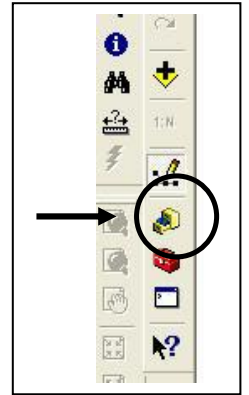


Geodatabases

Geodatabases are ESRI's preferred way for storing data layers. Geodatabases were developed to support complex relationships among and within layers, known as topology. Geodatabases also have provisions for allowing multiple users to edit the same database at the same time, for tracking versions, and for connecting to other databases, but we'll not use that feature here. You will create personal geodatabases, intended to be opened by only one user at a time.

You typically create a geodatabase using ArcCatalog.

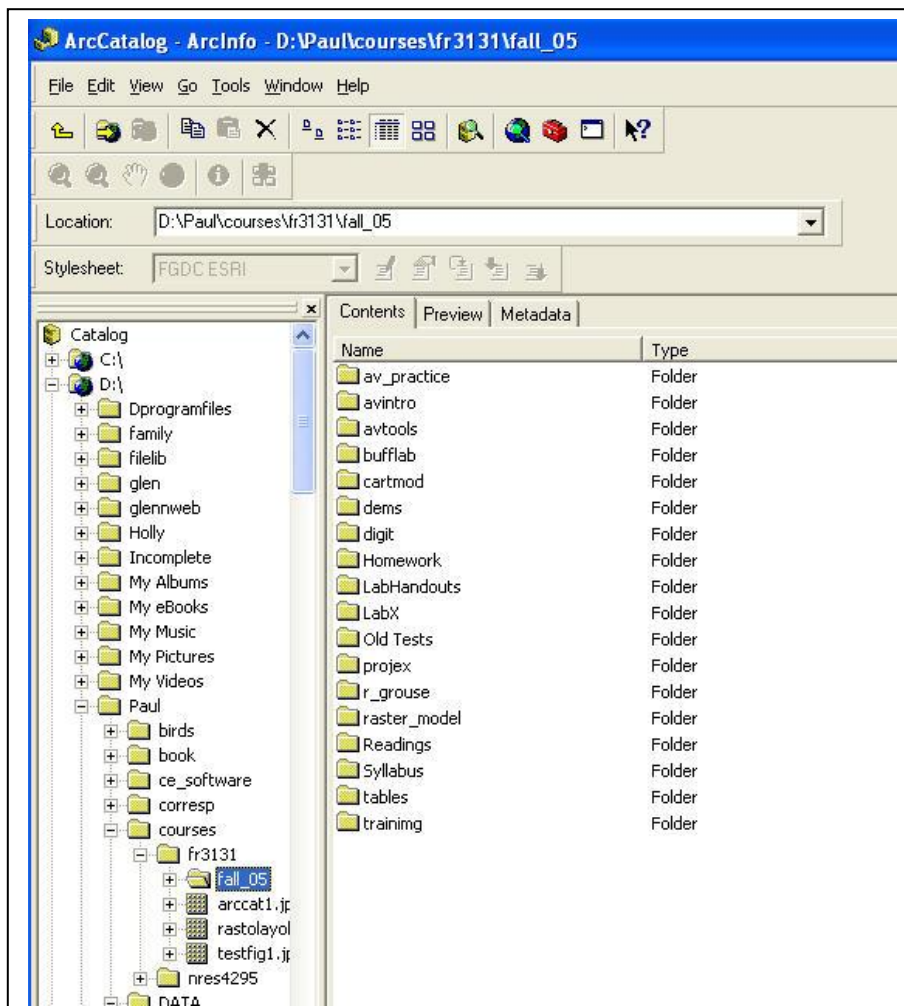
Start ArcCatalog by one of two ways: if ArcMap is running, click on the file cabinet icon, typically in a vertical panel of menu buttons, near the add layer button (see right)



Or, start from the ArcGIS program group,

click the start menu and select Programs > GIS-GPS > ArcGIS > ArcMAP.

ArcCatalog should start with a screen something like this:



Notice that to the left there is a directory tree, and the right pane may be blank, or have a set of directories. As you navigate the directory tree by left clicking on a directory or database in either the left or right pane, the files therein are shown in the left or right pane. Right click in the working directory to a folder with data, or into which you wish to place data. In the illustration to the left we are in D:\Paul\courses\fr3131\fall_05. Folders are listed in the panel on the right until you reach a level that contains data, in which case you may get a right panel that looks something like the figure below:



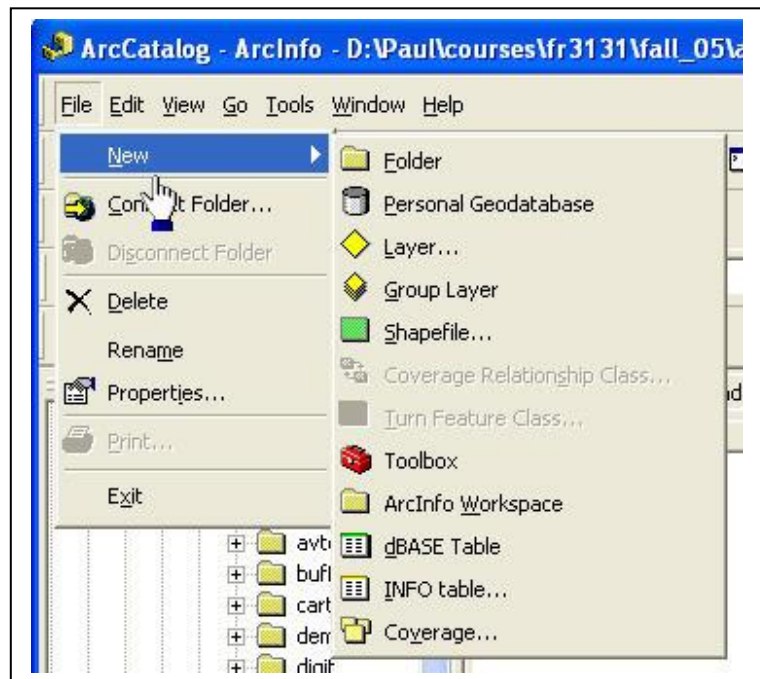
Note that the data files displayed with the type showing they are shapefiles. Each type of shapefile displays with a characteristic icon (polygons and lines, above), and geodatabases, tables, images, and other data types have unique icons.

Geodatabases are created one of three ways:

- 1) defining a schema in ArcCatalog
- 2) Importing existing data into a geodatabase
- 3) Creating a geodatabase with a computer-assisted software engineering (CASE) tool.

We'll describe only the first method.

Select File > New > Personal Geodatabase from the ArcCatalog main menu, you should see something like the screen to the right:



Note that you are asked to name the database, and that it has an .mdb extension. Also note that the type is listed as personal geodatabase. Type something in for the name, e.g., your name, or "testbase".

Double leftclick on the geodatabase in the right window pane. Notice it goes blank, and the left window pane shows the personal geodatabase.

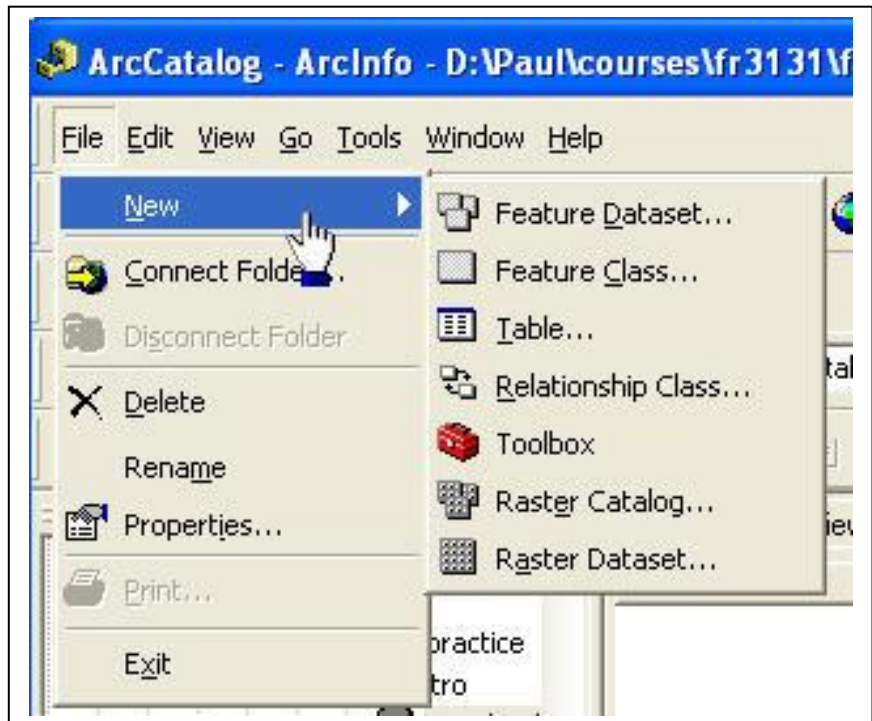
You will now create files to hold data layers, data tables, or other information.

Select File > New, and notice you have a different set of choices.

Menu items here are the types of new data sets, or other constructs, you may create and store within a geodatabase. You may also start the ArcToolbox, a set of operation for spatial data.

Creation of feature datasets, feature classes, and tables are the most common actions.

The base component of a geodatabase is typically a feature. It most often is a point, a line, a polygon, or some combination of these that represents something in the real world. A group of features may be combined in a feature class, e.g., a group of lines that represent a street network



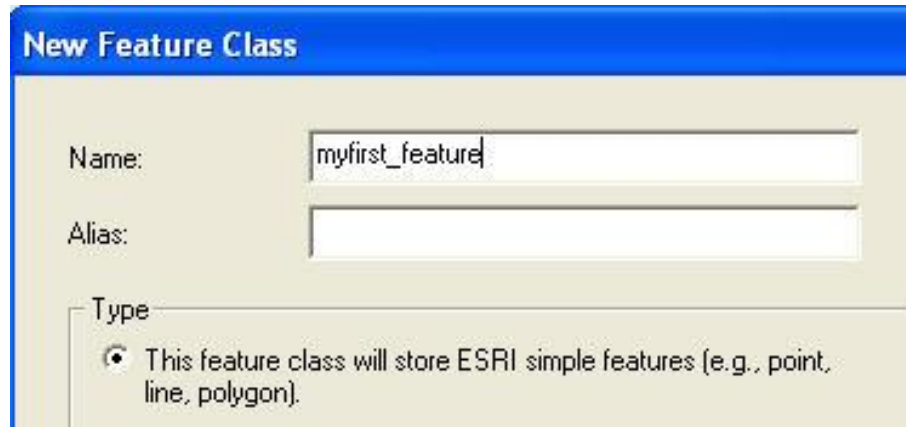
A feature dataset is a collection of feature classes that have the same spatial reference. This means they align properly when grouped together, for example, we may add a feature class for buildings in an area, and the polygons that represent the buildings align properly with our roads feature class. The primary purpose of the feature datasets is to group feature classes together when they have the same spatial reference.

The other common element to a geodatabase is a table. This stores attribute information, typically associated with a feature class.

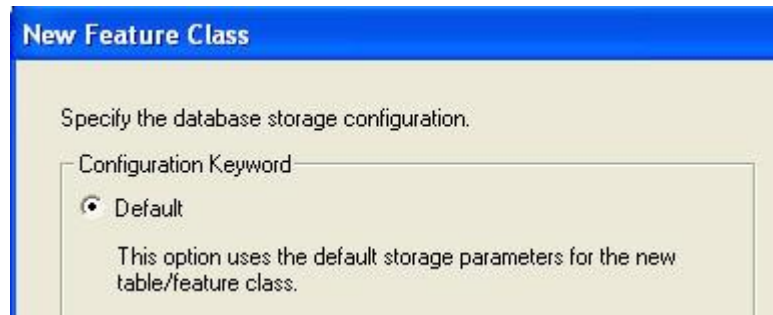
You may create a new feature dataset, feature class, or table by selecting File > New, then the geodatabase item you'd like to create. You'll be prompted by a series of menus asking you to specify the characteristics of the item.

For example, to create a stand-alone feature class (one not contained in a feature dataset), you could select File > New > Feature Class, and would get the following series of menus:

Name the feature class

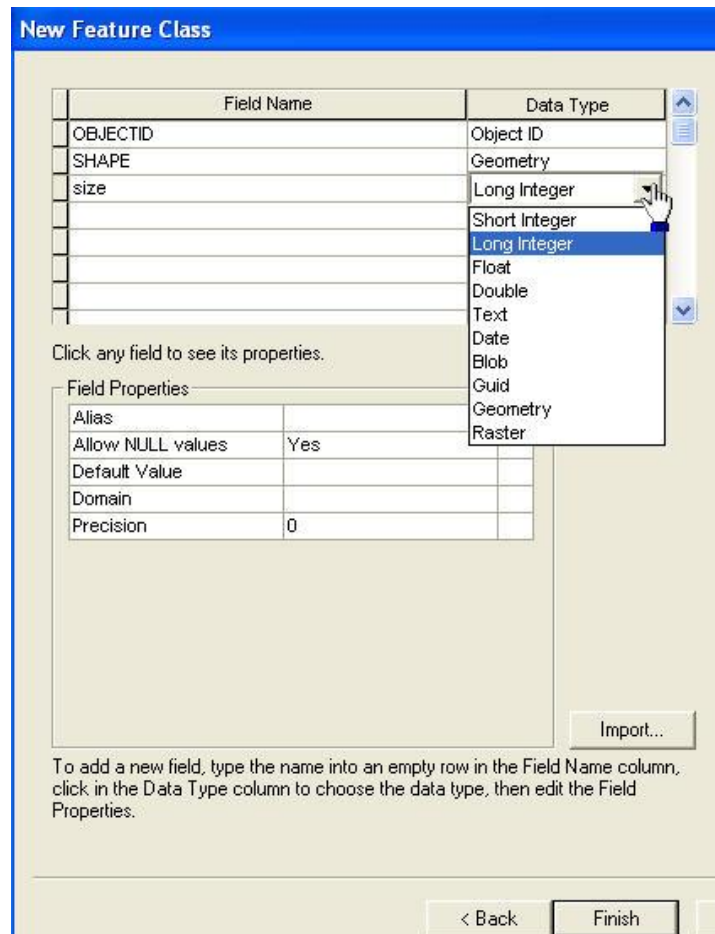


Specify the default storage configuration. This is an advanced feature primarily used when connecting to outside database software



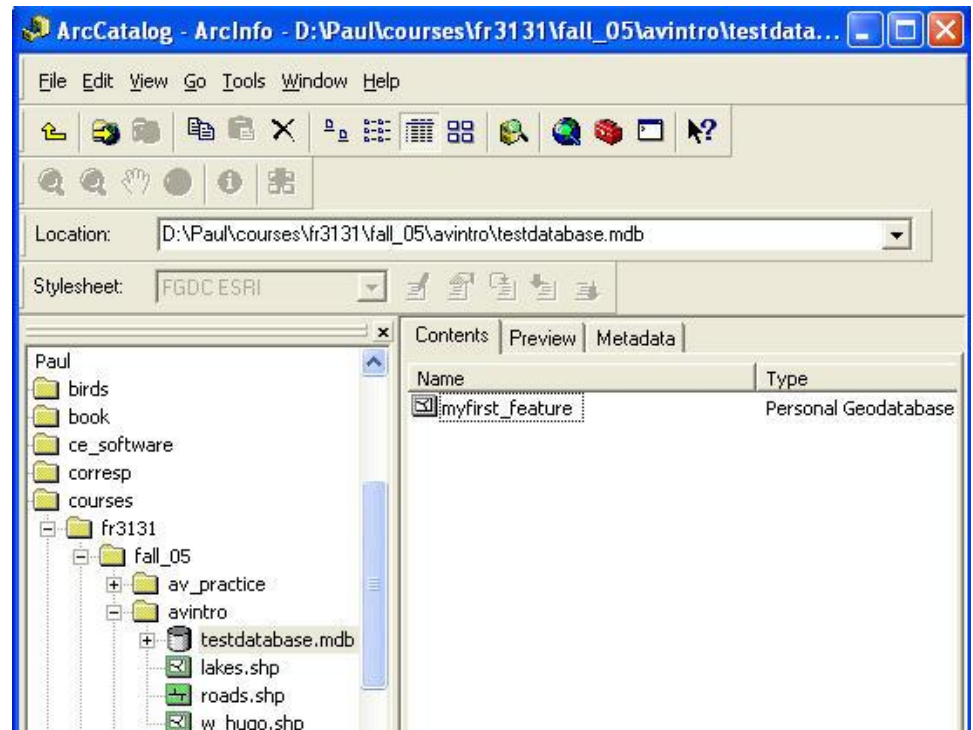
Specify the data fields for the feature class. ObjectID and SHAPE are typically defined by default for basic feature classes. You may add new fields (variables) that hold information about each feature. For example, for a stream feature class, I could define the stream size, order, type, name, etc. I would specify an appropriate data type for each, e.g., size as a long integer, order as a short integer, type and name as text, etc.

Note that you set the feature type, point, line, or polygon through the SHAPE field in the new feature class.



To add a new field, type the name into an empty row in the Field Name column, click in the Data Type column to choose the data type, then edit the Field Properties.

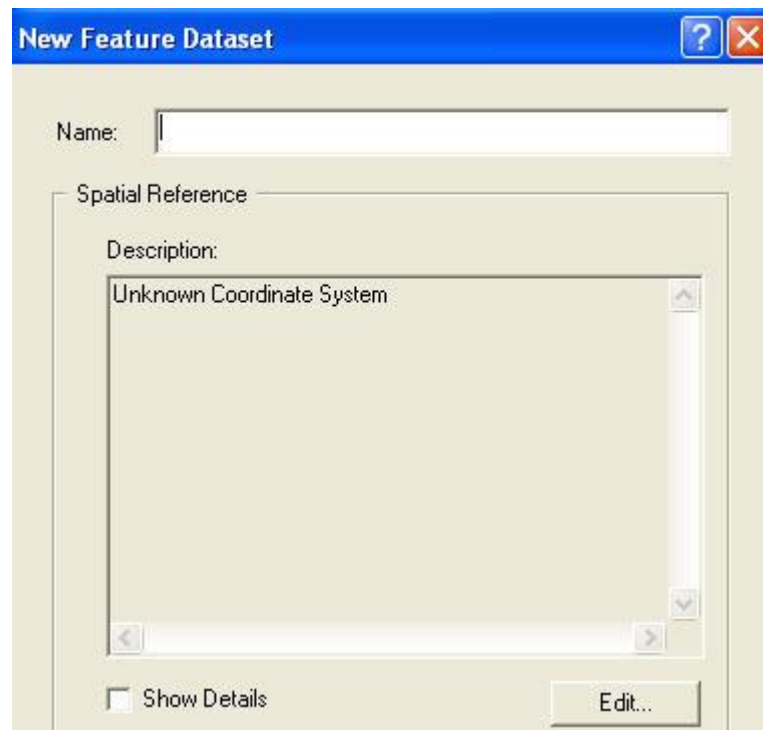
When you click finish, you should now get a view that shows your new feature class in a geodatabase, as on the right. The feature class doesn't have anything in it, and this is only the simplest sort of feature class as it is not inside a feature dataset, but it is a new, empty layer into which you may add features.



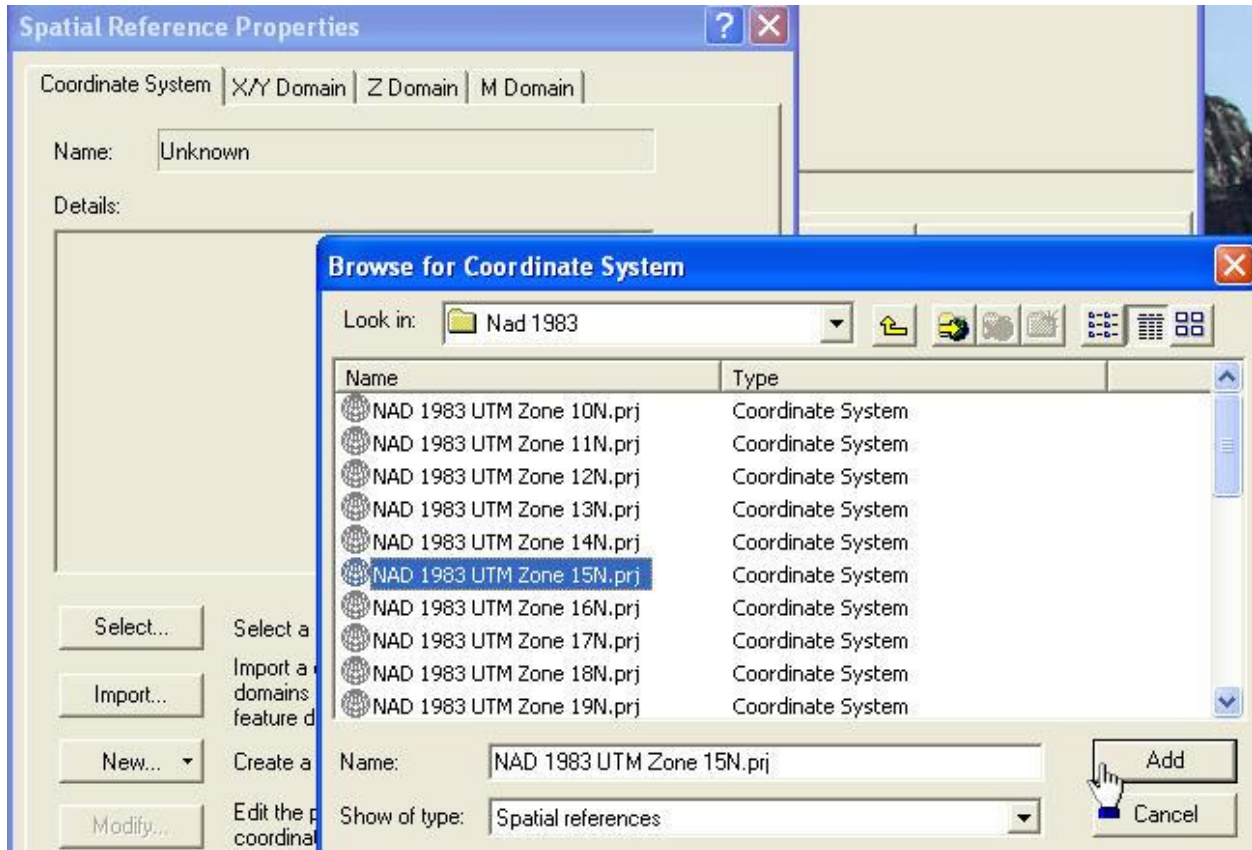
We more often first create a feature dataset, then add feature classes to the feature dataset. You create a feature dataset in a similar fashion to a feature class. First, select File > New > Feature Dataset from the main ArcCatalog menu. You'll get a pane similar to that on the left.

You'll need to provide a name for the feature dataset, and specify the coordinate system. Note that if you don't specify the coordinate system now, it is a bit of a pain to specify one later, so best get it over with here.

When you select the edit button, and this will spawn a series of windows that allow you to select an established coordinate system, or create a new one. We usually are working with an established system, e.g., UTM or state plane, but sometimes we may wish to use a non-standard system, e.g., the Minnesota County Coordinate System. You can enter the parameters for any mathematically tractable projection. For now, we'll use the UTM NAD83 zone 15N coordinates, so select from the existing systems, through the menus to indicate this system. You should arrive



at a screen similar
to:



Selecting add and apply.

You may then add feature classes to reside “inside” a feature dataset. In my view, this is a poor choice of names on ESRI’s part, because one would typically think of a class of objects as a higher level than a set, e.g., a dataset would more naturally seem to fit inside a data class, in the way we usually think about the words set and class. But in ESRI’s geodatabase world, feature classes are placed inside feature datasets.

Navigate to the feature dataset (double click on it), and you should initially see the directory tree with the feature dataset in a grey box, and an empty window on the right. You may then create new feature classes, and add these to the feature dataset.

I need to stress, feature datasets are typically created to contain a set of related feature classes. For example, I may be working in an area, and create three data sets with the same coordinate system, and approximately the same extent. You may want to place topological constraints on the data in the feature classes, e.g., you want the edges of a road layer to coincide with the edges of

an adjacent sidewalk layer. ArcCatalog allows you to store these data and assign these restrictions, organized in a feature dataset.

Notice a couple of things.

First, you must have some idea of the data layers you will be working with, and how they will be arranged. Will they be independent, each in a different geodatabase? If they are in the same geodatabase, will there be feature classes, with feature layers within each feature class? What feature layers go in which classes? Within each feature layer, what is the coordinate system, and what are the attributes, types, and domains of each feature layer?

Once you've answered all these questions, you may create the feature datasets, then create the feature classes within the feature dataset, then create any topologies or relationship classes you require, and enter data into the feature classes. For now, we'll only discuss topologies.

Topologies may be used to enforce restrictions on adjacency, connectivity, or coincidence in data layers. You may require that polygons close, or that points or polygons from one data layer be contained within single polygons of another data layer, or that edges are coincident across multiple data layers. You may set up topological rules within a feature dataset to require this.

Start by navigating to be within a feature dataset, then using the main ArcCatalog menu to select File > New > Topology. You will get a screen saying you'll be creating new topologies, select Next, and you should then see a name for setting the name and fuzzy tolerance:

The fuzzy tolerance should be smaller than $1/10^{\text{th}}$ the dimension you care about, e.g., if you are interested in maintaining information down to the nearest meter, the fuzzy tolerance should be 0.1 meters. Note the units used.

New Topology

Enter a name for your topology:

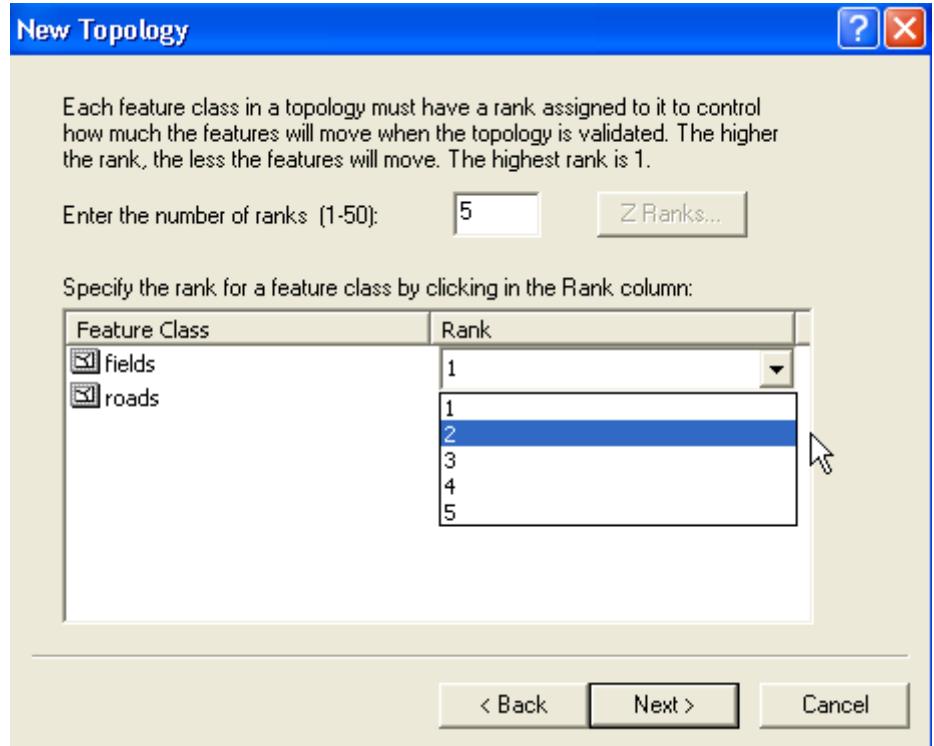
Enter a cluster tolerance:
 meters

The cluster tolerance is a distance range in which all vertices and boundaries are considered identical, or coincident. Vertices and endpoints falling within the cluster tolerance are snapped together.

The default value is based on the precision defined for the spatial reference of the feature dataset.

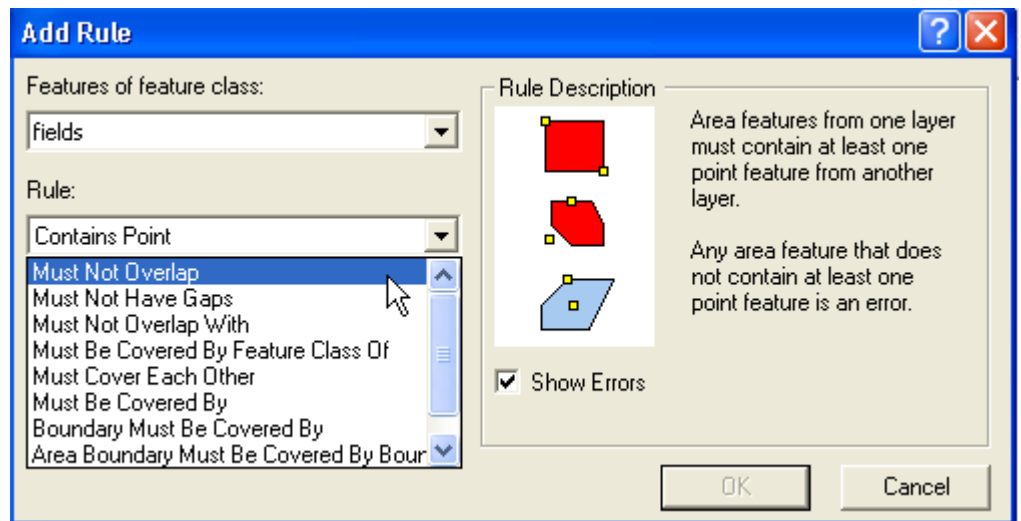
< Back Next > Cancel

After you enter the fuzzy tolerance and name values and select next, you will be prompted to enter the classes that will participate in the topology, and to set the ranks. Ranks identify the hierarchy of mobility for each feature class. Those features with a higher rank are moved to those with a lower rank when they are within the fuzzy tolerance distance. You may modify the rank by clicking on the table listing, as shown at right.



You then specify topological rules.

Basically, you specify the feature classes that will participate, and the rules that apply. For example, I can add rules that require points be inside of polygons, that polygons in the same feature class don't overlap, or that polygons in the different feature classes don't overlap. Basically, you add the topological rules you require, and save the topology. You'll notice that the topology appears as part of the geodatabase.



Once you've created the topology, you need to edit, but we'll cover that in another handout – for now, do the following exercise:

Create a personal geodatabase – include at least two polygon layers, a point layer, and a line layer. Ensure that the polygon layers cannot overlap each other, cannot overlap themselves (polygons within layers), cannot have slivers, and that the point layer must be contained within only one of the polygon layers.