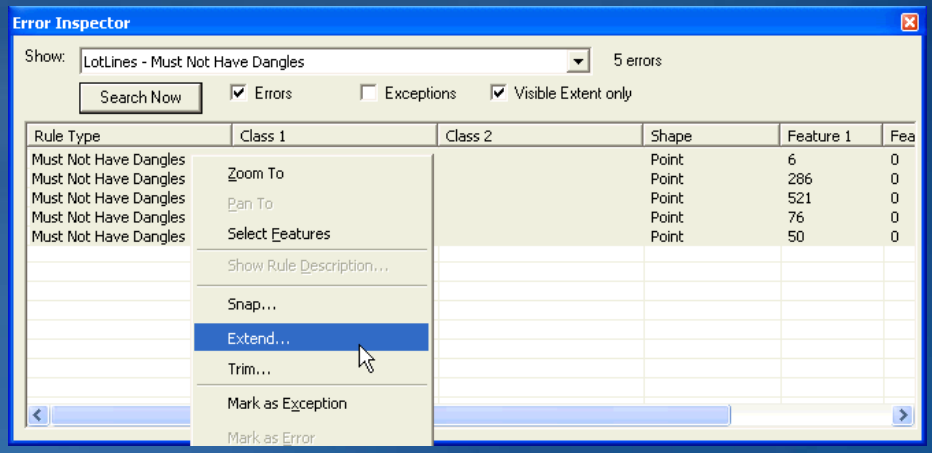




Fixing topology errors

- Editing features that break rules
- Error Inspector
  - Search for errors of a certain rule
  - Search in current or full extent
  - Apply fix to multiple features
  - List of common fixes available
- Fix Topology Error tool
  - Interactive error fixing
  - No search capability
  - List of common fixes available

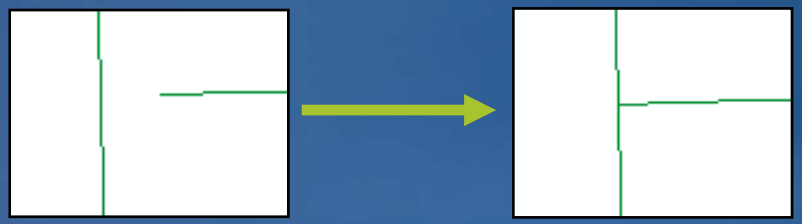




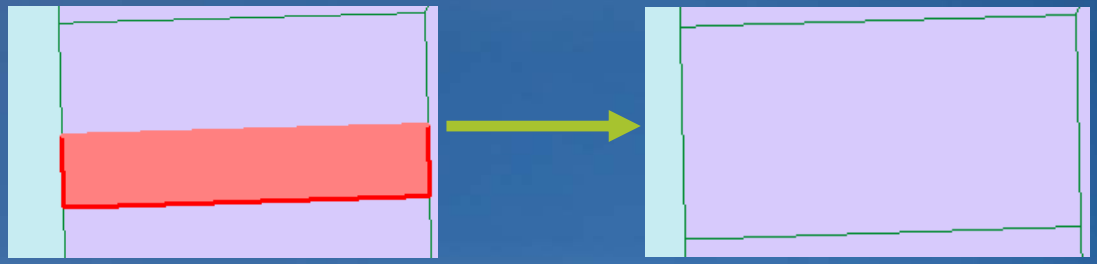
Common error fixes

- Trim: removes portion of line

- Extend: Adds segment to undershoot

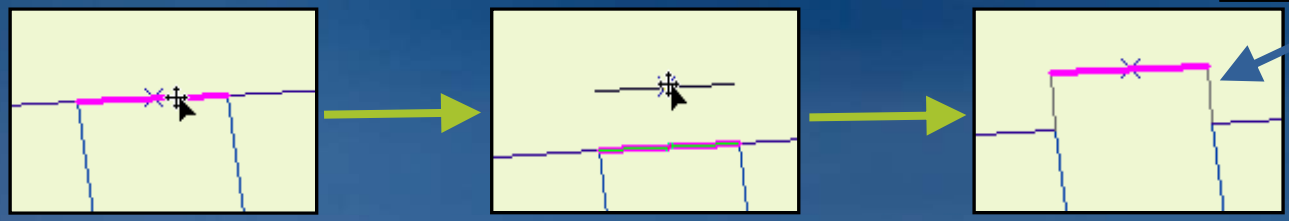


- Merge: Combines multiple features into one



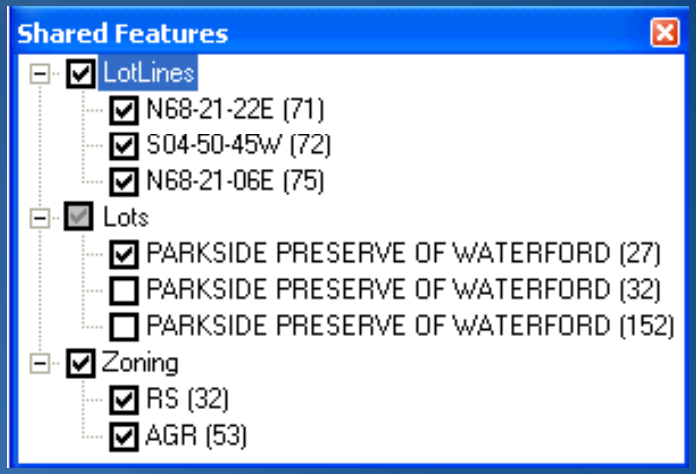
Editing coincident geometry

- Topology Edit tool



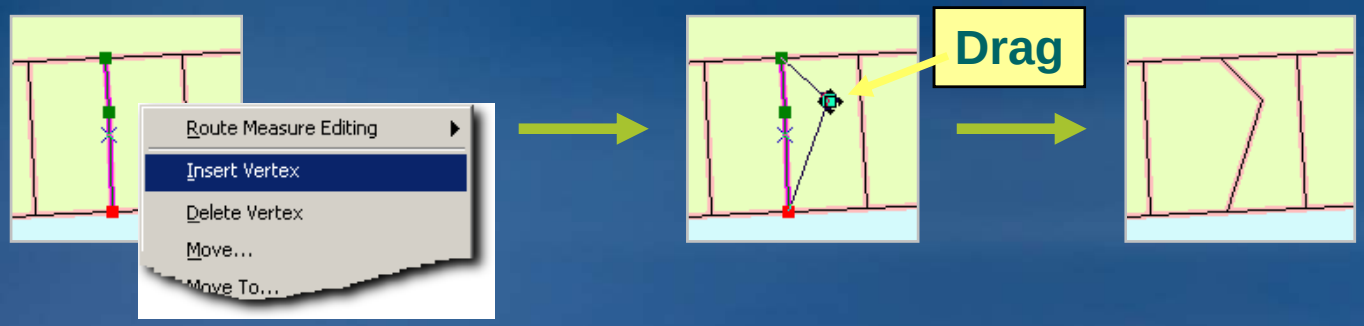
  - Selects and modifies edges and nodes
  - Press E to select only edges, N to select only nodes
- Show Shared Features tool
  - Pulls coincident geometries apart

Uncheck layers so they are not modified with the coincident geometry

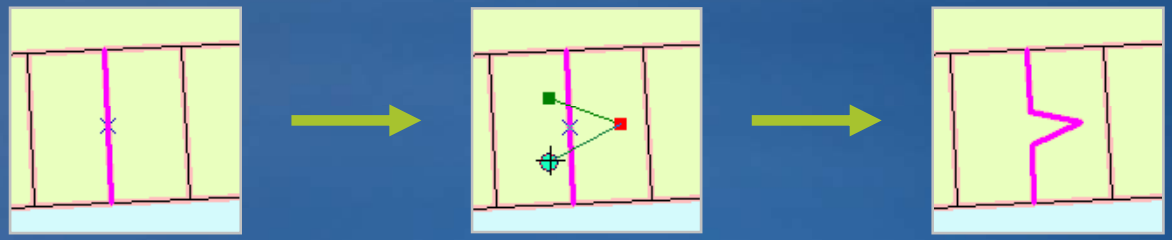


Using topology edit tasks

- Modify edge with Topology Edit tool
  - Vertex modification



- Reshape edge with Sketch tool
  - Use sketch to modify coincident geometry

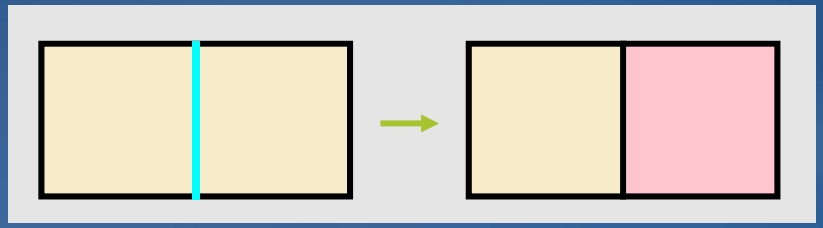


Select edge with Topology Edit tool

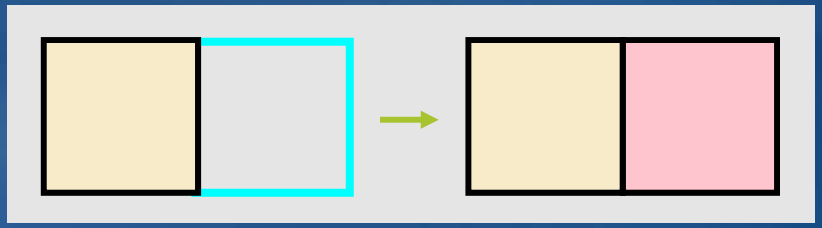
Add new line with Sketch tool

Creating polygons from lines in ArcMap

- ArcMap: Construct Features tool
  - Use selected lines to make polygons in target polygon layer
  - Considers existing polygons
  - Example: Create parcels from COGO lines



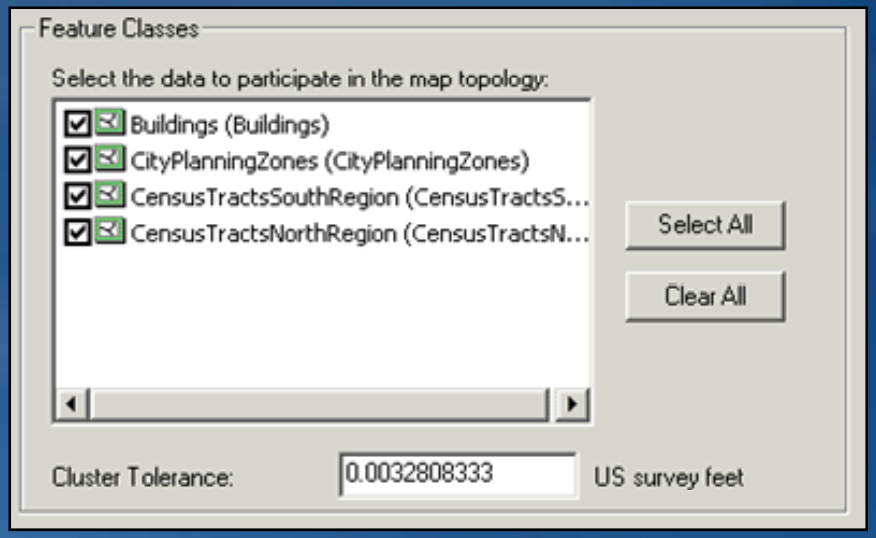
New line splits polygons



New lines add polygon

Topology for ArcView users - Map topology

- Topology available with an ArcView license
- Stored in map document (*.mxd)
- Temporary topology between shapefiles and feature classes
- No validation, no error checking
- Coincident boundary editing
- For data not in a geodatabase topology



Topology at the UC

Technical Workshop: Topology in the Geodatabase

Tues., July 14, 1:30 PM – 2:45 PM (Upper Level – Room 6C)
Thurs., July 16, 8:30 AM – 9:45 AM (Upper Level – Room 6C)

Technical Workshop: Geodatabase 9.4 Plans

Wed., July 15, 10:15 AM – 11:30 AM (Upper Level – Room 6B)
Thurs., July 16, 3:15 PM – 4:30 PM (Upper Level – Room 6B)

Demo Theater: Showcase Software Island – Geodatabase Management

Tues., July 14, 9 AM – 6 PM (Exhibit Hall C/D)
Wed., July 15, 9 AM – 6 PM (Exhibit Hall C/D)
Thurs., July 16, 9 AM – 6 PM (Exhibit Hall C/D)

Get a free 45-minute hands-on lesson
At the
Hands-On Learning Center

Topics include:

- **Introduction to ArcGIS Desktop**
- **Creating a Map In ArcGIS**
- **Basics of the Geodatabase Model**
- **and more**

Location: **ESRI Showcase**

GIS Training and Education Survey
http://www.esri.com/training

- **Brief online survey to get your feedback**
  - **All survey takers get a free one-module Web course**
- **Helps us develop training products that:**
  - **Support your workflows**
  - **Cover the ESRI products you use**
  - **Focus on most common GIS tasks and roles**
- **Survey available at:**
  - **ESRI Showcase: Training and Education Island**
  - **ESRI Training Web site (until July 20th)**

Questions?

Thank you!

Exercise

- EXERCISE 1A:
  - Explore coincident geometry
  - Create a geodatabase topology
  - Explore geodatabase topology in ArcMap
- EXERCISE 1B:
  - Create a new geodatabase topology
  - Identify and fix errors
  - Validate your topology

Thank you!