Geog 458: Map Sources and Errors
January 13, 2006

Lab 1: Exploring data format

Data format supported by ArcGIS

There are many file types supported by ArcGIS, in addition to specific cartographic objects. A fundamental goal of ArcGIS is to work with all file-based data and Data Base Management Systems (DBMS) data. ArcGIS lets the user work with an extensive array of data sources. In this lab we will introduce you to what some of the many are. Among the more difficult tasks for the first time user of ArcGIS is keeping track of the object types, file types and directory structures. It is also important to understand how database structures are organized within a GIS so that you have a basic understanding of how you may search for and manipulate the data contained in the database.

ArcGIS supports many different file formats. For example, you may need to use satellite imagery, or other compatible file types. For imagery, the following types are supported by the program:

Format	Extension(s)
Arc Digitized Raster Graphics (ADRG)	*.img or *.ovr
Band Interleaved by Line (ESRI BIL), Band Interleaved by Pixel (ESRI BIP), Band Sequential (ESRI BSQ)	*.bil, *.bip, or *.bsq
Bitmap (BMP), Device-Independent Bitmap format (DIB), or Microsoft Windows Bitmap	*.bmp
Compressed ARC Digitized Raster Graphics (CADRG)	no standard file extension
Controlled Image Base (CIB)	no standard file extension
Digital Terrain Elevation Data (DTED Level 1 & 2), and Digital Elevation Model	.dt1, .dem
ER Mapper	usually same as header

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|	file without the *.ers extension
Graphics Interchange Format (GIF)	*.gif
ERDAS 7.5 GIS	*.gis
ESRI GRID file format (ESRI GRID)	Directory
ESRI GRID Stack	Directory
ESRI GRID Stack file	*.stk
ERDAS IMAGINE file	*.img
JPEG File Interchange Format (JFIF)	*.jpg, *.jpeg, *.jfif
ERDAS 7.5 LAN	*.lan
Multiresolution Seamless Image Database (MrSID)	*.sid
Spatial Database Engine Raster file format (ArcSDE Raster)	Stored in SDE database
Tag Image File Format (GeoTIFF tags are supported) (TIFF)	*.tif, *.tiff, *.tff
ERDAS Raw	*.raw
Portable Network Graphics (PNG)	*.png
National Image Transfer Format (NITF)	*.ntf

Representing geography & data collection

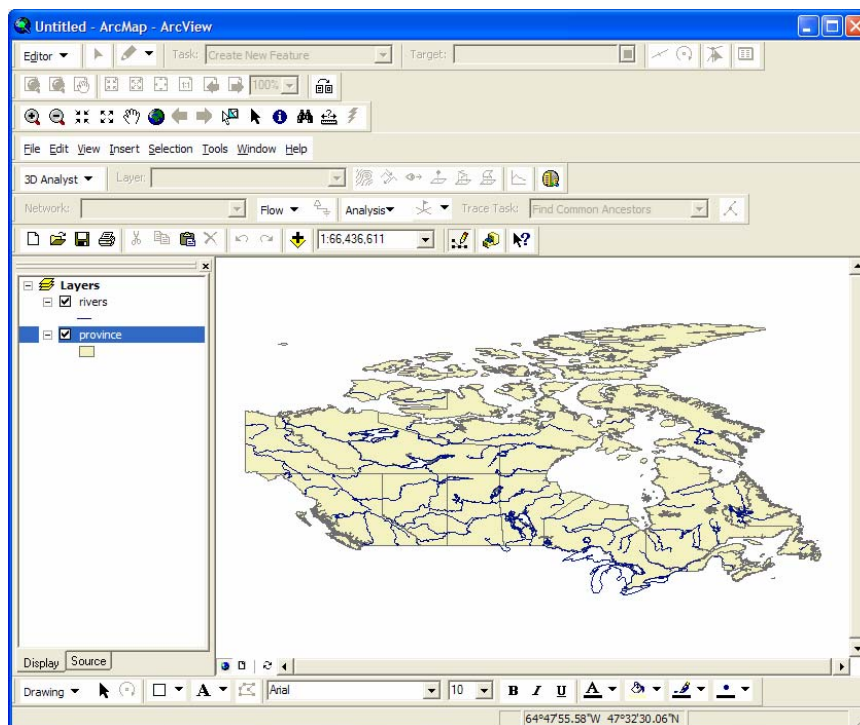Start ArcMap (choose Start – All Programs – ArcGIS – ArcMap)

Choose A new empty map and then click OK button
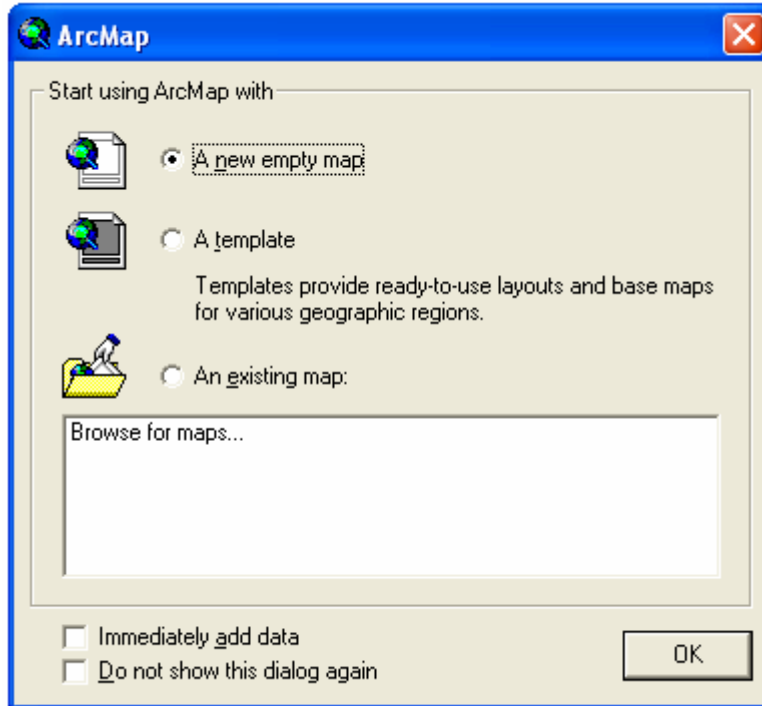
In your new map document, click the add data button and navigate to the c:\ESRI\ESRIDATA\Canada directory and select the rivers.shp file. Click "Add" to place it in your map document. The *shapefile* is one of the most basic types of object file structures used in ArcGIS. It might be useful to examine what some of these basic file types are all about. Rather than having you try to look at all of them, instead use the help pull down menu and, using the help index, search by topic first for "shapefiles, described." When you click on it you will receive a wealth of information (probably more than you can digest in a single sitting). You should remember the help file for future reference as it addresses most questions that you can think of about the program, as long as you use the correct terminology. You should notice that shape files come in a number of types. Examine, for example, a point and a line. We will look at polygons in our review questions at the end of the lab. Relate this information to what you have learned in your class, especially regarding dimensionality, and how these forms of the shape file are developed (e.g. a line being composed of at least two point locations). You now have the ability to search for any number of file types or for other information as you need.
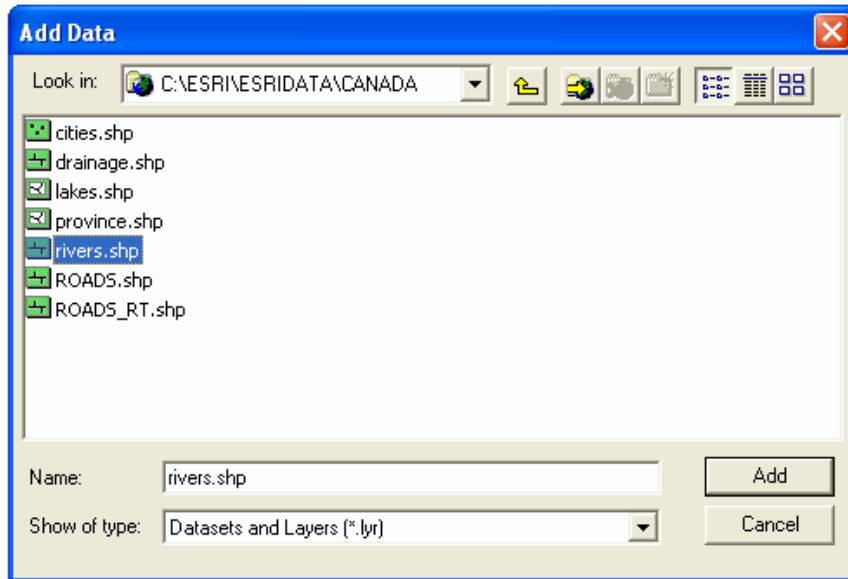
 Now that you have added the **rivers.shp** file to your map, think about the probable source of this information. Do you think that it was from surveyed data or input from an existing document? In other words is this collected through primary data capture or secondary data capture methods? Add another theme such as the **province.shp**. Again ask yourself whether this is created by direct measurements (e.g. remote sensing, survey) or this is input from paper maps?

This lab is adapted from lab materials provided by Demers MN, 2005, Fundamentals of Geographic Information Systems, 3rd Edition, John Wiley & Sons.

Examine the tables associated with the province.shp. To do this, right click on the province layer name in your map documents TOC, and select "Open attribute table." You may have noticed that tabular database (attribute table) is linked to the graphics portion of the database in ArcGIS. Examine what information is available in the shape file. While it indicates the area, does it also include all of the point, line and polygon data as well? What does this suggest about the type of GIS you are working with (e.g. hybrid or integrated)? Hybrid GIS means that spatial data are not entirely integrated into attribute data, but rather are linked to attribute data through a common identifier. On the other hand, integrated GIS means that the whole information is integrated into one database without having to separate the graphic portions (point, line, polygon) from attribute data.

FID	Shape*	AREA	CODE	NAME	POP1991	POP91_SQMI
0	Polygon	585860.072	CA10	Quebec	6895963	13.16378
1	Polygon	1320278.813	CA06	Northwest Territories	57649	0.045341
2	Polygon	21199.186	CA07	Nova Scotia	899942	44.11048
3	Polygon	251738.905	CA11	Saskatchewan	988928	4.488028
4	Polygon	256873.619	CA01	Alberta	2545553	10.23132
5	Polygon	152523.521	CA05	Newfoundland and Labrador	568474	3.961215
6	Polygon	364449.495	CA02	British Columbia	3282051	9.142941
7	Polygon	27996.778	CA04	New Brunswick	723900	26.00776
8	Polygon	2207.134	CA09	Prince Edward Island	129765	59.38902
9	Polygon	186112.055	CA12	Yukon Territory	27797	0.15031
10	Polygon	251261.199	CA03	Manitoba	1091942	5.157409
11	Polygon	380275.566	CA08	Ontario	10084885	29.30886

Attributes of province

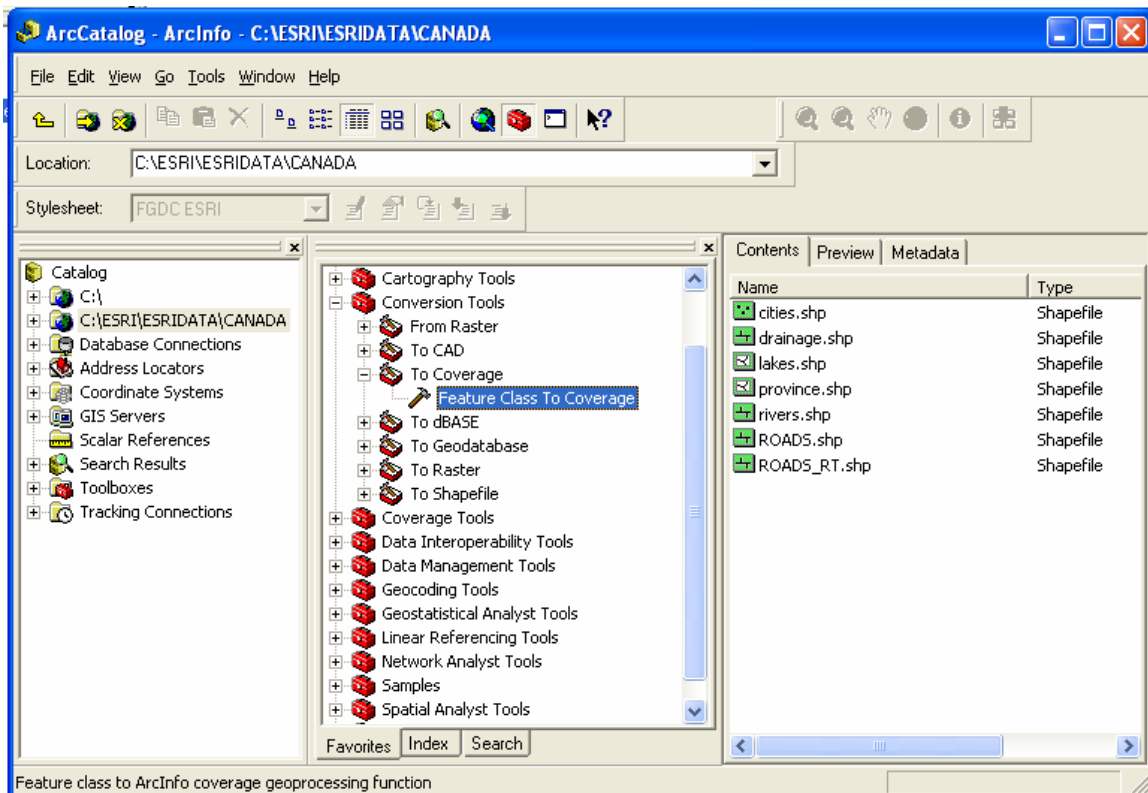Record: 1   Show: All | Selected   Records (0 out of 12 Selected.)   Options ▾

Imagine that instead of provinces, each polygon is, for example, a soil polygon or a vegetation type. Think about the problems you might encounter while analyzing such maps.

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In ArcGIS there are three primary feature classes, which include points, lines and polygons. The fundamental difference between an ArcView shapefile and an ArcInfo coverage is that a shapefile contains only one feature class, and a coverage may contain all feature classes. In other words a shapefile may only be either a point, line, or polygon feature, whereas a polygon coverage for example contains points (label points), lines (arcs), polygons, and nodes. Can a shapefile have topology? In ArcCatalog double click on the province shapefile. Browse through the different tabs (General, Fields, and Index). Did you see anything that said ARC#, FNODE#, TNODE#, LPOLY# or RPOLY#? No, because these only apply to coverage's because they have topological relationships.

When a coverage contains node and polygon feature classes, the coverage has topology, and the features in the classes are topologically related in topological associations with other features. The polygons are formed by perimeter arcs, and the endpoints of arcs are polygons, and finally the interiors of polygons are marked by label points

Converting shapefiles into coverage

Launch ArcToolbox from ArcCatalog by clicking on the red toolbox .
Choose Conversion Tools – To Coverage – Feature Class to Coverage

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Choose the province shapefile that you have been using for this lab as your
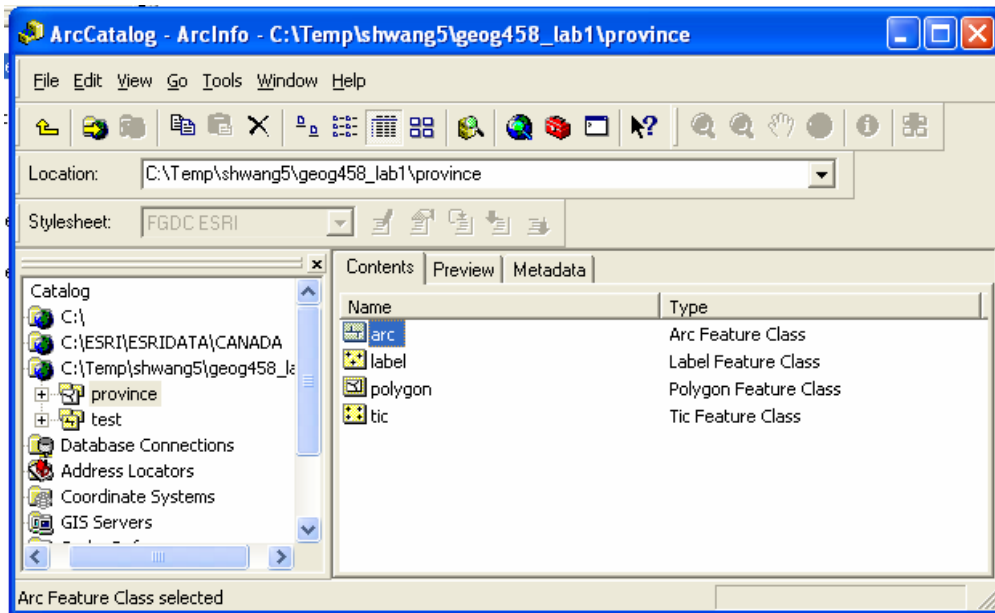input file

Choose polygon from type drop-down list to the right of the location of feature
class

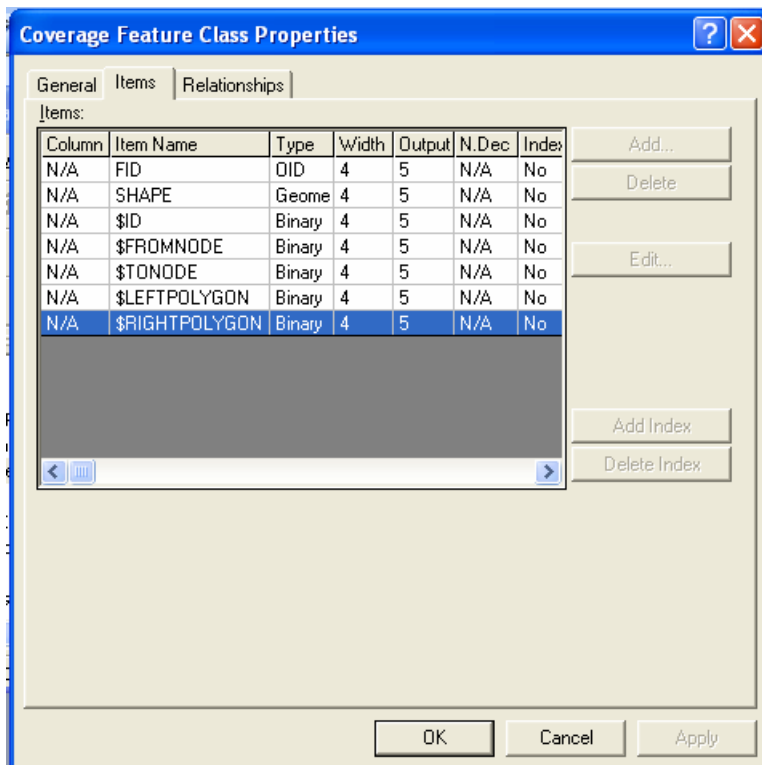Save the new file that you are creating in your directory. Select OK.
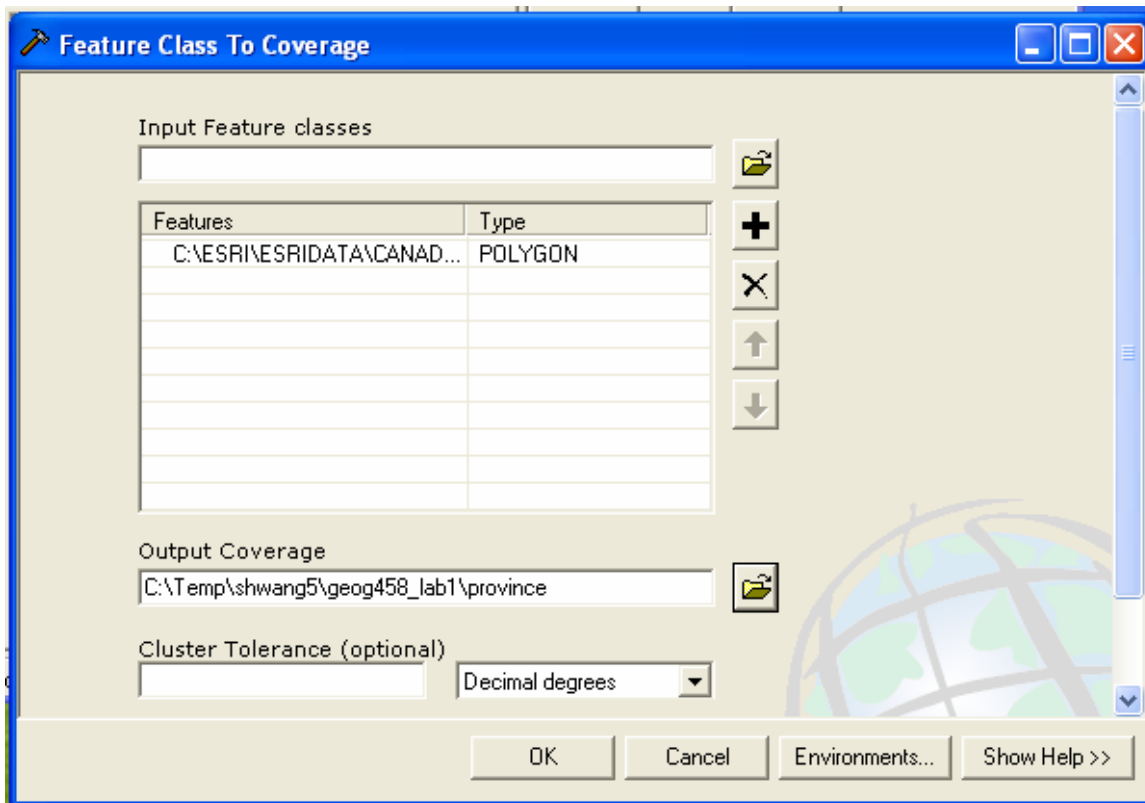
You will have an error message, but the processing toolbox still creates
coverage as you will find out despite incomplete conversion. Click Cancel. The
reason for errors is that there is no exact correspondence between polygon
features in shapefiles and polygon features in polygon. You will notice that
polygon coverage you created does not have the same attributes as polygon
attribute of shapefiles. Instead, line features of shapefiles will be converted into
line features of coverage with more information as you will find out soon.

Now in ArcCatalog double click on the province **coverage** that you just
created. You should see four sub-files to the coverage as shown below. Note
the four different feature classes. Now double click on the icon for the Arc
Feature Class, and select the items tab.

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You will now see FROMNODE, TONODE, LEFTPOLYGON, and RIGHTPOLYGON.

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What you are looking at is called a feature class table, where the topological associations between features are stored directly. The FROMNODE, TONODE, LEFTPOLYGON, and RIGHTPOLYGON define the topological associations between arc and polygon features.

How topology is stored in coverage

Add province coverage in ArcMap - both arc feature class and polygon feature class. Open attribute tables of both feature classes. Click "Select Features" tool, and then choose one province line (for example, draw rectangle as shown below in the right).
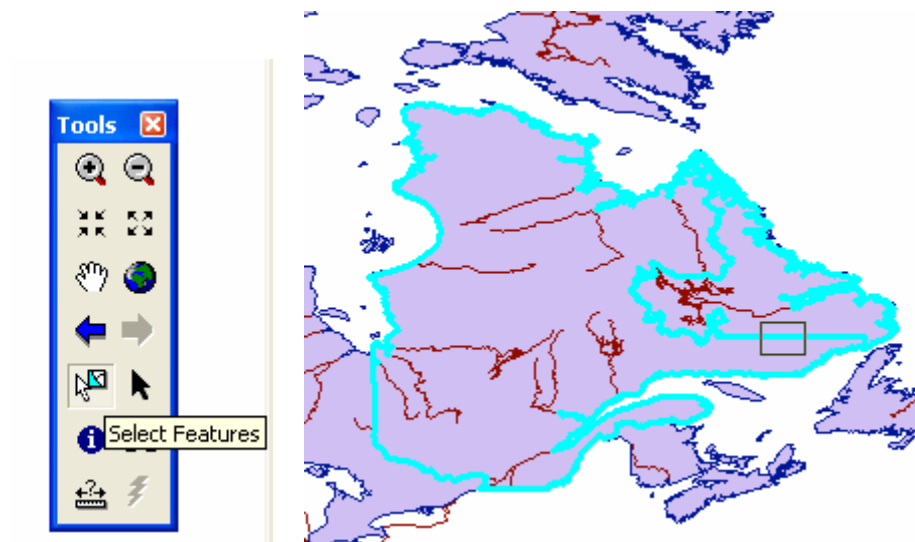
Then click Selected button in the attribute table of province line and province polygon at the bottom as shown below.
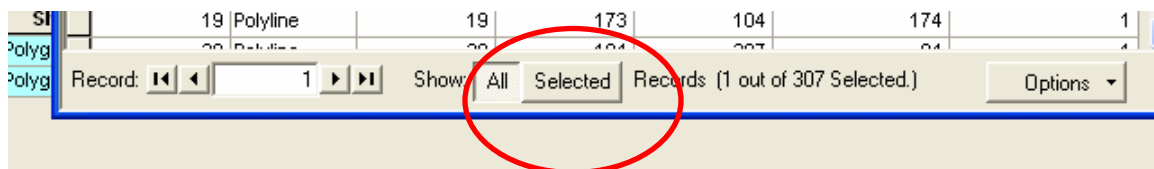
See how line feature and polygon feature are associated in two tables. In other words, see how topological information is coded in these two tables. The line selected (FID would be 306 if you chose the same line as above) is associated with two polygons (whose FID are 105 and 95) as you can read from $LEFTPOLYGON and $RIGHTPOLYGON. It means there is polygon 105 to

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the left of line 306, and polygon 95 to the right of line 306. The selected polygons FIDs are 95 and 105 as you see below.

Selected Attributes of province arc

FID	Shape	$ID	$FROMNODE	$TONODE	$LEFTPOLYGON	$RIGHTPOLYGON
306	Polyline	306	43	107	105	95

Record: 1 Show: All Selected Records (1 out of 307 Selected.) Options ▼

Selected Attributes of province polygon

FID	Shape	AREA	PERIMETER	PROVINCE#	PROVINCE-ID	PROVII
95	Polygon	39.156296	117.188795	95	95	
105	Polygon	203.899265	176.809227	105	105	

Record: 1 Show: All Selected Records (2 out of 269 Selected.) Options ▼

REVIEW AND DISCUSSION QUESTIONS

1. What would be the potential problem of representing soil boundary as polygon data such as province.shp? (max 25 words)

2. Can be shapefiles seen as being implemented in a hybrid GIS? (max 10 words)

3. What do you *think* were the sources of province boundary? What changes in abstraction take place? For example, were all the boundaries extremely detailed, or did you detect some generalization and simplification while you observed them? (min 40 words, max 80 words)

4. What is the relationship between a shapefile and points, lines and polygons? Where do line files inherit their properties from? Examine the help menu for line objects (under shape files) to see what information is given about what a line file is when you answer this question. Can a shape file contain topological information? Why or why not? What is the difference between a shapefile and a coverage? (min 50 words, max 100 words)

Turn in your answers (should be typed and printed out).
Due on January 20th 2006 on Friday 2:30pm
10% of the given points (5 out of 200) will be deducted for late submission per day

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