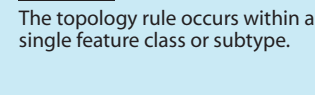# ArcGIS® Geodatabase Topology Rules

Topology in Esri® ArcGIS® allows you to model spatial relationships between feature classes in a feature dataset. Topology rules allow you to define those relationships between features in a single feature class or subtype or between two feature classes or subtypes. Topology rules allow you to define the spatial relationships that meet the needs of your data model. Topology errors are violations of the rules that you can easily find and manage using the editing tools found in ArcMap™.

How to read these diagrams:

The topology rule occurs within a single feature class or subtype.
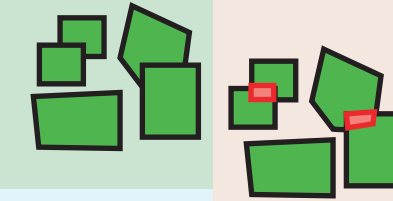
The topology rule occurs between two different feature classes or subtypes.

Topology rule name

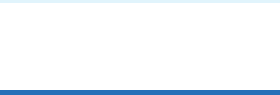Description and example of a valid case of the specified topology rule.

Description and example of a case of the specified topology rule where errors exist and will be returned. For each example, the error shape is shown in bright red.

Generalized description of when to use this rule.

Description of a real-world application of the specified topology rule.

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Polygon — Must not overlap

Polygons must not overlap within a feature class or subtype. Polygons can be disconnected or touch at a point or touch along an edge.

Polygon errors are created from areas where polygons overlap.

Use this rule to make sure that no polygon overlaps another polygon in the same feature class or subtype.

A voting district map cannot have any overlaps in its coverage.

Polygon — Must not have gaps

Polygons must not have a void between them within a feature class or subtype.

Line errors are created from the outlines of void areas in a single polygon or between polygons. Polygon boundaries that are not coincident with other polygon boundaries are errors.

Use this rule when all of your polygons should form a continuous surface with no voids or gaps.

Soil polygons cannot include gaps or form voids—they must form a continuous fabric.

Line or Polygon — Must be larger than cluster tolerance

Cluster tolerance is the minimum distance between vertices of features. Vertices that fall within the cluster tolerance are defined as coincident and are snapped together.

Any polygon or line feature that would collapse when validating the topology is an error.

This rule is applied to all line and polygon feature classes that participate in the topology.

Soil polygons must be larger than the cluster tolerance.

Line — Must not have pseudo nodes

The end of a line cannot touch the end of only one other line within a feature class or subtype. The end of a line can touch any part of itself.

Point errors are created where the end of a line touches the end of only one other line.

Use this rule to clean up data with inappropriately subdivided lines.

For hydrologic analysis, segments of a river system might be constrained to only have nodes at endpoints or junctions.

Polygon — Contains point

Each polygon of the first feature class or subtype must contain within its boundaries at least one point of the second feature class or subtype.

Polygon errors are created from the polygons that do not contain at least one point. A point on the boundary of a polygon is not contained in that polygon.

Use this rule to make sure that all polygons have at least one point within their boundaries. Overlapping polygons can share a point in that overlapping area.

School district boundaries must contain at least one school.

Polygon — Contains one point

Each polygon must contain exactly one point. Each point must fall within a polygon.

Polygon errors are created from the polygons that do not contain exactly one point. Point errors exist where points are not within a single polygon.

Use this rule to make sure that there is a one-to-one correspondence between features of a polygon feature class and a point feature class.

Parcels must contain exactly one address point.

Line — Must not have dangles

The end of a line must touch any part of one other line or any part of a feature class or subtype.

Point errors are created at the end of a line that does not touch at least one other line or itself.

Use this rule when you want lines in a feature class or subtype to connect to one another.

A street network has line segments that connect. If segments end for dead-end roads or cul-de-sacs, you could choose to set as exceptions during an edit session.

Line — Must not self-overlap

Lines must not overlap themselves within a feature class or subtype. Lines can touch, intersect, and overlap in another feature class or subtype.

Line errors are created where lines overlap themselves.

Use this rule with lines whose segments should never occupy the same space as another segment on the same line.

For transportation analysis, street and highway segments of the same feature should not overlap themselves.

Polygon — Must be covered by feature class of

The polygons in the first feature class or subtype must be covered by the polygons of the second feature class or subtype.

Polygon errors are created from the uncovered areas of the polygons in the first feature class or subtype.

Use this rule when each polygon in one feature class or subtype should be covered by all the polygons of another feature class or subtype.

States are covered by counties.

Polygon — Boundary must be covered by

Polygon boundaries in the first feature class or subtype must be covered by the lines of another feature class or subtype.

Line errors are created where polygon boundaries are not covered by a line of another feature class or subtype.

Use this rule when polygon boundaries should be coincident with another line feature class or subtype.

Major road lines form part of outlines for census blocks.

Line — Must not overlap

Lines must not overlap any part of another line within a feature class or subtype. Lines can touch, intersect, and overlap themselves.

Line errors are created where lines overlap.

Use this rule with lines that should never occupy the same space with other lines.

Lot lines cannot overlap one another.

Line — Must not self-intersect

Lines must not cross or overlap themselves within a feature class or subtype. Lines can touch themselves and touch, intersect, and overlap other lines.

Line errors are created where lines overlap themselves, and point errors are created where lines cross themselves.

Use this rule when you only want lines to touch at their ends without intersecting or overlapping themselves.

Contour lines cannot intersect themselves.

Polygon — Must not overlap with

Polygons of the first feature class or subtype must not overlap polygons of the second feature class or subtype.

Polygon errors are created where polygons from the two feature classes or subtypes overlap.

Use this rule when polygons from one feature class or subtype should not overlap polygons of another feature class or subtype.

Lakes and land parcels from two different feature classes must not overlap.

Polygon — Must be covered by

Polygons in one feature class or subtype must be covered by a single polygon from another feature class or subtype.

Polygon errors are created from polygons from the first feature class or subtype that are not covered by a single polygon from the second feature class or subtype.

Use this rule when you want one set of polygons to be covered by some part of another single polygon in another feature class or subtype.

Counties must be covered by states.

Line — Must not intersect

Lines must not cross or overlap any part of another line within the same feature class or subtype.

Line errors are created where lines overlap, and point errors are created where lines cross.

Use this rule with lines whose segments should never cross or occupy the same space with other lines.

Lot lines cannot intersect or overlap, and line errors at the end of one feature can touch the interior of another feature.

Line — Must be single part

Lines within a feature class or subtype must only have one part.

Multipart line errors are created where lines have more than one part.

Use this rule when you want lines to be composed of a single series of connected segments.

A highway system is made up of individual features where any one feature is not made up of more than one part.

Polygon — Area boundary must be covered by boundary of

The boundaries of polygons in one feature class or subtype must be covered by the boundaries of polygons in another feature class or subtype.

Line errors are created where polygon boundaries in the first feature class or subtype are not covered by the boundaries of polygons in another feature class or subtype.

Use this rule when the boundaries of polygons in one feature class or subtype should align with the boundaries of polygons in another feature class or subtype.

Subdivision boundaries are coincident with parcel boundaries, but do not cover all parcels.

Polygon — Must cover each other

All polygons in the first feature class and all polygons in the second feature class must cover each other.
- FC1 Must be covered by feature class of FC2.
- FC2 Must be covered by feature class of FC1.

Polygon errors are created where any part of a polygon is not covered by one or more polygons in the other feature class or subtype.

Use this rule when you want the polygons from two feature classes or subtypes to cover the same area.

Vegetation and soils must cover each other.

Line — Must not intersect with

Lines in one feature class or subtype must not cross or overlap any part of a line in another feature class or subtype.

Line errors are created where lines overlap, and point errors are created where lines cross.

Use this rule with lines whose segments should never cross or occupy the same space with lines in another feature class or subtype.

Local roads cannot intersect or overlap major highways and must connect only at ramps.

Line — Must be covered by feature class of

Lines in one feature class or subtype must be covered by the lines in another feature class or subtype.

Line errors are created on the lines in the first feature class that are not covered by the second feature class.

Use this rule when you have multiple groups of lines describing the same geography.

Lines that make up bus routes must be on top of lines in a road network.

Point — Must coincide with

Points in one feature class or subtype must be coincident with points in another feature class or subtype.

Point errors are created where points from the first feature class or subtype are not covered by points from the second feature class or subtype.

Use this rule when points from one feature class or subtype should be aligned with points from another feature class or subtype.

Meters must be coincident with service points in an electric utility network.

Point — Must be disjoint

Points cannot overlap within the same feature class or subtype.

Point errors are created where points overlap themselves.

Use this rule when points within one feature class or subtype should never occupy the same space.

Fittings in a water distribution network should not overlap.

Line — Must not intersect or touch interior

Lines can only touch at their ends and must not overlap each other within a feature class or subtype.

Line errors are created where lines overlap, and point errors are created where lines cross or touch.

Use this rule when you only want lines to touch at their ends and not intersect or overlap.

Lot lines cannot intersect or overlap and must connect to one another at the endpoint of each line feature.

Line — Must be covered by boundary of

Lines in one feature class or subtype must be covered by the boundaries of polygons in another feature class or subtype.

Line errors are created on lines that are not covered by the boundaries of polygons.

Use this rule when you want to model lines that are coincident with the boundaries of polygons.

Polylines used for displaying block and lot boundaries must be covered by parcel boundaries.

Point — Must be covered by endpoint of

Points in one feature class or subtype must be covered by the ends of lines in another feature class or subtype.

Point errors are created on the points that are not covered by the ends of lines.

Use this rule when you want to model points that are coincident with the ends of lines.

Street intersections must be covered by the endpoints of street centerlines.

Point — Point must be covered by line

Points in one feature class or subtype must be covered by lines in another feature class or subtype.

Point errors are created on the points that are not covered by lines.

Use this rule when you want to model points that are coincident with lines.

Monitoring stations must fall along streams.

Line — Must not intersect or touch interior with

Lines in one feature class or subtype can only touch at their ends and must not overlap lines in another feature class or subtype.

Line errors are created where lines overlap, and point errors are created where lines cross or touch.

Use this rule when you only want lines to touch at their ends and not intersect or overlap with lines in another feature class or subtype.

Lot lines cannot intersect or overlap block lines and must connect to one another only at the endpoint of each line feature.

Line — Must be properly inside

Lines in one feature class or subtype must be contained by polygons of another feature class or subtype.

Line errors are created where lines are not within polygons.

Use this rule when you want lines to be contained within the boundaries of polygons.

Streams are within watersheds.

Point — Must be properly inside

Points in one feature class or subtype must be inside polygons of another feature class or subtype.

Point errors are created where the points are outside or touch the boundaries of the polygons.

Use this rule when you want points to be completely within the boundaries of polygons.

State capitals must be inside each state.

Point — Must be covered by boundary of

Points in one feature class or subtype must touch boundaries of polygons from another feature class or subtype.

Point errors are created where points do not touch the boundaries of polygons.

Use this rule when you want points to align with the boundaries of polygons.

Utility service points might be required to be on the boundary of a parcel.

Line — Must not overlap with

Lines in one feature class or subtype must not overlap any part of another line in another feature class or subtype.

Line errors are created where lines overlap any part of another line in another feature classes or subtypes overlap.

Use this rule for lines that should never occupy the same space with lines in another feature class or subtype.

Highways can cross and come close to rivers, but road segments cannot overlap river segments.

Line — Endpoint must be covered by

The ends of lines in one feature class or subtype must be covered by points in another feature class or subtype.

Point errors are created at the ends of lines that are not covered by a point.

Use this rule when you want to model the ends of lines in one feature class or subtype that are coincident with point features in another feature class.

Endpoints of secondary electric lines must be capped by either a transformer or meter.