Tips and Tricks for using ArcGIS 8.3

This resource was developed from ideas gathered from ESRI software training instructors in Redlands, California and at ESRI regional offices. Its intended audience is educators and their students.

The items listed below are grouped into several categories (ArcCatalog, ArcMap, ArcSDE, Rasters, Scripts & Codes, Internationalization, and ArcGIS 9.0) and are not ranked in any order of importance. It is also assumed that the user has a basic understanding of ArcGIS 8.x as each tip does not specifically explain each process step by step. These tips are also offered as suggestions and should be used with caution, as they are not supported by ESRI, but offered as a resource (http://arcscripts.esri.com/disclaimer.asp)

ArcCatalog

If you open say an 8.2 geodatabase in 8.3, are you required to upgrade it to 8.3, or can you opt to not upgrade?

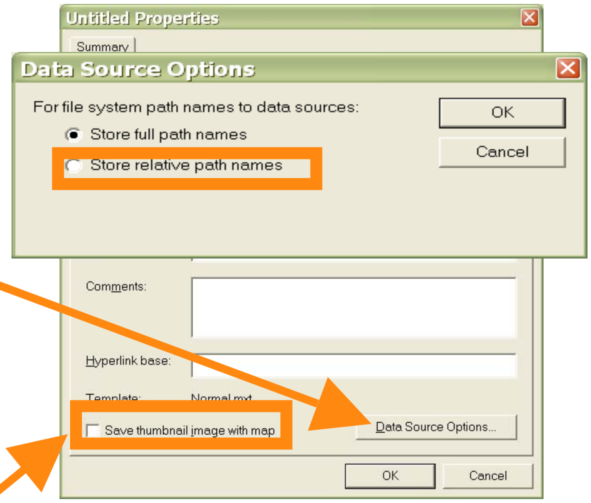
Everything below applies to PERSONAL geodatabases (PGDB's).

- You can open and view older pGDB's in 8.3 without upgrading. As always, if you do upgrade, there is no going back.
- If you do not upgrade:
  - You can add and delete fields to/from tables in an old pGDB in 8.3 and it won't stop you.
  - You cannot create a geodatabase topology in an old pGDB.
  - You can create a map topology with feature classes from an old pGDB. The topology edit tool works without yelling at you, and the changes can be saved. You can "planarize" lines and construct features, and it won't balk.
  - You cannot do disconnected editing.
  - You cannot create geodatabase annotation feature classes, nor feature linked annotation. Graphic annotation is ok, though.

ArcMap

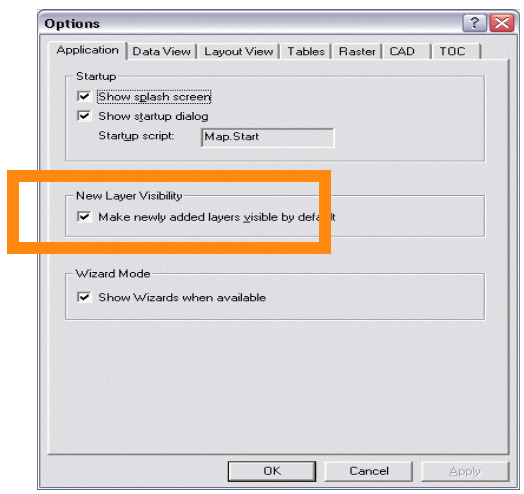
General

1.) Store relative path names
– Data source options



2.) Save thumbnail image with map
- Turn off for speed and space
- Press ESC to stop process

3.) Change ArcMap Default Behavior…
- Turn off new layer visibility



4.) Set additional Advanced ArcMap default Registry settings via the ArcMap advanced settings application located at:
C:\arcgis\arcexe83\Utilities\AdvancedArcMapSettings.exe

Data

1.) How could you go about summarizing attribute data contained within a buffer around a point?
Example:

a. Select a point (address)
b. Select all the features in the parcels layer within a distance of the point using select by location
c. Create a selection within selected set of just polygons that are parks

d. (Select by Attribute; Method = Select from Current Selection)
e. Select another point and repeat

The output is a table (or points feature class/shapefile) -- each record represents a point and contains the number of parks within the distance of each point.

2.) If a cad file has lines created as curves, when we convert that into a geodatabase (GDB) feature class, does it preserve the curves, or does it break it into the short straight line segments?

The GDB will preserve the two-point curve of a CAD file. The shapefiles and coverages on the other hand are brought in as densified line segments.

3.) Using 'group layer files' to access large collections of raster data.
Layer files are a method in ArcGIS desktop for storing location and rendering properties of data outside of a map document. Layer files are not limited to storing information from one data source. Many data sets from many sources rendered in various fashions can be included in a single layer called a 'group layer'.

Personal Geodatabase does not store raster data. So for those using rasters, but who are not using SDE, one solution is a 'group layer file' of all the data that would otherwise be managed in, say, an SDE mosaic. A workstation Arc/Info Image Catalog can be used, but since coverages and INFO datafiles are no longer editable at the 8.3 release of ArcGIS, changes in image pathnames or additions to the catalog cannot be made without an ArcInfo license for ArcGIS. An ArcViewGIS image catalog (in .DBF format) can also be used.

However, the 'group layer file' option is quite simple, effective, and includes many options.

a. Start ArcMap and go to Tools>Options>Application tab and uncheck "Make newly added layers visible by default". This will improve performance when adding the images in step b.
b. Add all the images that are to be assembled into a grouped layer. Use UNC pathnames for each data source to avoid mapped disks. Use the Connect tool in ArcCatalog, and connect through Network Neighborhood. See the ArcGIS documentation for more information on how to use UNC.
c. Select the entire list of images in the ArcMap TOC.
d. Right click on the list to expose the context sensitive menu and press "Group".
e. Right Click on "New Group Layer" and press "Save as layer file".
f. Navigate to where you wish to save the file, enter the name and press "Save". Again, use the UNC convention.
g. Return to the Tools>Options>Application tab and check "Make newly added layers visible by default." in order to view the images when added as a group layer file.

Vector layers and/or annotation layers could also be added to the group layer to serve as a map index. Scale dependent display can be set for individual images within the group or the group as a whole. Adding and removing layers for the group can be done using the GUI.

4.) Cluster Tolerance
When generating a topology, the user has the ability to specify the Cluster Tolerance for snapping features together. The Topology wizard describes the cluster tolerance as: "… 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 first thing to note about the cluster tolerance and snapping during Validation is that it was never designed to work in the same fashion as CLEAN does in Workstation ArcInfo. CLEAN, as the name applies, was designed to do a bulk clean of your data by snapping things together inside specified tolerances. Validate has some of the same traits, it will snap things together within a tolerance, but it is designed to check the validity of your data against a set of rules that you specify. The snapping of features is done to facilitate the validation process, not as a means of bulk cleaning your data.

With that said, there are some additional things about the cluster tolerance that should be mentioned. During the cracking and clustering phase of the Validation process, the application goes to each vertex (inside the dirty area being validated) and finds the next closest vertex. If the two vertices are not of the same rank, then the vertex with lower rank (biggest number) will be snapped to the vertex with the higher rank if it is within the cluster tolerance. However, if the two vertices are of the same rank, then a midpoint is determined and each vertex will move to that new midpoint location if it is within the cluster tolerance.

As example, suppose I have a cluster tolerance of 1. If I have two vertices of the same rank that are 2 units apart, then they would snap together because they would both be 1 unit (the cluster tolerance) away from the midpoint between the two. In this case vertices that are twice the cluster tolerance apart will snap together.

5.) What if I get survey data with xy coordinates in a single column and I want to use that data to add the xy data as a layer in the map document. For example, If the numeric string is: 123456789 and the numbers 12345 are the x data and 6789 are the y data, what SQL logic would I use in the field calculator to populate the x field with the first five numbers and the y field with the last 4?

Use the field calculator and VB functions to make the changes. The functions you use depend on how the coordinate information is stored.

a. If the combined coordinates are stored in a text field, then use the VB string manipulation functions in the Field Calculator to extract the first n characters and the last m characters, converting them to text as you go. For example, Val(Left([XYCoord],5)) would extract the first five characters and convert them to an integer; Val(Right([XYCoord],4)) would grab the last four.
b. If the coordinate pair is stored as a nine-digit number, then the x-coordinate is the integer value of the combined number divided by however many positions you need to move the decimal place to the left. For example, to extract 12345 from 123456789 use INT(123456789/10000). To get the y-coordinate you need to subtract the first five. To extract 6789 from 123456789 use the expression 123456789 - (Int(123456789 / 10000) * 10000)

Editing

1.) Are there any tools out there that can cut a polygon by a selected line feature?

The suggested solution is to use the Replace Sketch command:

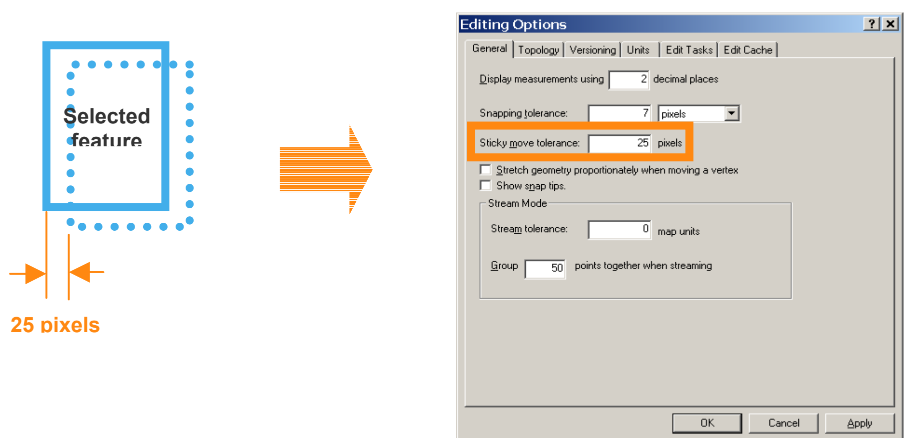
a. Set the Task to Cut Polygon Features and the Target to the Polygon layer
b. Using the Select tool, select the polygon feature you would like to cut
c. Using the Sketch tool, right-click on the line you want to use to split the polygon feature and choose Replace Sketch from the context menu.
d. Right-Click again and choose Finish Sketch.

2.) How do you digitize a donut into a polygon?
As usual, there are several ways. You can: Set your task to Cut polygon features. Turn on edit sketch vertex snapping.

And other variations:

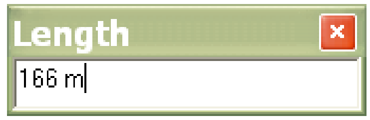
a. Digitize the outside portion first, and select 'finish part'. Then digitize the inner ring, and select 'finish sketch'.
b. Create a new line feature class with the same spatial reference as the polygon feature class that you want to contain the "donut-hole" shape. Start editing and recreate the donut shape as a multi-part line feature. Use 1 line for the "outer" boundary of the donut. Use a 2nd line for the "inner-hole" boundary of the donut. Save edits.
c. You can digitize a polygon into the same layer over top of another and then do the Editor > Clip operation with the smaller polygon selected and that will remove the portion of the larger polygon that is underneath the small one. Then you can either keep or delete the smaller polygon. There is your donut!

3.) Sticky move tolerance
The Sticky move tolerance is an option that can be set to prevent features from inadvertently being moved during an edit session. The default value for this option is 0. If a value of 30 pixels is entered, for example, the selected feature will not move at all until the pointer has been moved 30 pixels. The feature will then jump to the location of the pointer.

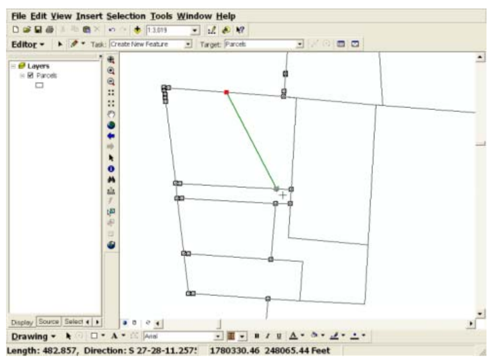


4.) Converting linear units (i.e. feet to meters)
While specifying a distance in an editing context menu you can enter data that was recorded in different distance units than the coordinate system of your data by typing the distance followed by one of the following abbreviations, rather than convert all of the measurements. You could also change the dataset's coordinate system definition and type the distances in without the suffix.

```
Distance
Meter - m
Centimeter - cm
Kilometer - km
Foot - ft
Inch - in
Yard - yd
Mile - mi
Nautical mile - nm
Chain - ch
Link - lk
Rod - rd
US Survey Foot - ftus
US Survey Chain - chus
US Survey Link - lkus
US Survey Rod - rdus
US Survey Mile - mius
```



5.) Shortcut Keys:
The V-key will show vertices when editing within 5x the snapping tolerance.



Z- Key – Zoom In
X- Key – Zoom Out
C- Key – Pan
T- Key – Display snapping tolerance (sketch tool only – 8.3)

Geodatabase

1.) Setting Security on the Geodatabase
In a Personal GDB you would have to modify the permission at the O/S level on the actual mdb file. So you would need to use Windows Explorer, navigate to the mdb file and then right-click and click Properties. You would then set read/write permission to your users. However, this is for the entire Personal Geodatabase and is not per feature class.

In ArcSDE, you would have to specifically grant SELECT/UPDATE/INSERT/DELETE privileges on any feature class to your particular user so they could do editing. If you only grant SELECT access then your user can only read the data. This is done by right-clicking on the ArcSDE feature class and click Privileges. You would then check off the privileges desired.

Also, if a feature class is not 'Registered as versioned' then no one can ever edit the data. The only person that can register a feature class as versioned is the owner of the feature class (the user that loads the data).

2.) Geodatabase Behavior Comparison: Relationship Class vs. Relate

Relationship Class	**Relates / Joins**
Saved in the Geodatabase	Saved in the .mxd project file
ArcEditor, ArcInfo to create	ArcView, ArcEditor, or ArcInfo to create
Simple and composite relationships	No parent / child dependencies
Created in ArcCatalog	Created in ArcMap
To create, right click Geodatabase, New, Relationship Class	To create, right click layer in Table of Contents in ArcMap, Joins and Relates
Can be created for Geodatabase feature classes and tables	Can be created for shapefiles, coverage's, geodatabase feature classes
Access to related records in Attribute Dialog box when Editing	When editing, won't see related records in Attribute Dialog box
Can assign relationship rules to a relationship class	
Can validate rules automatically	
Parent / child referential integrity constraints	

3.) Geodatabase Behavior Comparison: Subtype vs. Domain

Subtypes	**Domains**
Subset of records within a feature class or table	List of valid values for any Field including a field specified as subtype
Based on an integer field	Property of the Geodatabase
Need ArcEditor, or ArcInfo to create	Can be applied to a Field (Personal Geodatabase) ArcView, ArcEditor, ArcInfo
Property of the feature class or table	Can be applied to a Field (ArcSDE Geodatabase) ArcEditor, ArcInfo
1 subtype per feature class or table	Can be applied to a Subtype (Personal or ArcSDE Geodatabase) ArcEditor, ArcInfo
When editing you may choose to edit just the subtype from the target layer	Domain field type must Match the field type and width of the field or subtype applied to.
	Multiple Domains per table
	Two Types of Domains, Coded Value and Range Domain
	Coded Value = Auto Validation
	Range = User Validation

4.) Geodatabase Spatial Reference: Precision

- Accuracy: How correct is your X,Y, in relation to the surface of the earth?
- Precision: Number of storage units in one map unit
- GDB Coordinate Domain: 2,147,483,648 x 2,147,483,648 – so you have 2,147,483,648 inches/centimeters/feet/kilometers/miles to work with
- Is this a limitation? If you consider that you can fit the entire world at one Meter precision in this space 53 times or half the world at centimeter precision it is probably not a limitation.

Storage Units / Map Units = Precision

Example: You are storing data in UTM Meter = 1234.567 meters (This may be one of your coordinates.)
Map Units = Meters
Storage Units = Millimeter (you choose this based on the accuracy of your data)
Precision = 1 Meter/1 Millimeter = 1000

Checking your Precision: Will your data, with precision applied, fit into GDB coordinate domain?

a. Calculate the Range
   Range = larger of Width or Height
   Width = MaxX-MinX ex. 1,000,000 – 200,000 = 800,000
   Height = MaxY – MinY ex. 4,060,000 – 3,750,000 = 310,000
b. Take the larger range in this case it is Width and multiply by Precision and compare it to the GDB Coordinate Domain
   Ex. 800,000 * 1000 = 800,000,000 < 2.14 B (if yes then it will fit in the GDB coordinate domain)

Offset: Offsets will center your data in the GDB coordinate domain. This offset may not be necessary for all feature classes, it depends on the coordinate values.

Do you need to shift the GDB space by applying an offset?

a. Calculate your GDB Center in Map Units
   (2,147,483,648 / 2) / precision = GDB Center in Map Units
b. Get your data center
   (DataMinX + DataMaxX) / 2 – GDBCenter = ShiftX
   (DataMinY + DataMaxY) / 2 – GDBCenter = ShiftY

By knowing your Precision and your X,Y offsets you can store your data efficiently in your GDB.

Geometric Networks

1.) Bitgate Weights
There are two basic types of weights:

a. A "cost" weight is a value that is accumulated by certain types of traces as it constructs a path through the network edges and junctions. For example, if you use length for the weight, the Find Path trace will find the shortest path between the flags.
b. A "filter" weight is a value that the trace solver uses to identify the edges and junctions it can use. In effect, it is like querying the data for Interstates and Highways, then only tracing on the selection set. But, the solution will be found faster because the filter weights are attributes of the logical edges and junctions and the solver doesn't have to look at the feature attributes.

A "bitgate" weight is a type of filter weight. It is a pattern of zero's and one's that indicate which "vehicles" can cross an edge or junction. Consider that you have a city street network, and different streets allow trucks, buses and cars in different combinations. The bitgate representation would be something like this (read down the columns,):

```
T
R
U B C
C U A  Description
K S R  (Decimal value of bits in parenthesis)
-----  ---------------------------------------
0 0 0  (0) No vehicles
0 0 1  (1) Cars only
0 1 0  (2) Buses only
0 1 1  (3) Buses and cars
1 0 0  (4) Trucks only
1 0 1  (5) Trucks and cars
1 1 0  (6) Trucks and buses
1 1 1  (7) Trucks, buses and cars
```

So, you can constrain a "path" trace for Trucks so that only edges and junctions that have a "1" for the first "bit" will be considered.

Here's the secret: The attribute field that contains a bitgate weight must be Integer, and it must contain the DECIMAL VALUES of the bitgate weight, not the pattern of zero's and one's! And, when you use the Analysis Options on the network toolbar to set the weight filter values, you again specify the DECIMAL VALUES for the bitgate. In our example, if you wanted a trace to route a truck, you would set the weight filter values to the list "4, 5, 6, 7".

So where does the whole "bitgate" business come in? Well, it has to do with how the weight filter is stored in the logical network. It takes less space to store the binary representation of the weight filter values than it does to store the decimal numbers, so you can save a few bits per logical edge and junction by storing the bitgate representation of the weights. In effect, you're creating an integer coding scheme that indicates which combinations of "vehicles" may traverse the edges and junctions, then telling the logical network to store the codes in a more efficient manner.

2.) How do you determine the snapping distance when building a network?
You want to use the quality of your data to decide. When you're about to build a network, open up ArcMap and look around for any spaces between lines and use the Measure tool to get a feel for any gaps. Then, add a bit of leeway (say, you find a 1 foot gap, set the snapping tolerance to 1.5 feet). Once the network is built, re-open ArcMap and do a Find Disconnected trace. If there are sections of the network unconnected due to snapping (and the gap is still reasonably small), you may want to delete the network and recreate with a larger tolerance. If the gap distance is starting to get to large (eg: 5 feet or more), then the data is just plain bad so stop trying to "snap it better".

Georeferencing

1.) How good should your RMS error be when doing a spatial adjustment?
The RMS should be about how accurate your data is to begin with. "It all depends on the accuracy of the source data. If the source data is no better than + or - 50 meters, then an RMS error of 50 would be perfect. If someone were trying to maintain an RMS of 5 or 10 for the above data they would be implying accuracy

within the data, which was never there to begin with. Even with an RMS of 1, their data would still be no better than + or - 50 meters." This, of course, assumes you know the accuracy of your data...

2.) Setting the Spatial Reference for Geographic Coordinates (Written by Gary Kabot)

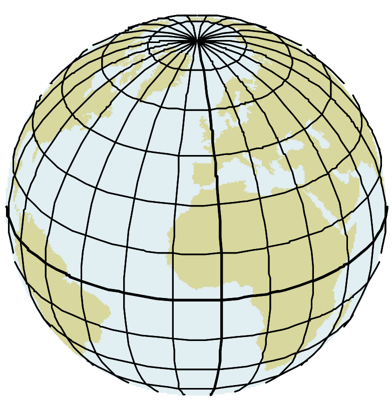
OVERVIEW

Storing geographic coordinates for world-wide or large extent map data eliminates many of the problems associated with various projected coordinate systems, like the discontinuities found at projection zone boundaries, the loss of coordinate accuracy in areas distant from a standard parallel, and so forth. Working with geographic coordinates is feasible because ArcMap can project coordinates on-the-fly, allowing you to draw and edit your spatial data in a projection that is appropriate to a specific area of the earth.

Geodatabase feature classes store both projected and geographic coordinates with equal ease; as far as the geodatabase is concerned, all coordinates are just numbers. The general process of setting the spatial reference for geographic coordinates is the same as for projected coordinates:

1. Determine the precision you need, as a function of your coordinate accuracy.
2. Determine the spatial extent of your study area.
3. Test the precision against the extent to ensure that the geodatabase can store the coordinates at the desired precision.
4. Calculate the x and y shift factors needed to center the study area in the geodatabase coordinate space (optional, but strongly recommended).
5. Enter the precision and shift factors in ArcCatalog to define the spatial reference.

This paper walks you through each of these five steps, with special emphasis on the only step that is peculiar to geographic data; that is, in the first step you must determine the number of map units that are represented by one degree of longitude at the equator.



- **1° of longitude (x) at the equator is ~ 67.4 miles (more accurately: 111,319.491 meters)**
- **1° of longitude decreases to 0 miles at the pole (set your precision based on the equator)**
- **Degrees of latitude (y) have almost constant length everywhere on the globe**

Geographic coordinates are angular measures. They locate a point on the earth's sphere with angles measured from the center of the earth east or west of the prime meridian (the longitude) and north or south of the equator (the latitude). In this system, the length of a degree of longitude decreases as the latitude increases, until its length becomes zero at a pole. In contrast, projected map coordinates are Cartesian and units of x and y always have the same length.

The only impact this has on the process of computing the Spatial Reference is that you must determine the precision where the length of a degree of longitude is greatest, at the equator.

For our examples, we will assume that our study area is the whole earth's surface, that the geographic coordinates are in decimal degrees, that they are based on the WGS 1984 datum, and that they are accurate to about ±10 meters, which is pretty good for global data.

STEP 1: CALCULATE THE PRECISION

This is the only step in the process that is a little different for geographic coordinates. The suggested precision for all coordinates – projected as well as geographic – is one or two orders of magnitude less than the coordinate accuracy. For our example, we want a precision that is equivalent to 1 meter (one order of magnitude less than our 10 meter accuracy) at the equator.

Fortunately, the calculation is easy. First you decide on the precision you want, expressed in normal units of meters, feet, inches, or whatever. Then you determine how many of those units there are in one degree of longitude at the equator. That number is your precision setting.

The general equation used to calculate precision for geographic and projected coordinates is:

$$\text{Precision} = \frac{\text{1 Map Unit}}{\text{1 Geodatabase Storage Unit}}$$

The numerator (1 Map Unit) is the input map units, which in our case is decimal degrees. The denominator (1 Geodatabase Storage Unit) is the number of map units that you want each integer in the geodatabase to represent, which in our case is a meter. So, for our data, the equation is:

$$\text{Precision} = \frac{\text{1 Degree}}{\text{1 Meter}}$$

The only trick is that you must express both the numerator and denominator in the geodatabase storage units – meters. This is where the general procedure varies a bit for geographic units; you must find the number of meters that there are in one degree of longitude at the equator. There are two ways that you can do this:

- **Divide the circumference** of the earth, in meters, by 360º. This is easy if you know the circumference of the earth in the desired datum (we are using WGS 1984):

$$\frac{40{,}075{,}016.686 \text{ meters}}{360^\circ} = 111{,}319.491 \text{ meters/degree}$$

- **Or, Multiply the radius of the earth**, in meters, by the Angular Unit (the number of radians per degree). This is even easier, because ArcCatalog can tell you the values you need for the Radius and Angular Unit, while finding the circumference may be harder:

$$\texttt{6,378,137.000 meters} \times \texttt{0.0174532925 radians/degree} = \texttt{111,319.491 meters/degree}$$

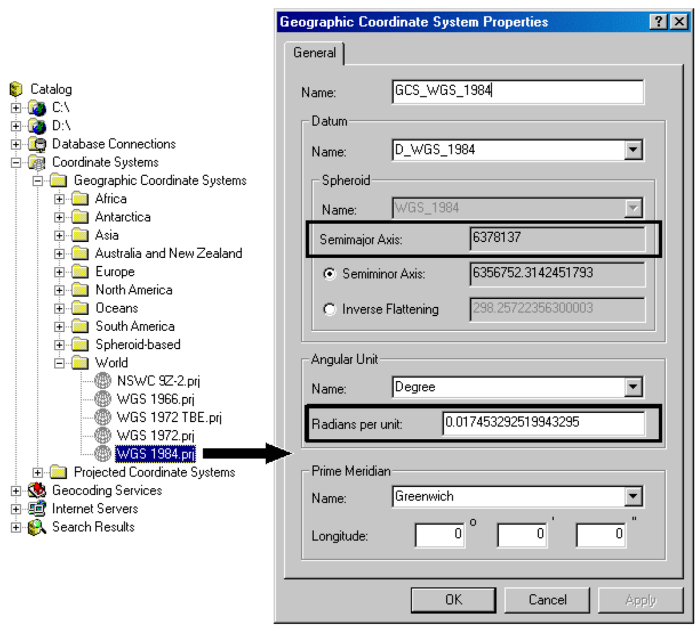
- Now that we know the number of meters in a degree, we can calculate the precision:

$$\texttt{Precision} = \frac{\texttt{111,319.491 Meter}}{\texttt{1 Meter}} = \texttt{111,319.491}$$

So, our precision is 111,319.491, which preserves one meter precision at the equator. If you want to express your precision in different units, like feet or inches, just convert the meters in the equation above into the desired units and carry out the division.

WHERE DID THE NUMBERS COME FROM?

- We used ArcCatalog to examine the properties of the WGS 1984 world geographic coordinate system to find the values for the earth's radius (the "Semimajor Axis") and the Angular Units:



You may need to add the Coordinate Systems folder to the ArcCatalog table of contents. Open the ArcCatalog options. On the General tab, scroll to and check the box for Coordinate Systems.

Be careful to select the geographic coordinate system with the correct datum, because each datum will have a slightly different value for the radius of the earth.

SOME EXAMPLES WITH PROJECTED MAP COORDINATES

For contrast, here are some examples of computing precision for projected map coordinates. First, assume your input data are in UTM meters, and you want a precision of 1 centimeter:

$$\texttt{Precision} = \frac{\texttt{1 Map Unit}}{\texttt{1 GDB Unit}} = \frac{\texttt{1 meter}}{\texttt{1 centimeter}} = \frac{\texttt{100 centimeters}}{\texttt{1 centimeter}} = \texttt{100}$$

Now assume your input data are in State Plane feet, and you want a precision of ¼ inch:

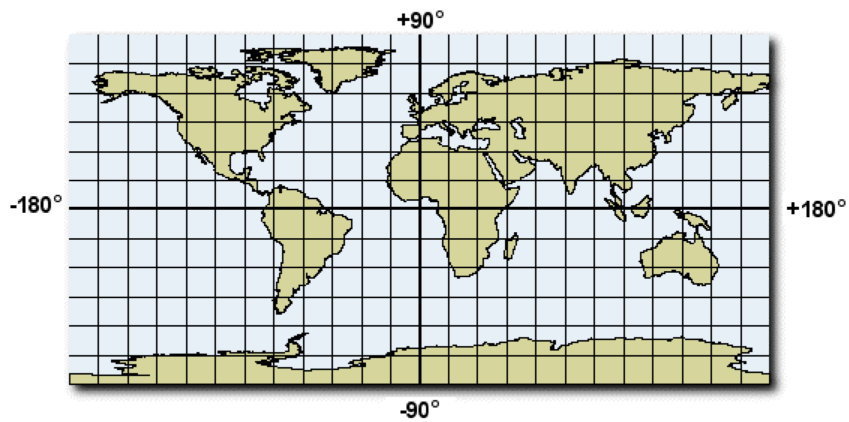
$$\textbf{Precision} = \frac{\textbf{1 Map Unit}}{\textbf{1 GDB Unit}} = \frac{\textbf{1 foot}}{\textbf{0.25 inches}} = \frac{\textbf{12 inches}}{\textbf{0.25 inches}} = \textbf{48}$$

Finally, let's mix the units. You have UTM meters and want ¼ inch precision:

$$\textbf{Precision} = \frac{\textbf{1 Map Unit}}{\textbf{1 GDB Unit}} = \frac{\textbf{1 meter}}{\textbf{0.25 inches}} = \frac{\textbf{39.37 inches}}{\textbf{0.25 inches}} = \textbf{157.48}$$

STEP 2: DETERMINE THE STUDY AREA EXTENT

Determining the extent of geographic data can be even easier than finding the precision; if you are working with world-wide data, like we are, then the ranges of longitude and latitude are:



Longitude ranges from -180° to +180°
Latitude ranges from -90° to +90°

If you are working with a smaller area than the whole earth, then you would look at a map with a latitude/longitude grid to discover the coordinate ranges for your study area.

STEP 3: TEST YOUR PRECISION AND EXTENT

You should always check to make sure your extent can fit in the geodatabase coordinate space at the desired precision; it is possible that your precision (a scale factor) is so large that it results in coordinates that exceed the coordinate range of the geodatabase. You should perform this step for all data, not just geographic coordinates.

Testing your precision against your extent is easy. You just multiply the *range* of your map coordinates (the greater of the width or height) by your precision. If the result is less than the largest number the geodatabase can store (2,147,483,648, or 2.14 billion), then the precision works for your extent. Here's how we test our example:

$$\textbf{StudyAreaWidth} = (\textbf{MaxX}) - (\textbf{MinX}) = (\textbf{180}) - (\textbf{-180}) = \textbf{360}$$

$$\textbf{StudyAreaHeight} = (\textbf{MaxY}) - (\textbf{MinY}) = (\textbf{90}) - (\textbf{-90}) = \textbf{180}$$

$$\textbf{Range} = \textbf{360} \ \textit{(the greater of the width or height)}$$

$$\textbf{PrecisionOkay?} = (\textbf{Range}) \times (\textbf{Precision}) = (\textbf{360}) \times (\textbf{111,319.491}) = \textbf{40,075,016.76} = \textbf{YES!}$$

Our desired precision is okay, since our calculated value of 40 million is less than 2.14 billion.

WHAT IS THE MOST PRECISION GEOGRAPHIC DATA CAN HAVE?

The highest precision you can get with geographic data is about ¾ of an inch (actually, 1.866139 centimeters) when you are storing the whole earth. Even higher precisions are possible with smaller study areas.

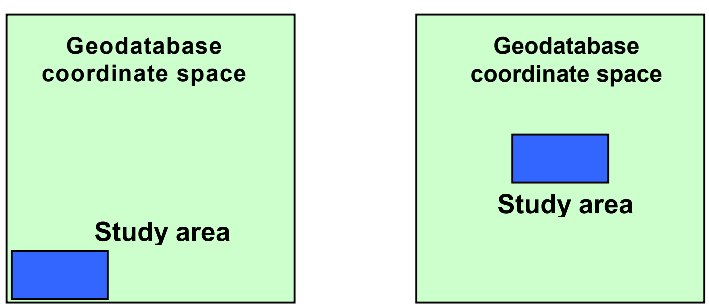
The limit to precision is the range of coordinates in the geodatabase coordinate space. The geodatabase stores integer values from 0 to 2,147,483,648. When you shift your map coordinates with the Min X and Min Y settings and scale them with the precision, the resulting integer coordinate values must fall within this range.

THE HIGHEST PRECISION IS NOT ALWAYS THE BEST

As the precision increases, so does the number of digits needed to store the coordinates. As the stored coordinates get "bigger", they take up more space and fewer of them can be sent from the server to the client in a given period of time. That is, higher precision means your geodatabase takes more room to store and slows the drawing and editing performance for the ArcMap session that is using the data. You should only use as much precision as you really need.

STEP 4: CENTER THE STUDY AREA IN THE GEODATABASE COORDINATE SPACE

You could enter your study area extent coordinates directly into the Min X, Min Y, Max X and Max Y fields in the Spatial Reference dialog. However, we strongly suggest that you calculate x and y shift factors to *center* your study area in the geodatabase coordinate space:



Un-shifted **Shifted**

You should always take the time to do this – with projected coordinates, too. The calculations only take a minute or two, and centering the study area ensures that coordinates around the edge of the study area will fall fully within the geodatabase space (otherwise, they may get clipped).

To center your study area, you find the coordinates for the centers of your study area and the geodatabase space. Then you subtract the one from the other to calculate the shift factors for x and y that "move" the study area center to the geodatabase coordinate space center.

FIND THE CENTER OF THE STUDY AREA

Finding the coordinates for the center of the study area is easy using the formulas below. We show the calculation for our world-wide data set:

$$\text{SAcenterX} = \frac{\text{MinX} + \text{MaxX}}{2} = \frac{-180 + 180}{2} = \frac{0}{2} = 0$$

$$\text{SAcenterY} = \frac{\text{MinY} + \text{MaxY}}{2} = \frac{-90 + 90}{2} = \frac{0}{2} = 0$$

The center of our world-wide data is 0,0. Of course, you knew this without doing the math, but we wanted to show you how you would make the calculations for other study areas, too.

FIND THE CENTER OF THE GEODATABASE

Finding the coordinates for the center of the geodatabase space is just as easy; you use the same formula as above. The only trick is that you must convert the geodatabase units into map units (decimal degrees, in our examples) by dividing the result by the precision we found in Step 1.

The geodatabase space is perfectly square, so we only need one equation to find both the x and y coordinates of the center. Also, we know that the geodatabase coordinates range from 0 to about 2.14 billion, so won't bother to add the Min and Max together; we'll just divide the Max X by 2:

$$\text{GDBcenter} = \frac{\left(\frac{\text{MaxX}}{2}\right)}{\text{Precision}} = \frac{\left(\frac{2{,}147{,}483{,}648}{2}\right)}{111{,}319.491} = \frac{1{,}073{,}741{,}824}{111{,}319.491} = 9645.586899063$$

CALCULATE THE X AND Y SHIFT FACTORS

Now that we know the x and y coordinates for both the center of the study area and the center of the geodatabase coordinate space, both expressed in decimal degrees, we can calculate the shift factors by simply subtracting the geodatabase coordinates from the study area coordinates:

$$\text{Xshift} = (\text{SAcenterX} - \text{GDBcenter}) = (0 - 9645.586899063) = -9645.586899063$$

$$\text{Yshift} = (\text{SAcenterY} - \text{GDBcenter}) = (0 - 9645.586899063) = -9645.586899063$$

Interesting that the same number showed up for both shift factors, isn't it? Of course, that is because our study area center coordinates are the same for both x and y (0,0). The x and y shift factor values will not be the same for other study areas.

SOME SPATIAL REFERENCE SETTINGS FOR GEOGRAPHIC DATA

For comparison, the following table shows several precision and x, y shift settings for a world-wide geographic data set in the WGS 1984 datum, centered in the geodatabase coordinate space:

Desired precision	Precision setting	Min X & Min Y shift factors
1,000 meters (1 kilometer)	111.319491	-9,645,586.899063
100 meters	1,113.194910	-964,558.6899063
10 meters	11,131.949100	-96,455.86899063
1 meter	111,319.491000*	-9,645.5868990630
0.3048 meters (1 foot)	365,221.427164	-2,939.974886846
0.1 meters (1 decimeter)	1,113,194.910000	-964.5586899063
0.0254 meters (1 inch)	4,382,657.125984	-244.9979070117
0.01866139 meters (*highest*)	5,965,230.403523	-180.0000589023

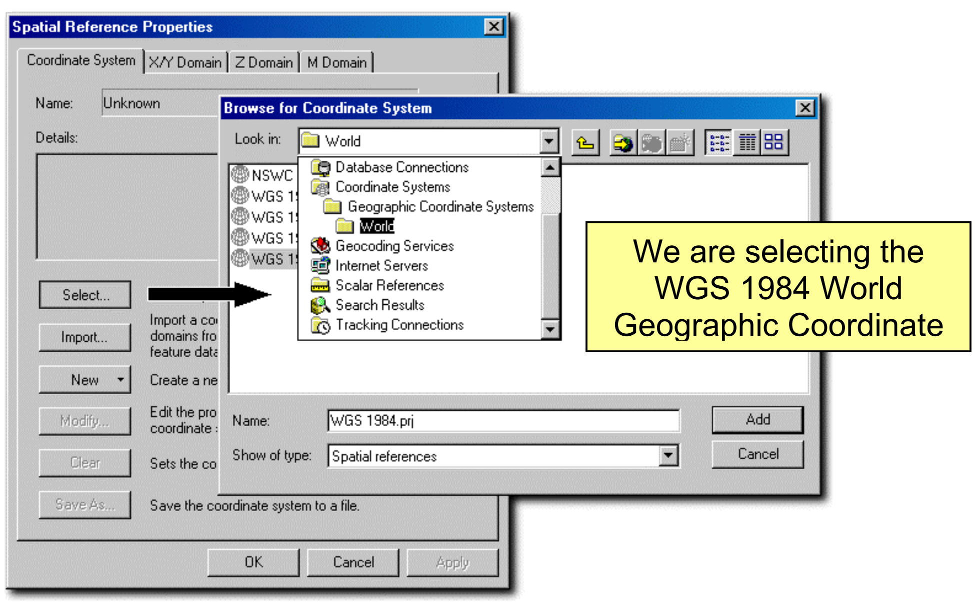
*This value is the number of meters in one degree of longitude at the equator

STEP 5: SET THE SPATIAL REFERENCE IN ARCCATALOG

In this last step we simply show you where you make the inputs for your spatial reference in the Spatial Reference dialog when you create a new feature dataset or stand-alone feature class, or when you import shapefiles, coverages or CAD files as stand-alone feature classes. The same dialog is used for all.

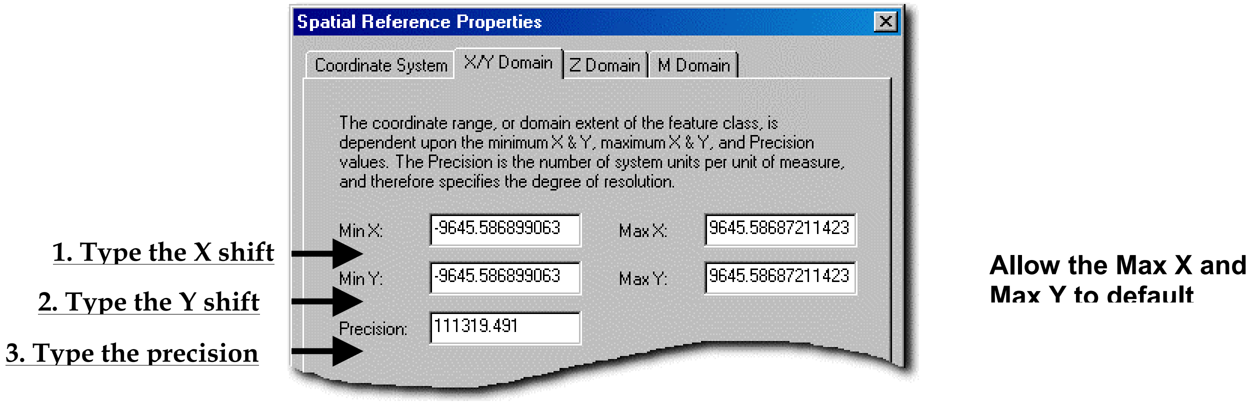
SET THE GEOGRAPHIC COORDINATE SYSTEM

In the open Spatial Reference dialog, click the Coordinate System tab. Click the Select button, and use the browser to navigate to and select the geographic coordinate system:



SET THE PRECISION AND X,Y SHIFTS

Click the X/Y Domain tab. The x and y shifts are entered in the Min X and Min Y fields, and the precision is entered in the Precision field. You allow the Max X and Max Y fields to default (their values change as you make your entries and tab between the fields).



You should set the Min X and Min Y first, then set the precision. Otherwise, if you set the precision first, it will be changed when you type into the other fields.

Click OK to close the Spatial Reference Properties dialog, and you are done.

The remainder of this paper addresses some issues related to setting the Spatial Reference.

A WORD OF CAUTION ABOUT DATUM CONVERSIONS

You may experience data loss or corruption if your input data have a different datum than the Geographic Coordinate System you chose for the geodatabase Spatial Reference, like if the input is NAD 1983 and the geodatabase Spatial Reference is WGS 1984. While ArcCatalog does project coordinates during an import or load, it does *not* perform a datum conversion. This is a known issue at ArcGIS version 8.3.

One effect is that features with coordinates that fall on the extreme edges (longitudes of –180 or 180, or latitudes of –90 or 90) may be created with a null geometry. Records are created in the output feature class for them, but there will be no coordinates in the Shape field. The Shape_Length and/or Shape_Area for these features will be zero. Unfortunately, this is only the most obvious effect; in fact, all the imported or loaded coordinates will have introduced error because the datum conversion has not taken place.

This problem can easily arise if your input shapefile or coverage lacks a projection (PRJ) file; in this case, ArcGIS will default to the "Assumed_Geographic" geographic coordinate system with the NAD 1927 datum for the input coordinates.

The solution is to first use ArcToolbox to define a projection for the undocumented shapefile or coverage (in ArcToolbox, open the Data Management Tools > Projection tools, and use the appropriate Define Projection Wizard). Then, if necessary, use the Project Wizard to convert the datum to the datum you will use in the geodatabase.

This process is described in technical articles found in the ESRI online Support Center. Use your Web browser to navigate to www.esri.com and click the Support link. In the Search Our Site text box, type 23025 to access an article about working with projections in ArcGIS for some important background information. Then type 21327 to access an article about performing datum conversions with the ArcToolbox Project Wizard (the Related Information link opens a page listing the hundreds of supported datum conversions).

THE TOPOLOGY CLUSTER TOLERANCE AND GEOGRAPHIC COORDINATES

Here we will review the cluster tolerance that is applied when you build a topology and show you how to select an appropriate cluster tolerance for geographic data. In fact, this may be quite simple, since you should probably accept the default cluster tolerance suggested by the software when you build a topology.

The geodatabase topology model introduced at ArcGIS version 8.3 ensures that spatially coincident features within or between feature classes, like bus routes that are coincident with street centerlines, have shared coordinates that are exactly the same within the precision of the coordinate storage. This enables topological editing of coincident features; that is, if you edit the vertices of the bus route, the street changes shape, too. It also permits the use of topology rules to find spatial errors in the data, like places where a bus route is not coincident with a street.

When a geodatabase topology is created, feature vertices that are within the cluster tolerance of one another are snapped together to ensure that they have exactly the same coordinate values. This process is similar to “cleaning” a coverage in Workstation ArcInfo, but it has a significant difference; it never deletes or adds features; it simply makes them coincident. Although to do so it may create new vertices, like at the point where one line crosses another.

The default cluster tolerance is proportional to the precision of the feature dataset that contains the participating feature classes; it is approximately two times the inverse of the precision. With our example data, this would be about:

$$\mathbf{DefaultClusterTolerance} = \mathbf{2} \times \frac{\mathbf{1}}{\mathbf{Precision}} = \mathbf{2} \times \frac{\mathbf{1}}{\mathbf{111{,}319.491}} = \mathbf{0.000018}$$

In our example, the default cluster tolerance is about 0.000018 decimal degrees, which translates into about 2 meters at the equator. (We arrived at 2 meters by multiplying the default cluster tolerance by the precision). Our coordinate accuracy is 10 meters, so the default cluster tolerance is well below the stated accuracy of the data, and we would accept the default.

If you wish, you may choose to override the default with a higher value. However, you cannot enter a lower value, since the default is the minimum that the software will accept. The software also imposes a maximum limit on the cluster tolerance, which is 100,000 times the default. In our example, this would be about 1.8 decimal degrees, or over 200,000 meters!

Note that ArcCatalog issues a warning if you try to enter a cluster tolerance less than the default. However, it will appear to accept values greater than the maximum – but it doesn’t, really. When you inspect the properties of the new topology to view the cluster tolerance, you will see that the maximum permissible value (100,000 times the default) was used instead of your value.

In short, you should set your cluster tolerance to any value that is greater than the default, but less than the actual accuracy of your coordinates. In general you should simply accept the default cluster tolerance.

IN CLOSING

The process of computing the precision and x,y shift factors for geographic data is the same as that followed for projected data, differing only in that you must determine the number of map units there are in a degree of longitude at the equator when you calculate the precision.

The calculations you perform to compute the precision and shift factors, and to verify the precision and extent are all simple algebra and only take a few minutes to perform. And, for most geodatabases, need only be performed once, unless you intend to store feature classes in a variety of projected and/or geographic coordinates systems. Following the procedures outlined in this paper will result in more efficient coordinate storage and better editing and drawing performance.

Symbology

1.) Showing transparency in legend
At ArcGIS 8.3, there is no explicit tool on the ArcMap interface that can create transparent shades in the legend to match the transparency that was applied to the symbology of the layers in the map. Here is a workaround to do that:

a. In the Customize dialog, click the Commands tab.
b. Under Categories, click Page Layout. Under Commands, find the Eye Dropper tool, click, drag, and drop it on any of the toolbars of the ArcMap interface. Close the Customize dialog.
c. Click on the Eye Dropper button to activate it.
d. Move your mouse pointer and click on the first transparent shade on your map (not on the legend), for example, the pink color which is a transparent red.
e. A Color dialog appears indicating the components of this transparent color. You can right this combination down on a piece of paper if you like, but this is not necessary. When you close this dialog this transparent pink color will be added at the top row in your color palette.
f. Move to your legend, right-click on it and convert it into graphics. You will also need to ungroup the legend twice so you can pick the now red color patch and later convert it to transparent red (pink).
g. Double-click on the red legend patch to open its Properties dialog.
h. In the Properties dialog click on the color box against the Fill Color option to invoke the Color palette.
i. Pick the transparent shade you earlier created from the top row of the Color palette.
j. Your red legend patch will turn into a matching transparent red (pink).
k. Repeat steps 4 to 10 for the remaining transparent colors.

2.) Line symbols with dashed lines and patterned lines will draw more slowly than solid lines, especially with polygon boundaries.

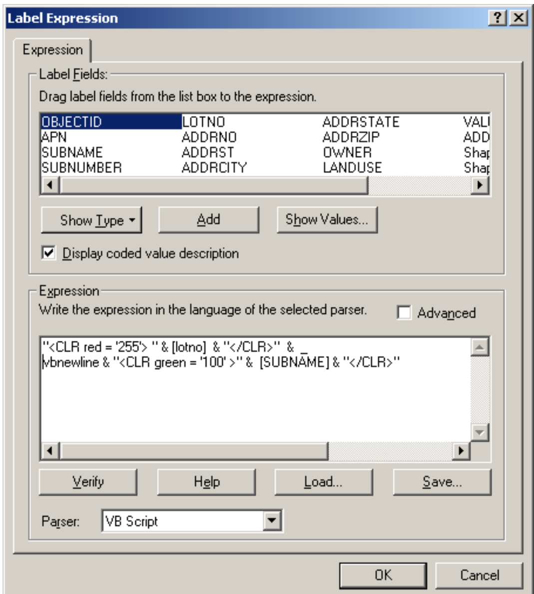
3.) Complex Polygon symbology will draw more slowly (picture fill, gradient fill, etc.).

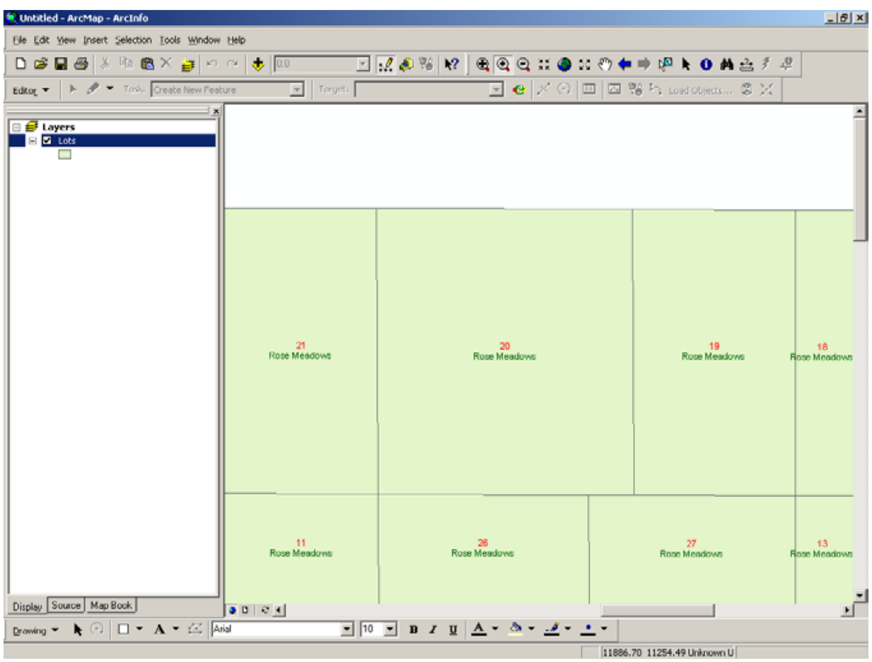
4.) Halos on a large amount of text is slow to display: use halos sparingly

5.) Formatting tags available in ArcMap

The following formatting elements and tags are supported in ArcMap:

Element description	Start tag	End tag	Valid attributes/values	Note	Example syntax	Example output
Font name and/or font size	<FNT>	</FNT>	name = {True type font} size = {1-}	Set either name or size or both	<FNT name = "Arial" size = "12">Text</FNT>	Text
Color (RGB)	<CLR>	</CLR>	red, green, blue = {0-255}	Missing attributes assumed = 0	<CLR red = "255">Text</CLR>	Text
Color (CMYK)	<CLR>	</CLR>	cyan, magenta, yellow, black = {0-100}	Missing attributes assumed = 0	<CLR magenta = "100">Text</CLR>	Text
Bold	<BOL>	</BOL>	none		<BOL>Text</BOL>	**Text**
Italic	<ITA>	</ITA>	none		<ITA>Text</ITA>	*Text*
Underline	<UND>	</UND>	none		<UND>Text</UND>	Text
All capitals	<ACP>	</ACP>	none		<ACP>Text</ACP>	TEXT
Small capitals	<SCP>	</SCP>	none		<SCP>Text</SCP>	TEXT
Superscript	[	]	none		E = mc²	$E = mc^2$
Subscript	_		none		H₂O	H_2O
Character spacing	<CHR>	</CHR>	spacing = {1-}	Expressed as the percentage adjustment to regular character spacing. 0% means no adjustment.	<CHR spacing = "200">Widely spaced text</CHR>	
Word spacing	<WRD >	</WRD>	spacing = {1-}	Expressed as the percentage of spacing between words. 100% means regular spacing.	<WRD spacing = "200">Word spacing</WRD>	
Line leading	<LIN>	</LIN>	leading = {1-}	Expressed as the adjustment to regular line spacing (in points). 0 points means no adjustment.	<LIN leading = "25">Text with a leading value of 25 points</LIN>	





6.) Does anyone know how you can make a marker symbol be a certain size based on map units?

A point is a unit of distance that equals .0137795 inch. So if you want points to equal ground distance you need to do the math!

Example: let's say you want a marker symbol to be 50 feet across at a scale of 1:100 We want to work in feet so...

1 point = .0137795 inch or 1 point = 0.0011483 foot (just divide by 12)

At 1:1000, 1 point on screen = 1000 points on the ground = 1.1483 feet on the ground (multiply by 1000).
50 / 1.1483 = 43.54, so at 1:1000 43.54 points on your map represents 50 feet on the ground.

ArcSDE

1.) What is the solution if you are stuck in "load only mode" with SQL Server?
At the SDE command line, you can run the sdelayer command with the normal_io option. (Type in sdelayer at the command line to see all of the syntax). But first you want to check out why this happened. Take a look at your database and see if the transaction log is full or if one of your datafiles is full. If it is your transaction log, then you want to back up your database before trying to put the layer in normal io. Remember when you are doing large data loads you might want to use the simple recovery option, which bypasses the transaction log for the data load. However you should not use simple recovery while your database is in production mode with other folks editing.

2.) When working with spatial views using ArcSDE, does the view utilize any column indexes that were created for the source tables? And, if so, is it better to index the view or index the source tables?

You have to index the underlying source data. The view is simply a stored query that does a SELECT statement on the underlying tables that you are referencing. You want to make sure you index the columns on the source tables -- especially index any columns you are using to do a
join.

3.) Using Topology with Versioned Geodatabases (Written By David Maguire)
The purpose of this note is to outline how to create and manage topologies for versioned geodatabases.

A database is a shared data repository. The many advantages of databases over files systems include data security, integrity, long-term persistence and multi-user access. The structure of a database is defined by the database schema (in a spatial database this is the feature classes, rules, relationships, topologies, etc.). It is a well-accepted practice that database schemas should be carefully designed to ensure fitness for purpose, good performance, and to avoid time-consuming and costly changes.

Versioning

Spatial (geographic) databases in ArcGIS are called geodatabases. ArcGIS uses a technique called versioning to implement several key GIS requirements: multi-user database access, long transactions, management of design alternatives, distributed databases (disconnected editing and replication) and history (temporal feature representations). In simple terms a version is a database state that contains information about changes to the original database. For example, David's version could contain the land parcel changes made by David as part of a sub-division re-survey, and Andy's version could contain some parallel edits made by Andy to easement and right of way features covering the same parcels. Because David's and Andy's versions of the database are derived from a common ancestor (the original or default version) they are said to be child versions. In order to maintain a single, shared view of the database, it is necessary at some point in time (at the user's discretion) to merge (post) the changes in David's and Andy's versions back into the default version. As part of this process any conflicting changes (that is updates to the same features) need to be reconciled before they can be posted so that the default version maintains data integrity (is correct).

Topology

Geodatabase topologies define a series of validation checks that establish specific structures and relationships for database features. For example, a topology built for parcels and easement-right of way feature classes could check that all parcels in the parcels feature class do not have gaps or overlap, or that all easement and right of way features in the easement-right of way feature class cover parcels.

In the case of the versioning example discussed above two workflows can be implemented to check the topological validation of the versions. First, topology can be validated on each of the versions to check for errors. David's and Andy's versions are then posted to the default, as described above. The default version, which now contains new data, will also have to be validated to check for possible errors. Alternatively, the data in the two versions can be posted and then topology validated for the default version.

Schema changes

The versioning and topology discussion above assumes normal operation of a geodatabase with a consistent structure (schema). As projects evolve over time it is to be expected that some changes to a database structure will be needed. In ArcGIS schema changes can be split into two types: minor (such as adding and deleting fields [attributes] or adding/removing relationship rules) and major (such as changing the topology cluster tolerance or a network weight). A fuller list of minor and major schema changes is provided at the end of this document. Minor changes can be implemented simply while a database is in full use, that is, there are multiple versions in the database. However, major schema changes can have significant cascading impacts on versions and affect database performance. Thus it is necessary for major schema changes to be performed after all affected versions have been reconciled and posted to the default version, and the database is in single user mode.

One other issue of note with schema changes and topology is exception handling. Exceptions are used to mark features that topology rules do not need to re-validate. Errors found in a topology can be marked as exceptions, which are saved in the database. Exceptions can be displayed and queried in the same manner as rules. At 8.3, when a database is brought back to single user mode for major schema changes, to avoid losing exceptions a Developer Sample tool is available for saving exceptions out of the database. This tool will be included in the core software in a future release.

Suggested topology workflow for versioned geodatabases

Given that major schema changes require the participating feature classes to be unversioned, such changes should be minimized and careful planning is required for their implementation. We strongly recommend, therefore, in keeping with good practice for any spatial or non-spatial database, that the database schema is well designed at the outset of a project. A good database schema will be one that matches current business practices, has sufficient in built flexibility to address future business requirements, and is optimized to support typical GIS queries with satisfactory performance. Good database schemas do not evolve into being; they are derived from detailed design studies that build on best practices in data modeling, and are tested by using prototypes. A prototype is an implementation of a useful subset (selected structures and/or data) used to test the validity of the full design. Users should be willing to discard a prototype in favor of an alternative design, and it is common practice to implement multiple prototypes, before an acceptable solution is found.

Handling History

Database versioning allows users to maintain a record of changes to a database (history). A version can be thought of as the state of a database at a particular point in time (for example, after addition of a new sub-division, or a re-survey of the road network, or the status of all assets at the end of the financial year). Because it is not practical for geodatabases to have versions with different schemas, geodatabases, which manage history, must have historical versions copied (archived) to a geodatabase (personal or enterprise) with the historical schema when major schema changes need to be performed on the production database. Minor schema changes can be made to the database without impacting historical versions. There are standard tools to copy both the schema and data out of the database.

Appendix: Types of Schema Change

Minor – no requirement to unversion geodatabase

- Adding and dropping fields
- Adding and dropping simple feature classes (those that do not participate in a topology or network)
- Adding and dropping tables
- Creating and deleting relationship classes
- Creating and deleting attribute domains
- Creating and deleting subtypes
- Changing the default value for an attribute of a given class or subtype
- Changing the attribute domain for an attribute of a given class or subtype
- Create and drop indexes for an attribute of a given class
- Alter the spatial index for a given feature class
- Adding an empty feature class to a network
- Adding and removing relationship rules
- Adding and removing network connectivity rules
- Alter the alias name for classes or fields

Major – must unversion geodatabase

- Adding or removing weights to a network
- Removing a feature class from a network
- Adding or removing a feature class to a topology
- Adding or removing topology rules
- Altering a topology's cluster tolerance
- Altering the rank for a feature class in a topology

Rasters

Questions and Answers concerning ArcGIS Raster Data Management and Display

Rasters in the shipped UI

Display issues

1) I am trying to display my raster image, but my display looks terrible (often too dark or blurry), is there any way to fix the display?
    a. Try calculating statistics, so that the renderer is able to display your raster dataset appropriately
    b. Try building pyramids so that each level can properly (and quickly) display the appropriate level of information
    c. Change the Stretch in the Symbology Tab, so that the display can show the best contrast between similar digital numbers
    d. It may be possible that the data is all black – use the identify tool to check
2) I have a fairly large raster dataset that is taking forever to display. Is there any way to speed up the process?
    a. Obviously larger dataset take longer to display, since there is usually more information that the program has to read and display. You can build pyramids for these larger file, so that the appropriate reduce resolution dataset will be displayed. The .rrd is the file where the reduced resolution dataset information is stored
3) My raster dataset has a black outline around the image, what is it, and how do I get rid of this?
    a. Most imagery (especially satellites) records the imagery as a parallelogram rather than a square (due to the Earth turning while the satellite is scanning). The areas that have no information are there as the background. We can get rid of the background (as long as it is all the same digital number) by setting the background value to be transparent, in the symbology tab.
4) Why is my multi-band raster dataset using different colors on my computer versus someone else's computer?
    a. We are able to set the default band combinations for multi-band rasters. Make sure the proper bands are being used in the default.
5) I have a raster catalog, but none of the images are showing up, just a bunch of rectangles, why is this occurring and how do I get my raster datasets to display?

    a. The wireframe appears when more than 9 raster datasets are in the display at once; this is done to save time in case many raster datasets are in the display
    b. We can change these setting either permanently or temporarily. To make more raster datasets appear by default, we can adjust the catalogDefaultDrawImages in the registry. To make more raster datasets appear for this particular catalog, there are several settings in the Display tab of Properties
6) How do I set my value ranges for my classified renderer? The value ranges do not seem to change when I click them, but I can change the labels without a problem.
    a. In order to change the class ranges for the classified renderer, you must click the classify button
7) I am trying to make my raster landuse dataset transparent, so that I can see the hillshading underneath, but the raster just won't become transparent
    a. Make sure that the proper layer is in the dropdown box for the Effects toolbar
8) Why don't you have an enhancement so that the user can see how the slider bar (in the effects toolbar) is affecting the raster layer?
    a. In Properties under the Display Tab, there is a checkbox for "allow interactive display for the effect toolbar". Check this box if you would like the slider to immediately update your raster while you are still adjusting the slider

<u>Raster Georeferencing</u>

1) I have two raster datasets added into ArcMap, but the display is still blank. Why?
    a. Zoom to layer, to make sure that the image does exist
    b. Make sure the two images both have a coordinate system
    c. Check to see if the image is just a blank image
2) I have a worldfile for my raster dataset, but it is not being used. Why?
    a. Internal georeferencing takes precedence over a world file
    b. Change the setting in the registry so that the worldfile takes precedence
3) How do I set a spatial reference?
    a. Use the Edit spatial reference button from ArcCatalog
    b. Wait long enough for the program to write the spatial reference to the file – sometimes we need to exit ArcCatalog and wait
4) I have am trying to georeference my raster dataset, but none of the links are making the image line up. What I am doing wrong?
    a. Have the links go from unreferenced to referenced
    b. Check to make sure the right layer is in the drop down
    c. Make sure that auto-adjust is on
5) I have georeferenced my raster dataset, but the results of the georeferencing look inaccurate (i.e. RMS or visually off). Is there any way to fix this?
    a. Zoom in a little further when selecting all your links, so that they are accurate
6) Why can't I rotate/shift my raster in ArcMap, it is grayed-out.
    a. If the image is projected on the fly, you are not able to rotate or shift the raster dataset
    b. If at least one link has been added to layer being georeferenced, rotate/shift will not be allowed

7) Defining a spatial reference (In ArcCatalog) for raster data does not project raster, only adds a spatial reference tag in the dataset, it does NOT re-project the raster data.
8) At 8.3, we can re-project raster data using the ProjectFast method using the IRasterGeometryProc interface. We have a project that will deliver this without the limitations (describe below in #9) in a future version.
9) Rasters can be projected on-the-fly at 8.x, but you need to limit the extent that you are trying to use. Additionally, for most projections the current implementation works for data within the +70 and –70 degree latitudes.

<u>File Information</u>

1) How do I convert my raster dataset into a different format?
    a. In ArcCatalog, right click on the raster dataset, then point to Export, and then click on raster to a different format. This gives you the option to export your file to either an ESRI grid, Erdas imagine, or TIFF file (or SDE).
2) I converted my BMP raster dataset into a MrSID raster dataset, and now my values seem to be different than the original data.
    a. When raster data is saved with a lossy compression (e.g. JPEG, MrSid), some of the value will be changed, so that a better compression ratio can be reached
3) Most file formats do not allow you to have a raster dataset over 2GB, what do I do?
    a. The Erdas Image format will allow the user to save raster dataset that are greater than 2GB in size. When you convert a file over 2GB to an Imagine format, an IGE file is created, which stores the information. The IMG file acts as a pointer to the IGE file.
4) My AUX file is not being written out, even though I have already calculated stats, built pyramids, or georeferenced my image
    a. The folder that the raster dataset is in may be read-only. In this case, all the AUX information is written out to the proxy file instead.
5) Why is my RRD file larger than my actual file? I thought RRD files tend to be 8% of the original file size.
    a. Usually the RRD file is 8% of the original file size, however if your original data is compressed, it is possible to have your RRD larger than your original compressed data.
6) Why can't I save a raster dataset or catalog into a personal geodatabase?
    a. We are able to do so in ArcGIS 9.0.

<u>**Raster ArcObjects programming**</u>

1.) Create default raster only creates a Raster that has first three bands. In 8.3, we need to co-create a Raster and append all raster bands. In 9.0, there will be a convenient method (IRasterDataset2::CreateFullRaster) to do that.

```
‘ This create a Raster with first 3 bands
    Set pRaster = pRasterDataset::CreateDefaultRaster

 ‘ In 8.x, to create a Raster with all bands
    Dim pRaster as IRasterBandCollection
    set pRaster = New Raster
    pRaster.Appends pRasterDatasets
```

```
‘ In 9.0, we can do
   Dim pRasterDataset as IRasterDataset2
‘ Create pRasterDataset from an image file or raster in sde, then
   set pRaster = pRasterDataset.CreateFullRaster
```

2.) A common sense approach for people wanting to clip a raster is to change the extent of the Raster object. However, when you change the Raster' extent, the Raster's column and row are not changed, the smart raster will use the new extent and the old column and row, you will get a raster with the small extent but same file size. To do it correctly, you also need to set the col/row to the raster after changing the extent.

```
 ‘ Set Raster's extent
     Set pRasterProp.Extent = pClipExtent
‘ Calculate the column and row of the output raster,
‘ then Raster's width and height
     pRasterProp.Height = NewRow
     pRasterProp.Width = NewColumn
```

Rasters in ArcSDE

1.) When should I start to use ArcSDE for my Raster data?

- Are you using ArcSDE already? The benefit of having all data in one location is very strategic.
- Are you struggling with multi-user access issues?
- Are you disappointed with file-based raster display speeds? Raster Datasets offer fast display at any resolution.
- Do you plan on distributing the data, sharing the data, selling the data? ArcSDE Rasters provide an excellent means of stitching together all data into one large mosaic to be cut randomly from, plus it can store the data compressed in a lossless fashion. Raster Catalogs offer an excellent storage mechanism for individual raster datasets designed to be displayed together, without having to mosaic the data into one large chunk.

2.) Why not just use my file-based rasters or make a few big MrSIDs?
This is a great solution for many clients who don’t need the multi-user, or mass-storage capabilities afforded by the ArcSDE Raster solution. The benefits are really seen for the same reasons you would use ArcSDE for vector data.

3.) When mosaicking rasters with colormap, if all the colormaps are the same, the colormap can be dropped and then added back to the raster dataset at the end. If the colormaps are not all the same, then you can load your raster data as RGB, so that all the colors can be represented in a multi-band fashion, rather than a single band fashion. This latter choice will increase disk usage.

4.) When mosaicking rasters with different properties (bit depth...), ensure that you make an empty Raster Dataset which can hold all of the different ranges.

5.) Do not build pyramids/stats before mosaicking completes, or you will be doing this over and over again for each newly added raster dataset. Version 9.0 will take care of this problem with our partial pyramid updating implementation.

6.) If you build statistics on an already stretched raster dataset, the display for ArcSDE raster will differ from that of the original file. If this occurs drop the statistics from the raster dataset in ArcSDE (using command line).

Scripts and Codes

1.) Adding functionality from ArcObjects Developer Kit Samples is another kind of customization. These tools can be installed in several different ways, however, depending on what each is implementing. For example, some are added as tools to a toolbar, others are added in context sensitive menus, and still others require 'assignment' from the Component Category Manager. But, all will require using the Add from File button on the Customize menu to search for the directory in Samples that contains the functionality of interest.

The first step in a proper installation is to read the documentation provided with the sample tool.

1) If there is a reference to a _INSTALL.BAT file, *use the one that is in the same directory as the sample tool*. There are dozens of _INSTALL.BAT files distributed among the sample tools; be certain you are running the one specific to the tool you wish to install.
2) If there is a reference to the Category Manager, you can access it from …\arcgis\arcexe83\bin\categories.exe and make a shortcut for the desktop. Use the Category manager to assign the tool's functionality into a group of similar functionalities. Be careful when locating the categories; several have similar names. For example, the **Parcel Split and Combine** sample requires the following use of the Category Manager:

a. Register the ParcelNGExt class under the ESRI Editor Extensions category.
b. Register the ParcelNGBar class under the ESRI Mx CommandBars category.
c. Register the SplitWiz and CombineWiz classes under the ESRI Mx Commands category.

3) If there is a reference to context sensitive menus, then first add those from the Customize menu to the current Map document. Next, scroll through them until the one specified in the sample help is found. Then, add the new context sensitive functionality, available from the Developer Samples category in the Customize menu.

Please note that some of tools will yield an additional tab, such as the DSMapBook, which adds a tab named **Map Book** next to the **Source** and **Display** tabs in ArcMap. Or the Snap to Center of Polygon snap agent, which adds a check box in the snapping men , indicating its presence.

And, finally, when using the Customize menu, don't forget to specify whether your additions are to go to normal.mxt, to another named template, or to the current map document.

2.) Create Layer Files
This sample creates layer files for each selected feature layer in the ArcMap Display table of contents.

http://arcobjectsonline.esri.com/default.asp?URL=/arcobjectsonline/samples/arcmap/layers/create%20layer%20files/createlayerfiles.htm

3.) Displaying, Granting, and Revoking User Privileges
This tool is designed to work within ArcCatalog and expands upon the out-of-the box functionality for granting and revoking user privileges to Enterprise Geodatabase objects. It only supports Oracle and SQLServer as the underlying RDBMS to ArcSDE. The tool allows you to see who has what privileges on a specific object based on editor (select, insert, update, delete) and viewer (select) privileges. Further the tool allows you to pick from available users and roles to grant and revoke privileges. To install unzip the file and run the included setup.

http://arcscripts.esri.com/details.asp?dbid=12936

4.) Editor Log
The purpose of the Editor Log is to give users a method for storing editing environments. Once stored, these environments can be used to quickly execute editing processes in ArcMap. For instance, when the task is to create a new building, the user needs to set the target layer, the edit task, the snapping environment, and activate the Sketch Tool. By storing these settings in an edit environment, everything can be set with a single button click. Editing environments can consist of one or all of the following settings: current tool or command, current task, target layer/subtype, snapping environment, selectable layers, and visible layers.

http://arcobjectsonline.esri.com/ArcObjectsOnline/Samples/Editing/Editor%20Extensions/EditorLog/EditorLogPrj.htm

5.) Parcel Extension
The parcel extension is a toolbar that provides the user with various tools to edit their parcels. It includes wizards to split and combine parcels, handling the parcel line maintenance and acreage calculations for the user. It also provides functionality to bring your CAD drawings into your existing feature classes. There are additional tools to automate the creation of annotation and make the placement and formatting of annotation easier using the place annotation, bulk annotation and lot annotation tools.

http://arcscripts.esri.com/details.asp?dbid=12745

6.) Selection Tab-a-nator
Use this script to make the selection tab in the table of contents "on" in all of your mxd's. This script also turns-off the automatic creation of thumbnails of your mxd when you save your document.

http://arcscripts.esri.com/details.asp?dbid=12729

7.) Shadow Renderer Tool
Is it possible to give a point, line, or poly a drop shadow?

1. Copy the geometry of all your features (use Union) to a single feature in a new feature class. Then just offset the feature in the X and Y by choosing to move the feature (Editor>Move). Then you can just symbolize the feature under the existing feature with a black symbol to give you a drop shadow.
2. You can create an additional offset layer to your symbol design that will simulate the drop shadow. You do this in the Symbol Property Editor.

3. Use the graphics tools for this. You have to play with the shapes to get them the way you like them though.
4. Shadow Renderer Code - The Shadow Renderer adds a 3D effect to polygon layers in ArcMAP.

http://arcscripts.esri.com/details.asp?dbid=12449

8.) Shapes to Points
Formerly known as "Lines to Points", this form driven tool has been generalized to export the vertices of features in the selected point, polygon or line shapefile to a delimited ASCII table. This conversion enables the transfer of shapefile vector point, lines, or polygons to an interchangeable XY flat file format.

For each feature in the shapefile the XY coordinate of each vertex (or point), along with the ID of the parent feature and one additional attribute field (if designated), are written to an ASCII file. If an attribute field is chosen to be included in the export the user may optionally also pick a value for this field to exclude from export. The available values to exclude are dynamically generated from the domain of all values in the shapefile.

http://arcscripts.esri.com/details.asp?dbid=12666

9.) Tested Printer Guide
This document lists the various printing devices we have tested here in-house at ESRI in their ability to work successfully with ArcGIS 8x, ArcInfo Workstation 8x, and ArcView GIS 3x.

http://support.esri.com/index.cfm?fa=knowledgebase.whitepapers.viewPaper&PID=43&MetaID=387

10.) Topology Rules
The attached file will install Topology Rules Documentation.

http://arcscripts.esri.com/details.asp?dbid=12767

11.) Zipper Task
This sample allows features within a user specified tolerance to be snapped to the edit sketch. Using the sketch tool a polyline sketch is created. When the sketch is finished, a dialog appears asking for a tolerance and the layers to be adjusted. Features from the specified layers that fall within the tolerance are then aligned to the geometry of the sketch.

http://arcobjectsonline.esri.com/default.asp?URL=/arcobjectsonline/samples/editing/edit%20tasks/zipper%20task/zippertask.htm

12.) Using the field calculator, the following code populates a field with consecutive numbers represented by a constant length string. The starting number, the step size and the length of the string can be adjusted.

....
```
      Static rec As Long
      Dim lStart As Long
      Dim lInterval As Long
      Dim i As Integer
      Dim iStringLength As Integer
      Dim sID As String
      '============================
      'set the variables bellow
      iStringLength = 7
      lStart = 1
      lInterval = 1
      '============================
      sID = ""
      If (rec = 0) Then
        rec = lStart
      Else
        rec = rec + lInterval
      End If
      For i = 1 To iStringLength - Len(CStr(rec))
        sID = sID & "0"
      Next i
      sID = sID & CStr(rec)
```
....

13.) Another useful field calculation script is this DMS2DD conversion **-** A DMS string in virtually any format is accepted. Any character delimiter except "." (used as a decimal point) can be used. The letters "E", "W", "N" & "S" are used to determine the location of the Lat/Long coordinate. They can be used as delimiters, but the last occurrence of the letter in the DMS string will define the sign of the coordinate. The expression checks for validity of the DD coordinate - all the valid Longitudes should be between -180.00 and 180 degrees. If you want to check for Latitude validity you have to replace these values to -90.00 to 90 degrees. The records with string values that the expression could not standardize will be assigned a value of 0.00.

....
```
      Dim sField
      Dim sDMS As String, sS As String, sSuf As String
      Dim sList
      Dim i As Integer, j As Integer
      Dim iDec As Integer, iNum As Integer
      Dim dD As Double, dM As Double, dS As Double, dDD As Double
      Dim bReplace As Boolean
      '=============================
      'Change the source field name bellow
      sField = [Long]
      '=============================
      sDMS = sField
      If Len(Trim(sDMS)) = 0 Then
        dDD = 0
      Else
        iDec = 0
        iNum = 0
        For i = 1 To Len(sDMS)
          sS = Mid(sDMS, i, 1)
```

```
    If Not IsNumeric(sS) Then
      If sS = "." Then
        If Not iDec = 0 Then
          bReplace = True
        Else
          bReplace = False
        End If
        iDec = iDec + 1
      ElseIf UCase(sS) = "S" Or UCase(sS) = "N" Or UCase(sS) =
"W" Or UCase(sS) = "E" Then
        sSuf = UCase(sS)
        bReplace = True
      Else
        bReplace = True
      End If
      If bReplace Then
        If iNum > 0 Then
          Mid(sDMS, i, 1) = ","
        Else
          Mid(sDMS, i, 1) = " "
        End If
      End If
    Else
      iNum = iNum + 1
    End If
  Next i
  sList = Split(sDMS, ",")
  Dim iLen As Integer
  If UBound(sList) = 0 Then
    sDMS = sList(0)
    iLen = Len(sDMS)
    If iLen >= 4 Then
      dS = CDbl(Mid(sDMS, iLen - 1, 2))
      dM = CDbl(Mid(sDMS, iLen - 3, 2))
      sDMS = Left(sDMS, (iLen - 4))
      If (Len(sDMS) > 2) Then
        dD = CDbl(Right(sDMS, 3))
      ElseIf (Len(sDMS) = 0) Then
        dD = 0#
      Else
        dD = CDbl(sDMS)
      End If
    Else
      dDD = 0
    End If
    dDD = dD + dM / 60# + dS / 3600#
  Else
    j = 0
    dD = 0#
    dM = 0#
    dS = 0#
    For i = 0 To UBound(sList)
      If IsNumeric(sList(i)) Then
        If j = 0 Then
          dD = CDbl(sList(i))
          j = j + 1
        ElseIf j = 1 Then
```

```
            dM = CDbl(sList(i))
            j = j + 1
          ElseIf j = 2 Then
            dS = CDbl(sList(i))
            j = j + 1
          End If
        End If
      Next i
      dDD = dD + dM / 60# + dS / 3600#
    End If
    If dDD < -180# Or dDD > 180# Then
      dDD = 0#
    End If
    If sSuf = "S" Or sSuf = "W" Then
      dDD = dDD * -1#
    End If
  End If
..........................................................
```

14.) File Extensions
The following is a list of File extensions for ArcGIS and ArcPad related files:

```
ArcGIS
.aux -- Raster auxilliary file
.asa -- ArcScene animation track
.avi -- Windows animation file
.cal -- Field calculator expression
.rul -- Topology rules
.rrd -- Raster pyramid file
.sxd -- ArcScene document
.**w -- raster world file

ArcPad
.apa -- ArcPad applet
.apm -- ArcPad map
.apx -- ArcPad configuration
.apl -- ArcPad layer for a shapefile
.vbs -- VB Script
```

Internationalization

1.) Using Foreign Characters in ArcGIS
What do I need in order to display a multilingual dataset in ArcGIS Desktop? First of all, you have to be on an operating system that supports Unicode, -- preferably Windows XP as it supports the largest number of languages. Secondly, you need a Unicode font that supports various languages and characters. It is important to note that not all Unicode fonts contain all of the characters defined by the Unicode standard.

For example, the core fonts for Windows (Arial, Times New Roman and Courier New) use the Unicode encoding for the characters, but contain only the characters that are required for Western, Central, and Eastern European languages, Cyrillic and Greek. Microsoft calls this the Pan-European character set (also known as Windows Glyph

List 4). The WGL4 standard contains 652 characters, and incorporates code pages 1250 (Eastern Europe), 1251 (Cyrillic), 1252 (US English = ANSI), 1253 (Greek), and 1254 (Turkish).

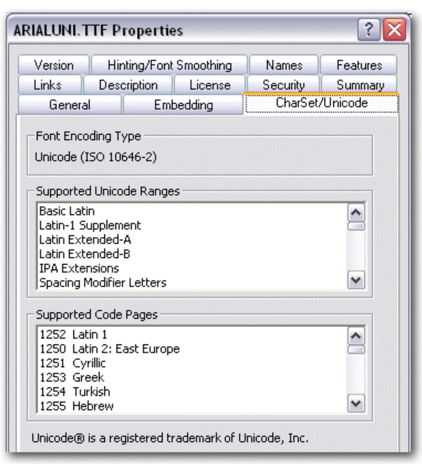
Note: a code page is a list of selected character codes in a certain order. Code pages are usually defined to support specific languages or groups of languages, which share common writing systems.

Office 2000 and 2002 include Arial Unicode MS, which contains 50,377 glyphs of the Unicode standard version 2.1. Arial Unicode MS is supplied with Office 2000, FrontPage 2000 and Office 2000.

Allan Wood's Unicode Resource site is a good place to visit for a list of Unicode fonts available for Windows: http://www.alanwood.net/unicode/fonts.html

You can also find out if the Windows fonts you have support Unicode by using Microsoft's Font Properties extension. This extension adds several new property tabs to the existing font's properties dialog box that is available when a TrueType (.TTF) font file is right-clicked in Windows Explorer. This extension provides statistics on the number of glyphs and on the Ranges and Code Pages that are supported. The extension is available from:

http://www.microsoft.com/typography/property/property.htm



2.) Supported languages in ArcGIS

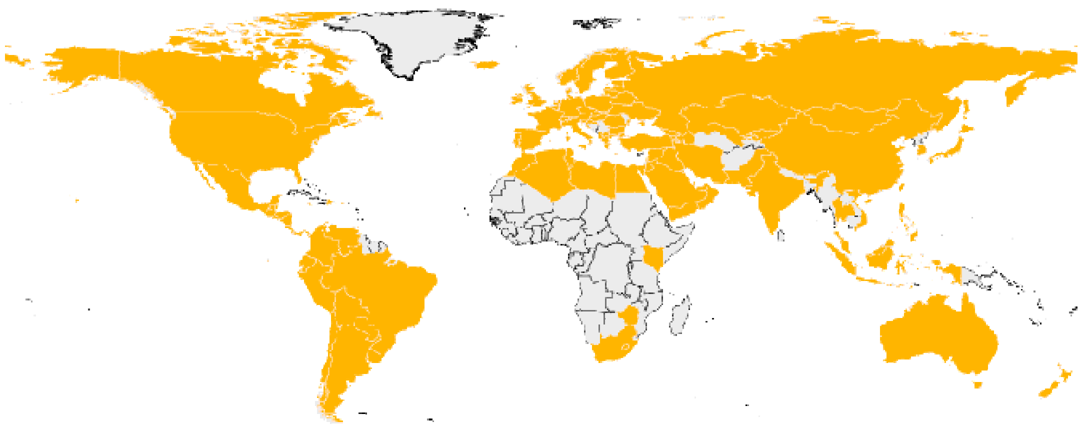
ArcGIS Desktop (ArcMap and ArcCatalog) can support 72 languages and 135 locales when Personal GeoDatabase is used on Windows XP. Below are the 72 languages:

Afrikaan, Albanian, Arabic, Armenian, Azeri (Cyrillic), Azeri (Latin), Basque, Belarusian, Bulgarian, Catalan Chinese (Simplified), Chinese (Traditional), Croatian, Czech, Danish, Divehi, Dutch, English, Estonian, Faroese, Farsi, Finnish, French, Macedonian, Galician, Georgian, German, Greek, Gujarati, Hebrew, Hindi, Hungarian, Icelandic, Indonesian, Italian, Japanese, Kannada, Kazakh, Konkani, Korean, Kyrgyz, Latvia, Lithuanian, Malay, Marathi, Mongolian, Norwegian (Bokmål), Norwegian (Nynorsk), Polish, Portuguese, Punjabi, Romanian, Russian, Sanskrit, Serbian (Cyrillic), Serbian (Latin), Slovak, Slovenia, Spanish, Swahili, Swedish, *Syriac, Tamil, Tatar, Telugu, Thai, Turkish, Ukrainian, Urdu, Uzbek (Cyrillic), Uzbek (Latin), and Vietnamese*

A locale is a set of user preference information related to the user's language, environment and/or cultural conventions, --either a language or a language in combination with a country. This information is represented as a list of values used to determine the correct input language, keyboard layout, sorting order, and the formats used for numbers, dates, currencies and time. For example, English is used in both *the United Kingdom* and *the United States,* but the locales are different. This is because some of the locale settings such as the currency symbol and time format differ.

Windows NT 4, Windows 2000 and Windows XP are all based on Unicode, but the number of languages supported by each operating system varies, -- XP has the most extensive support.

The countries in orange show the locales supported in ArcGIS Desktop and Personal Geodatabase.

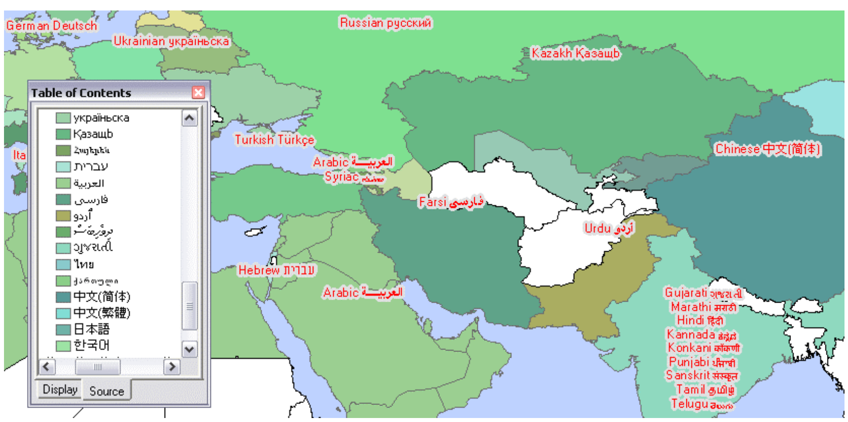


These are the supported locales:

Afrikaans, Albanian, Arabic (Algeria), Arabic (Bahrain), Arabic (Egypt), Arabic (Iraq), Arabic (Jordan), Arabic (Kuwait), Arabic (Lebanon), Arabic (Libya), Arabic (Morocco), Arabic (Oman), Arabic (Qatar), Arabic (Saudi Arabia), Arabic (Syria), Arabic (Tunisia), Arabic (U.A.E.), Arabic (Yemen), Armenian, Azeri (Cyrillic), Azeri (Latin), Basque, Belarusian, Bulgarian, Catalan, Chinese (Hong Kong S.A.R.), Chinese (Macau S.A.R.), Chinese (Simplified_PRC), Chinese (Singapore), Chinese (Traditional_Taiwan), Croatian,Czech, Danish, Divehi, Dutch (Belgium), Dutch (Netherlands), English (Australia), English (Belize), English (Canada), English (Caribbean), English (Ireland), English (Jamaica), English (New Zealand), English (Philippines), English (South Africa), English (Trinidad), English (United Kingdom), English (United States), English (Zimbabwe), Estonian, Faroese, Farsi, Finnish, French (Belgium), French (Canada), French (France), French (Luxembourg), French (Monaco), French (Switzerland), FYRO Macedonian, Galician, Georgian, German (Austria), German (Germany), German (Liechtenstein), German (Luxembourg), German (Switzerland), Greek, Gujarati, Hebrew, Hindi, Hungarian, Icelandic, Indonesian, Italian (Italy), Italian (Switzerland), Japanese, Kannada, Kazakh, Konkani, Korean, Kyrgyz (Cyrillic), Latvian, Lithuanian, Malay (Brunei Darussalam), *Malay (Malaysia), Marathi, Mongolian (Cyrillic), Norwegian (Bokmal), Norwegian (Nynorsk), Polish, Portuguese (Brazil), Portuguese (Portugal), Punjabi, Romanian, Russian, Sanskrit, Serbian (Cyrillic), Serbian (Latin), Slovak, Slovenian, Spanish (Argentina), Spanish (Bolivia), Spanish (Chile), Spanish (Colombia), Spanish (Costa Rica), Spanish (Dominican Republic), Spanish (Ecuador), Spanish (El Salvador), Spanish (Guatemala), Spanish (Honduras), Spanish (International Sort), Spanish (Mexico), Spanish (Nicaragua), Spanish (Panama), Spanish (Paraguay), Spanish (Peru), Spanish (Puerto Rico), Spanish (Traditional Sort), Spanish (Uruguay), Spanish (Venezuela), Swahili, Swedish, Swedish (Finland), Syriac, Tamil, Tatar, Telugu, Thai, Turkish, Ukrainian, Urdu, Uzbek (Cyrillic), Uzbek (Latin), and Vietnamese*

The reason why Personal Geodatabase can support so many languages is because Microsoft Access, the underlying database used by Personal Geodatabase, stores data in Unicode. The current version (3.2) of the Unicode Standard, developed by the Unicode Consortium, contains more than 95,000 characters, covering the scripts of the world's principal written languages and many mathematical and other symbols. Not only does Unicode include most of the characters of the common character sets, but it also gives you the ability to display them all at once, as long as you have the environment to support it. The image below shows ArcMap displaying several language names in their native writing systems.

3.) How to Display Multilingual data in ArcGIS Desktop:
ArcMap: Attribute Table > Options > Appearance > Table tab > Table Font
ArcMap: Tools > Options > TOC tab > Appearance
ArcMap: Layer Properties > Labels tab > Symbol... > Font List under Options
ArcCatalog: Tools > Options > Tables tab > Table Font



ArcGIS 9.0

ArcGIS 9 is the next major release of the ArcGIS system. ArcGIS 9 will extend the current platform with major new capabilities in the areas of geoprocessing, 3D visualization, and developer tools. Two new products, ArcGIS Engine and ArcGIS Server, will also be launched. To find out more about ArcGIS 9.0, please visit:

http://www.esri.com/software/arcgis/arcgis90.html