THE ESTABLISHMENT OF COMPREHENSIVE GEOGRAPHIC DATABASE SYSTEM

FOR

THE NATIONAL REHABILITATION AND DEVELOPMENT

IN

THE REPUBLIC OF ANGOLA

ARC/INFO OPERATION MANUAL

February 2002

PASCO CORPORATION, JAPAN

The Establishment of Comprehensive Geographic Database System

For

The National Rehabilitation and Development

In

The Republic of Angola

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1 Introduction

This guide book is prepared for use in "Learning ARC/INFO" as a part of Technology Transfer within the Project "The Establishment of Comprehensive Geographic Database System For The National Rehabilitation and Development In The Republic of Angola".

The guide book will briefly explain conceptual background, as well as the usage of project specific functions of GIS-Software ARC/INFO. The data compiled in this project at a scale of 1:1,000,000 covering the whole country, are used for exercises. The training data and this guide book will be available for the counterpart agency for use in their "self-study", as well. The data are in the following directory structure:
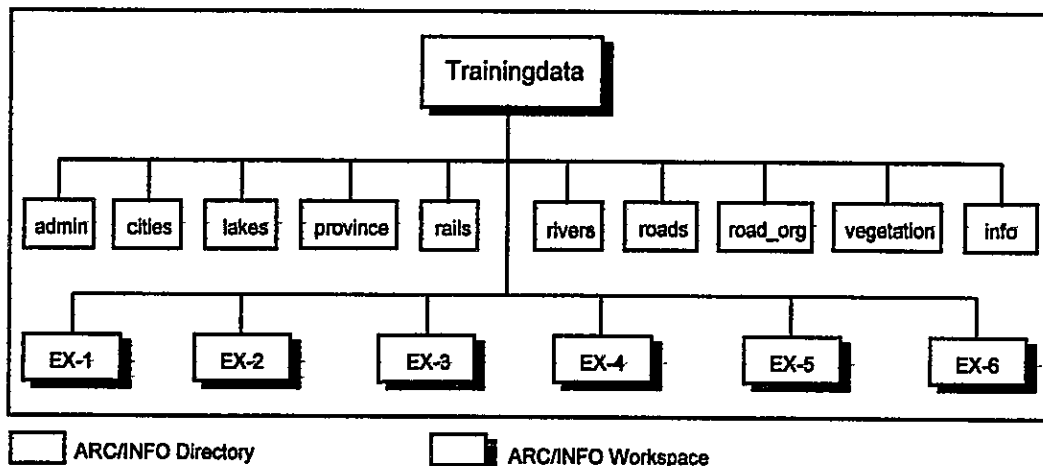
Prior to using those data, it is suggested to copy the whole "trainingdata" to a separate working area on the disk, where the exercises will be done. However, ARC/INFO workspace and/or ARC/INFO directory (see in the above Figure) should NOT be copied or deleted by the operating system commands. The following ARC/INFO commands are available for this purpose.

To copy a workspace, use "Arc: COPYWORKSPACE" command; and to copy a coverage, use "Arc: COPY" command:
To delete a workspace, use "Arc: DELETEWORKSPACE" command, and to delete a coverage, use "Arc: KILL" command with "ALL" option. Usage: Arc: KILL <Cover_Name> ALL

2 ARC/INFO and ArcView

This chapter will address mainly the basic functions of ARC/INFO. However, loading ASCII data into ARCVIEW is supplemented, which can then be converted into ARCINFO. ArcView has been introduced previously by ARCVIEW Operation Manual, March 1999.

Note: Page 2 - 5 have been attached in the Progress Report of March 1999.

2.1 Software Structure
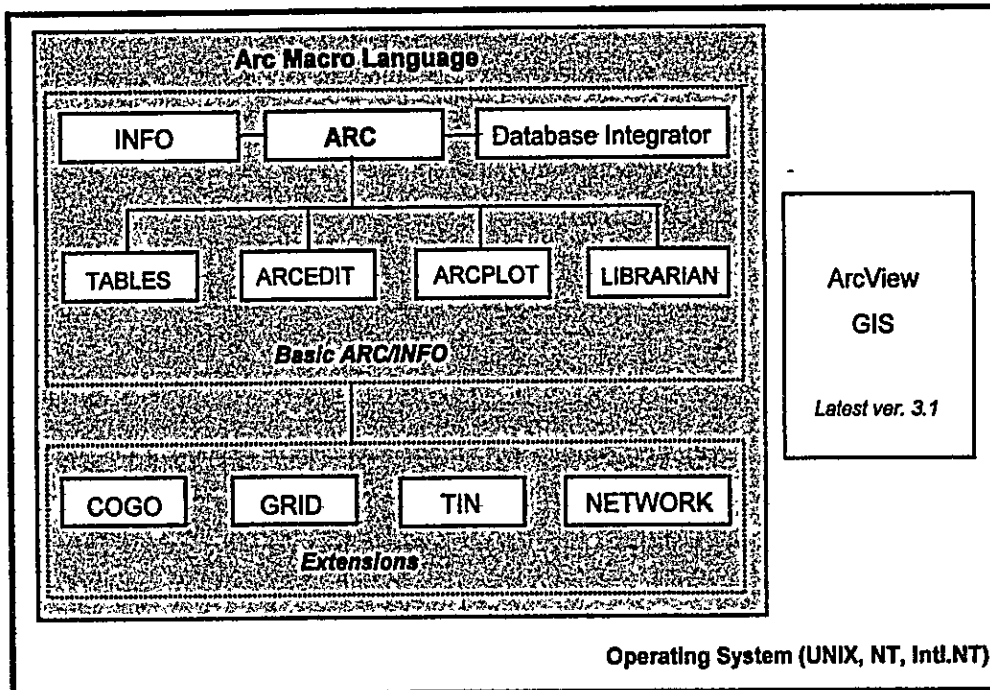
Also available: PC-ARC and ArcView for MS DOS & Windows

Both ARC/INFO and ArcView software are available on Workstation as well as PC platforms operating in UNIX, NT, or Windows environment.

The basic software and the optional Extensions are listed in below :

Basic Software (Latest version: 7.2)

ARC	: GIS Manager (All modules are managed by ARC)
INFO	: Relational Database Management System
TABLES	: INFO table operations
ARCEDIT	: Graphic Editing Module
ARCPLOT	: Graphic Display & Output Module
DB Integrator	: Link with External RDBMS
AML	: Arc Macro Language

Extension

COGO	: Coordinate Geometry (Field Survey Data Entry)
GRID	: ARC/INFO grid sub-system (raster-type)
TIN	: Triangulated Irregular Network (3-D Data Analysis Module)
NETWORK	: Network Analysis Module

2.2 Using ARC/INFO

To start ARC, generally type <arc> on UNIX or select "arc" in the Window's *START* menu. But, it can be different depending on the installation. Contact the system administrator in such case. When ARC is started, the "Arc:"- prompt will appear. All the ARC commands can be executed at "Arc:" prompt. To use INFO, type <Info> at the Arc: prompt, and then enter <arc> for "User Name". When Info started, "ENTER COMMAND>" prompt will appear (see example in below). Other modules, i.e. TABLE, ARCEDIT, and ARCPLOT have to be started at the Arc: prompt, as well. To close any of those sessions, enter <q> (for INFO, <q stop>) and it will return to Arc. Entering <q> at "Arc:", the arc session will be closed.

Examples:

(1) Start ARC Session

The following messages and "Arc:" prompt will appear on the screen.

Copyright (C) 1982-1998 Environmental Systems Research Institute, Inc.

All rights reserved.

ARC Version 7.2.1   (Thu Apr   2 15:59:38 PST 1998)

This software is provided with RESTRICTED AND LIMITED RIGHTS.   Use,

duplication, and disclosure by the U.S. Government are subject to

restrictions as set forth in FAR Section 52.227-14 Alternate III (g)(3)

(JUN 1987), FAR Section 52.227-19 (JUN 1987); and/or FAR Section

12.211/12.212 [Commercial Technical Data/Computer Software] and DFARS

Section 252.227-7015 (NOV 1995) [Technical Data] and/or DFARS Section

227.7202 [Computer Software], as applicable. Contractor/Manufacturer is

Environmental Systems Research Institute, Inc., 380 New York Street,

Redlands, CA 92373-8100, USA.

Arc:

(2) Arc: **Info**

INFO   EXCHANGE   CALL

23/06/1998   17:45:28

INFO   9.42   11/11/86   52.74.63*

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US Govt Agencies see usage restrictions in Help files (Help Restrictions)

ENTER USER NAME>arc   -----> *please note the entry of arc here*

ENTER COMMAND >q stop

Arc:

2.2.1 ARC/INFO Coverage and Workspace

The coverage is the framework for vector data storage in ARC/INFO. It generally represents a single set of geographic objects such as roads, parcels, soil units or forest stands in a given area. A coverage supports the geo-relational model - it contains both the spatial (location) and attribute (descriptive) data for geographic features.

An ARC/INFO workspace is the work area used during an ARC/INFO session. Within the computer file system, the workspace is a directory containing one or more geographic data sets (e.g., coverage, tin, grid), a local INFO database, and other supporting data. More than one user can read data from the same workspace, however, it is strongly recommended that only one user access a workspace for creating or updating data (RW access).

```
                    ┌───────────┐
                    │ Workspace │
                    └───────────┘
      ┌───────────┬───────┴───────┬───────────┐
┌───────────┐ ┌───────┐ ┌─────────┐ ┌─────────┐ ┌───────┐
│ .......... │ │ Soil  │ │ Contour │ │ Landuse │ │ Info  │
└───────────┘ └───────┘ └─────────┘ └─────────┘ └───────┘
```
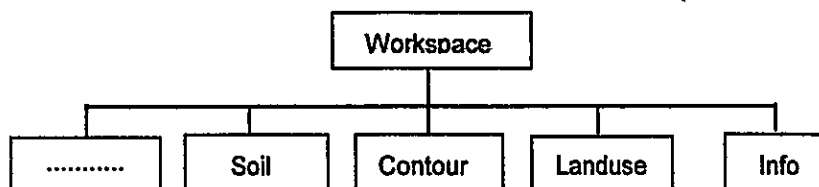
Naming Convention

Coverage names can be from 1 to 13 characters long. Item names in feature attribute tables are limited to 16 characters. The limit of 13 characters for coverage names allows ARC/INFO to append the -ID extension for the Cover-ID item. There may also be some operating system limitations on the length of coverage names (8 characters on PC). On UNIX operating systems, coverage names are converted to lowercase for directory storage.

2.2.2 Data Model

xxx.PAT: Polygon (Point) Attribute Table; xxx.AAT : Arc Attribute Table
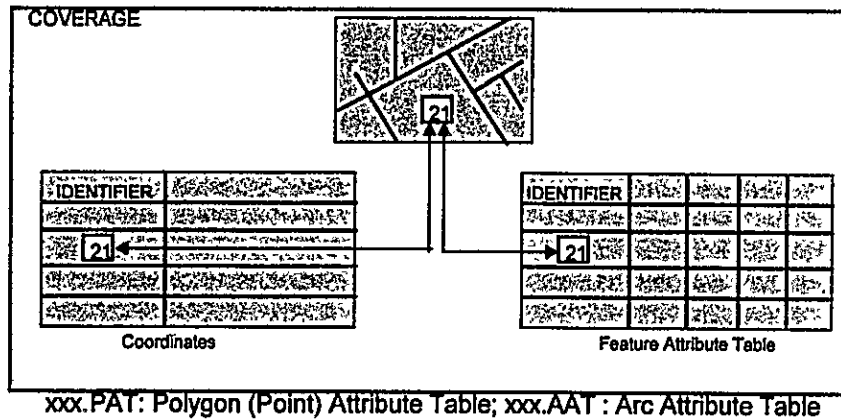
In the above figure, xxx stands for a user specified "Coverage Name". When the user specifies a coverage name, ARC/INFO uses that name to create a directory (coverage directory) in the current *Workspace*. All the *Locational Data*, as well as the data from *Feature Attribute Table* are stored under this coverage directory. The *Feature Attribute Table* schema and the path name for the data are stored under INFO directory.

2.3 Converting Coordinates and Attributes

The coordinates in ASCII data file can be converted to ARC/INFO coverage by using GENERATE command. One thing to be noted is that only the ID-Numbers and X, Y coordinates can be converted, but not the feature attributes.

ASCII text file with the POINT-coordinates and associating attribute items can be converted to *SHAPEFILE*, which is the ArcView data format.

Example:

```
ID,X-COORD,Y-COORD,SPOT
139,172914,303471.406,8.99
140,173224.563,394204,9.00
141,173548.891,484937.313,8.54
142,173886.969,575671.375,8.22
143,174238.781,666406.125,7.98
172,263829.688,303188.156,8.56
173,264101.375,393905.938,8.78
174,264385.094,484626.469,9.12
175,264680.813,575347.75,9.43
176,264988.594,666069.813,8.91
202,354096.844,30816.967,8.24
```

The following steps will convert the above text-file into ArcView SHAPE-file.

Step 1) Start ArcView

Step 2) Select "Tables" in Project Window; and press "Add" button

Step 3) "Add Table" scrolling list appears.
- Select "Delimited Text [*.txt]" from "List Files of Type" (lower left of the menu)
- Set full path name of data directory → the above file will be listed in the scrolling box on left hand side of the menu
- Select that file and double click the left mouse button → data is loaded in ArcView

Step 4) Add Theme to the current view from the text file.
- Close the *.txt window and select "Views" from the Project menu
- Press "New" —→ View window opens
- Select "Add Event Theme" from the "View" menu of pull-down menu
- "Add Event Theme" appears; and observe the list; Press Ok if the setting is correct
- Display the newly created theme on the view window
- Make that theme active; and press ⊞ (Table button) from the pull down menu Please Observe SPOT item in the table

Step 5) Convert active theme to a Shapefile

- Select "Convert to Shapefile " from the "Theme" menu
- Set Shapefile name and path; Press OK button → press "Yes" to add to the View
  -→ New theme is added, and display it to check the result

Step 6) Close ArcView with NO save

Step 7) Start ARC; move to the workspace where the coverage will be created

Step 8) Use Arc: SHAPEARC command to convert the ArcView Shapefile into ARC/INFO coverage.

Arc: shapearc

Usage: SHAPEARC <in_shape_file> <out_cover> {out_subclass} {DEFAULT | DEFINE}

Step 9) A point coverage will be created with .PAT file; Please observe that .PAT file.

Please note that steps 1 through 6 will have to be proceeded in ARCVIEW and the rest are in ARC/INFO .

3 Errors, Tolerance and Edge-Matching

3.1 Content of a COVERAGE and Type of Errors

User can view the content of a coverage by "Arc: DESCRIBE" command. It will allow the user to detect certain logical errors. One example will be shown in Exercise-1, in which the number of nodes is extremely low in compare to the number of arcs. Since one arc is defined by 2 nodes, more nodes should logically be present in the coverage. One exception is a ring polygon, where the arc is started and ended at a single node. The other exception is that the nodes are shared by several arcs. In those exceptions, the number of nodes will be equal to or less than the number of arcs. However, extreme discrepancies between the number of arcs and nodes are not logical.

■ DESCRIBE Command

Arc: describe

Usage: DESCRIBE <geo_dataset>

3.1.1 ARC-NODE Topology Error

When the number of nodes are much less than the number of arcs, or the number of nodes are extremely high in compare to the number of arcs, then it could be the "ARC-NODE Topology Error". The command "Arc: RENODE" is provided to correct such error.

■ RENODE Command

Arc: renode

Usage: RENODE <cover> {from_node_elev_item} {to_node_elev_item}

3.1.2 NODE Error : Overshoot and Undershoot

"Overshoot/Undershoot" are those errors which occur while digitizing linear features at the intersections. Overshoots will generate the "dangles" and the undershoots will generate "fuzzys".

- Node
- Node Error
- Pseudo Node
- Tolerance
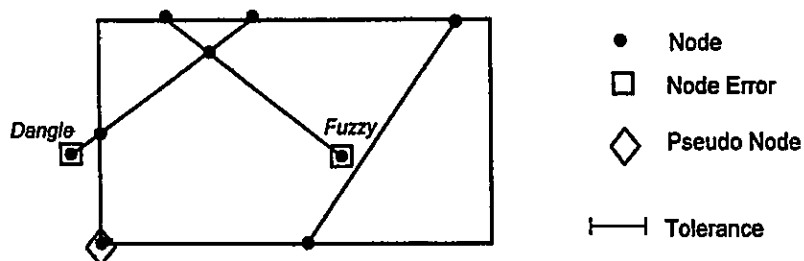
Node is normally defined by a point where two or more arcs are intersected. The error checking commands in ARC/INFO display the open ending node of an arc by a square shaped symbol (Node Error). And; the nodes at which only two arcs are intersected, are displayed by a diamond shaped symbol (Pseudo Node), unless those two arcs are different in feature attribute or in the ID-number.

Node errors can be checked in Arc, Arcplot, or in Arcedit.

- Arc: NODEERRORS Command

  Arc: **nodeerrors**

  Usage: NODEERRORS <cover> {ALL | DANGLES | PSEUDOS}

- Arcplot: NODEERRORS Command

  Arc: **arcplot**

  Arcplot : **nodeerrors**

  Usage: LABELERRORS <cover> {ARCS | NOARCS}

- Checking in Arcedit

  Arc: **arcedit**

  ————> The prompt will changed to Arcedit:

  Arcedit: **edit <cover>**

  Arcedit: **drawe arc node errors**

  Display device needs to be set only once throughout an ARC session. If it is not yet set, then the message "Device is not graphic" will appear on the screen.

  Arcedit: **draw**

  Device is not graphic

  Arcedit : **display 9999**   ————> Not needed, if no message appears

The usage of those commands in above is shown more detail in Exercise-1.

3.1.3 Label Error: Open Polygon and Multiple Labels

A polygon is made up of arcs which define the boundary and a label point which links the polygon feature to the attribute. When a polygon has no label, or when more than one label is present in one polygon then, it is termed as "Label Error".

Polygons defined by the connecting arcs must be closed, and otherwise, it is termed as "Open Polygon", which will cause the two neighboring polygons to be interpreted by the software as ONE polygon with two labels (Label Error).

Error checking commands are available in both Arc and Arcplot.

■ Arc:LABELERRORS Command

Arc: labelerrors

Usage: LABELERRORS <cover>

■ Arcplot:LABELERRORS Command

Arc: arcplot

Display device needs to be set only once throughout an ARC session. If it is not yet set, then the message "Graphic device not specified" will appear on the screen.

Arcplot: labelerrors

Graphic device not specified

Arcplot: display 9999   ----> Not needed, if no message appears

Arcplot: labelerrors

Usage: LABELERRORS <cover> {ARCS | NOARCS}

The usage of those commands in above is shown more detail in Exercise-1.

3.1.4 Errors in Feature Attribute Table

In coverage data-model, features (point, line, polygon) store the attributes in corresponding Feature Attribute Table (FAT). The naming convention for the INFO database is as follows:

Feature	FAT-Name	System Default Items
Point	<COVER>.PAT	AREA, PERIMETER, <COVER>#, <COVER>-ID
	Point Attribute Table	
Line	<COVER>.AAT	FNODE#, TNODE#, LPOLY#, RPOLY#, LENGTH,
	Arc Attribute Table	<COVER>#, <COVER>-ID
Poly	<COVER>.PAT	AREA, PERIMETER, <COVER>#, <COVER>-ID
	Polygon Attribute Table	

The system default items are defined by ARC/INFO automatically. However, user can add items to those FAT. The item definition of all coverages for the same layer in a given study area must be consistent. To check the item definition, as well as the item values, the following commands can be used.

■ Commands for checking Feature Attribute Tables

Listing an INFO Directory

Arc: dir Info <cover-name>.*

Listing an INFO File Schema

Arc: Items <cover-name>.AAT

Arc: Items <cover-name>.PAT

Listing an INFO File Content

Arc: list <cover-name>.AAT

Arc: list <cover-name>.PAT

Examples of using INFO and working with the FAT are explained in Exercise-2.

3.2 Tolerance In ARC/INFO

RMS (Root Mean Square) error - a measure of tic registration accuracy during digitizing and coverage transformation.

TIC match tolerance - the maximum registration error allowed when registering a map on the digitizer. This is used to help ensure accurate map registration (i.e., to keep RMS error low).

Fuzzy tolerance - the maximum distance coordinates can shift during CLEAN, BUFFER, and overlay operations. It is the distance used to remove arc vertices and detect intersections.

Dangle length - dangling arcs shorter than the dangle length are deleted during CLEAN.

Arc snap tolerance

The *distance* within which a new arc will be extended to intersect an existing arc is called the arc snapping tolerance. A node is created at the new intersection of the connecting arcs.

● Node

☐ Dangling Arc
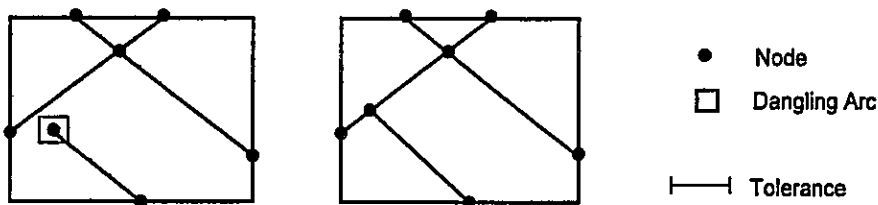
├───┤ Tolerance

The recommended value for the ARCSNAP tolerance is 0.05 inches (0.127 cm) or equivalent coverage units for the given input map scale.

Weed tolerance

The weed tolerance is the minimum allowable distance between any two vertices along an arc. The weed tolerance is used to reduce the number of coordinates in an arc. It is a parameter that can be set before adding arc features or to generalize existing arcs.

When adding a new arc, a new vertex within the weed tolerance of the previous vertex is disregarded.

●
△ Vertex
⊔ Tolerance

A weed tolerance value of 0.02 inches (0.0508 cm) or equivalent coverage units is recommended.

Grain tolerance

The grain tolerance controls the number of vertices in an arc and the distance between them along curved lines.

A recommended GRAIN tolerance, 0.02 inches (0.0508 cm) or equivalent coverage units, is the same value recommended for the weed tolerance. When creating new arcs, the weed tolerance controls the distance between vertices along straight arcs and the grain tolerance controls the distance along curved arcs.

Recommended tolerance in map units

The recommended tolerance values given in above are in digitizer units (inches or cm). A tolerance value in coverage units other than inches, can be calculated for various input map scales, as follows:

  For coverage units FEET -   tol(feet) = tol(inches) * scale / 12

  For coverage units METERs -   tol(meters) = tol(cm) * scale / 100

Note that SCALE in the above formulas is the denominator of the representative fraction (e.g., the value '250000' from a map whose scale is 1:250,000).

Tolerances define the resolution of coordinates in a coverage. The TOLERANCE command can be used to set the values in the coverage TOL file, and to examine currently associated tolerances with a coverage.

■ Arc: TOLERANCE Command

Arc: **tolerance**

Usage: TOLERANCE <cover> {LIST | FUZZY | DANGLE | TIC_MATCH | EDIT | NODESNAP | WEED | GRAIN | SNAP} {tolerance_value}

<cover> - the coverage for which tolerances are to be set or examined

{LIST | FUZZY | DANGLE | TIC_MATCH | EDIT | NODESNAP | WEED | GRAIN | SNAP} - the options

LIST - displays the current settings. This is the default option.

FUZZY - sets the coverage fuzzy tolerance to be the value specified in {tolerance_value}

DANGLE - sets the coverage dangle length to be the value specified in {tolerance_value}

TIC_MATCH - sets the tic match tolerance to be the value specified in {tolerance_value}

EDIT - sets the coverage edit distance to be the value specified in {tolerance_value}

NODESNAP - sets the node snap distance to be the value specified in {tolerance_value}

WEED - sets the weed tolerance to be the value specified in {tolerance_value}

GRAIN - sets the grain tolerance to be the value specified in {tolerance_value}

SNAP - sets the general snapping distance to be the value specified in {tolerance_value}

{tolerance_value} - the value to be set for the selected option { } tolerance

A tolerance value of 0 are invalid for : FUZZY, EDIT, NODESNAP, WEED, GRAIN and SNAP

3.3 Feature and Attribute Matching

Feature edge matching, as well as attribute matching must be checked:

■ within each individual map sheet

■ between the neighboring map sheets
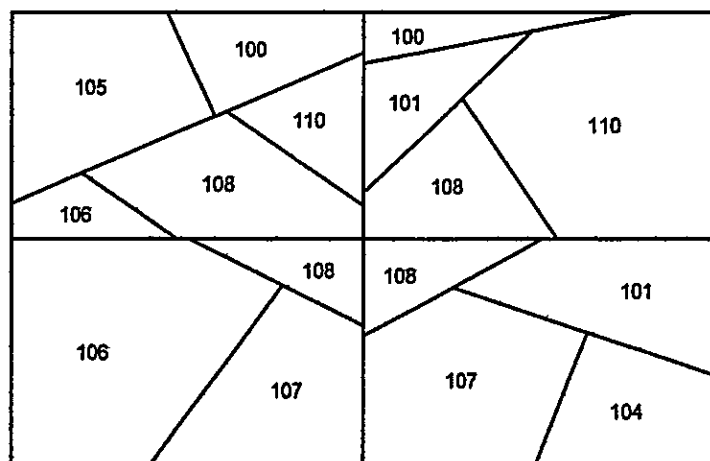
EdgeMatching steps

Arcedit: edit <cover_name>

Arcedit: editfeature link

Arcedit: back <back_cov> {symbol}

Arcedit: drawe arc node link

Arcedit: backe arc node

Arcedit: mapex <cover_name> {back_cov}

Arcedit: draw

Arcedit: snapcov <back_cov>

Arcedit: linkfeature node node

Arcedit: snapping closest *

Arcedit: autolink

Arcedit: adjust

EDGEMATCH Command is an ATOOL which runs at the Arcedit: prompt. The menus include all of the functions needed to perform edgematching.

Before starting EDGEMATCH, specify the graphic display device with the DISPLAY command.

The usage of Tolerance command and Edgematching procedure are shown in Exercise-3.

4 ARCEDIT - Interactive Data Editing

ARCEDIT is the program for editing coverage coordinate and attribute data. Editing can be done using ARC/INFO command line interface or the ARCTOOLS menu interface.

ARCEDIT may be useful for this project especially to :

✧ Create new coverages by digitizing

✧ Correct errors in digitized maps

✧ Add and modify feature attributes

✧ Create and edit INFO files

✧ Edgematch coverages

✧ Snap features in the same or other coverages

4.1 How Arcedit Works

■ **Starting ARCEDIT**

To start Arcedit, type <arcedit> or <ae> at the "Arc:" prompt.

Arc: ae

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ARCEDIT (COGO) Version 7.2.1   (Thu Apr   2 15.59:38 PST 1998)

Arcedit:

■ **Temporary files**

Once an ARCEDIT session has started, the temporary files are created in the workspace and in the INFO directory. Changes to the features are copied to temporary files in the workspace where ARCEDIT was started. Write access to this workspace is required. The temporary files are used by "Arcedit: SAVE" to write changes, by "Arcedit: OOPS" to undo an edit, and by "Arc: RESTOREARCEDIT" to recover from an aborted ARCEDIT session.

■ **Editing Operations**

Editing operations are performed at three different levels **coverage; feature class; selected set.**

Operations performed on the selected set only (See also schematic diagram in below).

The following schematic diagram shows how Arcedit works. Understanding of those logical steps will help users in working with this editing module.

```
┌─────────────────────────────────────────┐
│              Start ARCEDIT               │
└─────────────────────────────────────────┘
                    │
┌─────────────────────────────────────────┐
│ Set Device                               │
│     DISPLAY          COORDINATE          │
└─────────────────────────────────────────┘
                    │
┌─────────────────────────────────────────┐
│ Set Coverage to edit                     │◄──────────┐
│ CREATE    EDIT    BACKCOVERAGE           │           │
└─────────────────────────────────────────┘           │
                    │                                  │
┌─────────────────────────────────────────┐           │
│ Set Drawing Environment                  │           │
│ MAPEXTENT    DRAWENVIRONMENT             │           │
│ DRAW         BACKENVIRONMENT             │           │
└─────────────────────────────────────────┘           │
                    │                                  │
┌─────────────────────────────────────────┐           │
│ Set Feature to edit                      │           │
│          EDITFEATURE                     │           │
└─────────────────────────────────────────┘           │
                    │                                  │
┌─────────────────────────────────────────┐           │
│ Select Feature to edit                   │           │
│          SELECT                          │           │
└─────────────────────────────────────────┘           │
                    │                                  │
┌─────────────────────────────────────────┐           │
│ Use Editing commands                     │           │
│ ADD    V MOVE EXTEND and others          │           │
└─────────────────────────────────────────┘           │
          Yes       │                                  │
┌─────────────────────────────────────────┐           │
│ Next feature of same class to edit ?     │           │
└─────────────────────────────────────────┘           │
      Yes           │                                  │
┌─────────────────────────────────────────┐           │
│ Next feature class to edit ?             │           │
└─────────────────────────────────────────┘           │
                    │                         Yes      │
┌─────────────────────────────────────────┐           │
│ Next coverage to edit ?                  │───────────┘
└─────────────────────────────────────────┘
                    │
┌─────────────────────────────────────────┐
│ Close Arcedit:  QUIT                     │
└─────────────────────────────────────────┘
```

NOTE:

After editing, coverage topology MUST be updated using BUILD or CLEAN command.

■ **Environments for drawing and editing**

The results of drawing and editing are controlled by setting environments:

> the hardware devices,
>
> the coverages that will be displayed and edited,
>
> the type of features to edit, and
>
> which coverages and features to use for snapping.

The commands entered to set the environments stay in effect until changes are made on them.

Many environment-setting commands ensure topological *connectivity*. User can simply digitize features and correct errors afterwards, or set up the session to let ARCEDIT correct the errors while adding and moving features.

■ **Coverage Creation in ARCEDIT**

As an example, a coverage named EXCOV will be used to explain the steps for creation of a coverage.

It is suggested to practice the following example by referring to the schematic diagram in above.

✧ Create a new coverage and enter TICs

> Arcedit: **create excov**
>
> Creating EXCOV
>
> Digitize a minimum of 4 tics.
>
> Signal end of tic input with Tic-ID = 0

Begin by entering the Tic-ID on the digitizer cursor, followed by <CR>. Then digitize the tic location.

> Tic-ID: **1***
>
> Tic-ID: **2***
>
> Tic-ID: **3***   * *(digitizer); RETURN key (Keyboard)*
>
> Tic-ID: **4***
>
> Tic-ID: **0***
>
> Enter the lower-left and upper-right corners of the map on the digitizer.
>
> Enter the initial boundary. The edit coverage is now EXCOV.

✧ Set up the draw environment

> Arcedit: **drawenvironment arc tic ids node dangle**
>
> Arcedit: **draw**

✧   Specify the feature class to edit

        Arcedit: **editfeature arc**

        0 element(s) for edit feature ARC

        Coverage has no COGO attributes

    The arc attribute table can now be created to store attributes.

✧   Create the feature attribute table

        Arcedit: **createattributes**

        Adding arc attributes to EXCOV

        Arcedit: **additem symbol 4 5 b**

CREATEATTRIBUTES creates the basic attribute table (all of the standard items up to and including the User-ID) for the current edit feature. The attribute table can be created either before or after adding features. Additional items can also be added at any time using ADDITEM. Use the ITEMS command to list the items in the current edit feature attribute table.

✧   Set up the environment for adding arcs

        Arcedit: **nodesnap closest 10**

The edit environment can be set up so that some types of errors are avoided as arcs are added.

The NODESNAP command specifies a snap distance of 10 coverage units, and nodes of new arcs will snap to the closest node within the snap distance.

        Arcedit: **arcsnap on 1.5**

The ARCSNAP command automatically snaps arc undershoots and overshoots to an existing arc within the distance specified with the command.

        Arcedit: **add**

The following menu appears in your command window. This menu lists the options available for adding arcs.

————————————————— Options ——————————————————

1) Vertex	2) Node	3) Curve
4) Delete vertex	5) Delete arc	6) Spline on/off
7) Square on/off	8) Digitizing Options	9) Quit

Start digitizing by moving the cursor to starting position and press the 2 key to add a node. Now digitize the rest of the arc by moving the cursor along the shape of the arc and pressing the 1 key to enter vertices as single points.
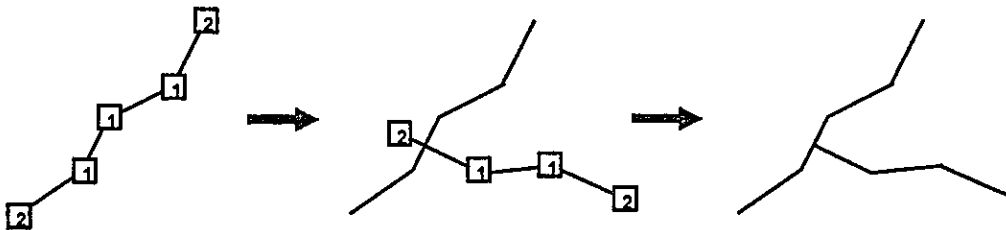
Enter Node by pressing KEY ☑
Enter Vertices by pressing KEY ☑

Vertices in a continuous stream can be entered by holding down the 1 key, as the arc is being traced. Digitizing one arc is completed by pressing the 2 key.

If arcs or nodes do not snap (where they should), the new tolerances can be set by quitting ADD.

Enter the 9 key to quit the ADD menu.

At this point, user can add new features or edit the existing coverage features.

4.2 Feature and Attribute Editing

The basic editing operations in ARCEDIT consist of the following steps (see also chapter 2.2.3) and commands:

Step	Commands
1. Specify the edit coverage(s) and feature class(es)	EDIT and EDITFEATURE
2. Set up the draw environment	DRAWENVIRONMENT
3. Set editing and snapping tolerances	INTERSECTARCS
	GRAIN, WEEDTOLERANCE,
	NODESNAP and ARCSNAP
4. Select features to edit	SELECT
5. Perform the edit operation	COPY, DELETE, etc.
6. Save changes	QUIT; or SAVE

■ **Extending arcs**

Edit feature must be arc.

EXTEND snaps dangling arcs to the first arc within a user specified distance. This is useful for fixing undershoots. EXTEND splits the arc to which the extended arc is snapped, and the resulting arcs have the same User-ID and attributes as the original arc. Multiple arcs can be selected and extended.

■ **Moving nodes**

If a coverage does not have an NAT (Node Attribute Table), nodes cannot be selected like other features but they can be moved.

>   Arcedit: **editfeature node**
>   123 element(s) for edit feature NODE
>   Arcedit: **move**
>   Point to the node to move <9 to Quit>

Select a node by positioning the cursor on the node and press any alphanumeric key.
>   Node (25.377,9.709999) selected
>   1 = Select   2 = Next   3 = Who   4 = Move   9 = Quit

Once the correct node is selected press the 4 key and this prompt appears:
>   Point to where to move the node <4 - Restart, 9 - Quit>

Position the cursor at the location where the selected node should be moved to, and press any alphanumeric key except 4 or 9. The selected node will then be moved to the indicated position.

■ **Editing INFO files**

INFO files can be created and modified within ARCEDIT. This is useful for creating tabular files that will be related to coverage features.

All ARCEDIT commands that do not require graphic interaction can be used to edit INFO files. For example, INFO records can be selected with any of the selection commands (e.g., SELECT and ASELECT) using a logical statement.

Example: :

Arcedit: **create cover.data info**

Creating COVER.DATA

Enter the initial INFO items:

      1

Item Name: **cover-id**

Item Width: **4**

Item Output Width: **5**

Item Type: **b**

      5

Item Name: **name,20,20,c**

      25

Item Name: **type,2,2,i**

      27

Item Name: **<CR>**

The same commands that are used to add and update coverage features are used to add and update INFO file records.

Use the ADD command to add records, then use FORMS menu, CALCULATE or MOVEITEM commands to update item values for selected records.

Arcedit: **add**

1 INFO record(s) added to COVER.DATA

Arcedit: **calculate cover-id = 100**

Arcedit: **calc name = 'columbia'**

Arcedit: **calc type = 2**

Arcedit: **list**

5 Projection and Coordinate Transformation

5.1 Supported Map Projections

A total of forty-six map projections are supported in the ARC/INFO at Version 7. A descriptive summary of each projection-option is available in the on-line manual.

An Example of "Arc: PROJECT" command usage for *TRANSVERSE* Projection is given in the following :

Arc: PROJECT <COVER | FILE> <input> <output> {projection_file}

<COVER | FILE>	: Input data format (ARC/INFO coverage or a System File)
<input>	: File name in which input coordinates are stored
<output>	: Output file name (after projection)
{projection_file}	: option to specify a projection parameters file

The usage of PROJECT command for the Lambert Azimuthal projection is introduced and the sample data are provided in Exercise-4. This projection method is considered to be the best suited for those land areas, which are in symmetrically proportioned (either round or square) shape, as a country like Angola.

All the digital map data acquired at a scale of 1 : 1,000,000 are projected by Lambert Azimuthal Method. The following parameters are used:

✧	Projection Method	: Lambert Azimuthal
✧	Spheroid	: Sphere with radius 6370997.000
✧	Units	: Meters
✧	Center of Projection	:
	Longitude	18 0 0.000
	Latitude	-6 30 0.000
✧	False easting (meters)	: 0.00000
✧	False northing (meters)	: 0.00000

5.2 Planar Coordinate Transformation

For transformation of planar coordinates (x, y) from one coordinate system into another, Arc: command TRANSFORM can be used. The command provides 3 options:

(See "Note" In below for description of TIC feature)

✦ AFFINE (requires a minimum of 3 TICs) : $x' = Ax + By + C$

$y' = Dx + Ey + F$

✦ SIMILARITY (requires a minimum of 2 TICs) : $x' = Ax + By + C$

$y' = Bx + Ay + F$

✦ PROJECTIVE (requires a minimum of 4 TICs) : $x' = (Ax + By + C) / (Gx + Hy + 1)$

$y' = (Dx + Ey + F) / (Gx + Hy + 1)$

5.2.1 Using TRANSFORM Command and RMS Error

Arc: **transform**

Usage: TRANSFORM <in_cover> <out_cover> {AFFINE | PROJECTIVE | SIMILARITY}

Before using "Arc: TRANSFORM", an output coverage containing only the projected tics, should be prepared. The command uses corresponding Tic-IDs to compare the input coverage tics to those of the output coverage. The calculated transformation is applied to all feature coordinates in the input coverage as they are copied to the output coverage.

An Example: Arc: **transform incov trcov affine**

Transforming coordinates for coverage INCOV

Scale (X,Y) = (1452.317,1508.433)   Skew (degrees) = (0.416)

Rotation (degrees) = (0.218) Translation = (2124994.654,317664.385)

RMS Error (input, output) = (0.048,71.614)

Affine   X = Ax + By + C

Y = Dx + Ey + F

A =	1452.230	B =	-5.526	C =	2124994.654
D =	15.858	E =	1508.462	F =	317664.385

tic id   input x   input y

output x   output y   x error   y error

|				
1	2.000	16.946		
	2127791.000	343183.000	14.463	75.499
2	12.764	16.821		
	2143469.000	343326.000	-31.043	-85.363
3	2.052	1.976		
	2128000.000	320680.000	-36.290	-2.353
4	12.922	2.013		
	2143729.000	320912 000	20.245	-6.163
5	2.082	9.442		
	2127944.000	332015.000	22.016	-74.699
6	12.662	9.442		
	2143320.000	332015.000	10.609	93.079

Arc:

■ RMS Error

As shown in the above example, "Arc: TRANSFORM" command generates and displays a report on the screen showing comparisons between input and output coverage tics, the parameters used for the transformation, as well as the RMS error.

The RMS error describes the deviation between the tic locations in the output coverage and the values calculated by the transformation.
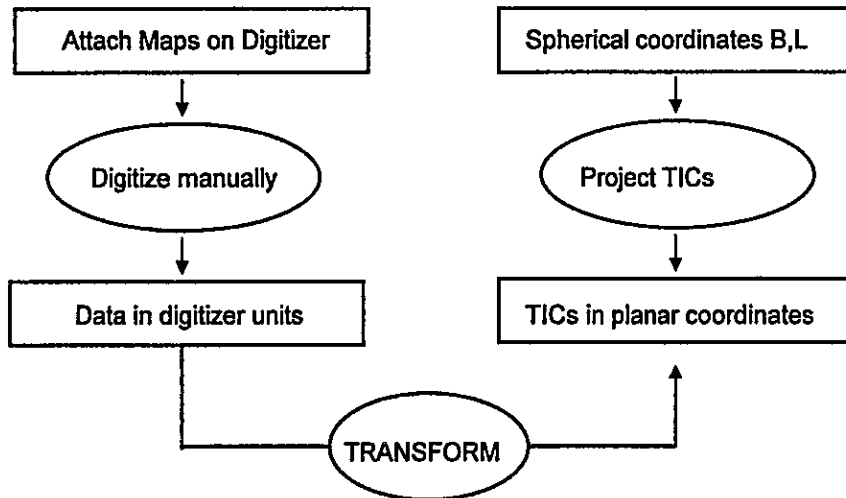

e1   e2
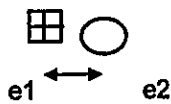
⊞ Coverage TIC

◯ Computed by parameters

e3

e4
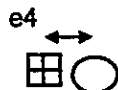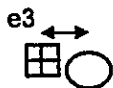
$$\text{RMS error} = \sqrt{\frac{e_1^2 + e_2^2 + \dots\dots + e_n^2}{n}}$$

5.2.2 Transform Digitizer Coordinates to Real-world coordinates

"Arc: TRANSFORM" is commonly used to transform the digitized data in *"Digitizer Unit"* into the *"Real-world Coordinates"*.

```
┌──────────────────────────┐      ┌──────────────────────────┐
│  Attach Maps on Digitizer │      │  Spherical coordinates B,L│
└──────────────────────────┘      └──────────────────────────┘
              │                                  │
              ▼                                  ▼
     ╭─────────────────╮              ╭──────────────────╮
     │ Digitize manually │              │   Project TICs   │
     ╰─────────────────╯              ╰──────────────────╯
              │                                  │
              ▼                                  ▼
┌──────────────────────────┐      ┌──────────────────────────┐
│   Data in digitizer units │      │  TICs in planar coordinates│
└──────────────────────────┘      └──────────────────────────┘
              │                                  ▲
              └──────╮   ╭────────────────╮  ╭───┘
                     ╰───│   TRANSFORM    │──╯
                         ╰────────────────╯
```
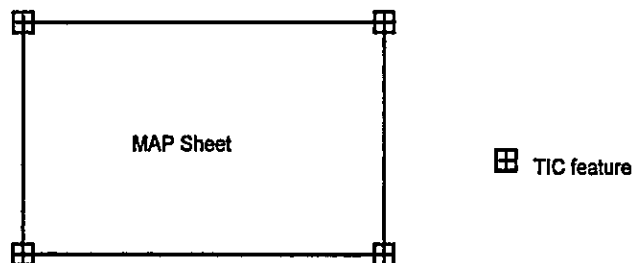
The procedures are shown in the above diagram. An example for practicing the use of TRANSFORM command for such purpose is shown in Exercise-4.

==

Note:

TIC is the feature used for geo-referencing a coverage in ARC/INFO. There is no limitation by the software. However, Arc: TRANSFORM command required certain minimum number of Tics depending on the method chosen by the user. Commonly, the four map corners are used as TICs in a coverage.

```
    ⊞─────────────────────⊞
    │                     │
    │                     │
    │    MAP Sheet        │        ⊞  TIC feature
    │                     │
    ⊞─────────────────────⊞
```

6   ARCPLOT: Display & Output GIS-Maps

ARCPLOT provides:

  ✧ Cartographic Tools for ARC/INFO mapping needs

    With ARCPLOT, different symbols can be linked to different coverage features. In this way, maps can be designed to reflect any of the attributes of the coverage data in an ARC/INFO database.

  ✧ Capability for manipulating map components; creating metafiles for high quality output on the plotter/printer

  ✧ Interactive query functions to retrieve data from internal or external database(s).

6.1 Concept

For simple ARCPLOT maps and informal screen displays created for browsing and query, the only files needed are the *coverages* to be displayed.

Coverage *topology* does not have to exist or be updated before a coverage is used in ARCPLOT, but many important ARCPLOT functions will not work unless coverage topology is present and up-to-date. For example, arcs and node errors can be drawn, but the polygons will not be able to shade, and the ARCPLOT query operations will also not be able to perform.

6.1.1 Additional Files

To create sophisticated ARCPLOT maps with cartographic elements such as titles, key legends, customized symbols, etc., there are some additional files which are used by ARCPLOT.

Key files:

are system text files that define the contents of key legends. INFO data files can also be used to supply text for key legends.

Symbolset files:

are binary files that store individual characteristics for ARC/INFO symbols (i.e., lineset, markerset, shadeset and textset files).

Lookup tables, related tables:

are tabular database files that assign graphic symbols or text labels to coverage features based on their feature attributes.

Graphics metafiles, standard interchange formats, and a wide variety of raster images:

can be used as graphic elements in the map.

6.1.2 Map-to-Page Environment

Map positioning and scaling is also known as map-to-page transformation because it controls how the coverage coordinates in real-world map units are transformed onto the graphics page coordinates in page units on the specified display device (screen or output). Coverages contain the unscaled coordinates that ARCPLOT uses to draw maps.

ARCPLOT lets the user to specify all the vital statistics of maps as well as page layout. Such information includes what area the map will represent, map scale, angle of rotation and where maps are positioned on the graphics page, as well as the page size and units that will be used for transformation operations.

If map scale or page dimensions are not specified, ARCPLOT will automatically scale the map to fill the graphics extent of the current display device, whether it be a graphics screen or hardcopy surface (plot paper - PAGESIZE, MAPLIMITS).

MAPSCALE command is used to specify the denominator of the scale to draw the map. MAPUNITS command tells ARCPLOT what coordinate units the coverages will be drawn, or are stored in. The default for MAPUNITS is inches. If the coverage data is stored in inches, only MAPSCALE is used, otherwise the coverage unit (mapunit) has to be specified.

> Example:
>> Arcplot: **mapunits meters**
>> Arcplot: **mapscale 24000**

ensure that coverage features stored in meters will be drawn at a scale of 1:24,000.

6.1.3 Map Symbolization

In ARC/INFO, symbols and labels are divided into four groups: line symbols, for linear data such as streets and map borders; marker symbols, for point and label features; shade symbols, for filling polygon features; and text symbols, for annotation, labels and titles. When something is drawn, the appropriate symbols are used automatically. Each symbol is accessed in ARCPLOT and ARCEDIT from its *symbolset file*: lineset, markerset, shadeset or textset.

The current symbols are defined by the current parameter settings for each of the four symbol groups. The symbol definition is stored in symbol number 1000 which is reserved for interactive symbol specifications. Symbol locations 1—999 are used to store symbols that can be used later in the current ARCPLOT session, or saved to a symbolset file.

The characteristics of the current symbols can be modified any number of times during an ARCPLOT session. Most ARCPLOT commands that draw features use one of these current symbols. For example, the ARCS command uses the current line symbol to draw the arcs from a coverage. So, the symbol design used to draw the arcs will be the one defined by the most recent choice of line symbol characteristics.

To return the parameter values of the current symbol as well as the current symbol environment the commands: LINEINFO, MARKERINFO, SHADEINFO, TEXTINFO; can be used.

Example:

Arcplot: lineinfo 1000

Weeddraw is ON, weed operator is POINTREMOVE, weed tolerance is DEFAULT

Linescale factor is 1

Layer	Type	Option	Size	Hollow	Offset	Interval	Pensize	Linecap	Linejoin	Template
1 Hardware		0	0.025	0.000	0.000	0.000	0.000	BUTT	MITER	0

1 Closure angle: 0.000, Miter angle: 0.000, Pattern Adjustment: 0.000

1 Color: C-100.000% M-0.000% Y-100.000% K-0.000% (GREEN)

If LINEINFO, MARKERINFO, SHADEINFO, or TEXTINFO are used without a specific symbol number, the current definitions that are stored in symbol 1000 are listed.

6.1.4 Drawing Coverage Features

The simplest way to draw coverage features is with one of the following drawing commands that use one of the current symbols.

ARCS   LABELS   POLYGONS   NODES   POINTS   TICS

Examples:

> Arcplot: **linesymbol 3**
>
> Arcplot: **arcs streams**
>
> *will draw all of the arcs in a coverage called streams using line symbol 3 from the current lineset file.*

> Arcplot: **linesize 0.01**
>
> Arcplot: **linecolor red**
>
> Arcplot: **polygons europe**
>
> *will draw all of the polygon outlines in the europe coverage using the current line symbol with a width of 0.01 and color red.*

Another way of drawing coverage features with the same symbol pattern is to specify a symbol number with one of these commands:

ARCLINES   POLYGONSHADES   POINTMARKERS

Specifying the following commands, line symbol 34 will draw all the arcs in the streams coverage, marker symbol 9 will draw all the points in the mines coverage and shade symbol 2 will fill all the polygons from the zones coverage.

> Arcplot: **arclines streams 34**
>
> Arcplot: **pointmarkers mines 9**
>
> Arcplot: **polygonshades zones 2**

Further, the coverage features can be drawn in a variety of ways such as, using item values; using lookup tables, etc.Please refer to the examples in "Learning ARC/INFO [3]".

6.2 ARC/INFO Graphics Files

DISPLAY command can be used to create graphics files (Plot Files) by setting device to 1040.
There are eight options for file formats:

option	metafile format	default page size [Inches]
1	ARC/INFO graphics file (.gra), the default	100 x 100
2	Encapsulated PostScript (.eps)	1000 x 1000
3	Adobe Illustrator (.ai)	1000 x 1000
4	Computer Graphics Metafile - character (.cgm)	1000 x 1000
5	Computer Graphics Metafile - clear text (.cgm)	1000 x 1000
6	Computer Graphics Metafile - binary (.cgm)	1000 x 1000
*7	Windows Metafile (.wmf)	100 x 100
*8	Enhanced Metafile (.emf)	100 x 100

Supported only on NT.

When <device> is set to 1040, it will be prompted to name the metafile. A standard extension will be appended to the filename unless the user has already specified such. The industry standard naming conventions for each file format are shown in parenthesis () in the above list.

6.3 Using ARCPLOT Commands in ARCEDIT

Most ARCPLOT commands, including SHOW functions can be used within ARCEDIT in 2 ways.

✧   AP Command with AP file

AP files are ASCII files containing ARCPLOT commands that execute when the Arcedit DRAW command is executed. AP files are generally used for accessing ARCPLOT commands in ARCEDIT (can also include, AML directives, functions, and variables).

For example, an AP-file *DRAWGAS.AP* contains the following ARCPLOT commands:

    arclines gas 2
    pointmarkers valves 3

To draw GAS and VALVES coverages in ARCEDIT, the following commands are used :

    Arcedit: **ap drawgas.ap**
    Arcedit: **draw**

❖ **ARCPLOT (APC) command**

The APC command allows interactive input of ARCPLOT commands within ARCEDIT. All ARCPLOT commands issued with the APC command are executed immediately.

Arcedit: **apc arclines gas 2**

Arcedit: **apc pointmarkers valvs 3**

Or by starting a dialog by typing APC followed by a carriage return:

Arcedit: **apc**

AP: **arclines gas 2**

AP: **pointmarkers valvs 3**

AP: **quit**

Arcedit:

The following table shows the differences between the (APC) ARCPLOT command environment in ARCEDIT and the ARCPLOT program.

Command	ARCEDIT	ARCPLOT
shadeset	color.shd	plotter.shd
markerset	color.mrk	plotter.mrk
lineset	color.lin	plotter.lin
clipmapextent	off	on
units	map	page
mapposition	cen cen	LL LL

■ **Using APMODE command**

While editing a coverage or INFO file in ARCEDIT, all changes are written to temporary files in the current workspace. The edits contained in these temporary files are written back to the original coverage when the command SAVE is used.

By default, all ARCPLOT commands executed from ARCEDIT using the AP or APC commands will affect the last saved or disk version of the data. The version of the edit coverage or INFO file affected by ARCPLOT commands can be toggled between the disk and the current edit version using an ARCEDIT command called APMODE.

For example, with APMODE set to DISK, ARCPLOT drawing commands will not draw newly added (unsaved) features. Switching APMODE to EDIT and issuing the same ARCPLOT command will draw the added features.

✧ NOT to draw Newly added polygons:

        Arcedit: **editcoverage coverage polygon**

        Arcedit: **add**

        Arcedit: **show apmode**

        DISK

        Arcedit: **apc polygonshades canada 3**

✧ To Draw Newly added polygons:

        Arcedit: **apmode edit**

        Arcedit: **apc polygonshades canada symbol**

Warning: Not all ARCPLOT and ARC funtionality will work with APMODE set to EDIT. Most problems can be avoided by setting APMODE to DISK.

■ **Using ARC Commands in ARCEDIT**

ARC commands can be used within ARCEDIT by issuing &system directive, or APC command followed by any ARC command. For example, the following set of commands will execute the ARC DESCRIBE command and display information about the contours coverage.

        Arcedit: **&sys arc describe contours**

                OR

        Arcedit: **apc arc describe contours**

The use of ARCPLOT is explained more detail in Exercise-5.

7 Data Conversion

7.1 Interchange File

Arc:EXPORT command is used to create an interchange file, which contains all coverage information and the INFO file information in a fixed-length (80 bytes), ASCII format. Once the interchange file is created it can be transferred by tape/CD-Rom to another machine where Arc: IMPORT command is used to recreate the coverage.

7.1.1 Using EXPORT Command

Arc: EXPORT command can be used to transport a coverage and its associated INFO files by using the keyword "COVER", or to transport a single INFO file by using the keyword "INFO" for the first argument.

Arc: export

Usage: EXPORT <option> <input> <interchange_file> {NONE | PARTIAL | FULL} {max_lines}

<option> - specifies the data type to be exported. The following are valid options.

COVER - a coverage, associated INFO files and any index files.

INFO - an INFO file.

and others

<input> - the name of the input coverage, file, or data set to be exported.

<interchange_file> - the prefix name of the ARC/INFO interchange file(s) to be created by EXPORT.

A volume ID of.E00 will be appended to the file name of the first interchange file,.E01 to the second file,

and so on. Each subsequent file is created when the {max_lines} for each file is reached.

{NONE | PARTIAL | FULL} - specifies how numbers and blanks will be compressed in the export file.

NONE - no compression is performed.

PARTIAL - compresses blanks but does not compress numbers.

FULL - compresses both blanks and numbers using ASCII compression characters.

{max_lines} - maximum number of lines for each volume (i.e., disk file) of an EXPORT file.

A volume has the extension .E00 through .E99. Only one export file is created if {max_lines} is not specified.

7.1.2 Using IMPORT Command

Arc: IMPORT command allows the user to recreate the coverage, INFO file(s), or other exported ARC/INFO data from the interchange file.

> Arc: Import
>
> Usage: IMPORT <option> <interchange_file> <output>

<option> - type of output to be created from the interchange file. The following options are available:

> AUTO - automatically determines the correct import option from the format of the export file.
>
> COVER - a coverage, associated INFO data files and any index files.
>
> INFO - an INFO data file.
>
> and others

<interchange_file> - name of the ARC/INFO interchange file to be converted. A volume ID of .E00, .E01, and so on, will always be appended to the given <interchange_file> to specify the file(s) to be imported.

<output> - the name of the output coverage, file or data set to be created from the interchange file.

7.2 Data Conversion Tools

ARC includes a number of commands for converting data. These commands provide a variety of tools to transfer data into and out of ARC/INFO from several sources.

7.2.1 DXF files into ARC/INFO

Step 1:   Use DXFINFO

> Usage: DXFINFO <dxf_file>
>
> To capture this information in a file, use AML to start a watch file before executing DXFINFO.
>
> Arc: &watch test_dxf.log
>
> Arc: dxfinfo test_dxf

LAYER NAME	ARCS	POINTS	TEXT	ATTRIB	INSERT	LEN	DEF COLOR	DEFAULT LINETYPE
A123	4	0	0	0	0	0	7	CONTINUOUS
LOTS	13	2	5	0	0	32	14	CONTINUOUS
DATA	0	0	0	2	1	5	6	CONTINUOUS
HIDE	1	0	0	0	0	0	-1	DASHED
ALL LAYERS	18	2	5	2	1	32		

> Arc: &watch &off

Step 2: Perform the conversion

The layer names and their options are entered interactively during the command dialog.

The item widths for items storing text and attribute entities can be controlled using the {text_width} and {attrib_width} options on the DXFARC command line. The default item widths are 40 for text entity strings and 16 for attribute entity names.

> **Arc: dxfarc**
>
> Usage: DXFARC <in_dxf_file> <out_cover> {text_width} {attrib_width}
>
> **Arc: dxfarc test_dxf dxfcov 32 5**
>
> Enter layer names and options (type END or $REST when done)
>
> ═══
>
> Enter the 1st layer and options: **$rest all**
>
> Do you wish to use the above layers and options (Y/N)? **Y**
>
> Processing <AI50>ARCTEST>DATCON>TEST_DXF
>
> Externally BND and TIC...
>
> > 19 Arcs written.
> >
> > 5 Labels written.
> >
> > 7 Annotations written.
> >
> > 2 Annotation levels.
>
> Arc:

Step 3: After conversion

Once the DXF has been converted to an ARC/INFO coverage, BUILD command is used with the LINE or POINT option to generate line or point coverage topology correspondingly. To build polygon topology CLEAN command can be used.

If DXF arcs are converted, an INFO data file named <out_cover>.ACODE is created, and if label points are created from DXF points, text, attribute or insert entities, an INFO data file named <out_cover>.XCODE is created to hold the associating attribute codes from the DXF file.

■ Supported DXF entities

DXF Entity types	Converted to ...
POINT, SHAPE	Points
LINE , 3DLINE	Two -point arcs
TRACE , SOLID , 3DFACE	Four - or five-point arcs
TEXT, ATTRIBUTE	Annotation or points
INSERT	Points
CIRCLE , ARC	Up to 361 point arcs
POLYLINE	Multipoint arcs
POLYLINE with bulge	Up to 360 point arcs
BLOCK	Points, two, four, five-point and multipoint arcs

■ Line attributes: <out_cover>.ACODE file:

ITEM NAME	WDTH	OPUT	TYP	N.DEC
Cover-ID	4	5	B	
DXF-LAYER	31	31	C	-
DXF-COLOR	3	3	I	-
DXF-THICKNESS	4	12	F	3
DXF-TYPE	10	10	C	-
DXF-ELEVATION	4	12	F	3
DXF-HANDLE	16	16	C	-
DXF-CURVE	1	1	I	-

■ Point attributes: <out_cover>.XCODE file:

ITEM NAME	WDTH	OPUT	TYP	N.DEC
Cover-ID	4	5	B	
DXF-LAYER	31	31	C	-
DXF-COLOR	3	3	I	-
DXF-THICKNESS	4	12	F	3
DXF-TYPE	10	10	C	-
DXF-ELEVATION	4	12	F	3
DXF-HANDLE	16	16	C	-
DXF-ANGLE	4	12	F	3
DXF-SIZE	4	12	F	3
DXF-TEXT	xx	xx	C	-

7.2.2 ARC/INFO coverages to DXF file

Since AutoCAD does not accept a layer name that has an extension, the original ARC/INFO coverage names should not include any suffixes. This is because ARCDXF uses the input coverage names as part of each layer name it creates.

To convert the arcs of a polygon coverage, first use BUILD with the LINE option to create an AAT file and then convert as for arc features. If label points exist for the polygon coverage, they can be converted as point features.

> Arc: arcdxf
>
> Usage: ARCDXF <out_dxf_file> {in_line_cover} {in_point_cover}
> {in_annotation_cover} {decimal_places}{ASCII | BINARY}

ARC/INFO feature	DXF entity	Comments
Arc	Polyline or Circle or Arc	The type of entity created by ARCDXF depends on the presence of certain items in the AAT.
Point	Point or Text	The type of entity created by ARCDXF depends on the presence of certain items in the PAT.
Annotation	Text	Each level of annotation is written as a unique DXF layer.
Polygon	- - -	To convert the arcs of a polygon coverage, first use BUILD with the LINE option to create an AAT file and then convert as for arc features. Label points for polygon coverage can be converted as point features.

Example:

In the following example, a polygon coverage will be converted into <outfile.dxf>. Both polygon and Arc topology must exist for "POLYCOV" to be converted.

> Arc: arcdxf outfile.dxf polycov polycov # 3
> Creating DXF file OUTFILE from:
> POLYCOV
> POLYCOV
> Arc:

8 Learning ARCINFO Exercise for Use with Training Database

8.1 Exercise [1]

8.1.1 Move to the Working Directory

■ Start arc

■ Use "workspace" command (or just w), to move to the working directory.

Arc: w c:¥.....¥ trainingdata

⌐— It represents the "full pathname", where the "trainingdata" is located.

■ Use "listcoverages" command (or just lc) to list up all coverages in the current workspace.

Arc: lc

Workspace: C:¥.....¥TRAININGDATA

Available Coverages

ADMIN	CITIES	LAKES	PROVINCE	-
RAILS	RIVERS	ROADS	ROAD_ORG	
VEGETATION				

■ Use "listworkspaces" command (or just lw) to list up available workspaces.

Arc: lw

List of workspaces at location: C:¥.....¥TRAININGDATA

Available workspaces

EX-1	EX-2
EX-3	EX-4
EX-5	EX-6

Arc:

■ Now, move to the workspace "ex-1"

Arc: w ex-1

Arc:

8.1.2 Arc-Node Topology Error

■ **Arc: copy ..¥road_org noderr**

Copied ..¥road_org to noderr

Arc:

Note:

This coverage "NODERR" will be used in all the commands in this Exercise-1.

■ **Arc: describe noderr**

Description of DOUBLE precision coverage noderr

FEATURE CLASSES

Feature Class	Subclass	Number of Features	Attribute data (bytes)	Spatial Index?	Topology?
ARCS		3700	76		
NODES		552			

SECONDARY FEATURES

Tics	4
Arc Segments	77576

TOLERANCES

Fuzzy	=	150.439 N	Dangle	=	0.000 N

COVERAGE BOUNDARY

Xmin =	-669222.061	Xmax =	662171.838

Continue?   →   <ENTER> Key

Note:

When the screen is full, the system issues a prompt "Continue?". Press <ENTER>Key to continue, or type <N> to stop listing.

| Ymin = | -1278927.513 | Ymax = | 225459.709 |

STATUS

The coverage has not been Edited since the last BUILD or CLEAN.

COORDINATE SYSTEM DESCRIPTION

Projection   LAMBERT_AZIMUTHAL

| Units | METERS | Spheroid | DEFINED |

Major Axis   6370997.00000   Minor Axis   0.00000

Parameters:

radius of the sphere of reference	6370997.00000
longitude of center of projection	18 0 0.000
latitude of center of projection	-6 30 0.000
false easting (meters)	0.00000
false northing (meters)	0.00000

Arc:

DESCRIBE command will list the content of a coverage, as well as the projection information (when exists) as shown in above.

Further in the above example, the number of nodes (552) shows considerably low compared to the number of arcs (3700). It might be the arc-node topology error.

8.1.3 Node Errors (Dangling & Pseudo Nodes)

Three ways of checking node errors (by using Arc; Arcplot; and Arcedit commands) will be introduced in this exercise. Please compare the results.

■ **Using Arc-Command**

Arc: nodeerrors noderr

| Dangling Node | 1 at (| -567288.18701, | 224748.12742) |
| Dangling Node | 2 at (| -567224.83862, | 225459.70927) |

| Pseudo Node | 528 at (| 190859.95636, | -526221.47895) |
| Dangling Node | 530 at (| 162626.67549, | -523090.10410) |

```
. . . . . . . . . . . . . . . . . . .

. . . . . . . . . . . . . . . . . . .
```

Dangling Node   551 at (-520.77626,   -1152717.54348)

Dangling Node   552 at (9145.62622,   -1158272.77855)

Total number of Pseudo Nodes: 10

Total number of Dangling Nodes: 288

Arc:

A very long error-list will be displayed on the screen, showing the total number of "errors" (dangling & pseudo nodes) at the end.

■ **Using Arcplot Command**

    Arc: arcplot (or just ap)

    Arcplot: **disp 9999**   ----→   *needs only once throughout an ARC session*

    Arcplot: **mapex noderr**

    Arcplot: **nodeerrors noderr**

    Arcplot: **q**
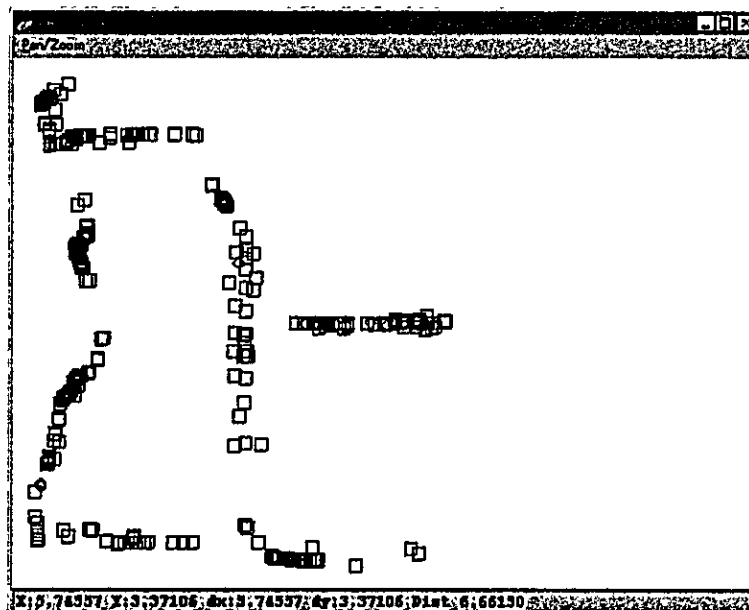
■ Using Arcedit Commands

Arc: **arcedit (or just ae)**

Arcedit : **edit noderr**

Arcedit : **drawe node errors**

Arcedit : **draw**

Device is not graphic

Arcedit : **display 9999** ——→ *type only, if the above message appears; and use DRAW again*
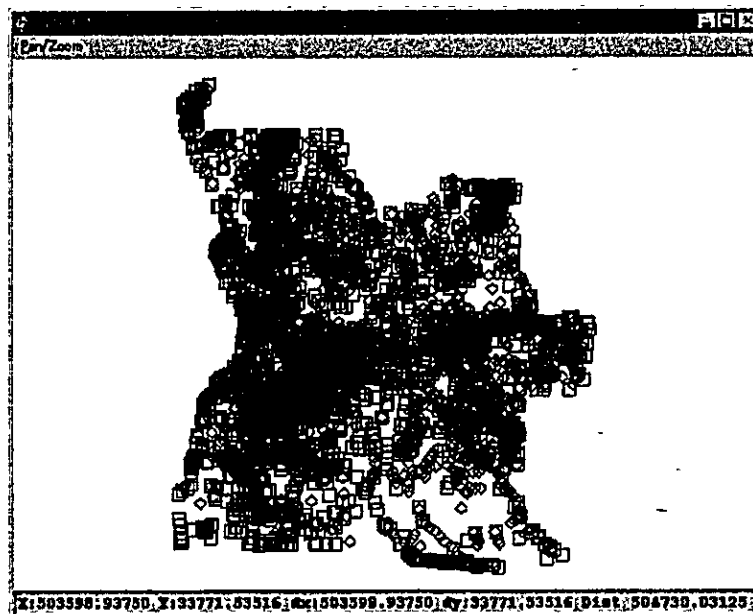
Discussion:

The results of checking node error by the Arc, Arcplot, and Arcedit commands are different, and it can be observed more clearly in Arcplot and Arcedit displays (see the figures in above).

By "DESCRIBE" command, a possible arc-node topology error was found. This error might be the reason for producing different results in checking node errors by different commands. It can be verified by repeating node-error checking steps in Arcplot and Arcedit after removal of the arc-node topology error.

8.1.4 Edit Node Errors

■ **Correcting Arc-Node Topology**

Arc: **copy noderr cnoderr**

Arc: **renode cnoderr**

Arc: **describe cnoderr**　　　　　⎯⎯→ Observe the number of nodes

After completion of the RENODE command, repeat the three node-error checking commands (Arc, Arcplot, and Arcedit), and note the total number of errors listed by Arc: command.

■ **Editing Node Errors**

Arc: **matchnode cnoderr cn200 200 # extend**

Matching Nodes for cn200...

Extending undershoots...

Saving arcs...

4785 arc attribute record(s) written to C.¥ANGOLA_DATA¥TRAININGDATA¥EX-1¥CN200

4785 arc(s) written to C:¥ANGOLA_DATA¥TRAININGDATA¥EX-1¥CN200

　from the original 3700, 4744 added and 3659 deleted

　　BND replaced into cn200

From 7400 nodes: 5205 matched onto themselves

　　　　　　　　1025 arc(s) extended into other arcs

Removing Topology...

Arc·

Discussion:

In the above example, a node-matching tolerance is set to 200m, which would be allowable at a scale of 1:1,000,000. By increasing this tolerance, more node errors can be removed. However, the maximum allowable tolerance is subject to the purpose of using that coverage. In the above exercise, only the "undershoots" will be corrected. It is possible to automatically remove the "overshoots" by specifying appropriate "dangle-tolerance", which also depends on the purpose. It means that the errors can be removed automatically within the allowable tolerance. All the rest errors may have to be edited manually.

For removal of "pseudo-nodes", use "Arcedit: unsplit" command. It's usage is well explained in the on-line manual. It might be the best opportunity to conduct a "self-study".

8.1.5 Label Errors

Polygon features must be closed, and each polygon must have only one label in it. Polygons with no labels, or those with more than one label are interpreted by the software as "Label Error".

Prior to the start of the exercises, working directory "Ex-1" should be confirmed first.

■ **Working Directory and Data for Exercise**

　Arc: **workspace** (or just **w**)

　Current location: c:¥angola_data¥trainingdata¥ex-1

And then, copy data for "Label Error" exercise

　Arc: **copy ..¥lakes laberr**

Checking "Label Errors" can be performed in "Arc:" or "Arcplot:".

■ **Using Arc-Command**

　Arc: **labelerrors laberr**

Polygon	1 has	0 label points.
Polygon	477 has	2 label points.
Label User ID:	1952	
Label User ID:	1964	
Polygon	479 has	0 label points.

　Total number of Polygons with No Labels:　　2

　Total number of Polygons with Multiple Labels:　1

　Arc:

ARC/INFO always assign internal ID #1 for the "Universe Polygon". Commonly, no label point is assigned for that polygon. ARC Command LABELERRORS can be used to list the errors, and Arcplot command LABELERRORS can be used to check those errors visually.

■ **Using Arcplot-Command**

　Arc: **ap**

　Arcplot: **disp 9999**　　——→　needs only once throughout an ARC session

　Arcplot: **mapex laberr**

　Arcplot: **markercolor 2**

　Arcplot: **labelerrors laberr**
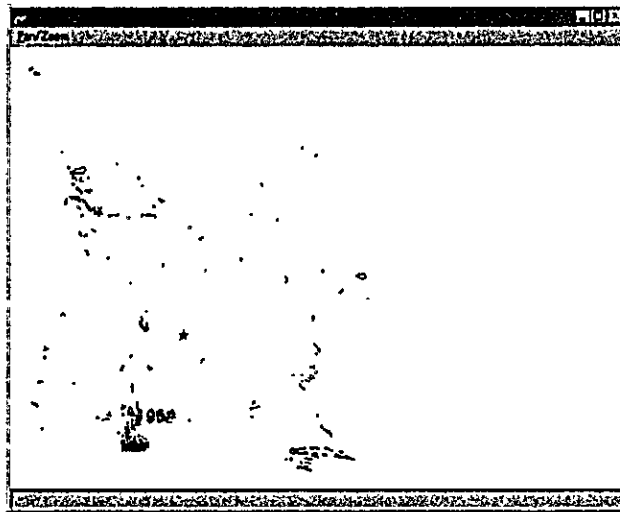
The STAR-shape marker indicates polygons with no label point (Polygons #1 and #479). Two label numbers, #1952 and #1964 are (overlap) displayed. By combining the above two results (Arc & Arcplot), position of the errors and corresponding label-numbers can be identified.

8.1.6 Edit Label Errors

Arc: copy laberr edlaberr

Arc: arcedit

Arcedit: edit edlaberr

Arcedit: drawe arc label

Arcedit: draw

If the message "*Device is not graphic*" appears set disp 9999 and type draw again
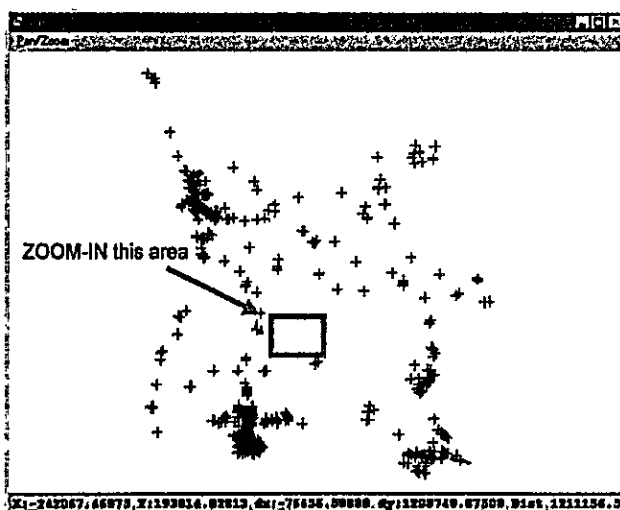
Zoom-in the area where "Label Error" has been identified (see above figure), and the screen after zoom-in should look like the figure in below.
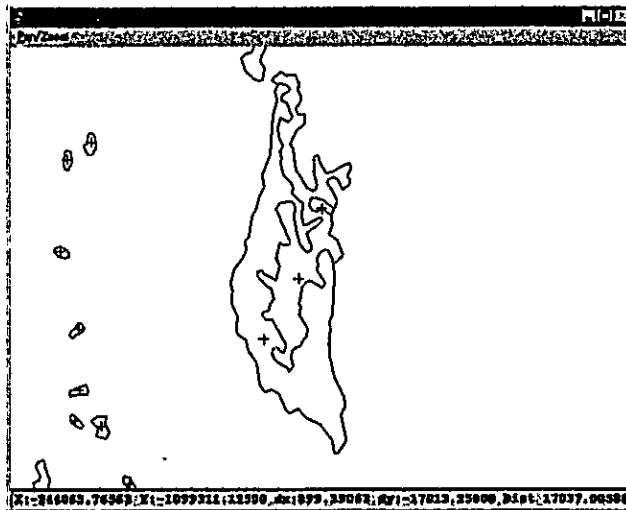
The command <APC> will allow user to execute Arcplot-commands at "AP:" prompt in Arcedit environment. To exit AP-mode, type <q>, and it will return to the "Arcedit:" prompt.

Using "Arcplot: Labelerrors" command will facilitate identification of the errors.

> Arcedit: apc
>
> AP: markercolor 2
>
> AP: labelerrors edlaberr
>
> AP: q
>
> Arcedit:

ZOOM-IN this area
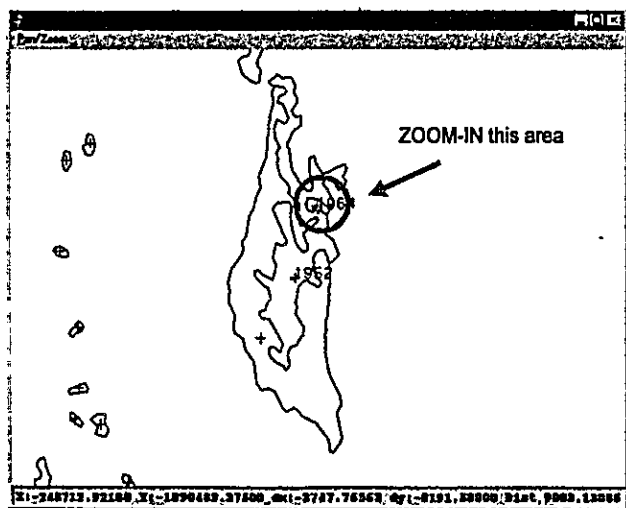
In the above figure, polygon with Label #1964 is indicated by a circle. Zoom-in that polygon until the following situation appears on the screen.
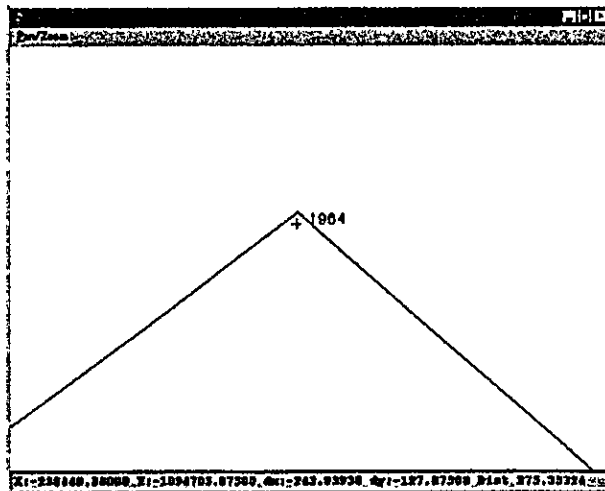
Discussion:

The problems in above can be explained as follows:

❖ Label #1952 is the correct label for the polygon #477

❖ Label #1964 was not correctly placed in the polygon #479, and it is located within the polygon #477, so that the result of "Arc: Labelerrors" command shows: *"polygon #479 has no label, and the polygon #477 has 2 labels"*.

❖ The correction measure (in Arcedit) is as follows:

> Set edit feature to label, and select the label to be moved; then move the selected label into the polygon #479 by using "Arcedit: MOVE" command.

❖ When the editing is complete, then quit Arcedit, save the edits, and recreate topology.

To avoid problems in repeating exercises in this workspace, it may be advisable to delete all the new data created in this Exercise.

Arc: **kill cn200 all**

Killed meter_cov with the ALL option

Arc: **kill cnoderr all**

Killed tr_cov with the ALL option

Arc: **kill edlaberr all**

Killed tr_cov with the ALL option

Arc: **kill laberr all**

Killed tr_cov with the ALL option

Arc: **kill noderr all**

Killed tr_cov with the ALL option

Arc: .

8.2 Exercise [2]

8.2.1 Move to the Working Directory

- Start arc

- Use "workspace" command (or just w), to move to the working directory.

Arc: w c:¥....¥trainingdata

↳ It represents the "full pathname", where the "trainingdata" is located.

- Use "listcoverages" command (or just lc) to list up all coverages in the current workspace.

Arc: lc

Workspace: C:¥.....¥TRAININGDATA

Available Coverages

ADMIN	CITIES	LAKES	PROVINCE
RAILS	RIVERS	ROADS	ROAD_ORG
VEGETATION			

- Use "listworkspaces" command (or just lw) to list up available workspaces.

Arc: lw

List of workspaces at location: C:¥.....¥TRAININGDATA

Available workspaces

EX-1	EX-2
EX-3	EX-4
EX-5	EX-6

Arc:

- Now, move to the workspace "ex-2"

Arc: w ex-2

Arc:

8.2.2 INFO and TABLES Sub-Systems

For handling tabular (Attribute) data, INFO or TABLE can be used.

Using INFO

Arc: **info**

INFO   EXCHANGE   CALL

05/02/2000   14:20:28

INFO   9.42   11/11/86   52.74.63*

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US Govt Agencies see usage restrictions in Help files (Help Restrictions)

ENTER USER NAME>**arc**

ENTER COMMAND >**q stop**

Arc:

Using TABLES

Arc: **tables**

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All rights reserved.

TABLES Version 7.2.1   (Thu Apr   2 15:59:38 PST 1998)

Enter Command:**q**

Arc:

The exercises introduced here can be performed in both INFO or in TABLES. The user can select preferable system. However, CAUTION should be paid in entering file names.

It is suggested to work with "UPPER CASE" file names in INFO.

8.2.3 Creating and Editing INFO Files

Arc: **tables**

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All rights reserved.

TABLES Version 7.2.1   (Thu Apr   2 15:59:38 PST 1998)

Enter Command:

To input the following data into INFO, follow the steps in below :

EX_PROV-ID	POP	MALE	FEMALE
1	185000	88940	96060
2	247000	118720	128280
3	948000	455780	492220
4	308140	148160	159980

Step 1) Define an INFO File

Enter Command: **define my_file.dat**

1

Item Name: **ex_prov-id**

Item Width: **4**   -→ *Data will be stored in 4-Bytes*

Item Output Width: **10**   -→ *Data will be displayed in 5-Digits*

Item Type: **b**   -→ *Data will be stored in Binary type*

5

Item Name: **pop,4,10,b**   -→ *All together can be entered in one line*

9

Item Name: **male,4,10,b**

13

Item Name: **female,4,10,b**

17

Item Name: -→ *Press <ENTER>Key to end the entry*

Enter Command:

Step 2) Add data to selected INFO File :

Enter Command: **add**

                    1

EX_PROV-ID: **1**   --> Entering data at the system prompt

POP: **185000**

MALE: **88940**

FEMALE: **96060**

                    2

EX_PROV-ID: **2, 274000, 118720,128280**   --> Entering all together in one line

                    3

EX_PROV-ID: **3, 948000, 455780,492220**

                    4

EX_PROV-ID: **4, 308140, 148160,159980**

                    5

EX_PROV-ID: --> Hit <ENTER>Key to end the entry

Enter Command: **li**

Record	EX_PROV-ID	POP	MALE	FEMALE
1	1	185000	88940	96060
2	2	274000	118720	128280
3	3	948000	455780	492220
4	4	308140	148160	159980

Enter Command:

Step 3) Update Data in selected File:

A POP-Item data error in Record Number 2 can be identified in the above list. The value 274000 must be edited to 247000. It can be done as follows:

Enter Command: **upd**

Enter Record Number: **2**

                    2

EX_PROV-ID   =   2

POP   =   274000

```
MALE                    =    118720

FEMALE                  =    128280

Edit?: pop = 247000              -> Entry for update

Edit?:              --> Hit <ENTER>Key

Enter Record Number: ----> Hit <ENTER>Key


Enter Command: li

Record   EX_PROV-ID         POP      MALE     FEMALE

     1     1              185000    88940      96060

     2     2              247000   118720     128280

     3     3              948000   455780     492220

     4     4              308140   148160     159980


Enter Command:
```

8.2.4 Joining Attribute to the Coverage

For this exercise purpose, a coverage EX_PROV and attribute INFO-File POP.DAT are prepared.

```
Arc: lc

Workspace:          C:¥ANGOLA-CD¥TRAININGDATA¥EX-2


Available Coverages

     ------------

     EX_PROV

Arc:
```

EX_PROV is a polygon coverage, and the PAT-File is as follows :

```
Arc: items ex_prov.pat
```

COLUMN	ITEM NAME	WIDTH	OUTPUT	TYPE	N.DEC	ALTERNATE NAME	INDEXED?
1	AREA	8	18	F	5	-	
9	PERIMETER	8	18	F	5	-	
17	EX_PROV#	4	5	B	-	-	
21	EX_PROV-ID	4	5	B	-	-	
25	PROVINCIA	40	40	C	-	-	

To check the presence of POP.DAT and item definition, the following command can be used.

Arc: **dir info**

TYPE NAME	INTERNAL NAME	NO. RECS	LENGTH	EXTERNL
DF EX_PROV.TIC	ARC0000DAT	4	20	XX
DF EX_PROV.BND	ARC0001DAT	1	32	XX
DF EX_PROV.PAT	ARC0002DAT	19	64	XX
DF POP.DAT	ARC0003DAT	18	16	
DF MY_FILE.DAT	ARC0004DAT	4	16	

Arc: **items pop.dat**

COLUMN	ITEM NAME	WIDTH	OUTPUT	TYPE	N.DEC	ALTERNATE NAME	INDEXED?
1	EX_PROV-ID	4	5	B	-		-
5	POP	4	10	B	-		-
9	MALE	4	10	B	-		-
13	FEMALE	4	10	B	-		-

Arc:

The two files, EX_PROV.PAT and POP.DAT have a common item, which is EX_PROV-ID. Now, by using this common item the two files can be joined.

Arc: **joinitem ex_prov.pat pop.dat ex_prov.pat ex_prov-id**

Joining ex_prov.pat and pop.dat to create ex_prov.pat

Arc:

The result can be verified as follows.

Arc: **items ex_prov.pat**

COLUMN	ITEM NAME	WIDTH	OUTPUT	TYPE	N.DEC	ALTERNATE NAME	INDEXED?
1	AREA	8	18	F	5		-
9	PERIMETER	8	18	F	5		-
17	EX_PROV#	4	5	B	-		-
21	EX_PROV-ID	4	5	B	-		-
25	PROVINCIA	40	40	C	-		-
65	POP	4	10	B	-		-
69	MALE	4	10	B	-		-
73	FEMALE	4	10	B	-		-

Arc:

To avoid problems in repeating exercises in this workspace, it may be advisable to delete all the new data created in this Exercise.

Arc: **&ty [delete my_file.dat -info]**

0

Arc:

8.3 Exercise [3]

8.3.1 Move to the Working Directory

- Start arc

- Use "workspace" command (or just w), to move to the working directory.

Arc: w

↑— It represents the "full pathname", where the "trainingdata" is located.

- Use "listcoverages" command (or just lc) to list up all coverages in the current workspace.

Arc: lc

Workspace: C:¥.....¥TRAININGDATA

Available Coverages

————————

ADMIN	CITIES	LAKES	PROVINCE
RAILS	RIVERS	ROADS	ROAD_ORG
VEGETATION			

- Use "listworkspaces" command (or just lw) to list up available workspaces.

Arc: lw

List of workspaces at location: C:¥.....¥TRAININGDATA

Available workspaces

————————

EX-1	EX-2
EX-3	EX-4
EX-5	EX-6

Arc:

- Now, move to the workspace "ex-3"

Arc: w ex-3

Arc:

8.3.2 Check Feature and Attribute Matching

Both features and their associating attribute must match within an individual map sheet, as well as across all the neighboring map sheets. Checking this can be done either by using hardcopies (Check-plots, Attribute listing), or visually on the graphic display. Arcplot or ArcView provide tools for this purpose.

Two dummy coverages, TO_EDIT and TO_MATCH are prepared for this exercise. The availability of those coverages can be checked by "Arc: listcoverages (or just lc)" command :

- Arc: lc

        Workspace: C:¥ANGOLA_DATA¥TRAININGDATA¥EX-3

        Available Coverages

        _____

        TO_EDIT   TO_MATCH

        Arc:

The figure in below is an example of using ArcView. That view can be created by referring to the Project document "ArcView Operation Manual, March'99". Similar view can also be created in Arcplot, and the functions needed for this purpose are introduced in Exercise-5.
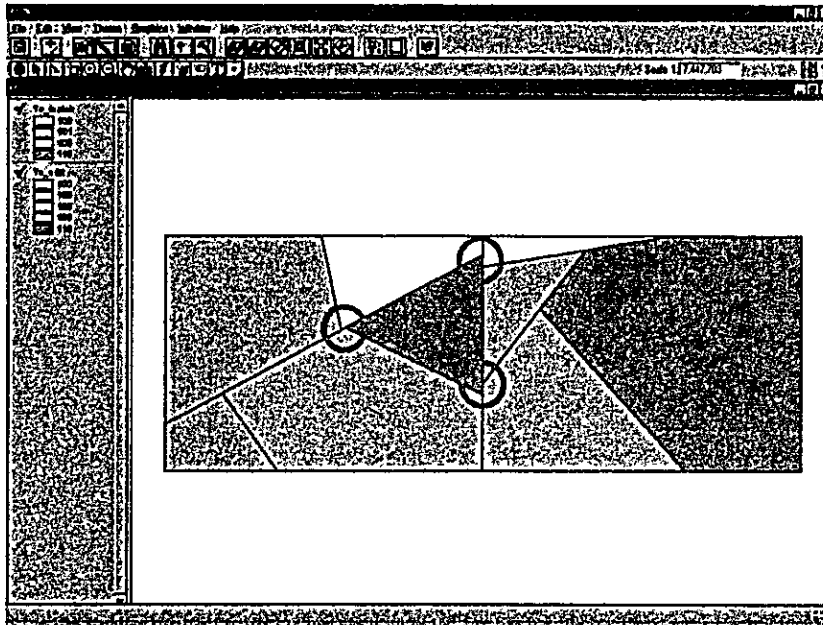
In the above figure, the un-matching features are indicated by "red circles", and the conflicting attributes can be identified by colors.

8.3.3 Edge Matching Within Individual Map Sheet

Arc: copy to_edit ed_cov

Copied to_edit to ed_cov

Arc: ae

Arcedit: disp 9999   → type only, if the device is not yet set

Arcedit: edit ed_cov

Arcedit: de arc node

Arcedit: draw

Arcedit: ef node

Arcedit: move

Point to the node to move <9 to Quit>

Enter point

Now, make the graphic window active and place the cursor on the node to be moved; then press left mouse-button.

Node (4.005,3.048) selected   ————→ confirm, the node is selected !

1 = Select   2 = Next   3 = Who

4 = Move   9 = Quit

If the above menu appears on the "dialog window", then press KEY <4>.

Point to where to move the node <4 - Restart, 9 - Quit>

Enter point

Menu in the dialog window will change as shown in above. Then, place the cursor on the new location to where the selected node should be moved, and press left mouse-button.
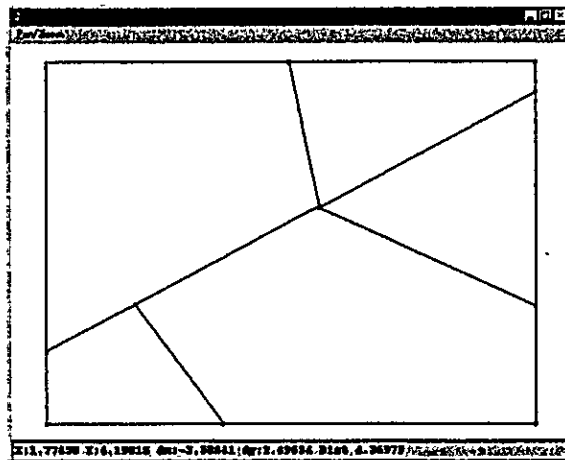
Arcedit: q   ——→   SAVE the edits, and re-build topology !

8.3.4 Edge Matching Commands

Arc : **arcedit**

Arcedit : **edit ed_cov**

Arcedit : **ef link**

Arcedit : **back to_match 2**

Arcedit : **be arc node**

Arcedit : **de arc node link**

Arcedit : **mapex ed_cov to_match**

Arcedit : **draw**

If the message "*Device is not graphic*" appears, then set "disp 9999" and "draw" again
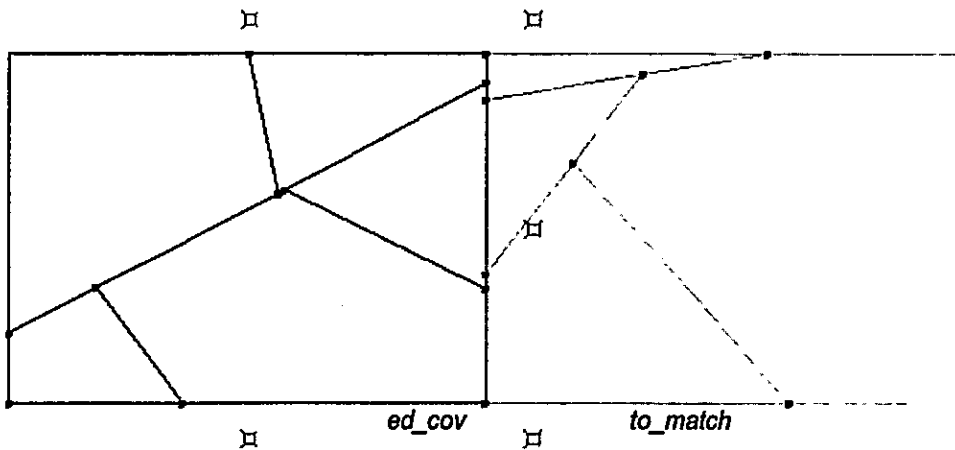
Arcedit : **snapcov to_match**

Arcedit : **linkfeature node node**

Arcedit : **snapping closest ***   —> enter snap distance by mouse

Arcedit : **autolink**

Links are added automatically as shown in this figure
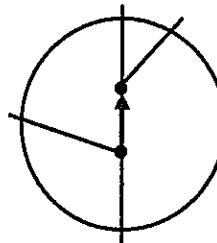
Arcedit : **adjust**

     Observe on the screen how the nodes are adjusted.

Arcedit : **q**   ———> Do not SAVE the edits

8.3.5 Edge Matching Tools

"Edgematch" tool is provided, and it has to be executed in Arcedit.

Arc ae

Arcedit. disp 9999   → type only, if the device is not yet set

Arcedit: edgematch

     &Terminal type being set to 9999...   -→ if it is not the case, type &term 9999

     Starting the Edgematch macros..

The above message will appear on the dialog window, and the menu as shown in below will appear, to specify parameters for matching.

Set here ED_COV
from scrolling list

Set here TO_MATCH
from scrolling list
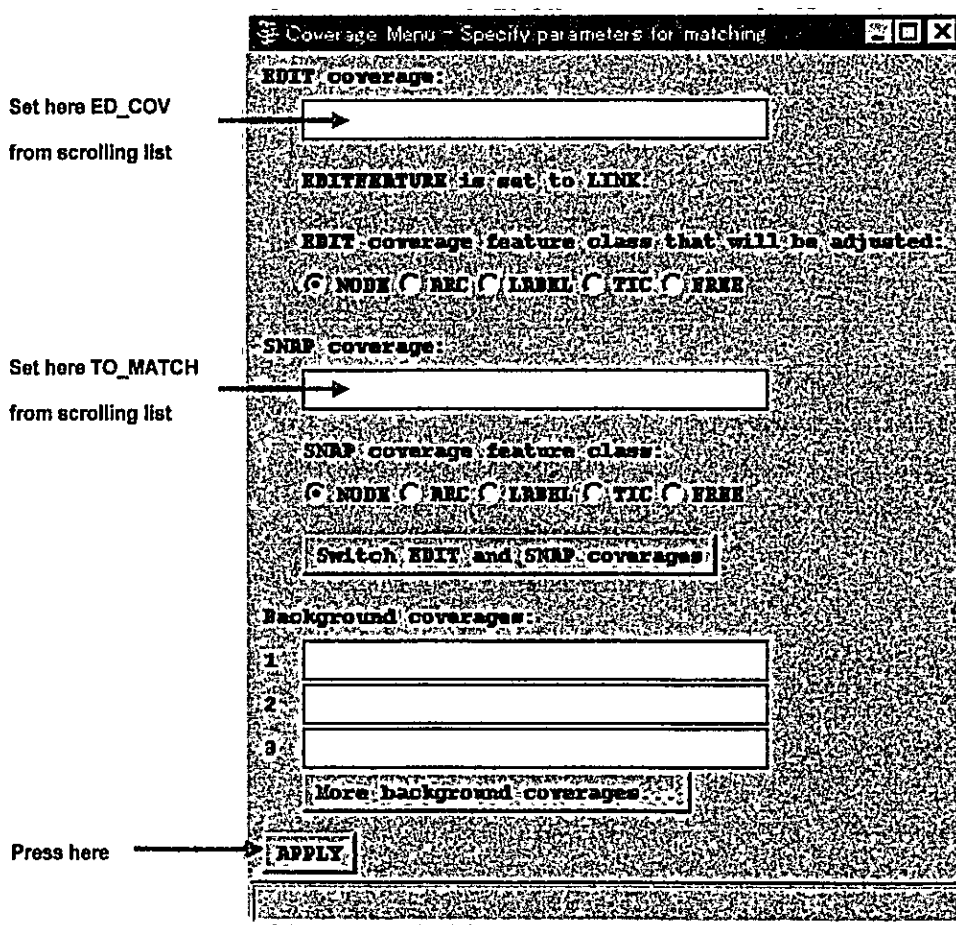
Press here

When the parameters setting is done in the above menu, the coverage will be displayed on the graphic screen, and the following "Edgematching Menu" will appear.
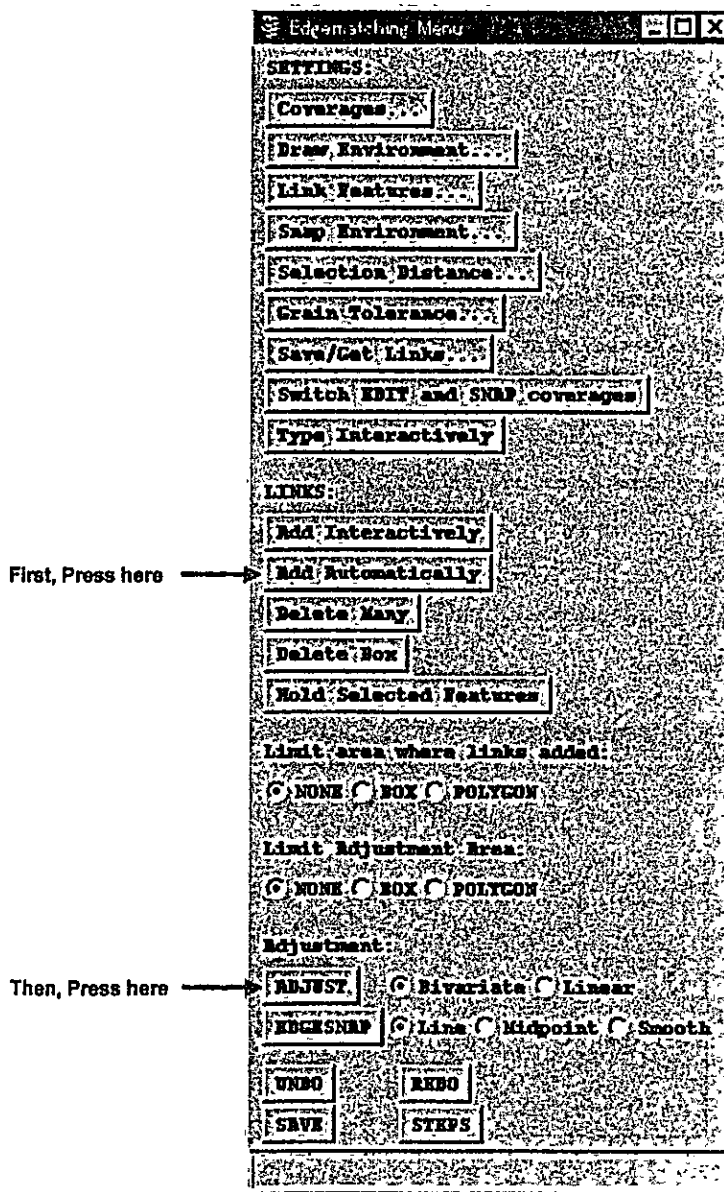
Observe the screen while setting in the menu. The process here is a customization of commands in 8.3.4 by Arc Macro Language (AML) and Graphical User Interface (GUI).

Arcedit: q ——→ SAVE the edits, and re-build topology !

8.3.6 Attribute Matching

Editing attribute values can be done in INFO or TABLES (Exercise-2), in ARCEDIT or ARCPLOT (Form Menu) and in ARCVIEW (Project Document "Operation Manual, March'99"). Formenu can be used in both Arcedit and Arcplot. In this exercise, the use of that Form menu will be introduced.

Errors have to be identified, first. Any convenient way (Checkplot or Listing) can be used. In below, the attribute values will be displayed and visualized together with the features.

Arc: ae

Arcedit: disp 9999   —> type only, if the device is not yet set   -

Arcedit: mapex ed_cov to_match

Arcedit: edit ed_cov

Arcedit: back to_match 3

Arcedit: textitem ed_cov label code

Arcedit: backtextitem to_match label code

Arcedit: de arc label

Arcedit: be arc label

Arcedit: draw   -
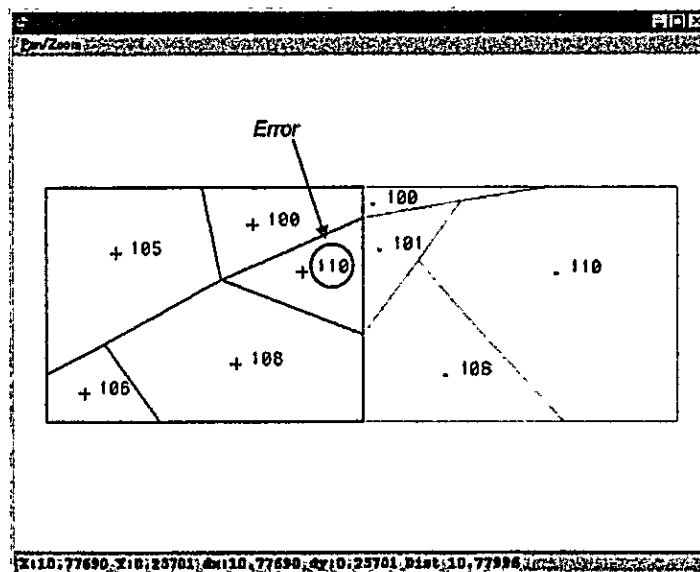
It is assumed that the CODE value 110, which is indicated by the circle in red color is an error. The correct value should be 101.

Arcedit: ef label

Arcedit: forms
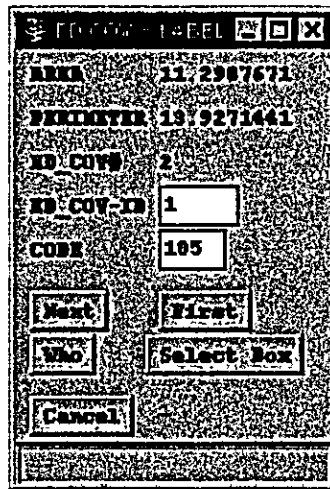
Currently selected feature (label) will be highlighted in yellow color by default. Press "Next"-button until the label to be edited is selected. Then, update the value of CODE item from 110 to 101 in the menu.

Arcedit: q ————————> quit Arcedit session and SAVE the edits

===

To avoid problems in repeating exercises in this workspace, it may be advisable to delete all the new data created in this Exercise.

Arc: **kill edcov all**

Killed meter_cov with the ALL option

Arc:

8.4 Exercise [4]

8.4.1 Move to the Working Directory

- Start arc

- Use "workspace" command (or just w), to move to the working directory.

Arc: w ██████ trainingdata

        ⌐ *It represents the "full pathname", where the "trainingdata" is located.*

- Use "listcoverages" command (or just lc) to list up all coverages in the current workspace.

Arc: lc

Workspace: C:¥.....¥TRAININGDATA

Available Coverages

———————

ADMIN	CITIES	LAKES	PROVINCE
RAILS	RIVERS	ROADS	ROAD_ORG
VEGETATION			

- Use "listworkspaces" command (or just lw) to list up available workspaces.

Arc: lw

List of workspaces at location: C:¥.....¥TRAININGDATA

Available workspaces

———————

EX-1	EX-2
EX-3	EX-4
EX-5	EX-6

Arc:

- Now, move to the workspace "ex-4"

Arc: w ex-4

Arc:

8.4.2 Map Projection

A variety of map projections are supported in ARC/INFO. The Lambert Azimuthal projection introduced in this exercise is considered to be the best suited for those land areas, which are in symmetrically proportioned (either round or square) shape, as a country like Angola.

8.4.2.1 Using PROJECT Command

A coverage, dd_cov is prepared for use in this exercise. Check that coverage by Arc: DESCRIBE command, and note that no projection is defined for this coverage.

```
Arc: lc

  Workspace:          C:¥ANGOLA_DATA¥TRAININGDATA¥EX-4

  Available Coverages


  ─────────────

    DD_COV            DIG_COV


Arc: describe dd_cov
```

Description of DOUBLE precision coverage dd_cov

FEATURE CLASSES

Feature Class	Subclass	Number of Features	Attribute data (bytes)	Spatial Index?	Topology?
ARCS		55			
POLYGONS		20	64		Yes
NODES		38			

SECONDARY FEATURES

Tics	4
Arc Segments	10376
Polygon Labels	19

TOLERANCES

Fuzzy =	0.002 V	Dangle =	0.000 V

COVERAGE BOUNDARY

Xmin =	11.756	Xmax =	24.103
Ymin =	-18 035	Ymax =	-4.412

STATUS

The coverage has not been Edited since the last BUILD or CLEAN.

NO COORDINATE SYSTEM DEFINED

As it can be observed in the above list, the minimum and maximum coordinates (xmin, ymin, xmax, ymax) of the coverage are in DD (Decimal Degree). To project those latitude and longitude (Geographic Coordinates) to the planar x,y coordinates (Lambert) in meters, the following procedure can be used.

Arc: **project cover dd_cov meter_cov**

    Please define the input and output map projections.

    Use INPUT to define the input projection, OUTPUT   *Guide for the next step*

    to define the output projection, and END to finish.

Project:

Notice that the prompt is changed from "Arc" to "Project"

The input coverage to be projected has been specified in the command-line in above. As it was observed by DESCRIBE command, it is in geographic coordinates, in DD (Decimal Degree) on the sphere. Those input parameters will enter by the following steps.

    Project: **input**

    Project: **projection geographic**

    Project: **units dd**

    Project: **spheroid sphere** → *default to radius 6370997.0 m*

    Project: **parameters**

    Project:

Then, the output projection parameters have to be entered as follows :

    Project: **output**

    Project: **projection lambert_azimuth**

    Project: **units meters**

    Project: **spheroid sphere**

    Project: **parameters**

radius of the sphere of reference	[0.00000]:	**6370997.0**
longitude of center of projection	[0 0 0.000]:	**18 0 0**
latitude of center of projection	[0 0 0.000]:	**-6 30 0**
false easting (meters)	[0.00000]:	**0**
false northing (meters)	[0.00000]:	**0**

    Project: **end** → *computation begins by entering <end>*

    Arc: → *Arc-prompt will appear, when the computation is complete*

The resulting coverage can be confirmed by LISTCOVERS (lc)-command :

Arc: **lc**

Workspace: C:¥ANGOLA-CD¥TRAININGDATA¥EX-4

Available Coverages

─────────────

DD_COV   DIG_COV   METER_COV

Further, the content of METER_COV can be checked by DESCRIBE command:

Arc: **describe meter_cov**

Description of DOUBLE precision coverage meter_cov

FEATURE CLASSES

Feature Class	Subclass	Number of Features	Attribute data (bytes)	Spatial Index?	Topology?
ARCS		55			
POLYGONS		20	64		Preliminary
NODES		38			

This means :

Topology has to be updated

SECONDARY FEATURES

Tics	4
Arc Segments	10376
Polygon Labels	19

TOLERANCES

Fuzzy	=	151.138 N	Dangle	=	0.000 N

COVERAGE BOUNDARY

Xmin =	-669723.983	Xmax =	665463.724
Ymin =	-1282049.265	Ymax =	229332.952

STATUS

Use BUILD or CLEAN to create Topology from Preliminary POLYGONS.

COORDINATE SYSTEM DESCRIPTION

Projection   LAMBERT_AZIMUTHAL

Datum   NONE

Units   METERS   Spheroid   DEFINED

Major Axis   6370997.00000   Minor Axis   0.00000

Parameters:

radius of the sphere of reference   6370997.00000

longitude of center of projection   18   0   0.000

latitude of center of projection   .   -6 30   0.000

false easting (meters)   0.00000

false northing (meters)   0.00000

Arc:

The following step will update Topology, and the coverage will then be ready to use.

Arc: **clean meter_cov**

8.4.2.2 Using TRANSFORM Command

This command is used to transform the coordinates between the planar coordinate systems. Most commonly use is in transforming the map data after digitizing into a real world coordinate system. For use with this command, a coverage DIG_COV in digitizer unit (inch) is prepared. Use <lc> to confirm this in the Workspace EX-4 :

Arc: **lc**

Workspace: C:¥ANGOLA-CD¥TRAININGDATA¥EX-4

Available Coverages

_____

DD_COV   DIG_COV   METER_COV   '

Arc:

- 68 -

To check the number and position of TICs (4 map corners), the following steps can be used.

Arc: **ae**

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All rights reserved.

ARCEDIT (COGO) Version 7.2.1   (Thu Apr   2 15:59:38 PST 1998)

Arcedit: **disp 9999**

WARNING the Map extent is not defined

Arcedit: **edit dig_cov**

The edit coverage is now C.¥ANGOLA-CD¥TRAININGDATA¥EX-4¥DIG_COV

Defaulting the map extent to the BND of C:¥ANGOLA-CD¥TRAININGDATA¥EX-4¥DIG_COV

Arcedit: **de arc tic ids**

Arcedit: **mapex tic dig_cov**

Arcedit: **draw**

Arcedit:

(WARNING messages in above can be neglected. Those are NOT errors)
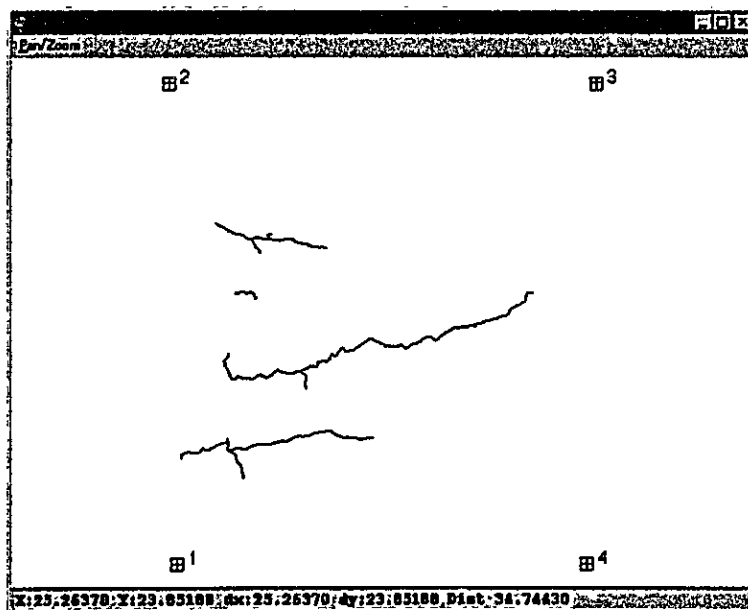
Similarly, TICs of the METER_COV can be verified as follows :

Arcedit: **edit meter_cov**

The edit coverage is now C:¥ANGOLA-CD¥TRAININGDATA¥EX-4¥METER_COV

Defaulting the map extent to the BND of C:¥ANGOLA-CD¥TRAININGDATA¥EX-4¥METER_COV

Arcedit: **de arc tic ids**

Arcedit: **draw**

Arcedit:
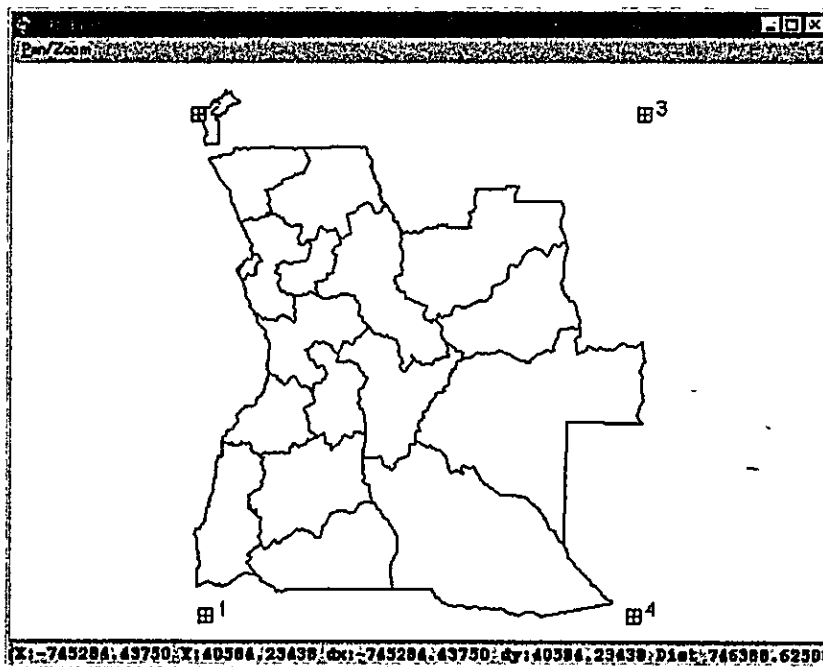
CREATE command will create a coverage by copying TICs from a specified {tic_bnd_cover} :

Arc: **create**

Usage: CREATE <out_cover> {tic_bnd_cover}

For exercise, TICs can be copied from the METER_COV :

Arc: **create tr_cov meter_cov**

Creating coverage tr_cov

Now, by using TRANSFORM command, the digitized map data DIG_COV can be geo-referenced in the same coordinate system as the METER_COV.

Arc: **transform dig_cov tr_cov**

Transforming coordinates for coverage dig_cov

Scale (X,Y) = (51673.228,51673.228)   Skew (degrees) = (0.000)

Rotation (degrees) = (0.000)   Translation = (-730405.010,-1341473.478)

RMS Error (input,output) = (0.000,0.000)

Affine   X = Ax + By + C

$\quad$ Y = Dx + Ey + F

A =	51673.228	B =	0 000	C =	-730405.010
D =	0.000	E =	51673.228	F =	-1341473.478

tic id	input x	input y		
	output x	output y	x error	y error
1	1.800	1.150		
	-637393.199	-1282049.265	0.000	0.000
4	26.470	1.150		
	637393.199	-1282049.265	0 000	0.000
2	1.278	29.117		
	-664374.580	163072.581	0.000	0.000
3	26.992	29.117		
	664374.580	163072.581	0.000	0.000

Arc:

Checking the results can be performed by using Arcplot, ArcView and so on.

To avoid problems in repeating exercises in this workspace, it may be advisable to delete all the new data created in this Exercise.

$\qquad$ Arc: **kill meter_cov all**

$\qquad$ Killed meter_cov with the ALL option

$\qquad$ Arc: **kill tr_cov all**

$\qquad$ Killed tr_cov with the ALL option

$\qquad$ Arc:

8.5 Exercise [5]

8.5.1 Move to the Working Directory

■ Start arc

■ Use "workspace" command (or just w), to move to the working directory.

Arc: w c:¥.....¥trainingdata

↑ It represents the "full pathname", where the "trainingdata" is located.

■ Use "listcoverages" command (or just lc) to list up all coverages in the current workspace.

Arc: lc

Workspace: C:¥.....¥TRAININGDATA

Available Coverages

ADMIN	CITIES	LAKES	PROVINCE
RAILS	RIVERS	ROADS	ROAD_ORG
VEGETATION			

■ Use "listworkspaces" command (or just lw) to list up available workspaces.

Arc: lw

List of workspaces at location: C:¥.....¥TRAININGDATA

Available workspaces

EX-1	EX-2
EX-3	EX-4
EX-5	EX-6

Arc:

■ Now, move to the workspace "ex-5"

Arc: w ex-5

Arc:

For use in this exercise, the ROAD and PROVINCE coverages will be copied from the Training Database.

> Arc: **copy ..¥roads road**   -→ *copy to different coverage name*
>
> Copied ..¥roads to road
>
> Arc: **copy ..¥province**   -→ *copy to the same coverage name*
>
> Copied ..¥province to PROVINCE
>
> Arc: **lc**
>
> Workspace: C.¥ANGOLA-CD¥TRAININGDATA¥EX-5
>
> Available Coverages
>
> ――――――――
>
> PROVINCE   ROAD
>
> Arc:

8.5.2 Using Symbol Set File and Lookup Table

By default, ARCPLOT sets the symbol file PLOTTER.LIN for line features, PLOTTER.SHD for polygon features and PLOTTER.MRK for point features, to symbolize the corresponding features. Symbolizing is performed commonly by the attributes. To check the attribute of ROAD coverage, ROAD.AAT (Arc Attribute Table) can be listed as follows:

Arc: **items road.aat**

COLUMN	ITEM NAME	WIDTH	OUTPUT	TYPE	N.DEC	ALTERNATE NAME	INDEXED?
1	FNODE#	4	5	B	-	-	
5	TNODE#	4	5	B	-	-	
9	LPOLY#	4	5	B	-	-	
13	RPOLY#	4	5	B	-	-	
17	LENGTH	8	18	F	5	-	
25	ROAD#	4	5	B	-	-	
29	ROAD-ID	4	5	B	-	-	
33	REVESTIR	2	3	I	-	-	
35	ESTADO	2	3	I	-	-	
37	TXNAM	40	40	C	-	-	

Arc:

The following steps will symbolize ROAD data using the values of REVESTIR-Item as the default symbol numbers.

Arc: **ap**

Arcplot: **disp 9999** ----→ *this will need, only if the display device is not set previously*

Arcplot: **mapex road**

Arcplot: **arclines road revestir** ----→ *symbolize lines using Item values*
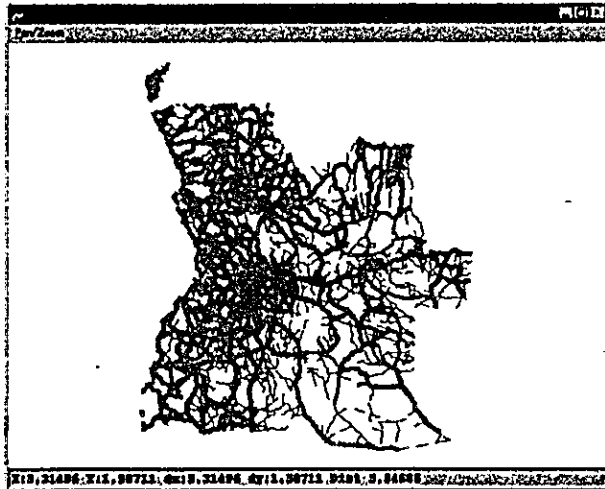
By option, the other symbol files are available in Arcplot. To observe the different symbols in different symbol files, one optional file COLOR.xxx will be introduced here. The default PLOTTER.LIN will be replaced by COLOR.LIN by using LINESET command.

. Arcplot: **clear**

Arcplot: **lineset color** ----→ *Suffix .LIN will be added automatically*

Arcplot: **arclines road revestir**
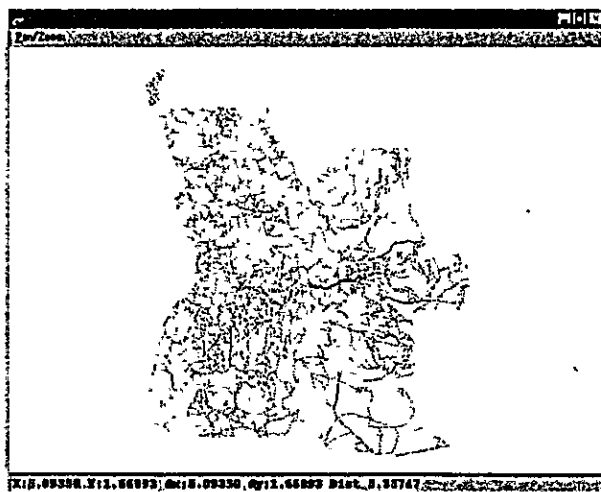
Please observe the difference.

Arcplot: **clear**

Arcplot uses item values as the symbol numbers. However, user can assign specific symbol for specific item value, by using a (INFO) Lookup Table. A lookup table is prepared for this exercise. For method of creating or updating such INFO tables, please refer to Exercise-2.

In below, the presence of lookup table (LOOKUP.TAB) and it's content will be verified.

Arcplot: **arc dir info**

TYPE NAME		INTERNAL NAME	NO. RECS	LENGTH	EXTERNL
DF	ROAD.TIC	ARC0000DAT	4	20	XX
DF	ROAD.BND	ARC0001DAT	1	32	XX
DF	ROAD.AAT	ARC0002DAT	5457	76	XX
DF	LOOKUP.TAB	ARC0004DAT	5	8	
DF	PROVINCE.TIC	ARC0005DAT	4	20	XX
DF	PROVINCE.BND	ARC0006DAT	1	32	XX
DF	PROVINCE.PAT	ARC0007DAT	19	64	XX

Arcplot: **arc list lookup.tab**

Record	CODE	SYMBOL	
1	10	1	--> Black color
2	12	2	--> Red color
3	14	3	--> Green color
4	16	4	--> Blue color
5	18	8	--> Orange color

Arcplot: **arclines road revestir lookup.tab**

Note:

Please observe the results and compare with the previous views. And, do not QUIT the Arcplot session, to continue exercise on the next page.

In Arcplot, POINT, LINE, and POLYGON features are symbolized in the same concept. The command names however, are different (See 6.1.4). To demonstrate this, the PROVINCE polygon coverage will be used in the following. First, please check the PROVINCE.PAT file to understand the use of the command in below :

Arcplot: **polygonshades province province-id**

Arcplot: **linecolor yellow**

Arcplot: **polygons province**
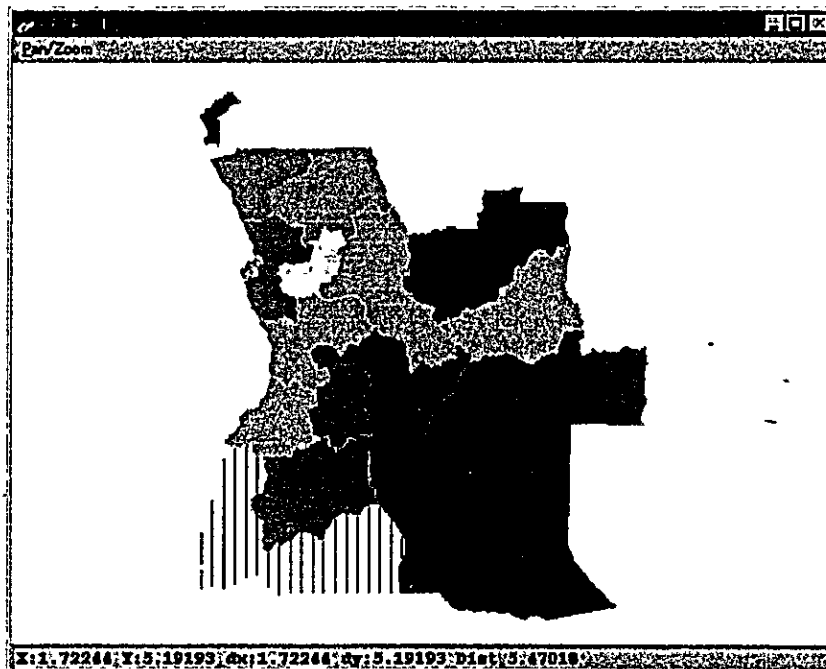
To avoid problems in repeating exercises in this workspace, it may be advisable to delete all the new data created in this Exercise.

Arc: **kill road all**

Killed road with the ALL option

Arc: **kill province all**

Killed province with the ALL option

Arc:

8.6 Exercise [6]

8.6.1 Move to the Working Directory

■ Start arc

■ Use "workspace" command (or just w), to move to the working directory.

Arc: w ▨c:¥....¥trainingdata▨

⤷ It represents the "full pathname", where the "trainingdata" is located.

■ Use "listcoverages" command (or just lc) to list up all coverages in the current workspace.

Arc: lc

Workspace: C:¥.....¥TRAININGDATA

Available Coverages

ADMIN	CITIES	LAKES	PROVINCE
RAILS	RIVERS	ROADS	ROAD_ORG
VEGETATION			

■ Use "listworkspaces" command (or just lw) to list up available workspaces.

Arc: lw

List of workspaces at location: C:¥.....¥TRAININGDATA

Available workspaces

EX-1	EX-2
EX-3	EX-4
EX-5	EX-6

Arc:

■ Now, move to the workspace "ex-6"

Arc: w ex-6

Arc:

For use in this exercise, the PROVINCE coverage will be copied from the Training Database.

> Arc: **copy ..¥province**
>
> Copied ..¥province to PROVINCE
>
> Arc: **lc**
>
> Workspace: C:¥ANGOLA-CD¥TRAININGDATA¥EX-5
>
> Available Coverages
>
> ─────────────
>
> PROVINCE
>
> Arc:

8.6.2 EXPORT and IMPORTing a coverage

To interchange the data between the multiple users, ARC/INFO provides an interchange file. EXPORT command is used to create an interchange file, and IMPORT command is used to convert that interchange file into a Coverage.

> Arc: **export cover province exp_cov**
>
> Exporting province into interchange file exp_cov.e00...
>
> Arc:
>
> export   : Name of the command
>
> cover   : Optional KEY-word (meaning Input data is a coverage)
>
> province   : Name of the Input data (coverage)
>
> exp_cov   : Output File name (Suffix .e00 will be added automatically)

Now, that "exp_cov.e00" file can be transferred to the other computer, where ARC/INFO is also installed. By using IMPORT command, the other user can convert that exp_cov.e00 into a coverage format.

> Arc: **import cover exp_cov imp_cov**
>
> Importing imp_cov from interchange file exp_cov.e00...
>
> Arc:
>
> import   : Name of the command
>
> cover   : Optional KEY-word (meaning output data must be a coverage)
>
> exp_cov   : Input File name (Suffix .e00 will be recognized automatically)
>
> imp_cov   : Name of the Output data (coverage)

8.6.3 Converting DXF-File into Coverage

In the work directory, a DXF file "89c2.dxf" is available for use in this exercise. To check the content of that .dxf file DXFINFO command can be used. Data conversion can be performed by the command DXFARC, as shown in below.

Arc: **dxfinfo 89c2.dxf**

Note : It will take for a while, because of the large file-size. Please wait until the results appear on the screen.

							TEXT	DEF	DEFAULT
LAYER NAME	ARCS	POINTS	TEXT	ATTRIB	ATTDEF	INSERT	LEN	COLOR	LINETYPE
-		.							
0	0	0	0	0	0	0	0	7 CON	
TINUOUS									
CONSTRUCTION_CLA*	0	0	0	0	0	0	0	7 CON	
TINUOUS								-	

The List will look like this. Scroll the list up to the bottom end and observe summary of All Layers.

-	.								
ALL LAYERS	9241	0	489	0	0	2629	21		

There are 9241 lines, 2629 points and 489 text strings. The following step will convert these data into coverage.

Arc: **dxfarc 89c2.dxf conv_cov**

Enter layer names and options (type END or $REST when done)

===

Enter the 1st layer and options : **$REST**

Do you wish to use the above layers and options (Y/N)? **y**

Processing C:¥ANGOLA-CD¥TRAININGDATA¥EX-6¥89C2.DXF ...

Externalling BND and TIC...

    9316 Arcs written.

    3118 Labels written.

    489 Annotations written.

    17 Annotation levels.

Arc:

Please observe the files associated with the coverage CONV_COV by the following steps.

Arc: **dir info conv_cov.***

TYPE	NAME	INTERNAL NAME	NO. RECS	LENGTH	EXTERNL
DF	CONV_COV.TIC	ARC0006DAT	4	20	XX
DF	CONV_COV.ACODE	ARC0007DAT	9241	74	
DF	CONV_COV.XCODE	ARC0008DAT	3118	140	
DF	CONV_COV.BND	ARC0009DAT	1	32	XX

Arc:

The coverage has no .AAT (Arc Attribute Table) or .PAT (Poly/Point Attribute Table). To create AAT use BUILD command.

Arc: **build conv_cov line**

Building lines...

Arc: **dir info conv_cov.***

TYPE	NAME	INTERNAL NAME	NO. RECS	LENGTH	EXTERNL
DF	CONV_COV.TIC	ARC0006DAT	4	20	XX
DF	CONV_COV.ACODE	ARC0007DAT	9241	74	
DF	CONV_COV.XCODE	ARC0008DAT	3118	140	
DF	CONV_COV.BND	ARC0009DAT	1	32	XX
DF	CONV_COV.AAT	ARC0010DAT	9316	32	XX

Arc:

The same as in other exercises, the content of CONV_COV.ACODE or CONV_COV.XCODE can be listed. In ACODE file the line (CAD)-attributes, in XCODE file the point (CAD)-attributes are stored. Depending on the user's need those can be joined to the coverage. Joining attributes to the coverage is introduced in Exercise-2.

To avoid problems in repeating exercises in this workspace, it may be advisable to delete all the new data created in this Exercise.

Arc: **kill conv_cov all**

Killed conv_cov with the ALL option

Arc: **kill imp_cov all**

Killed imp_cov with the ALL option

Arc: **kill province all**

Killed province with the ALL option

Arc: **&ty [delete exp_cov.e00 -file]**

0

Arc:

Appendix

Introduction of Arc/Info 8

TABLE OF CONTENTS

1 Welcome to Arc/Info 8

ESRI Arc/Info 8 software is consisted of the three desktop applications - ArcCatalog, ArcMap and ArcToolbox.

ArcCatalog is the tool such as Microsoft Explorer for browsing, organizing and documenting organization's GIS data holdings. ArcMap is the tool for creating, viewing, querying, editing, composing and publishing maps. ArcToolbox is a set of the same geo-processing tools as Workstation Arc/Info tools in a handy toolbox.

This appendix is intended to show you a first step of Arc/Info 8. You will be able to understand the basic functions of ArcCatalog and ArcMap. After leaning this appendix, you can also use the other books that come with Arc/Info 8 to learn more.
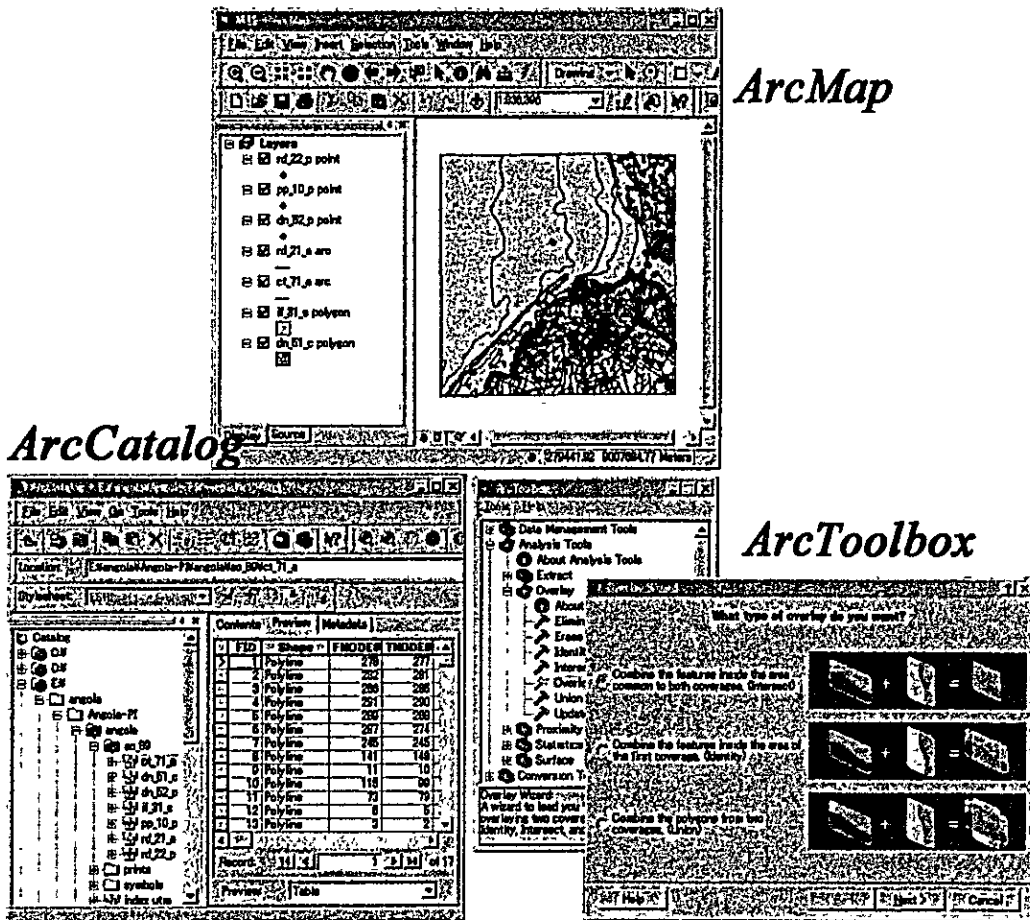
2 Introduction of ArcCatalog

ArcCatalog is the tool such as Microsoft Explorer for browsing, organizing and documenting organization's GIS data holdings.

2.1 Starting and Exiting ArcCatalog
2.1.1 How to Start ArcCatalog

1) Click the Start button on the taskbar.

2) Point to Programs to display the Programs menu.

3) Point to ArcInfo.

4) Click ArcCatalog. Then ArcCatalog starts and you see the following window.
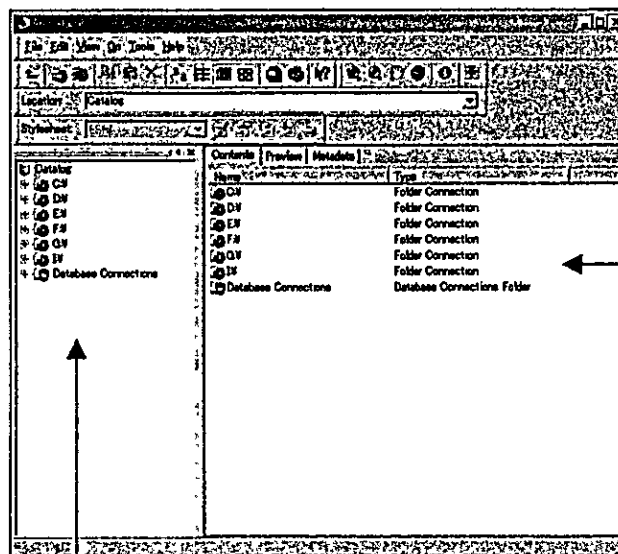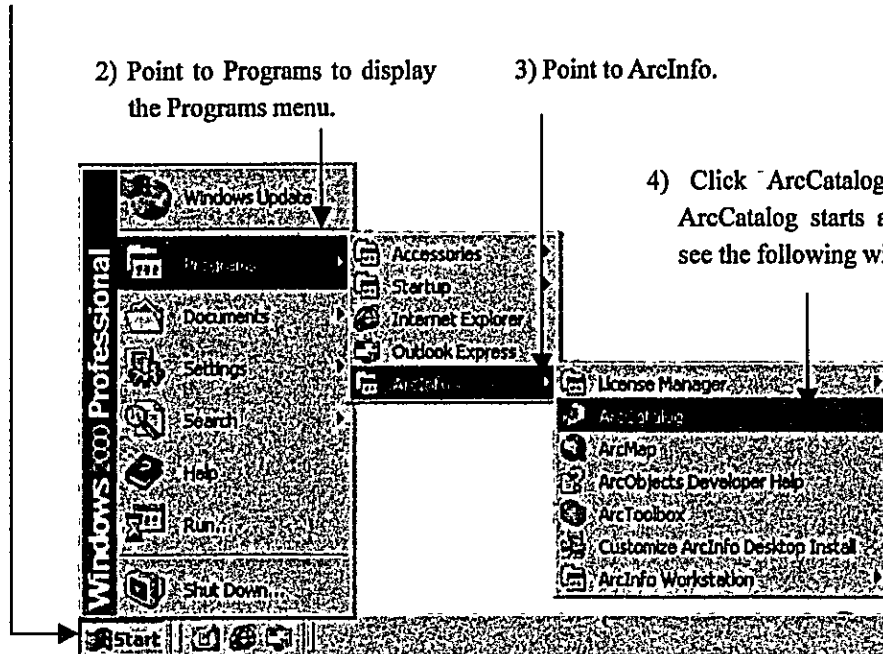
The contents of the current branch are displayed on the right side of the ArcCatalog window.

The Catalog tree on the left side of the ArcCatalog window is for browsing and organizing your GIS data.

When you start ArcCatalog for the first time, you may see branches for each local hard drive, a branch for database, etc. As you can use ArcCatalog like Microsoft Explorer, you can view the contents of a branch by double-clicking it or by clicking the plus sign beside it.

Functions of Toolbars buttons are the followings:
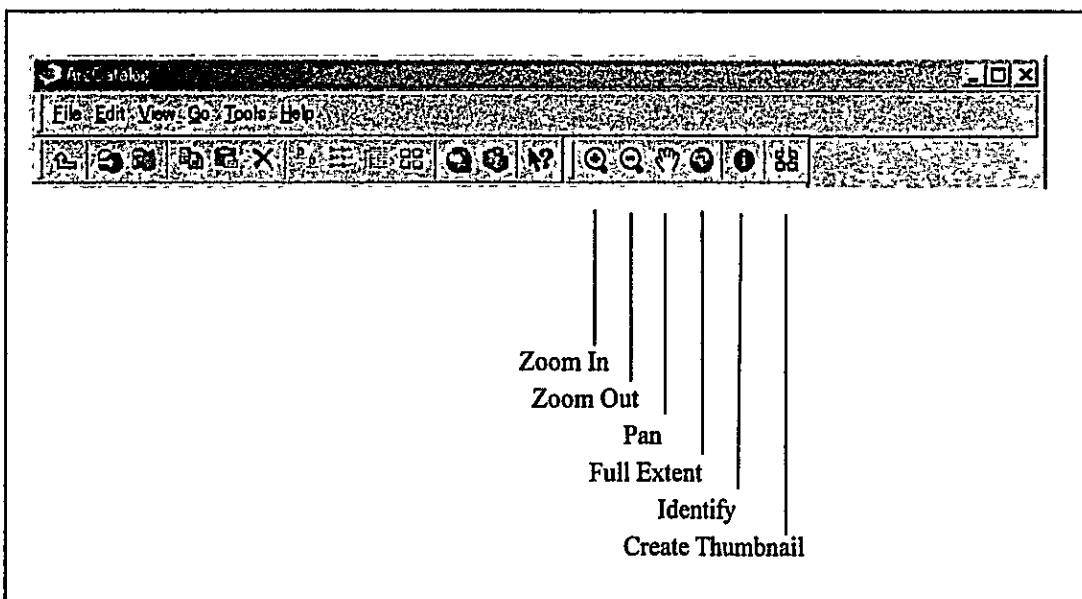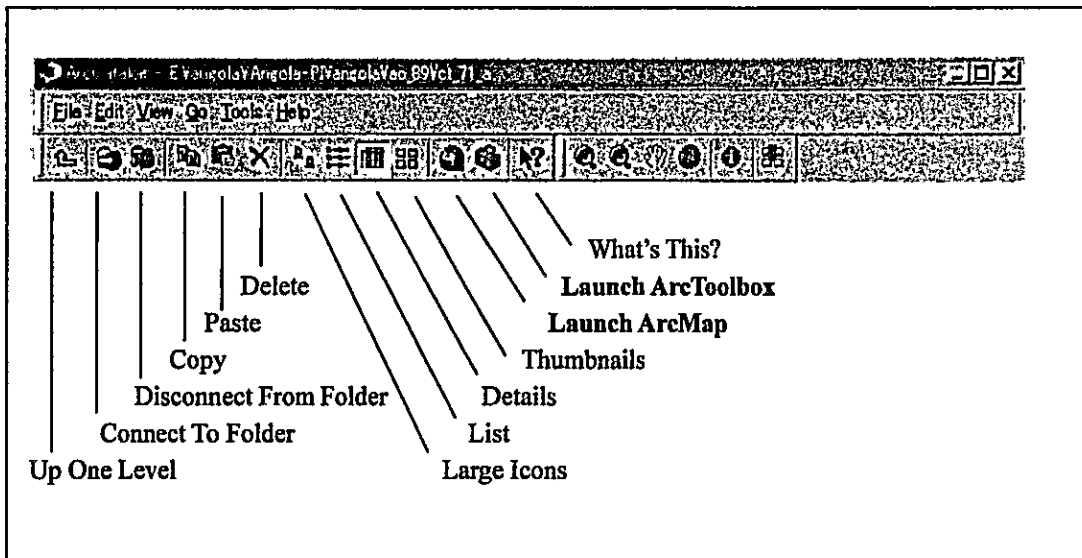
Note: Please see Page 12 for operation examples of Zoom In and Identify.

2.1.2 How to Exit ArcCatalog

There are two ways for exiting ArcCatalog. Click File and click Exit or only click the Close button.
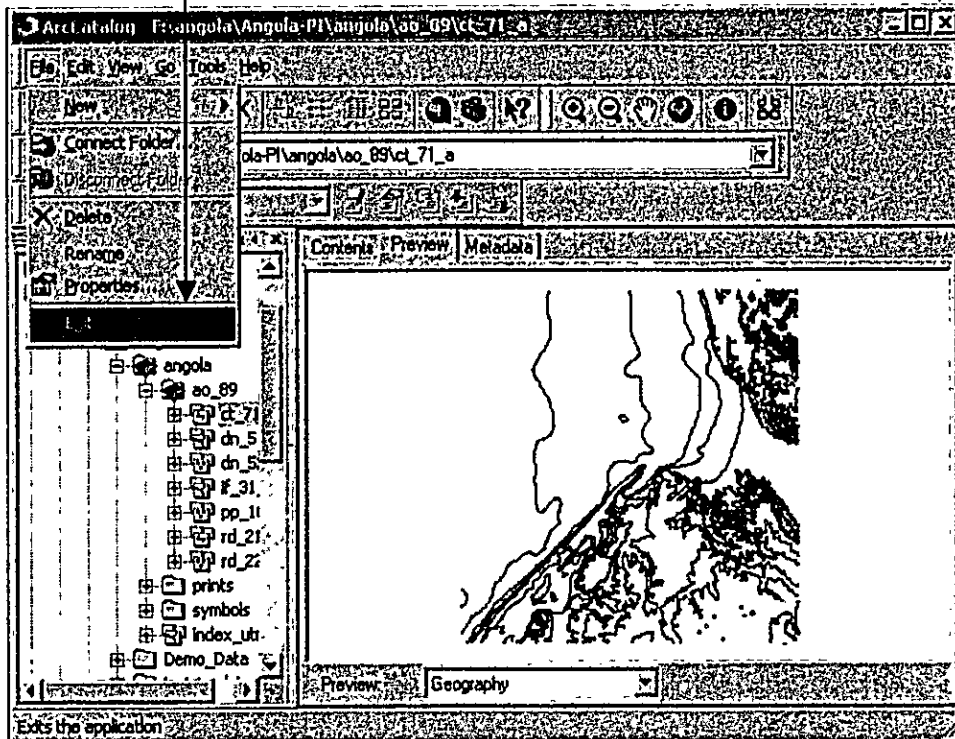
2.2 How to View Data in ArcCatalog

On the right side of the ArcCatalog window you can view a data source in the three ways - Contents, Preview and Metadata.

<u>**Example 1 of Contents view:**</u>

Click the Large Icons button
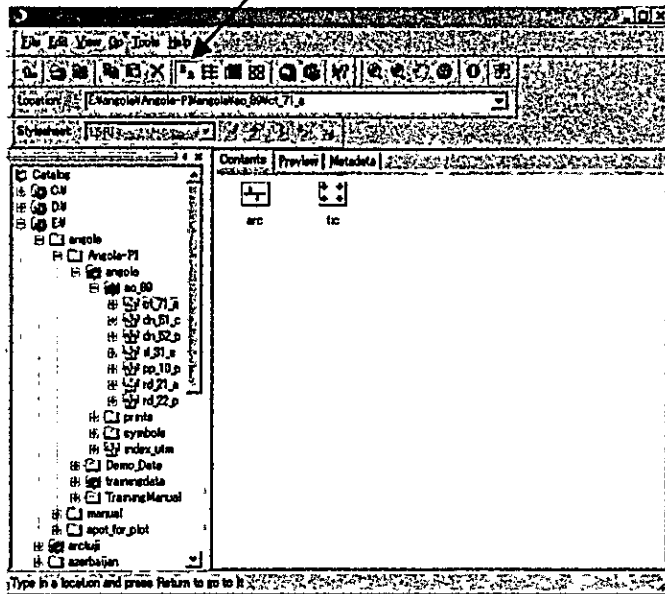
<u>**Example 2 of Contents view:**</u>

Click the Details button
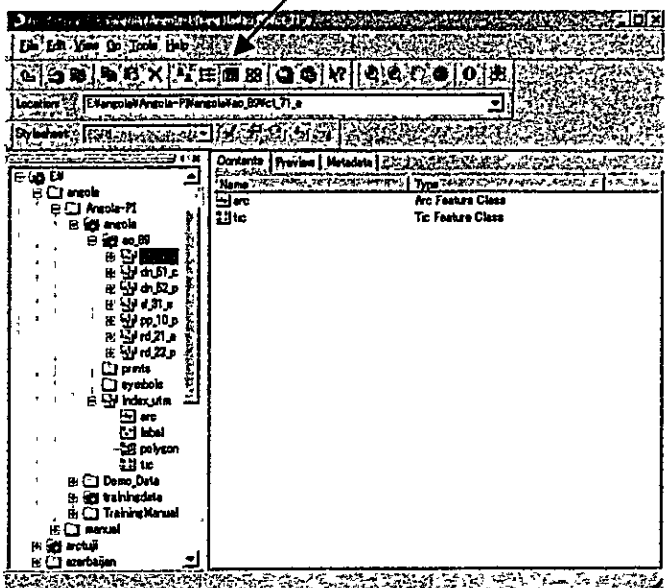
Example 1 of Preview view:
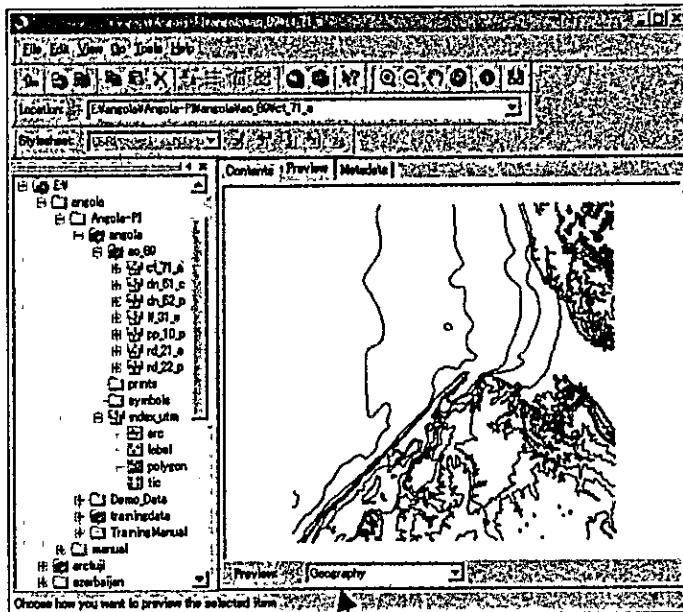
Select the Geography option

Example 2 of Preview view:
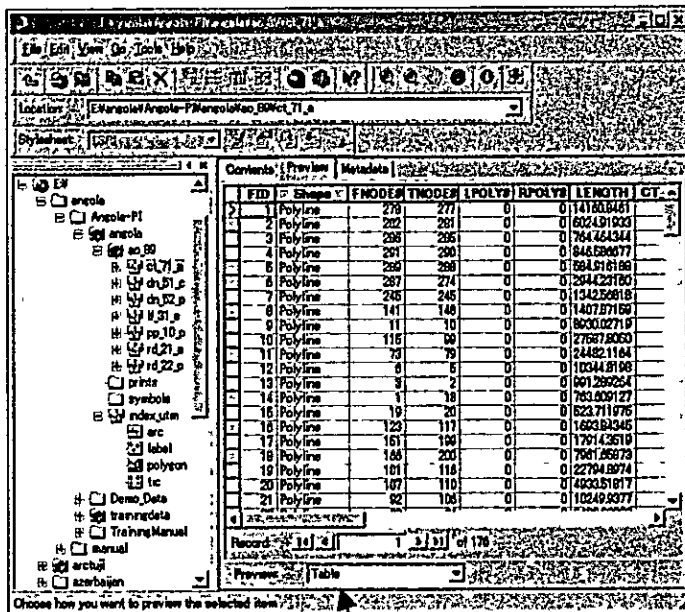
Select the Table option

Example 1 of Metadata view:

Select the ESRI Stylesheet
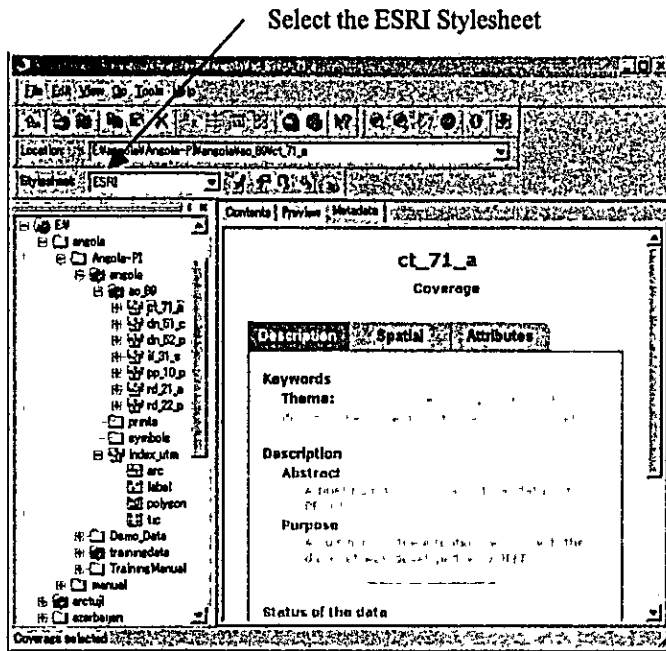
Example 2 of Metadata view:

Select the FGDS Stylesheet
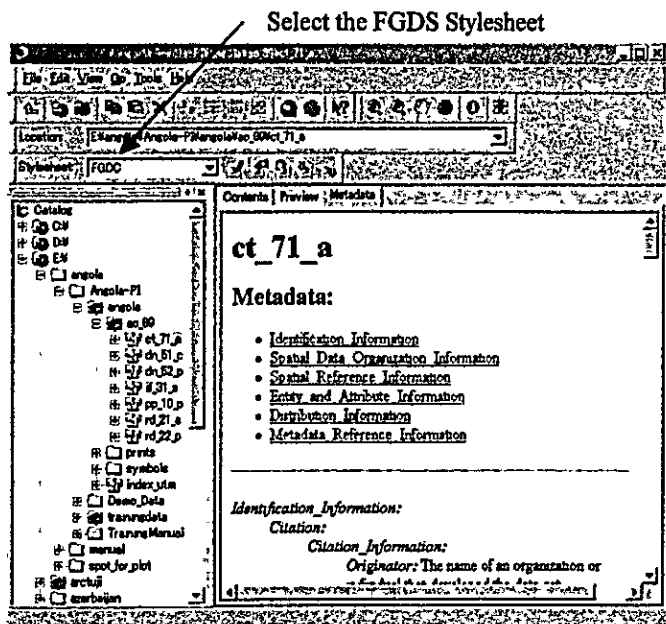
3 Introduction of ArcMap

ArcMap is the tool for creating, viewing, querying, editing, composing and publishing maps.

3.1 Starting and Exiting ArcMap
3.1.1 How to Start ArcMap

1) Click the Start button on the taskbar.

2) Point to Programs to display the Programs menu.

3) Point to ArcInfo.

4) Click ArcMap. Then ArcMap starts and you see the following window.
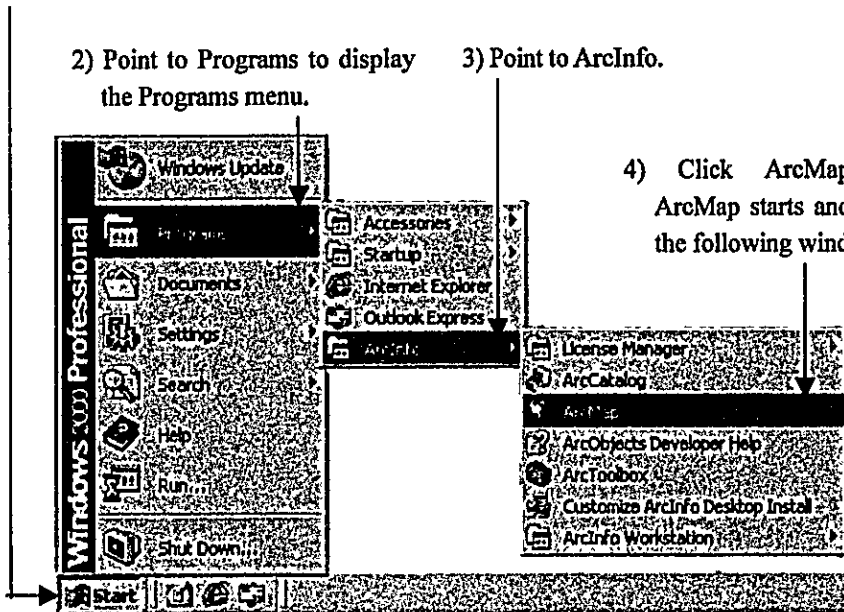
Note: You can also start ArcMap by clicking the Launch ArcMap button in ArcCatalog. Please see Page 3.

Click here to start using ArcMap
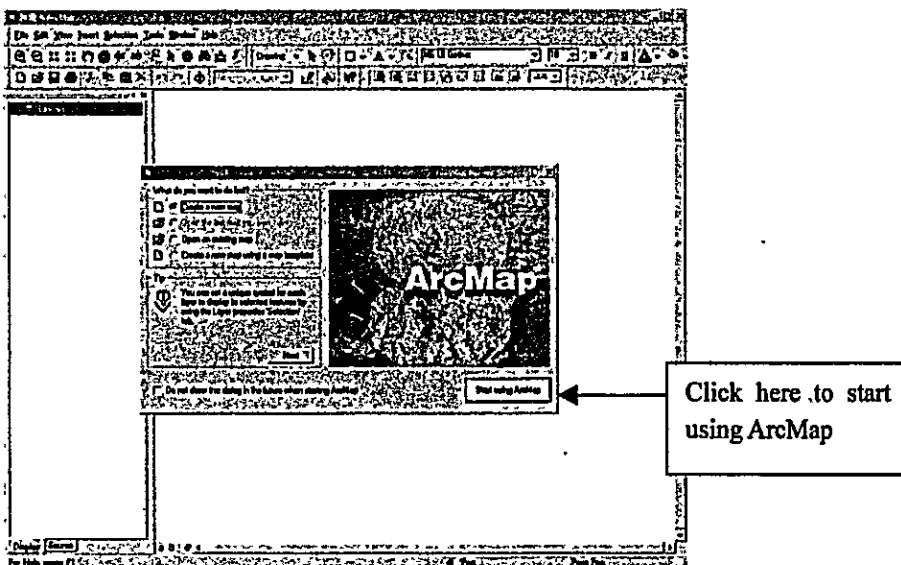
3.1.2 How to Exit ArcMap

There are two ways for exiting ArcCatalog. Click File and click Exit or only click the Close button.
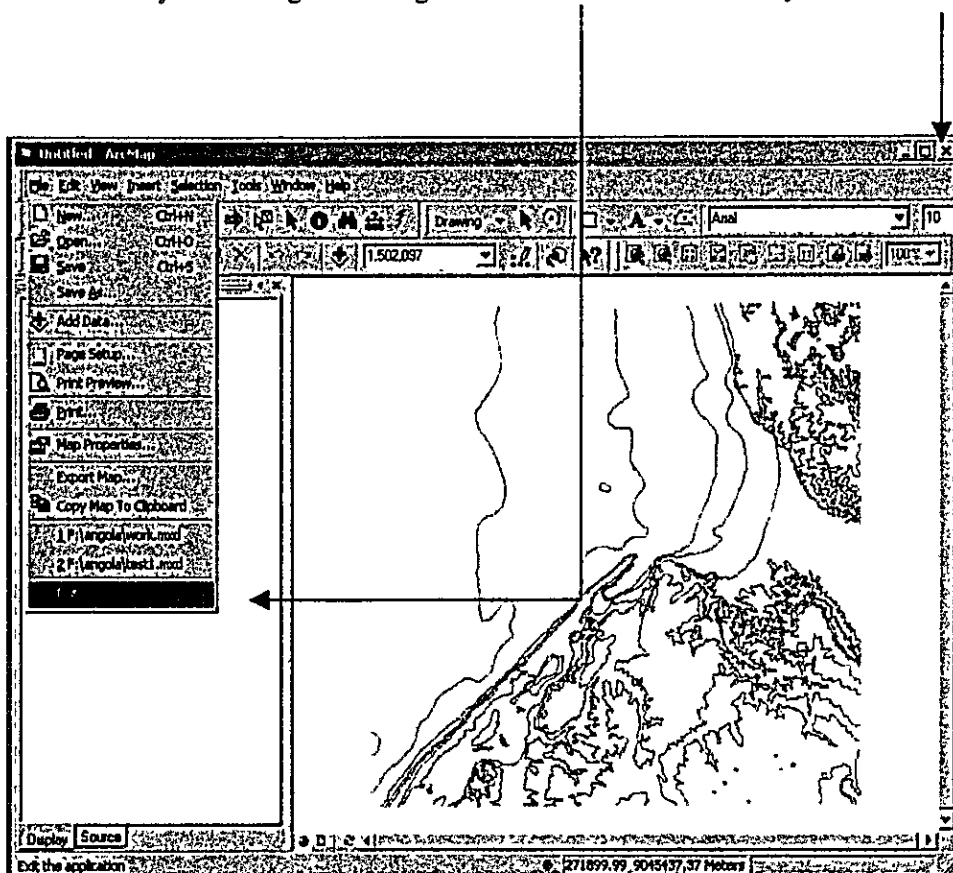
Note: As the warning dialog box appears before closing ArcMap, click No if it is not necessary to save a map.
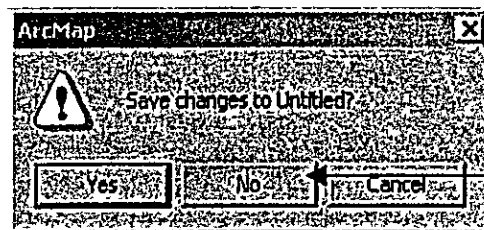
3.2 How to View a Map in ArcMap

3.2.1 How to Connect to Data
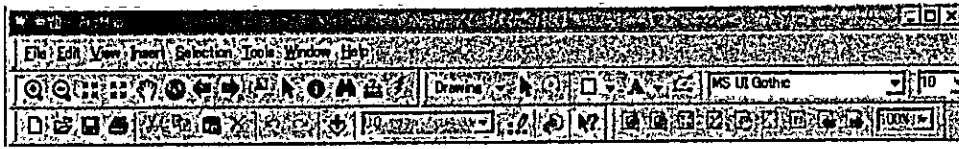
1) Click the Add Data button. Then the Add Data window appears.

Connect To Folder button
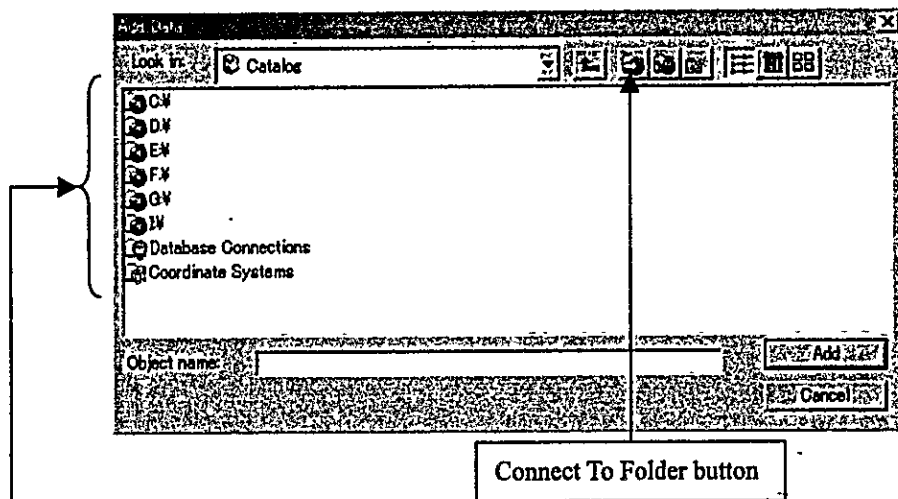
2) Connect to your data by double-clicking. If you cannot see a drive you want, click the Connect To Folder button.
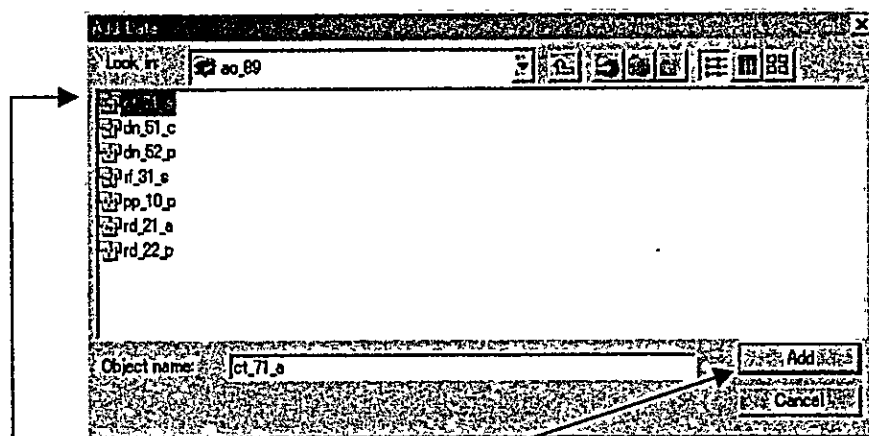
3) Click your data.

4) Click the Add button. Then your data appear in the map display of ArcMap like the figure of the next page.

Example of Map Display:
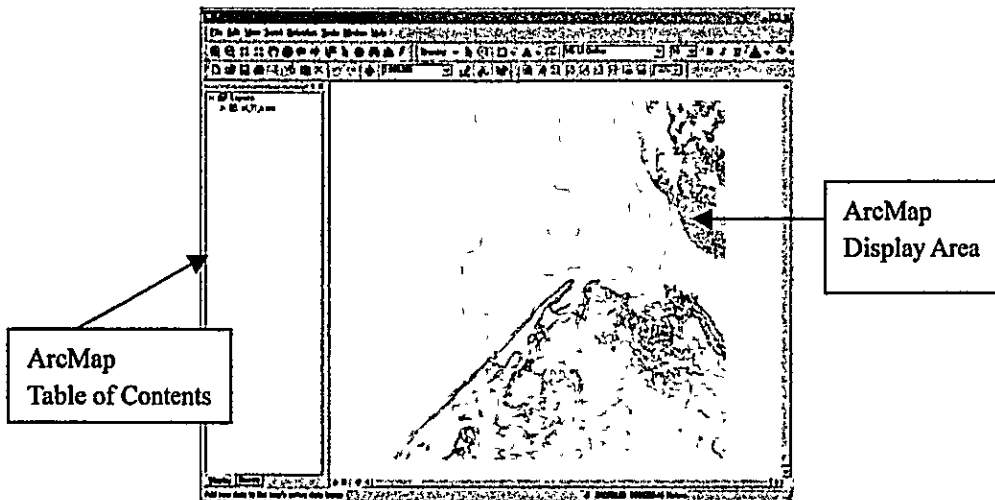
Note: You can add your feature data from ArcCatalog to ArcMap by dragging.
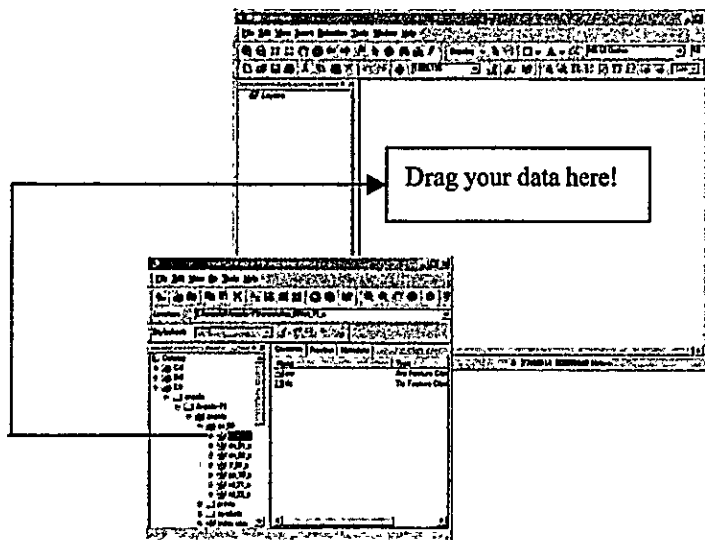
Note: To eliminate a map, right-click the map and click Remove.
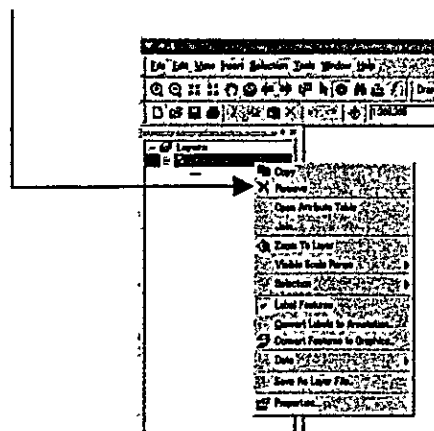
3.2.2 How to Explore a Map

You can explore a map in several ways. The browse toolbar contains frequently used tools as the followings:

Full Extent
Pan
Fixed Zoom Out
Fixed Zoom In
Zoom Out
Zoom In

Measure
Find
Identify Features
Select Graphics
Select Features
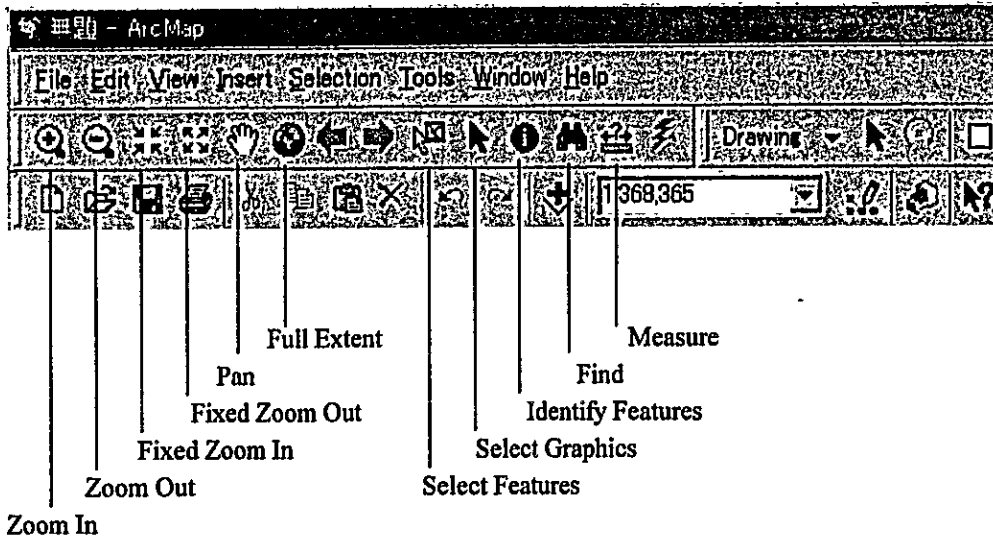
Operation for Zoom In or Zoon Out:

1) Click the Zoom In or Zoom Out button.
2) Drag a box on the map where you want to zoom in or zoom out.

Operation for Identify Features:

1) Click the Identify Features button.
2) Click a feature on the map that you want to know the feature attributes. Then the Identify Results window appears.

Operation example for Find:

1) Add ct_71_a arc from the sample data.
2) Click the Find button. Then the Find dialog box appears.
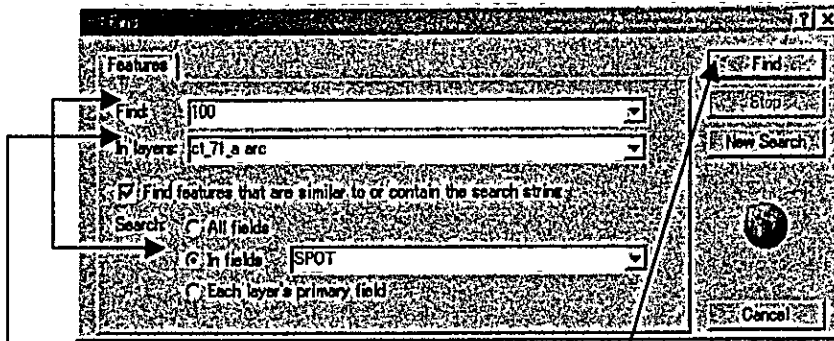
3) Full in values like as the above figure.
4) Click the Find button. Then the result appears in the Find dialog box like the following.
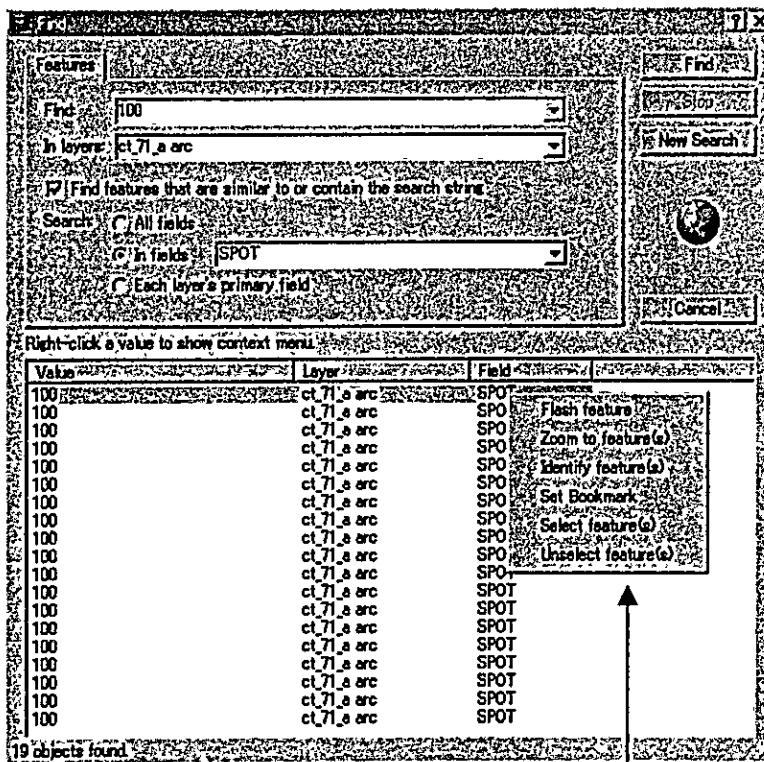
5) Right-click one line of the result. Then the context menu appears.
6) Click one in the context menu to function it.

3.2.3 How to Change the Way of Feature Drawing on a Map

You can change the drawing way on a map.

Example of Features/Single symbol:
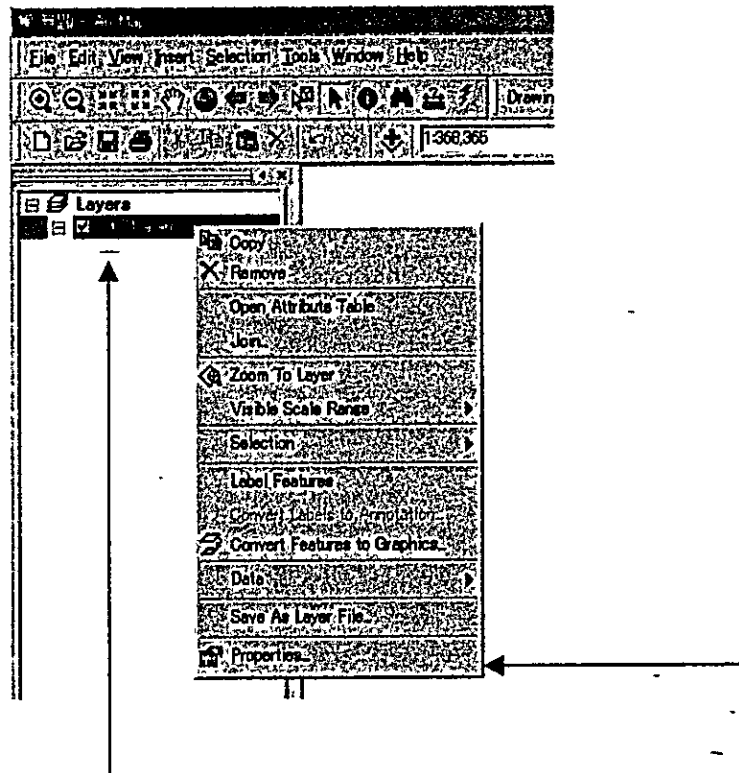
1) Right-click one layer that you want to change the drawing way.
   In this example, select ct_71_a arc.

2) As the pop-up menu appears, click Properties.

3) The following Properties dialog box appears.
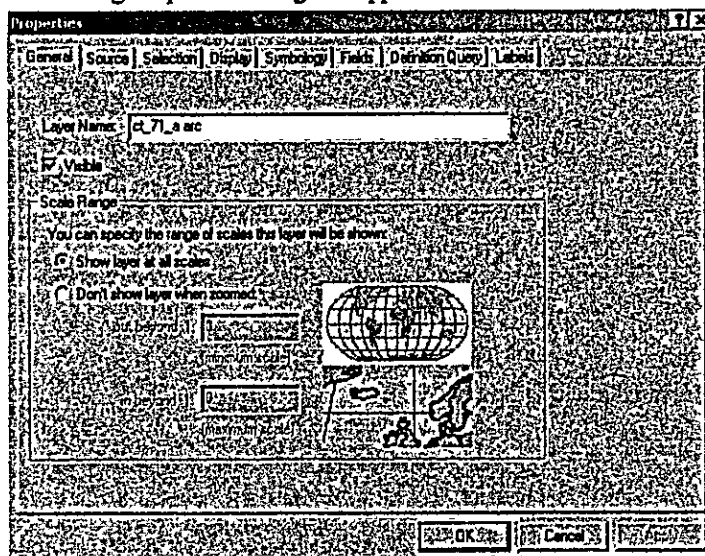
4) Click Symbology tab and click the Symbol. If Features/Single symbol is not chosen, click Features and click Single Symbol.
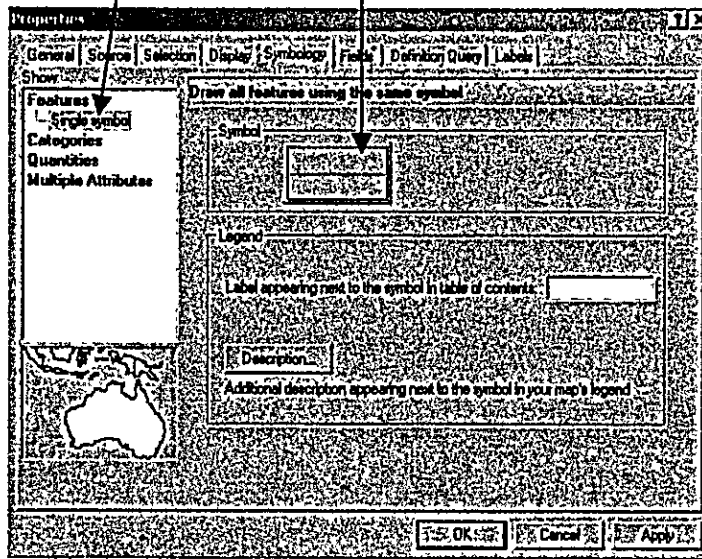
5) As the Symbol Selector dialog box appears, you can choose one of predefined symbols.

You can change a width of the features.
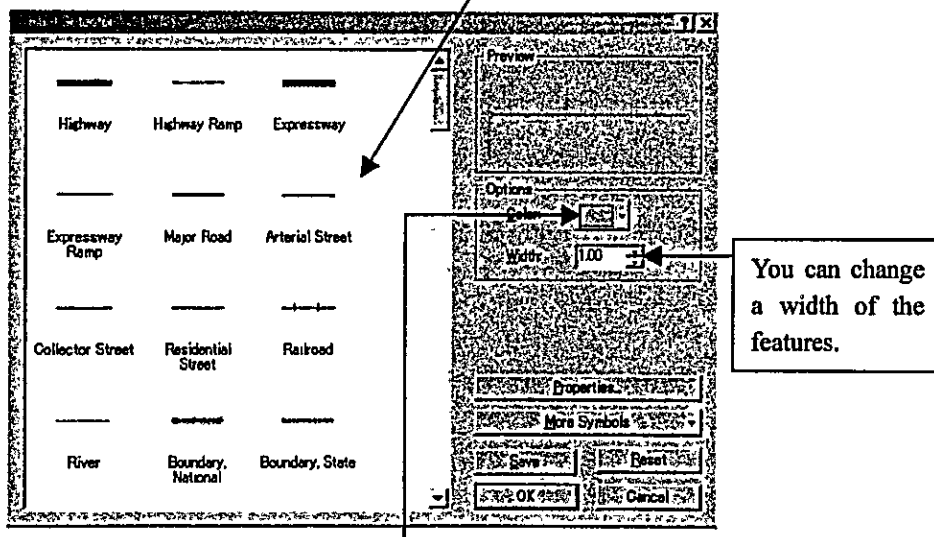
6) Click Color. Then the color selector dialog box appears.
7) Click a color that you want.
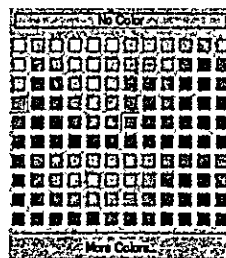
8) Click Ok in the Symbol Selector dialog box. After that click OK in the Properties dialog box. Then you can see the features with color that you wanted.

Example of Categories/Unique values:

1) Open the Properties dialog box and click the Symbology tab by the same way as Features/Single symbol on Page 15.

2) Click Categories and click Unique values.

3) Click the down arrow and select a value field that you want.
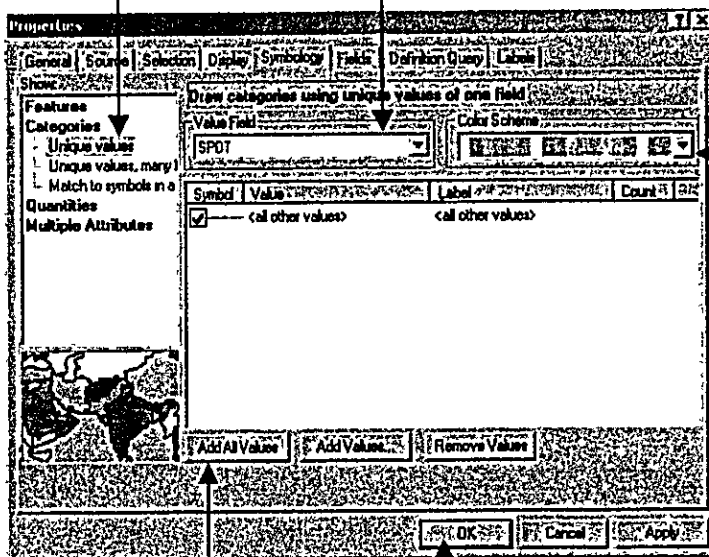
4) Select one of the color schemes.

5) Click Add All Values.

6) Finally click OK. Then you can see the features with colors that you wanted.

Note: You can choose several show ways as below.
- *Features/Single symbol*
- *Categories/ Unique values*
- *Categories/ Unique values, many fields*
- *Categories/Match to symbols in a style*
- *Quantities/Graduated colors*
- *Quantities/Graduated symbols*
- *Quantities/Proportional symbols*
- *Multiple Attributes/Quantity by category*

3.2.4 How to Query Data

You can select some features depend on attributes values. In this example, the way of query data is explained using the sample data of rd_22_p point.
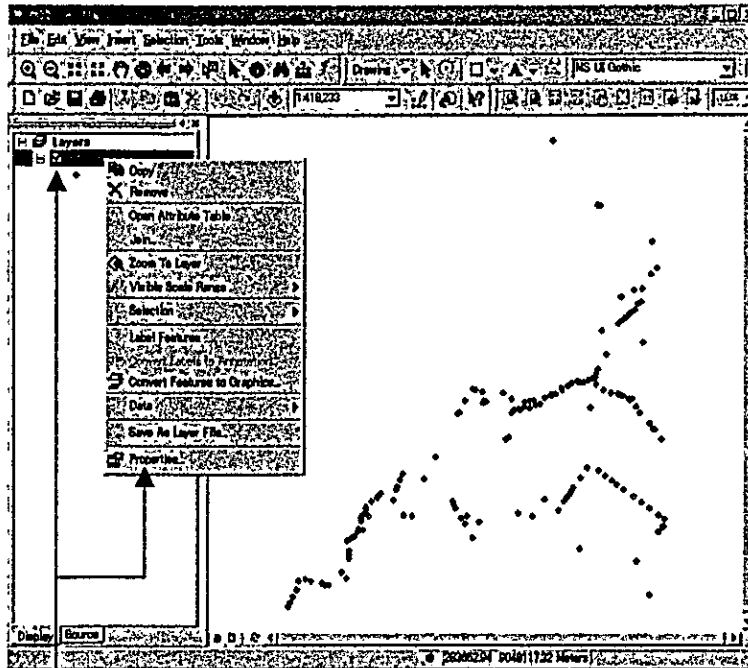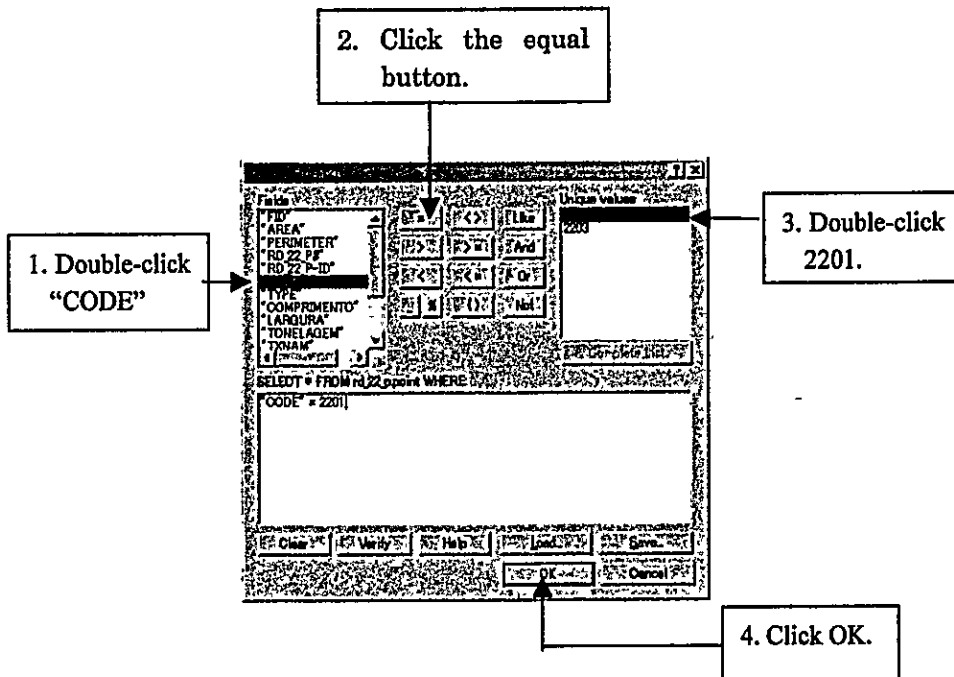

1) Right-click rd_22_p point in the ArcMap table of contents and click Properties.

2) As the Properties dialog box appears, click Definition Query tab and click Query Builder.
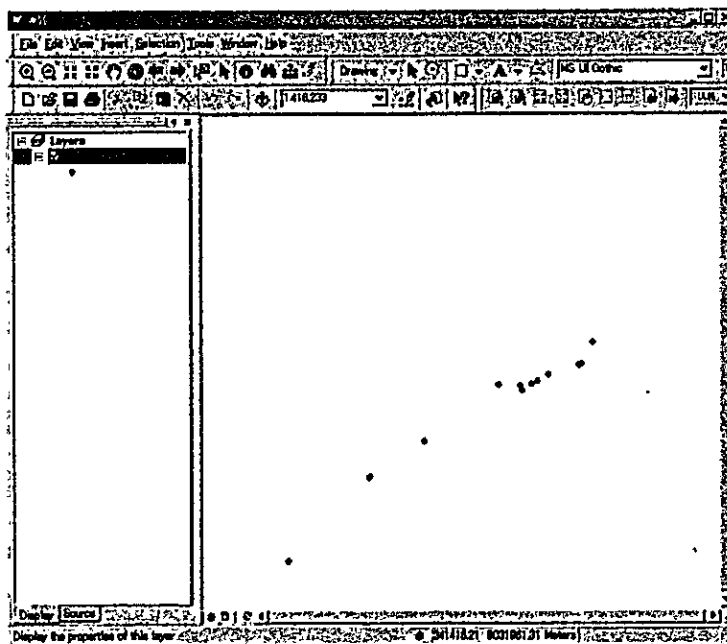

A-17
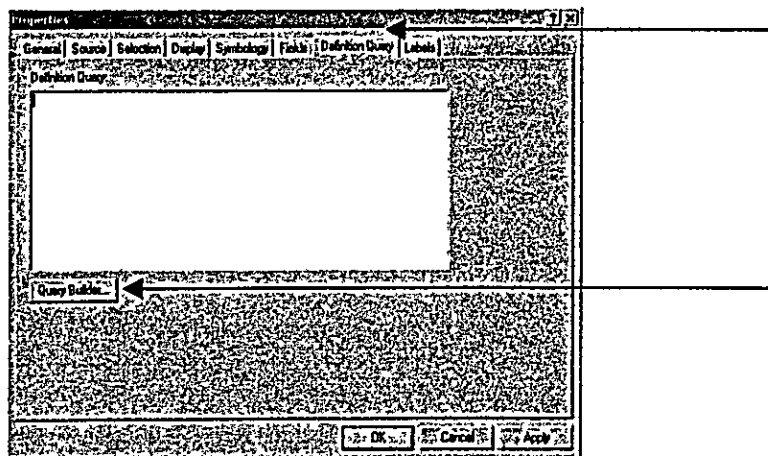
3) As the Query Expression dialog box appears, fill in values that you want. In this example, select CODE = 2201 like the following figure.

4) As the Properties dialog box appears again, click OK.

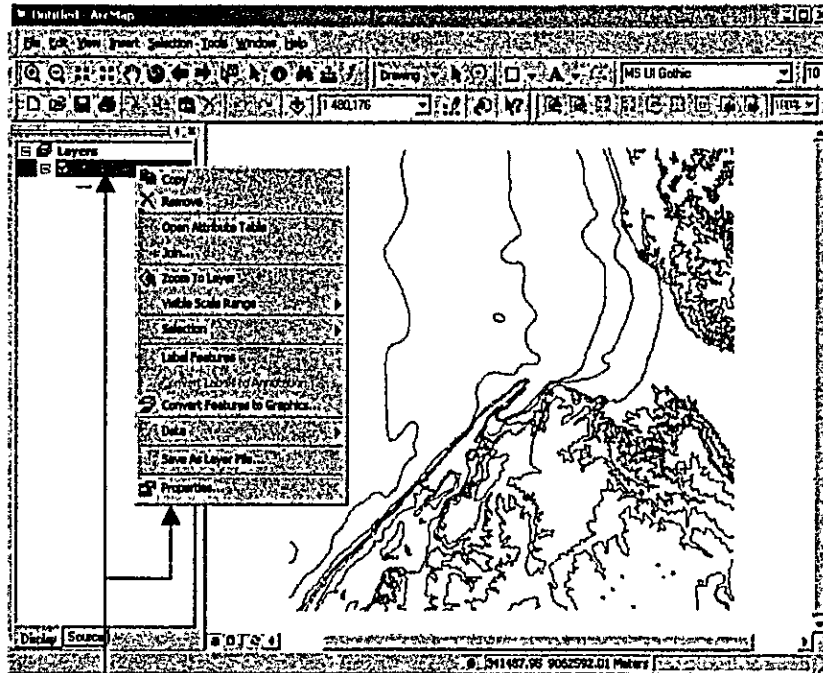5) The result is viewed. Please compare with the map of Page 17.

Note: To cancel the query result, display the Query Expression dialog box of 3) and click Clear, after that close the box by OK and close the Properties dialog box by OK.
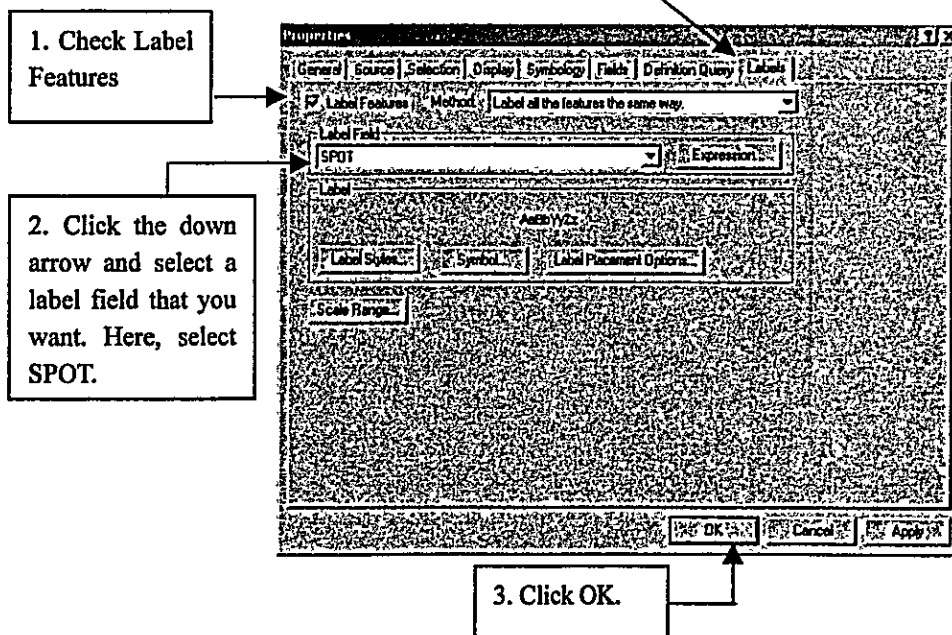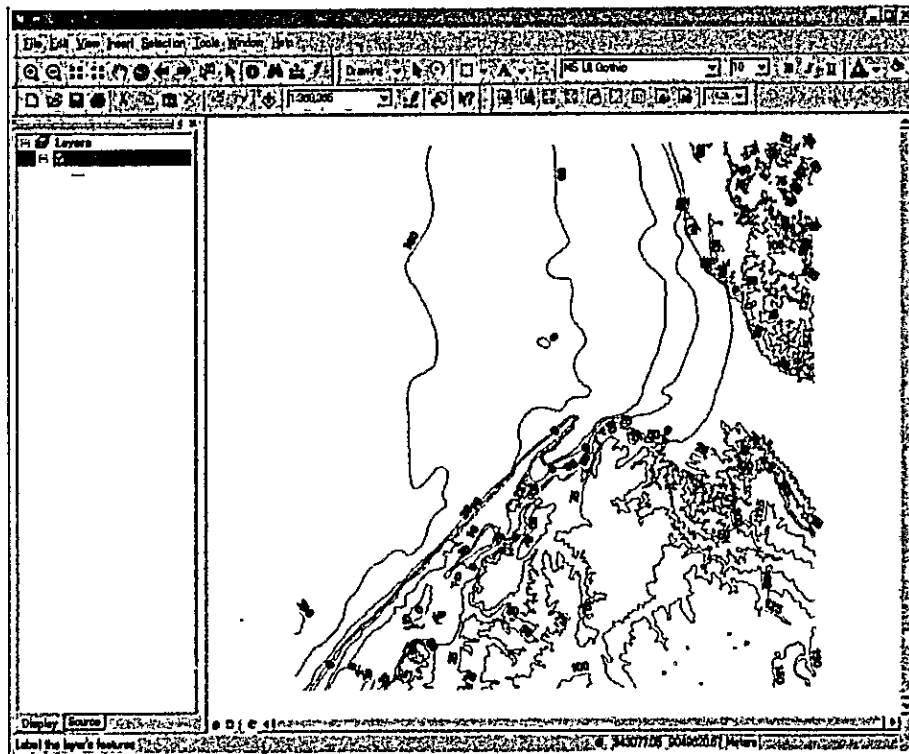
3.2.5 How to Add Labels to a Map

You can add some labels from the attributes data. In this example, the way of adding labels is explained using the sample data of ct_71_a arc.

1) Right-click ct_71_a arc in the ArcMap table of contents and click Properties.

2) As the Properties dialog box appears, click Labels tab and follow the below instructions.

1. Check Label Features

2. Click the down arrow and select a label field that you want. Here, select SPOT.

3. Click OK.

3) The result is viewed. Please compare with the map of Page 19.

Note: To eliminate the label, right-click ct_71_a arc on the ArcMap Table of Contents and click Label Features. If you want to add the label again, right-click ct_71_a arc and click Label Features again.