地理資訊系統概論

Lab 2: Vector Data Model - Topology

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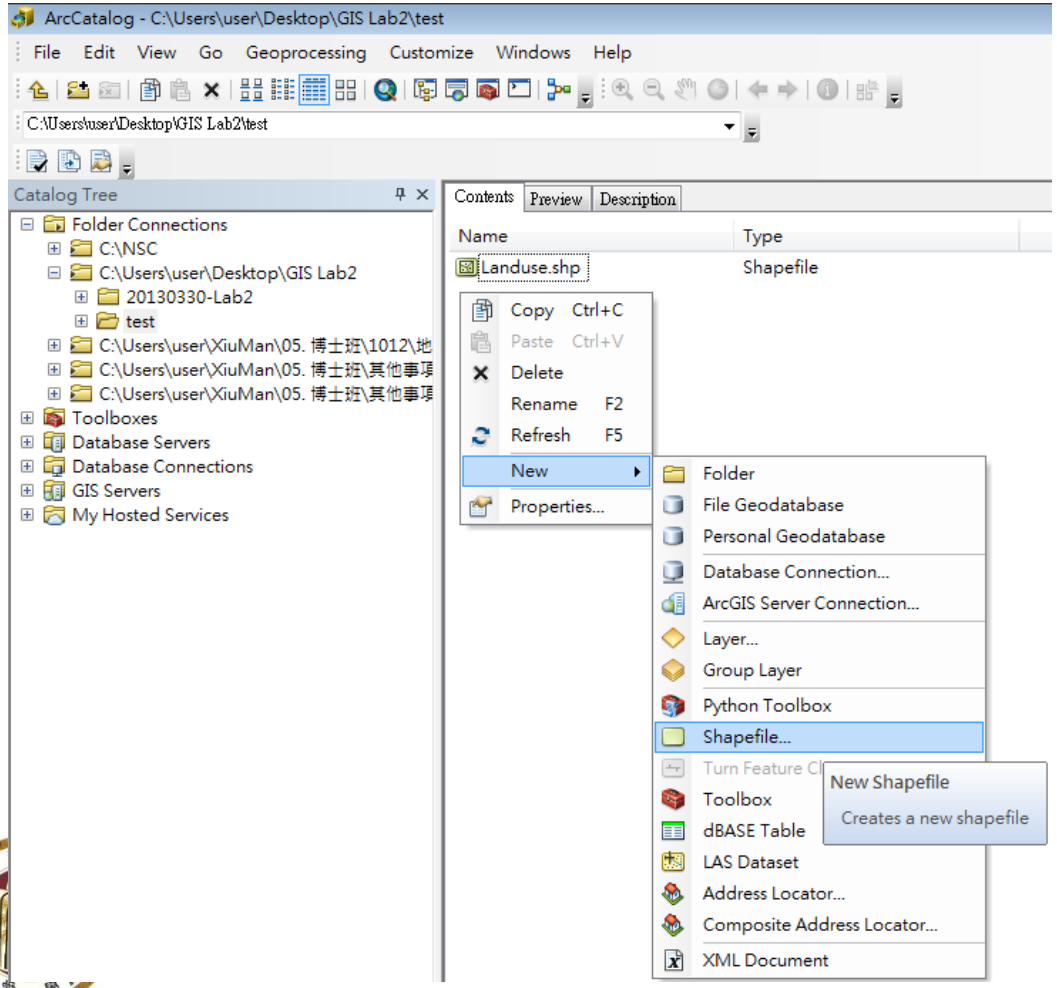
張世光 r03521120@ntu.edu.tw

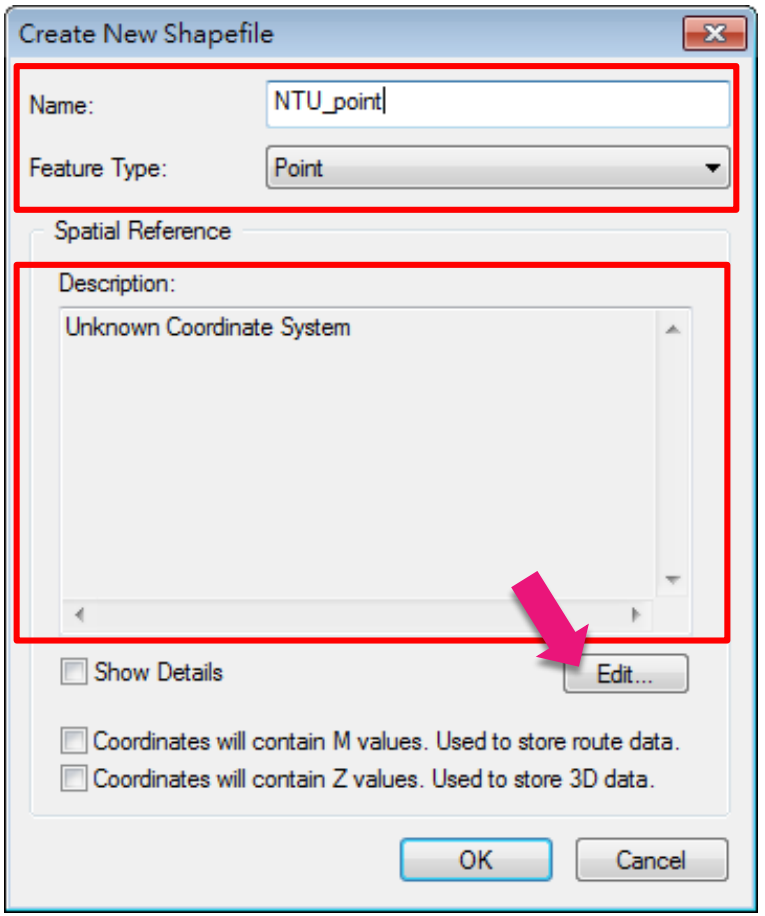
Outline

- 新增Shapefile
- Editor Toolbar與編輯Shapefile
- Geodatabase and Topology Rule
- 操作實習

新增Shapefile

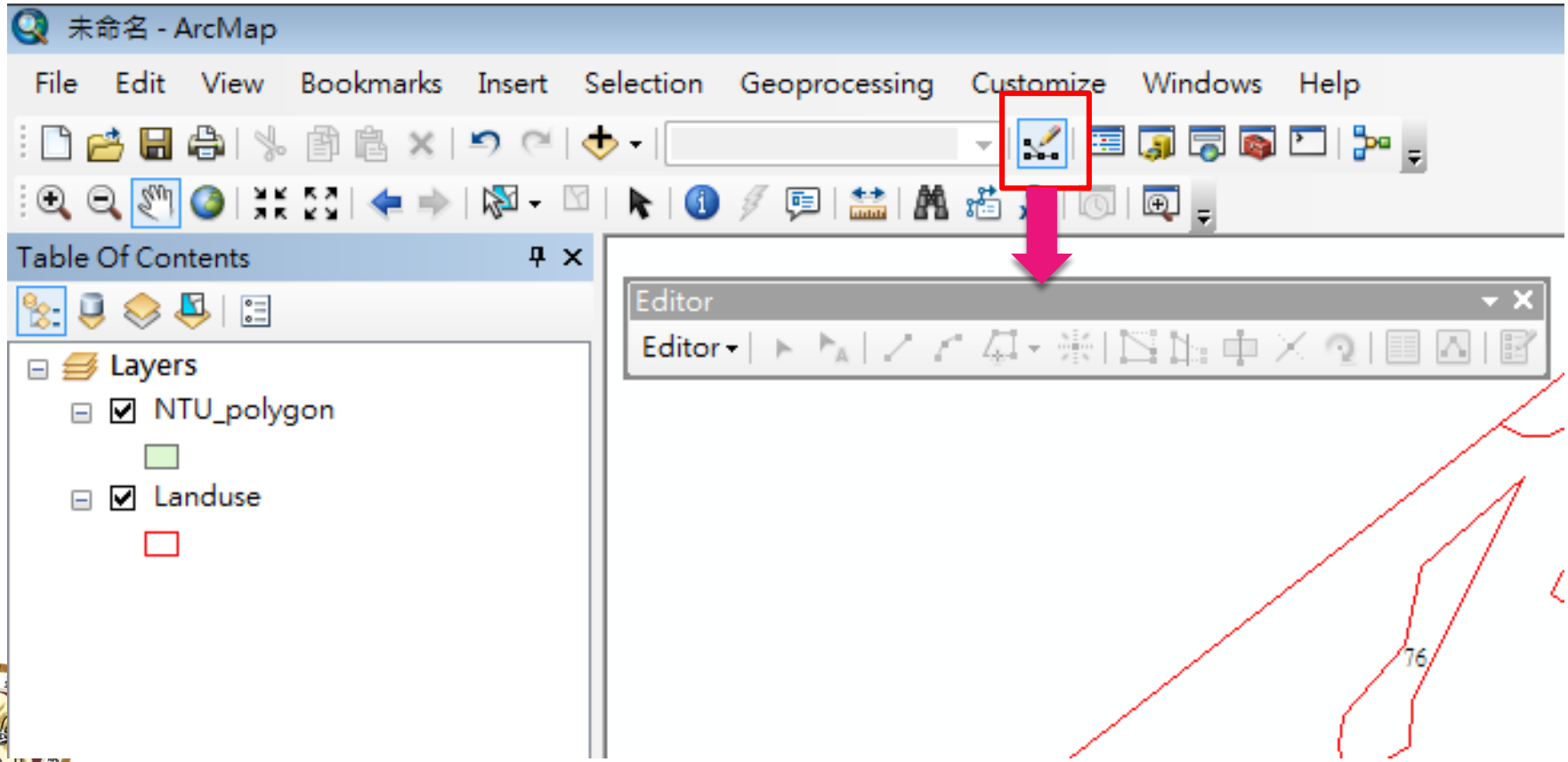
- 新增shapefile並注意坐標系統設定





Editor Toolbar

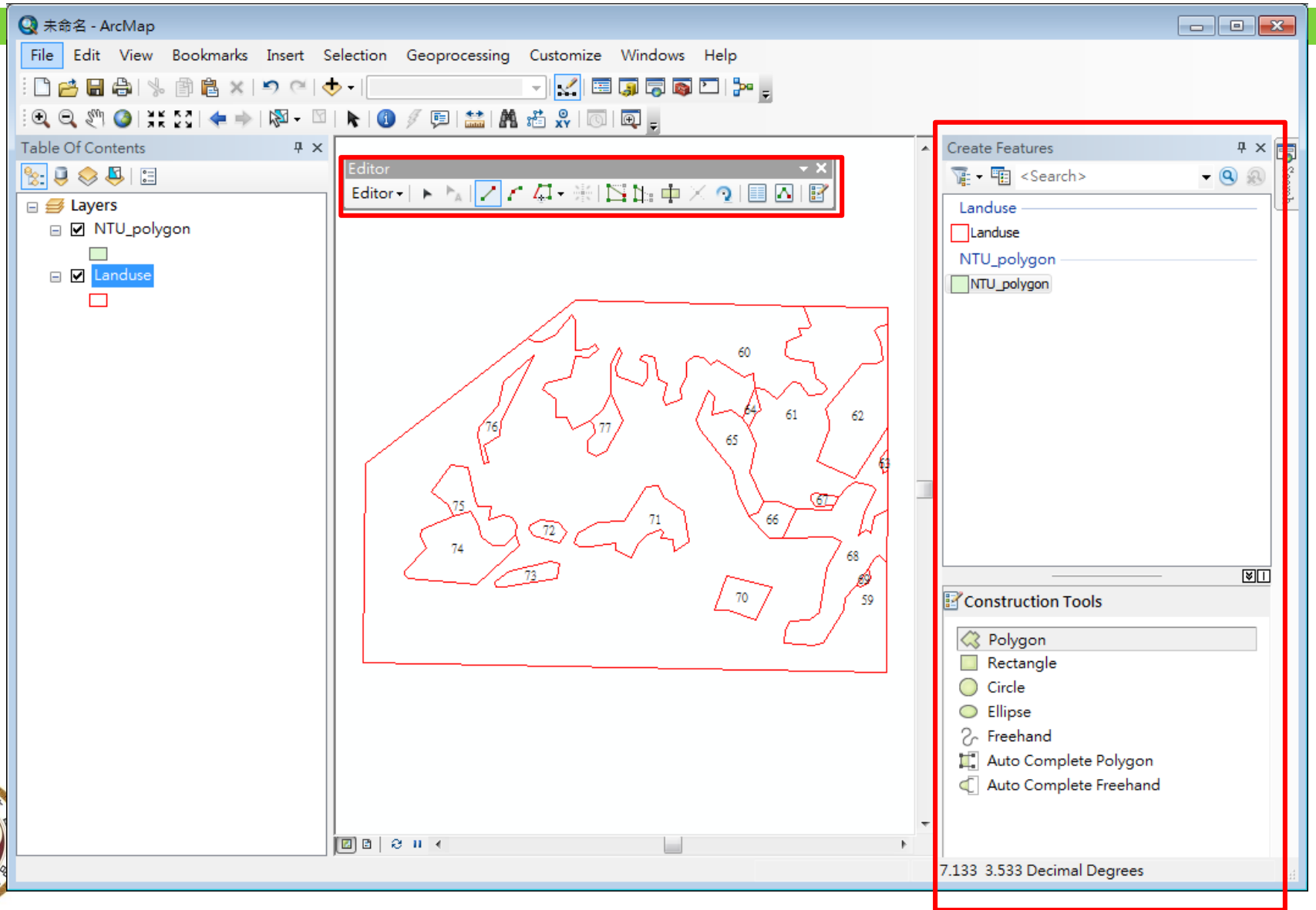
- 開啟editor toolbar
  - 進行向量圖檔數化或編輯



編輯Shapefile

- Start Editing
  - 選擇所要編輯的圖層(檔案)
  - 新增 / 編輯圖徵
  - Construction Tools
  - Snapping (snapping toolbar)
- Save Edits / Stop Editing

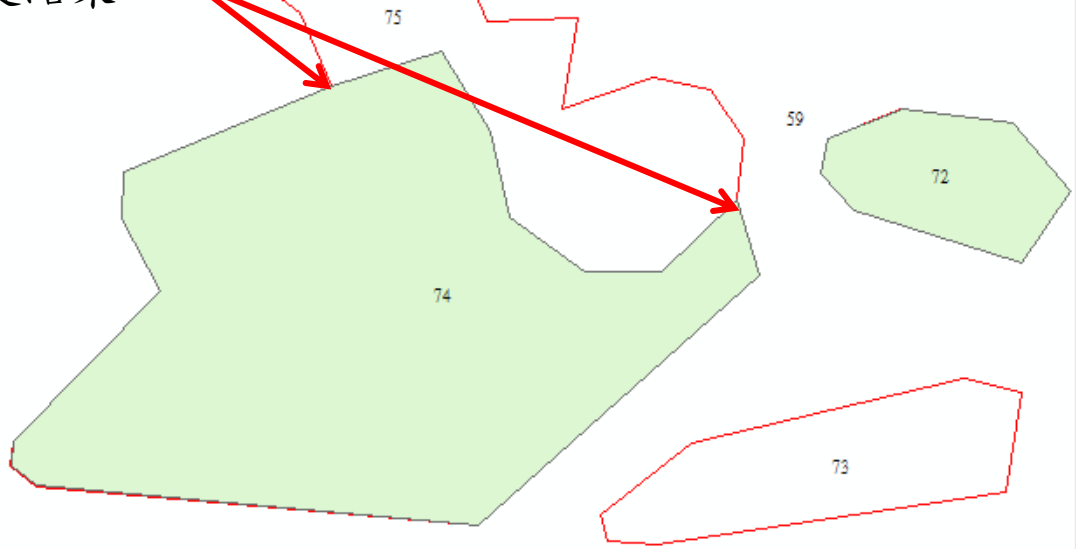
編輯Shapefile

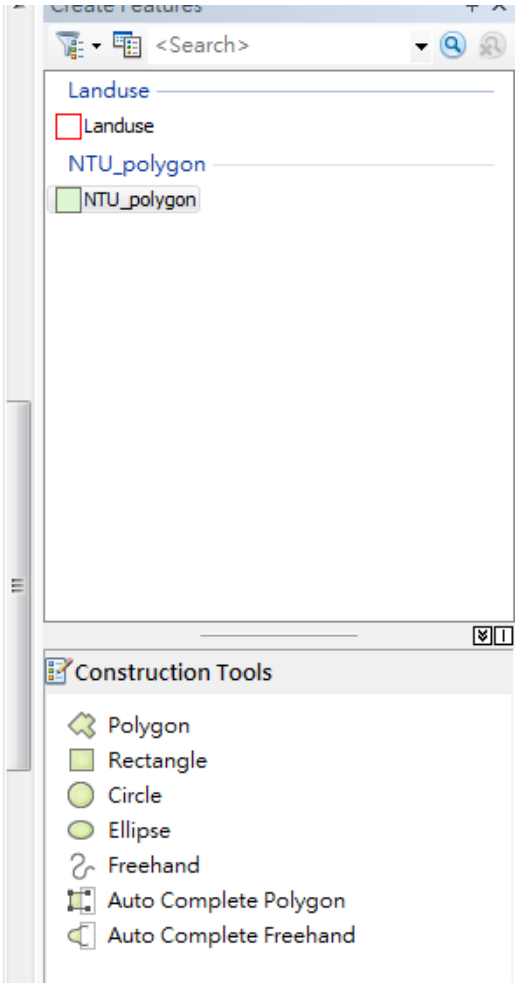


編輯Shapefile

- 相鄰polygon數化 (練習73~76)

為了避免2個polygon的共邊被重複數化，
利用Auto Complete Polygon:
由共邊中的一點開始，至共邊的另一點，
點2下左鍵結束。





Geodatabase and Topology Rule

Geodatabase

- The common data storage and management framework for ArcGIS.
- Combines "geo" (spatial data) with "database" (data repository) to create a central data repository for spatial data storage and management.
- Define advanced geospatial relational models (e.g., topologies, networks).

- Resource: http://www.esri.com/software/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.
  - 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.
    - Resource: http://resources.arcgis.com/en/help/main/10.1/index.html#//01mm0000000m000000

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™.

ArcGIS ESRI

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 shapes shown in bright red.

Generalized description of when to use this rule.

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

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 where polygons overlap.

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

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

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. Void areas are those that are not coincident with other polygon boundaries are errors.

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

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

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.

School district boundaries must contain at least one school.

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.

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 are created where points are not within a single polygon.

Parcels must contain exactly one address point.

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.

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 area of the polygons in the first feature class or subtype.

States are covered by countries.

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.

Boundary must be covered by

Polygon boundaries in one 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.

Major road lines form part of outline for census blocks.

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

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.

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

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

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.

Counties must be covered by states.

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.

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 of polygons in one feature class or subtype are not covered by boundaries of polygons in another feature class or subtype.

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

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.

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 part of a polygon is not covered by polygons in the other feature class or subtype.

Vegetation and soils must cover each other.

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

Point

Must be coincident 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 coincident with points from the second feature class or subtype.

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

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

Must be disjoint

Points cannot overlap within the same feature class or subtype.

Point errors are created where points overlap themselves.

Fittings in a water distribution network should not overlap.

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

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.

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

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

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.

Monitoring stations must fall along streams.

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

Must be properly inside polygons

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

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

Water asphalt must be inside each state.

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

Must be covered by boundary of

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

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

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

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

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 topology is an error.

Soil polygons must be larger than the cluster tolerance.

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

Line

Must not have pseudonodes

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 at the end of a line that touches the end of only one other line.

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

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

Must not have dangles

The end of a line must touch any part of one other line or area or part of itself within 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.

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

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

Must not self overlap

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

Line errors are created where lines overlap themselves.

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

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

Lot lines cannot overlap one another.

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

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.

Contour lines cannot intersect themselves.

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

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.

Lot lines cannot intersect or overlap, but the endpoint of one line can touch the sides or of another feature.

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

Must be single part

Lines within a feature class or subtype must not have more than one part.

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

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

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

Must not intersect with

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

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

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

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

Must be covered by feature class of

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

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

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

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

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.

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

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

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.

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

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

Must not intersect or touch interior with

Lines in one feature class or subtype can only touch at their ends and not cross 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.

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

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.

Must be 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.

Streams are within watersheds.

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

Must not overlap with

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

Line errors are created where lines from two feature classes or subtypes overlap.

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

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

Endpoint must be covered by

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

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

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

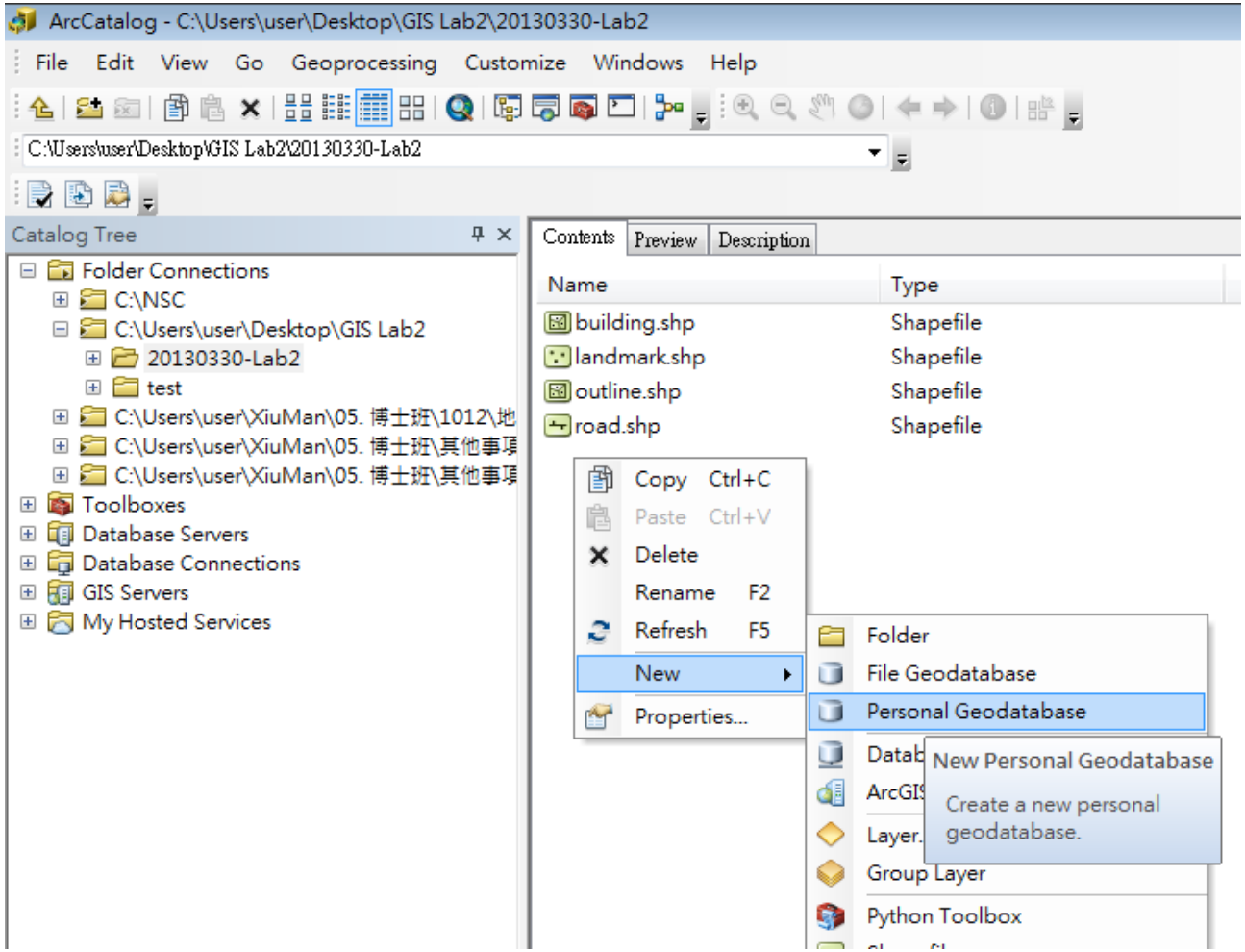
Use this rule when you want to model the ends of lines in one feature class or subtype that are coincident with point features in another feature class.

資料圖層與操作目標

- 資料圖層
  - 地標 – landmark.shp
  - 道路 – road.shp
  - 建築 – building.shp
  - 圖框 – outline.shp
- 操作目標 – 建立topology rule並消除錯誤位相關係
  - 規則
    - 大部分的地標點必須在建物框內，除了少部分的地標，如公園、捷運站或其他特殊地標
    - 道路不能穿越建物，且必須為完整直線(strat 到end)中間不能有pseudo nodes

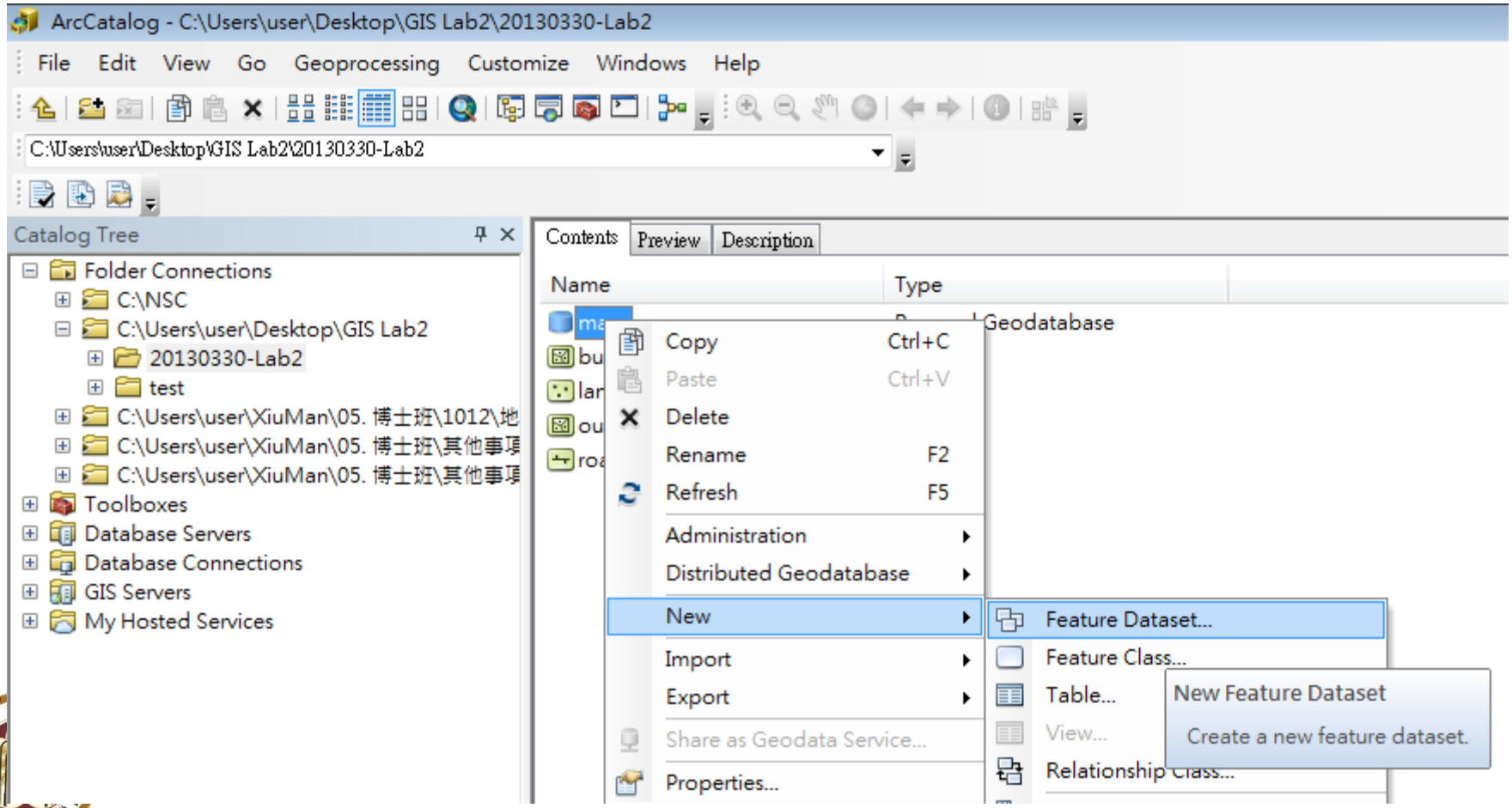
步驟1: 建立Personal Geodatabase

- 在ArcCatalog中, 建立personal geodatabase (如map.mdb)



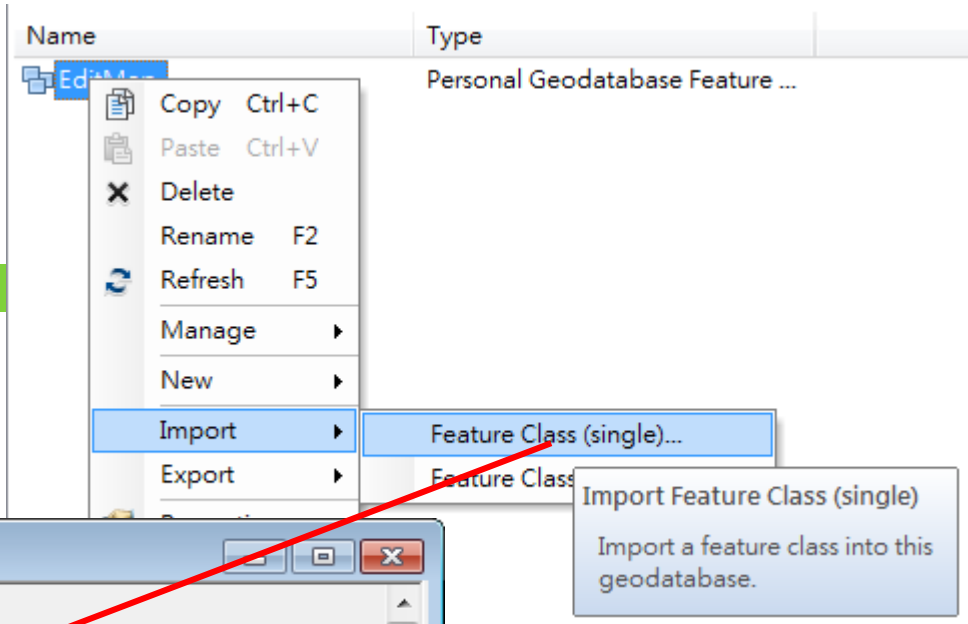
步驟2: 建立Feature Dataset

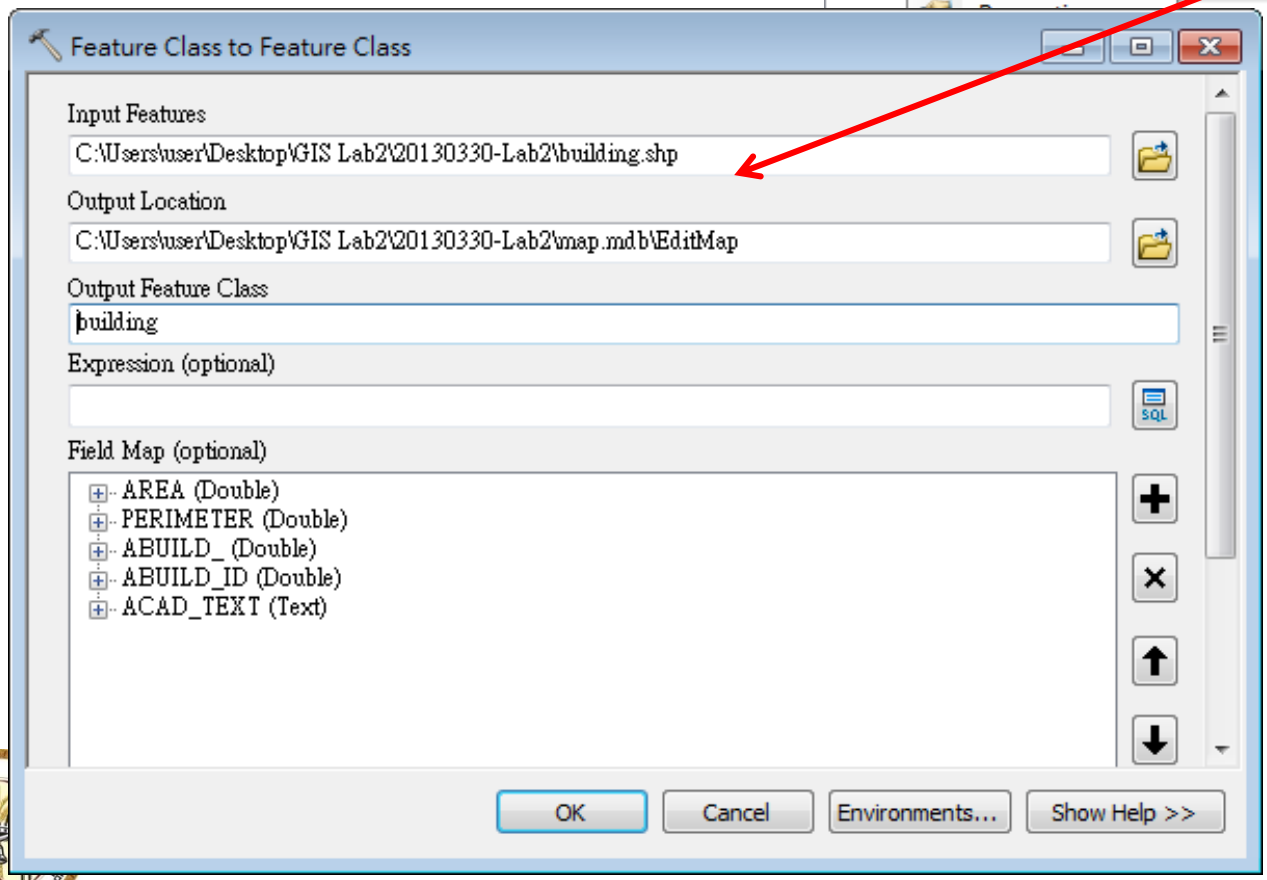
- Name: EditMap
- Project Coordinate System: TWD 97
- Vertical Coordinate system: 可以忽略



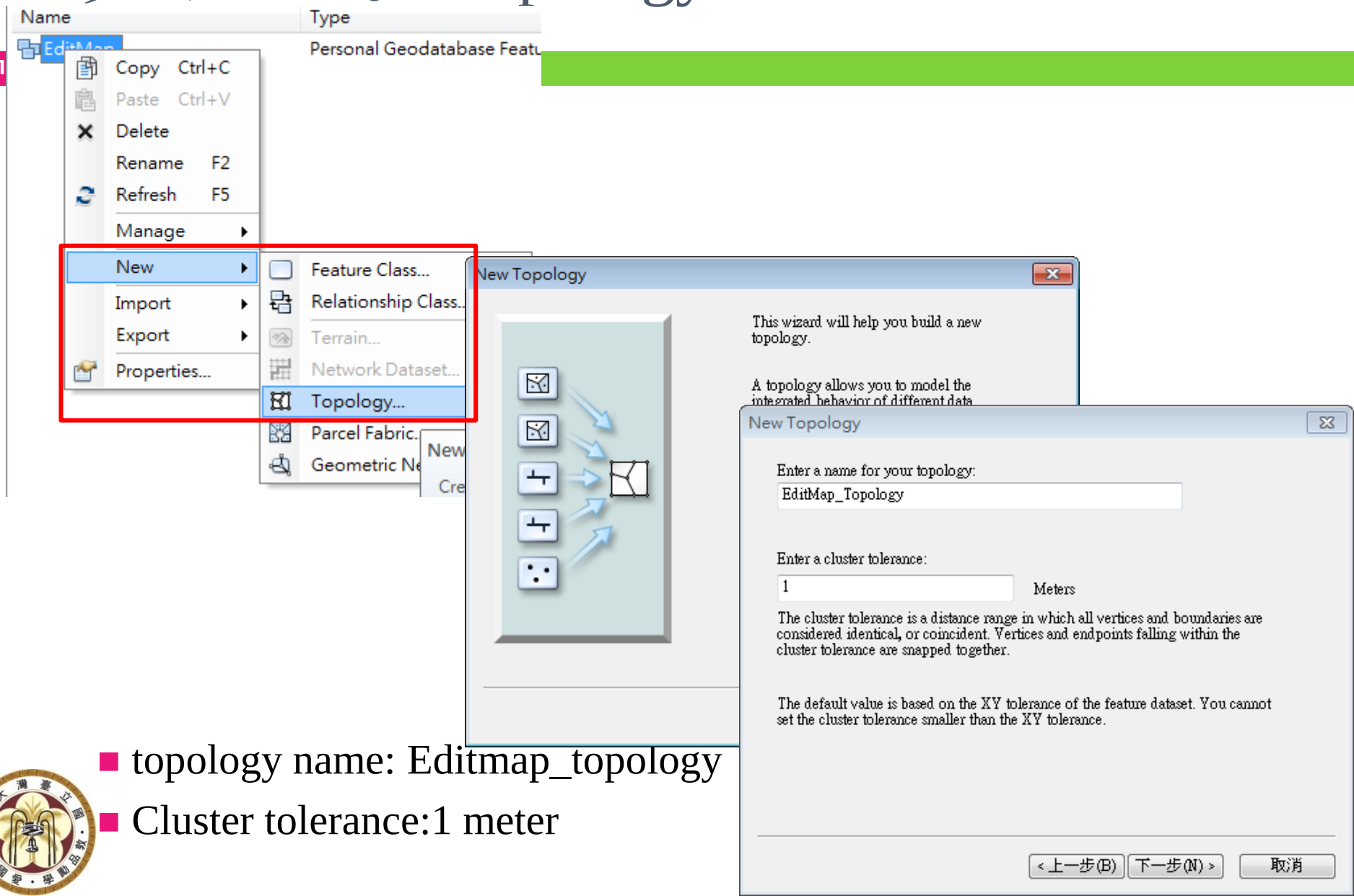
步驟3

- 將所有圖層匯入EditMap





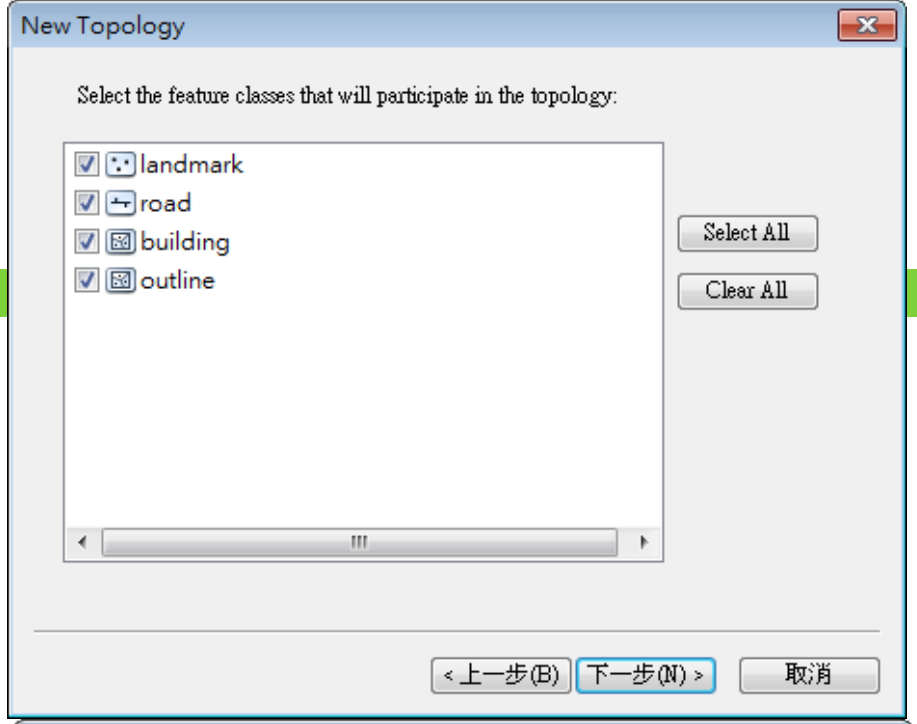
步驟4-1:建立topology rules

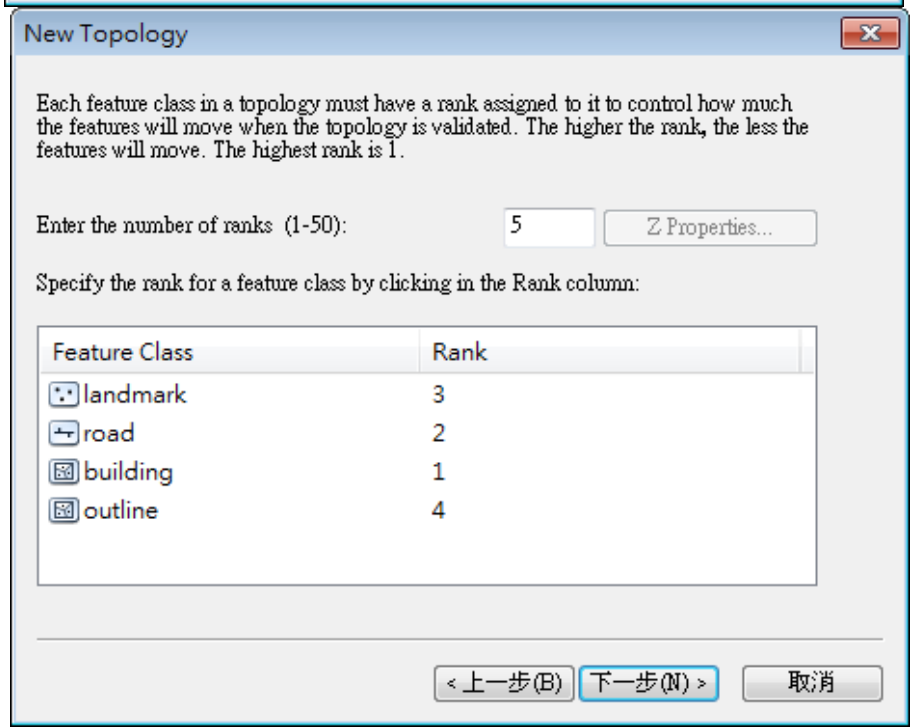


- topology name: Editmap_topology
- Cluster tolerance:1 meter

步驟4-2

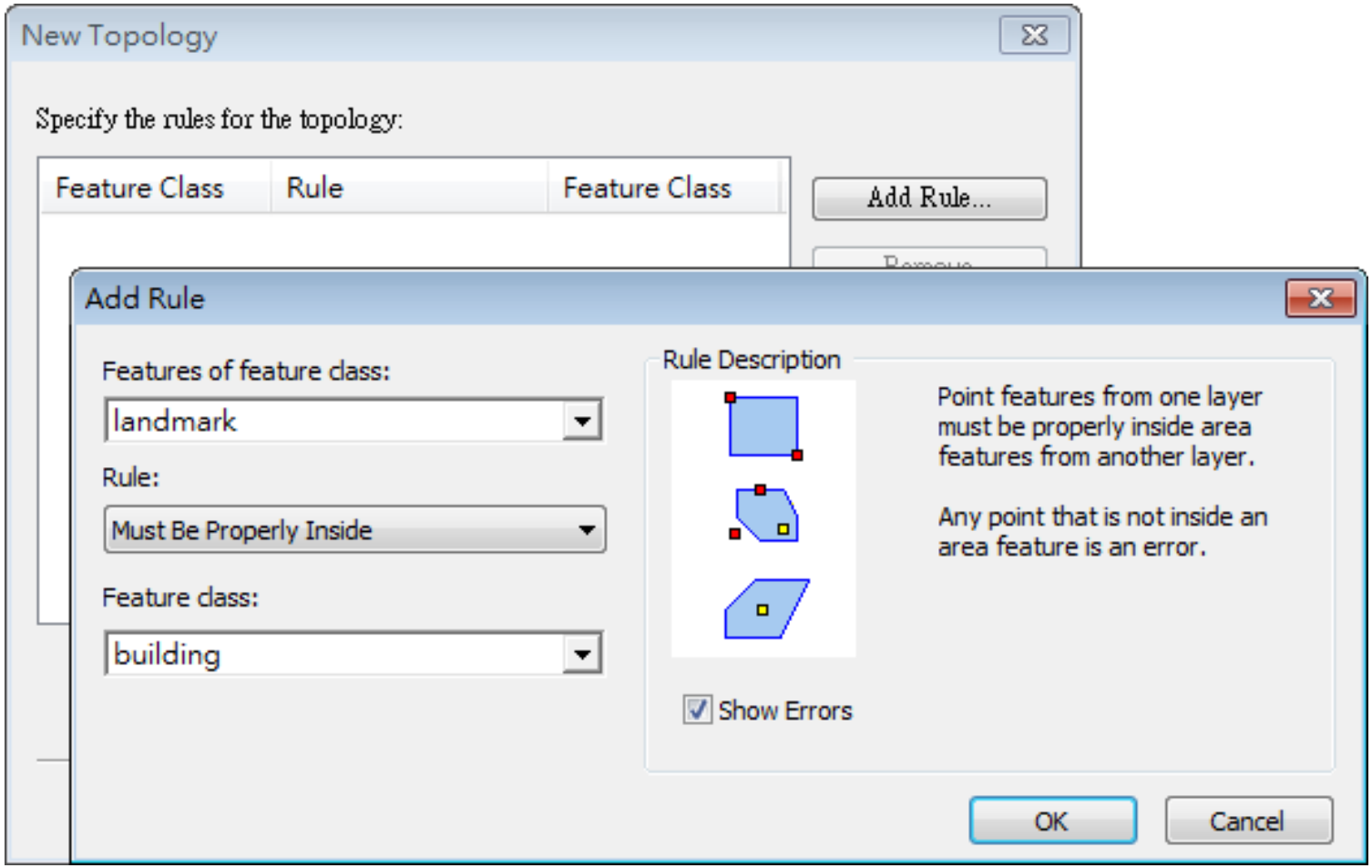
- 選擇要編輯的圖層
- 設定rank
  - building:1
  - road:2
  - landmark:3
  - Outline: 4
  - rank越高(數字越小)，表示越重要，被移動的數量越少





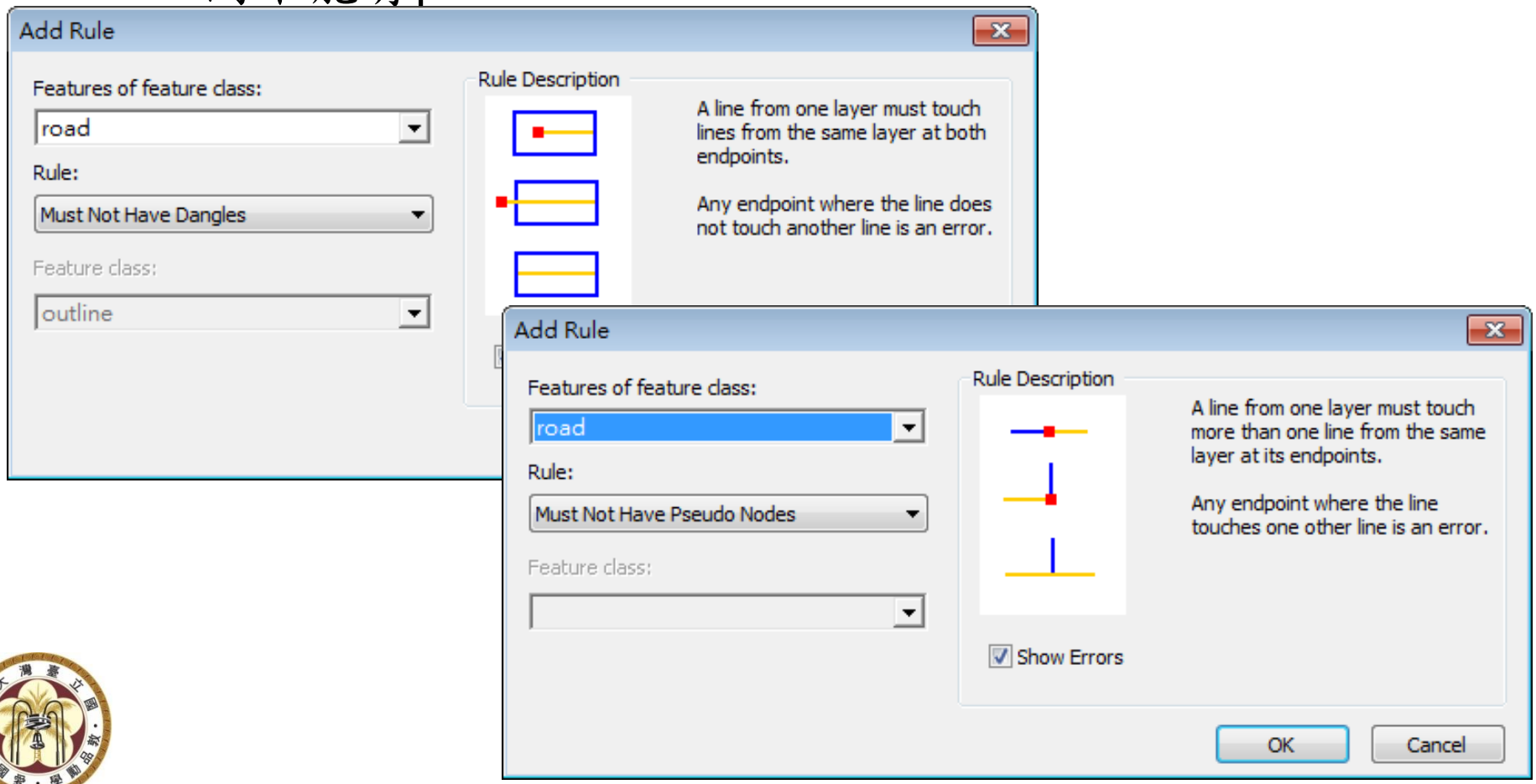
Step4-3:規則1

- 大部分的地標點必須在建物框內



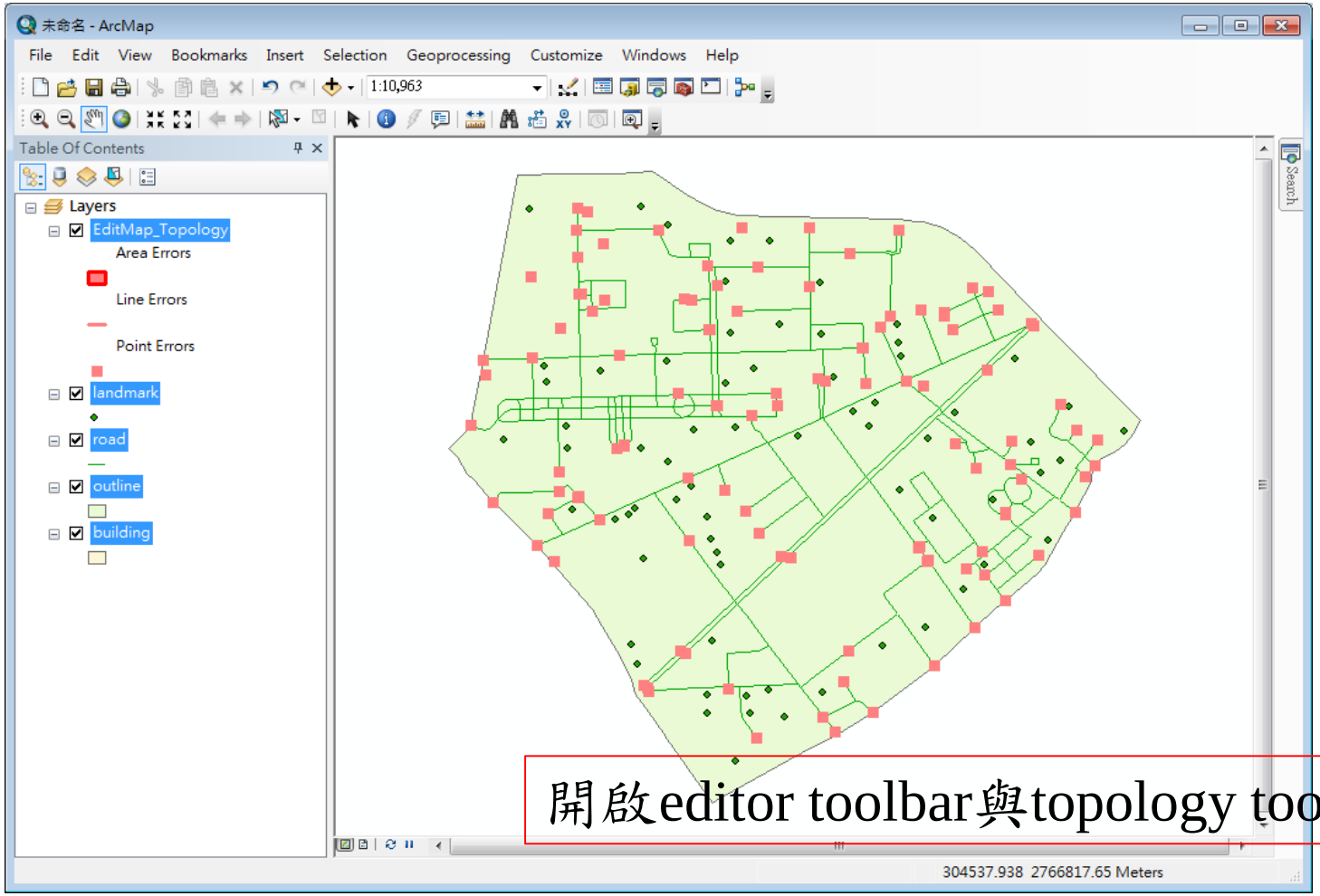
Step4-3:規則2

- 道路不能穿越建物，且必須為完整直線(strat 到end)中間不能有pseudo nodes



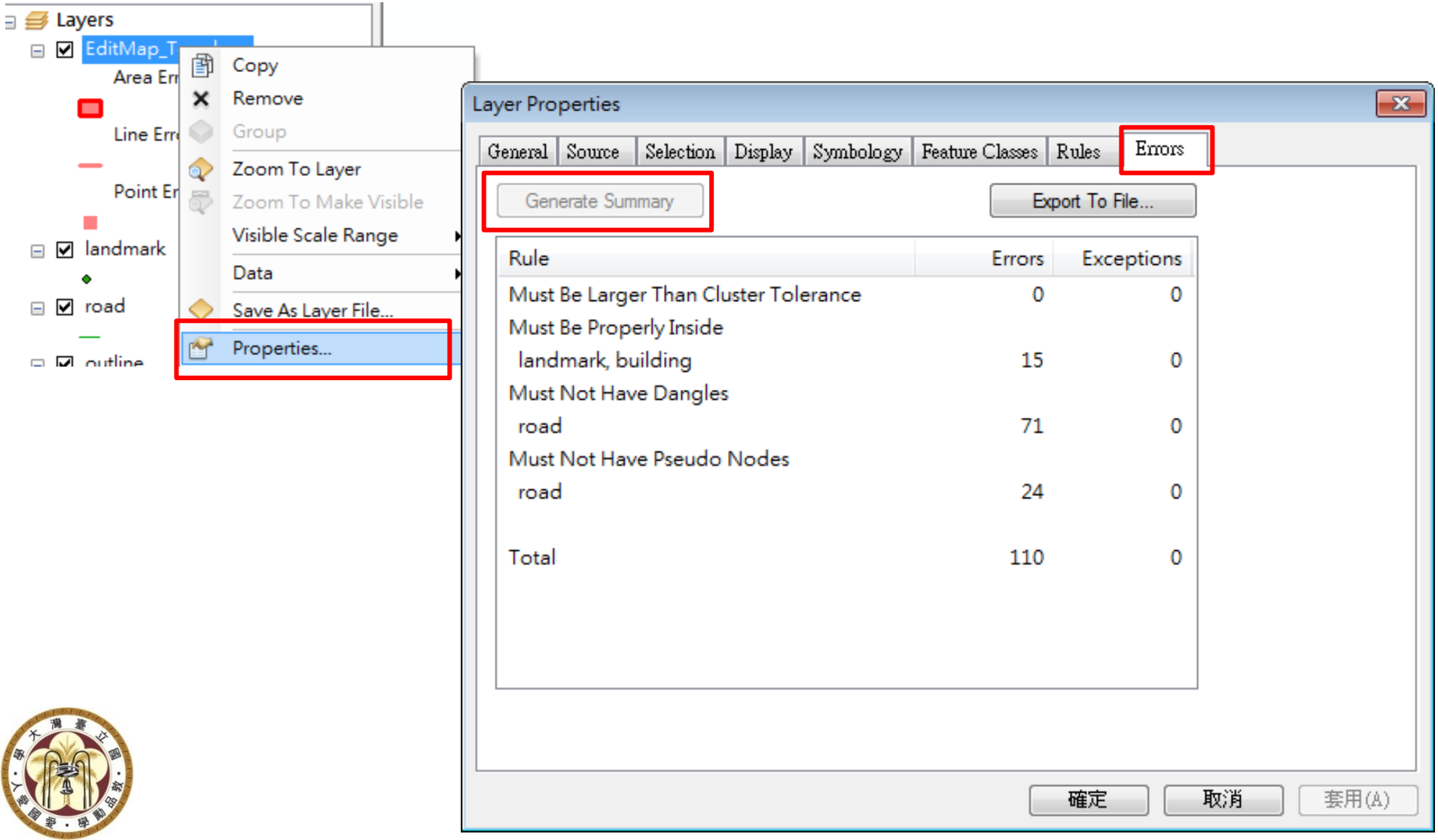
步驟5:在ArcMap中檢查並修正錯誤

- Add data(Editmap_topology)

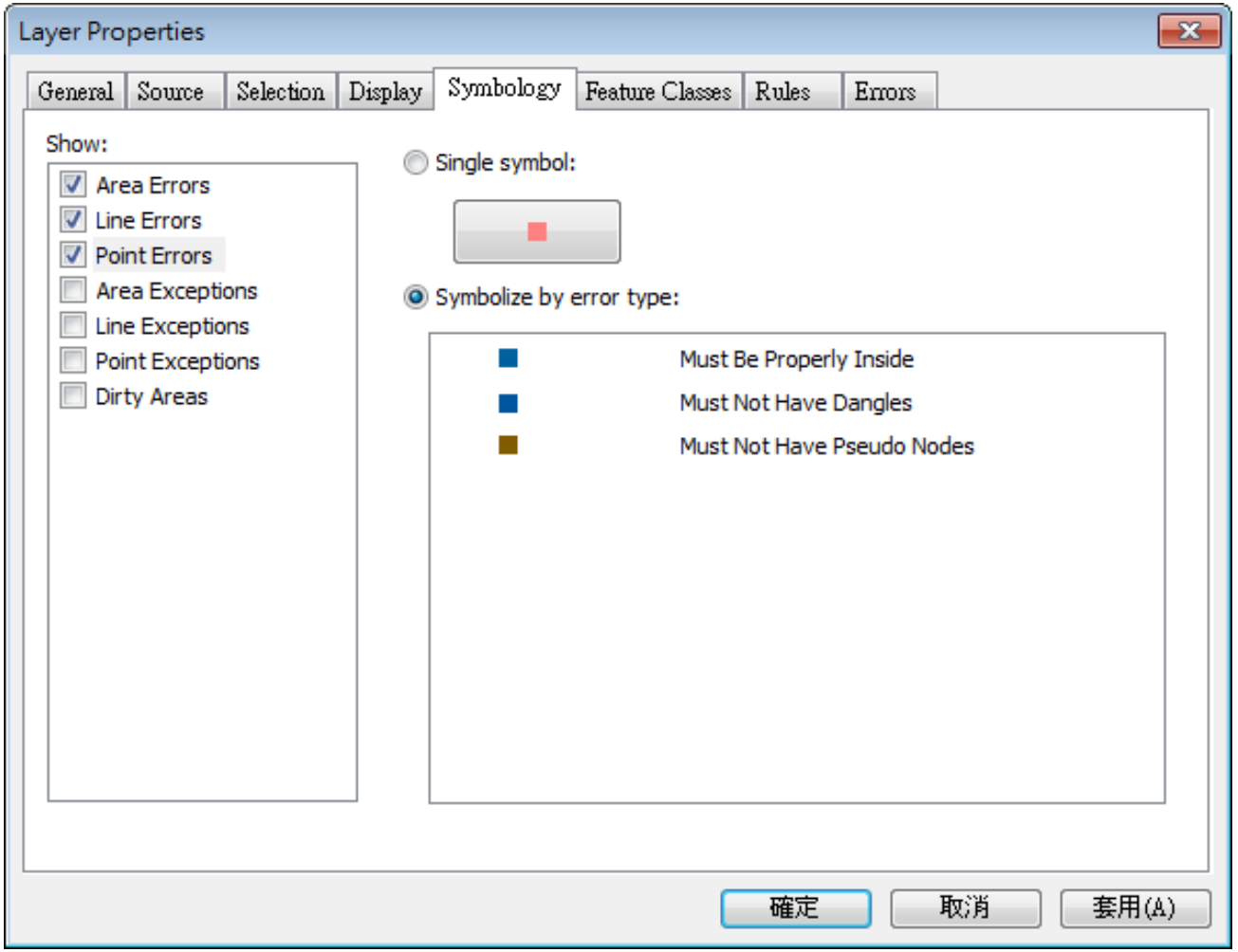


開啟editor toolbar與topology toolbar

步驟6:查看報表


Layers
EditMap_T
Area Err
Line Err
Point Er
landmark
road
outline
Copy
Remove
Group
Zoom To Layer
Zoom To Make Visible
Visible Scale Range
Data
Save As Layer File...
Properties...
Layer Properties
General
Source
Selection
Display
Symbology
Feature Classes
Rules
Errors
Generate Summary
Export To File...
Rule
Errors
Exceptions
Must Be Larger Than Cluster Tolerance 0 0
Must Be Properly Inside
landmark, building 15 0
Must Not Have Dangles
road 71 0
Must Not Have Pseudo Nodes
road 24 0
Total 110 0
確定
取消
套用(A)

步驟7: 調整Symbology以方便查看錯誤



步驟7-1:搜尋錯誤資料所在位置

- 點選  ，並搜尋錯誤

選擇資料列→ 右鍵→ zoom to

Error Inspector

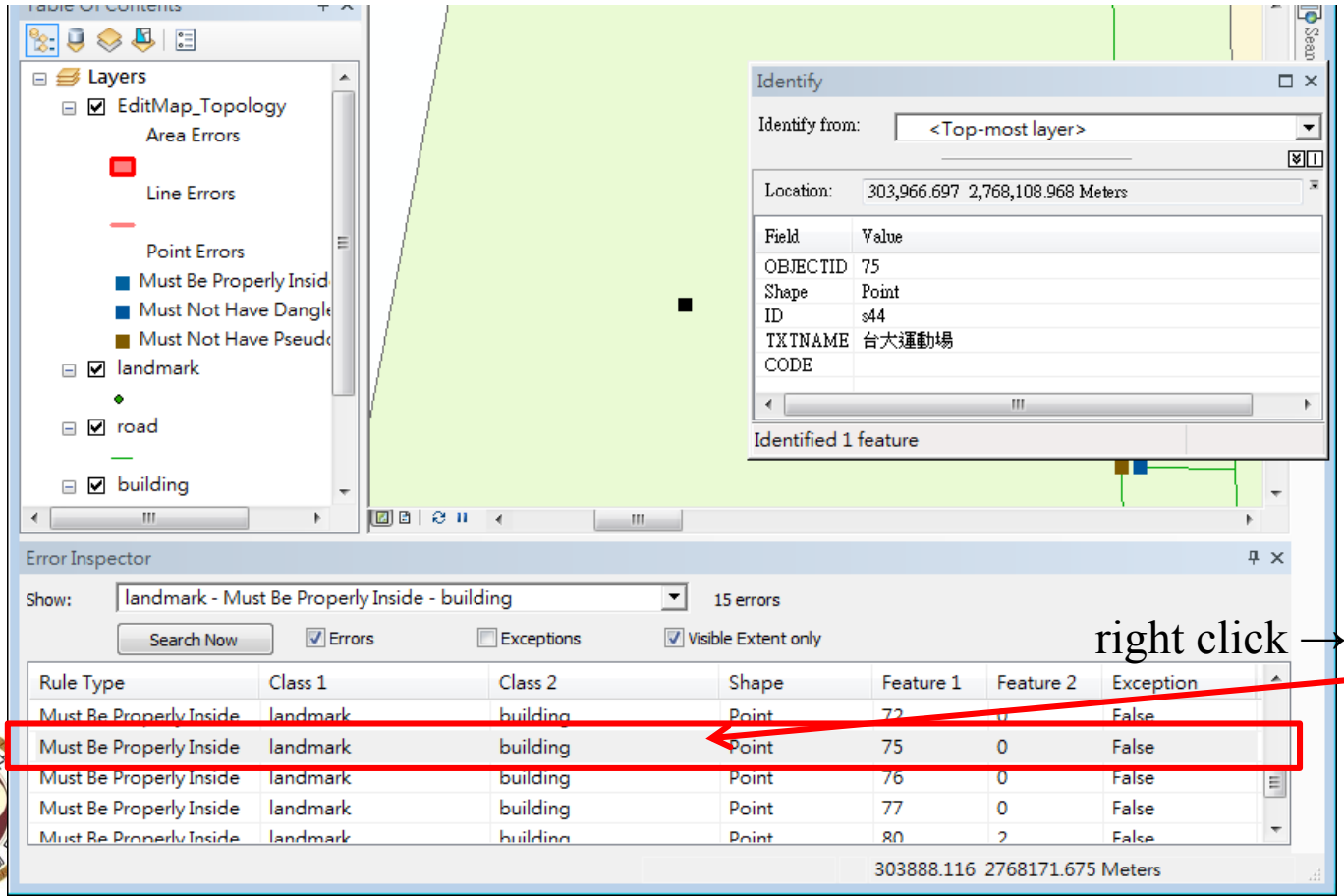
Show: landmark - Must Be Properly Inside - building　15 errors

Search Now　Errors　Exceptions　Visible Extent only

Rule Type	Class 1	Class 2	Shape	Feature 1	Feature 2	Exception
Must Be Properly Inside	landmark	building	Point	20	0	False
Must Be Properly Inside	landmark	building	Point	15	30	False
Must Be Properly Inside	landmark	building	Point	51	17	False
Must Be Properly Inside	landmark	building	Point	55	0	False
Must Be Properly Inside	landmark	building	Point	52	0	False
Must Be Properly Inside	landmark	building	Point	57	0	False
Must Be Properly Inside	landmark	building	Point	67	0	False
Must Be Properly Inside	landmark	building	Point	70	0	False
Must Be Properly Inside	landmark	building	Point	71	0	False
Must Be Properly Inside	landmark	building	Point	72	0	False
Must Be Properly Inside	landmark	building	Point	75	0	False
Must Be Properly Inside	landmark	building	Point	76	0	False

步驟7-2:修正錯誤(landmark)

- 若地標點確實不在建物內(如公園、運動場)
  - Make as expection

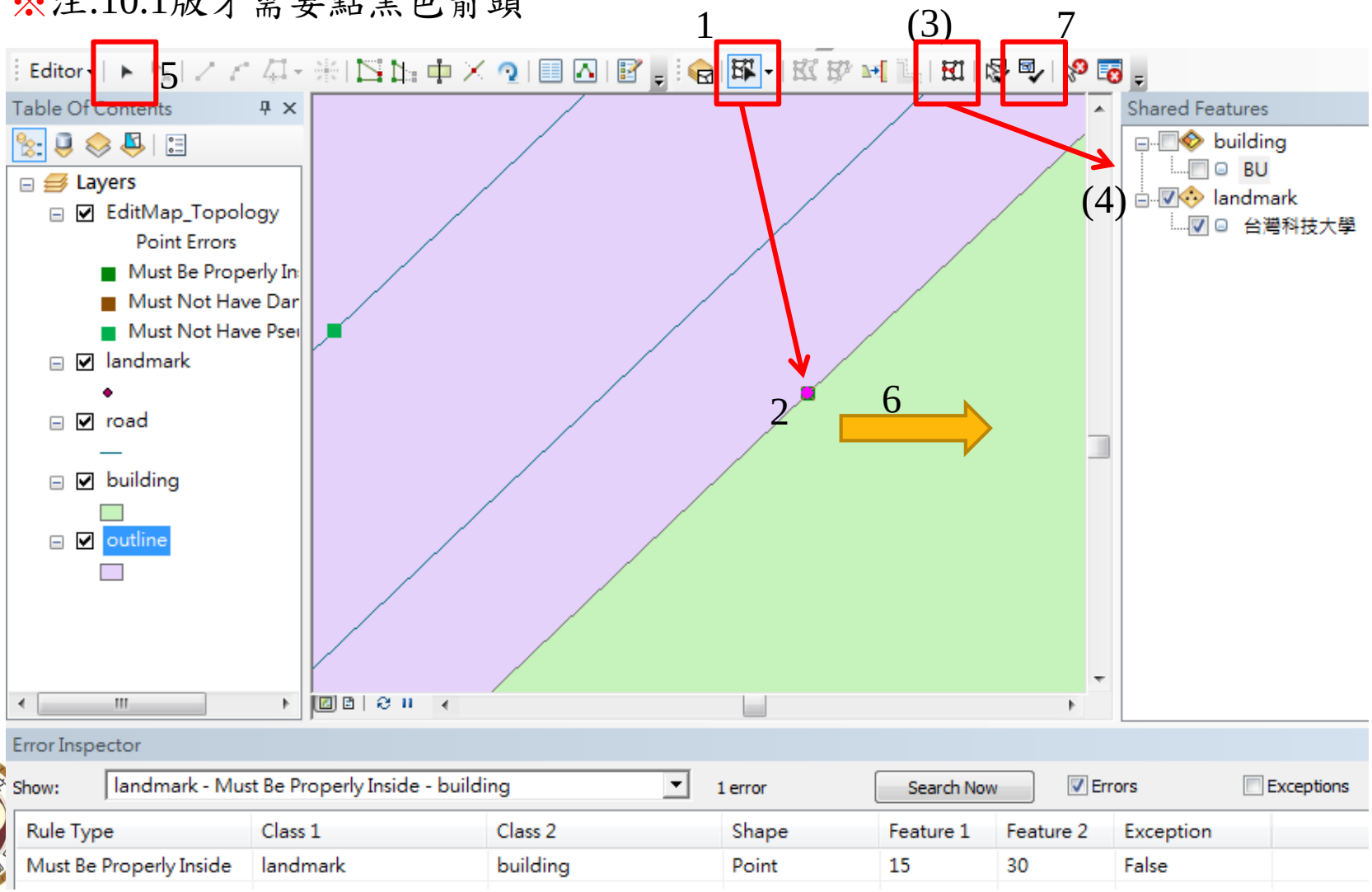


right click → make as expection

步驟7-2:修正錯誤(landmark)

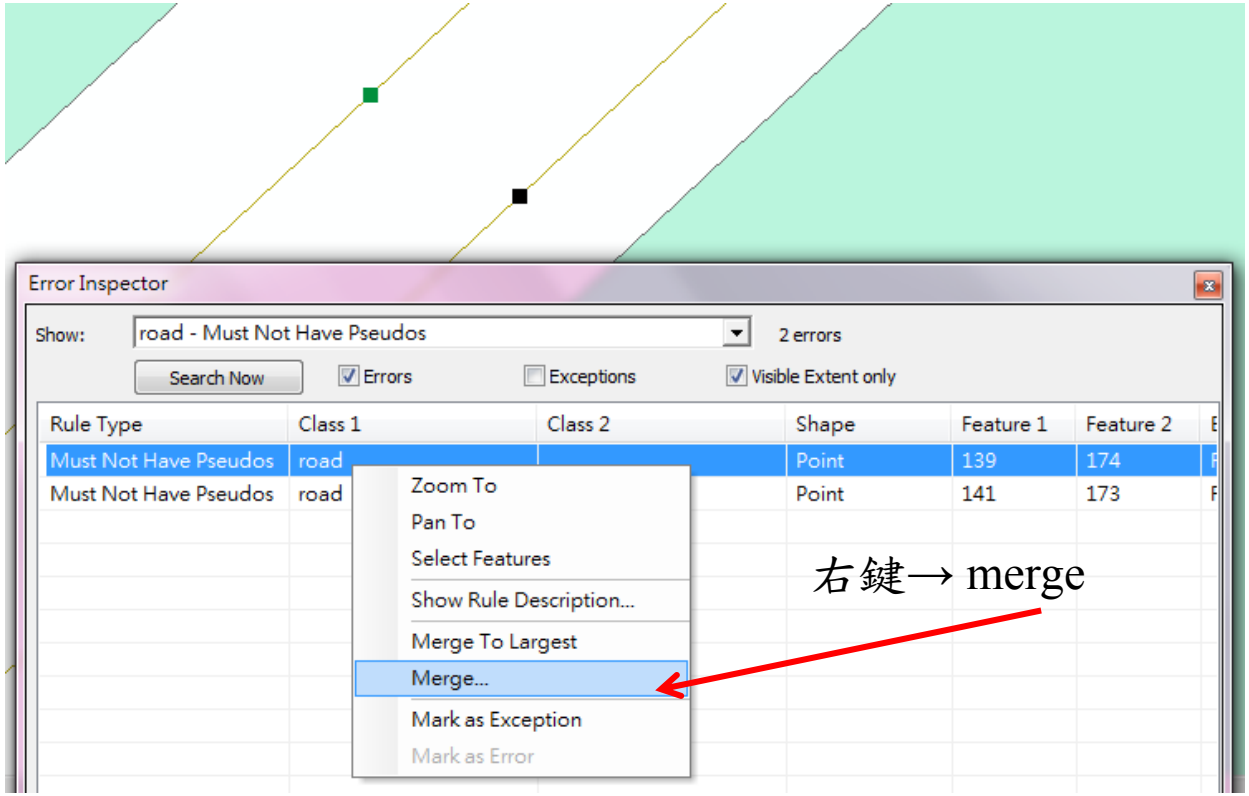
- 應在建物內的地標點

※注:10.1版才需要點黑色箭頭



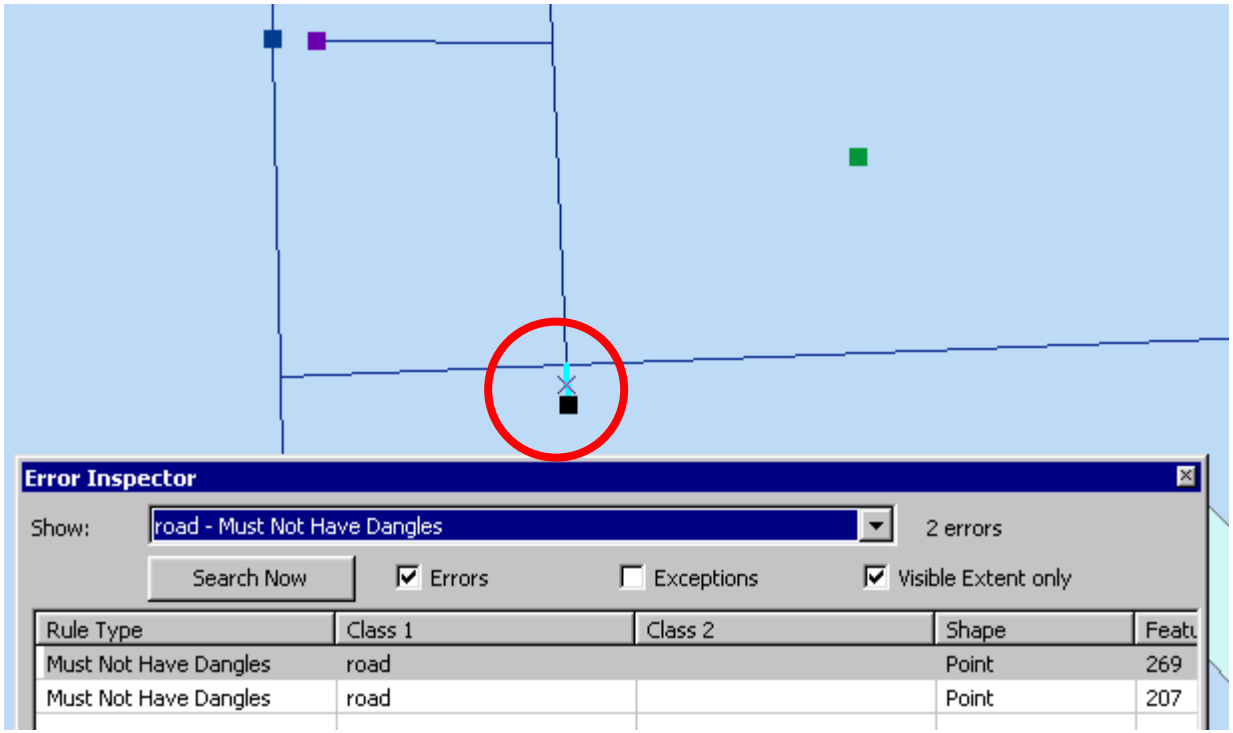
步驟7-3:修正錯誤(road)

- 有虛擬點(pseudos) → 合併線段



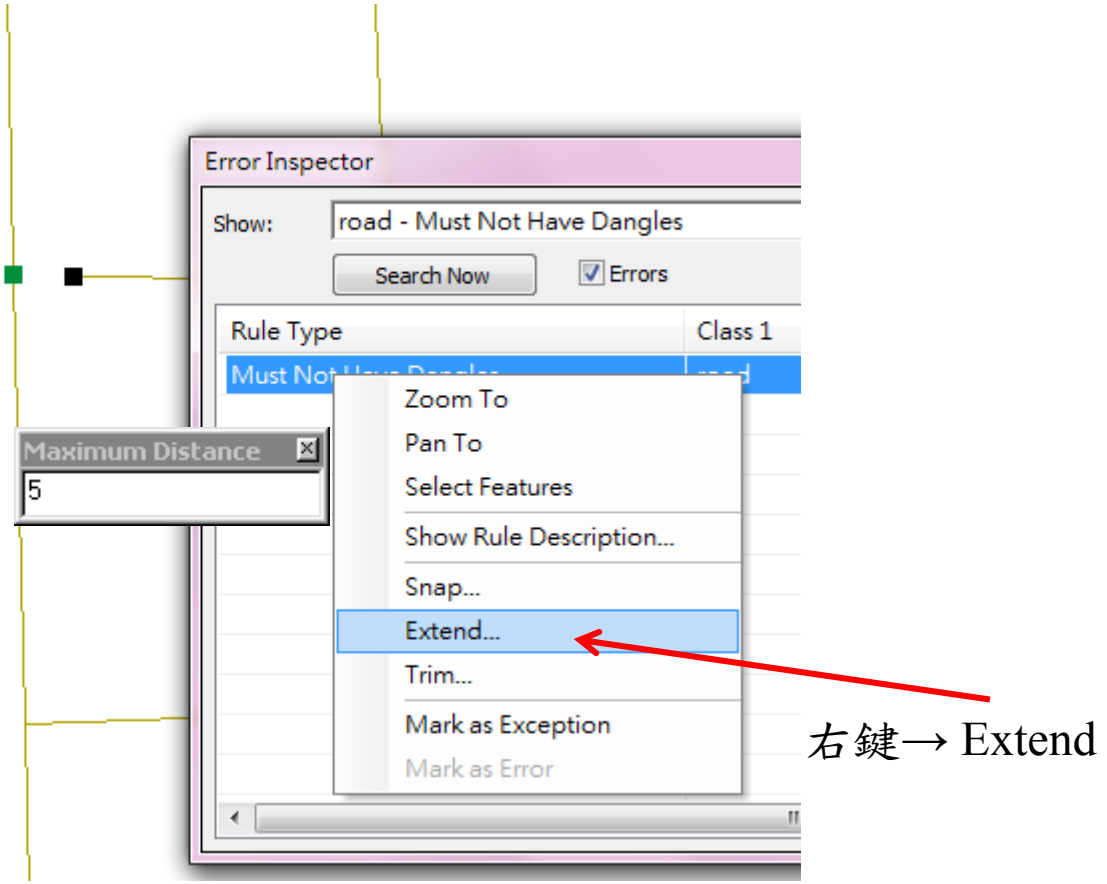
步驟7-3:修正錯誤(road)

- 突出線段(dangles) → (1) 選擇該線段並刪除



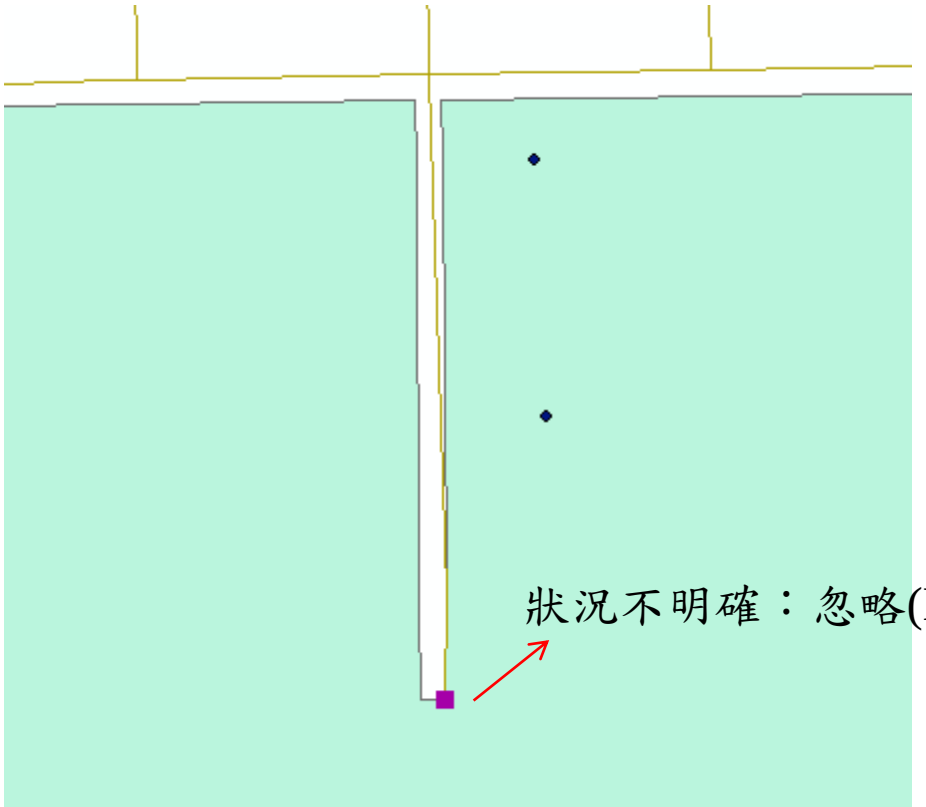
步驟7-3:修正錯誤(road)

- 未閉合線段(dangles)→ (2) 延伸



步驟7-3:修正錯誤(road)

- 狀況不明確→ (3) 忽略



Lab 2 –操作實習

- 新增圖層並進行數化
  - 新增學號.shp圖層，並數化polygon(64~66、70~72、77)
- 位相關係修正(根據前述練習之步驟)
  - 新增geodatabase (檔案名稱: 學號.mdb)
    - 需注意設定坐標系統為
  - 編輯shapefile並修正所有錯誤
- 壓縮學號.shp與學號.mdb上傳至Ceiba
- 繳交期限：2014/11/04 14:00前

注意

- 台大校園附近的錯誤地標，必須要移到正確的位置，不可隨意移動到任意的建物內。

- Topology Rules
  - landmark must properly inside building area
  - road must not have pseudos
  - road must not have dangles

Lab 2 – Vector Data Model Practice

- Part1. Create a new shapefile and digitalize
  - Create a shapefile (Student ID.shp), and digitalize polygon no. 64~66, 70~72, 77
- Part2. According to the steps…
  - Create a new geodatabase (filename: student ID.mdb)
    - Set a coordinate system
  - Edit shapefiles to fix topology errors based on the rules
- Compress the .mdb and .shp, and upload to Ceiba

- Deadline: 2014/11/04 14:00

Notice

- When fixing errors of landmark, you should move point to right place (building). Do not move to wrong building.

- Topology Rules
  - landmark must properly inside building area
  - road must not have pseudos
  - road must not have dangles