

## INTRODUCTION TO ARCGIS SOFTWARE

- I. History of Software Development
  - a. Developer – ESRI - Environmental Systems Research Institute, Inc., in 1969 as a privately held consulting firm that specialized in landuse analysis projects.
    - i. Software Developers originated at Harvard graphics lab
  - b. ArcInfo – early version of software
    - i. Main-frame, unix-based software
    - ii. “arc” refers to line segments of map elements
    - iii. “info” refers to information in database system
    - iv. Command driven software package (analogous to “DOS”)
  - c. ArcView (1990’s)– first release of a windows-based, GUI (graphical-user interface) based GIS system for desktop computers; still available but phasing out.
  - d. ArcGIS (2000’s) – next generation GIS software merging codes and routines from best of ArcInfo and placed in a GUI-Windows environment of ArcView, compatible with desktop computing
  
- II. Basics of Spatial Data Model
  - a. Georeferencing - To establish the relationship between digital map elements and real-world geographic coordinate location systems.
    - i. Real-world coordinates = an x,y coordinate system used to represent geographic locations.
  - b. Vector Model – map elements composed of points, lines, and polygons; with each point located at a georeferenced X,Y coordinate.
    - i. Feature classes – points, lines, polygons
      - 1. Attributes – information attached to map elements
    - ii. Vector models
      - 1. Topological models – individual map elements are spatially related to one another
      - 2. Spaghetti models – individual map elements are independent and piled on top of one another like a plate of spaghetti
  - c. Raster Model – map features are comprised of a matrix array of cells (“pixels” or “grid cells”) that are arranged in rectangular blocks
    - i. Columns and Rows of cells
    - ii. Cells are georeferenced to X-Y locations
    - iii. Real-world X-Y dimensions of grid cells = “resolution”
  
- III. Overview of ArcGIS Software - Software collective referred to as “ArcGIS Desktop”
  - a. Software Modules
    - i. ArcMap – software used to display, analyze, and create GIS data
      - 1. ArcView level install – basic level application
      - 2. ArcEditor – 1 step up, includes data editing capabilities
      - 3. ArcInfo – highest level install, with advanced editing and analysis features
    - ii. ArcCatalog- tool for viewing and managing spatial data files (analogous to Windows Explorer)
    - iii. ArcToolbox – set of tools and functions used to convert data formats, manage map projections, perform analysis, modify data.

- b. Extensions
  - i. The Extensions dialog allows you to load and unload software capabilities, allowing you to enhance your working environment with additional objects, scripts and customization.
  - ii. You can use extensions provided by ESRI and you can also create your own.
- c. Data Files in ArcGIS
  - i. Shapefiles – developed for ArcView

ArcView shapefiles are a simple, non-topological format for storing the geometric location and attribute information of geographic features. A shapefile is one of the spatial data formats that you can work with in ArcView. The shapefile format defines the geometry and attributes of geographically-referenced features in as many as five files with specific file extensions that should be stored in the same project workspace. They are:

.shp - the file that stores the feature geometry.

.shx - the file that stores the index of the feature geometry.

.dbf - the dBASE file that stores the attribute information of features. When a shapefile is added as a theme to a view, this file is displayed as a feature table.

.sbn and .sbx - the files that store the spatial index of the features.

**WARNING:** shapefiles come in connected bundles of 3+; when you are managing your files, do not delete or rename any of the related files, it will corrupt the data source, and ArcGIS will not be able to load the data.

- ii. Coverages – vector data developed for Arc/Info, using a topological model.
  1. coverages come in bundles of multiple files and multiple folders; the main coverage folder is assigned a \*.adf (arc data file) extension. All coverage files must be grouped and located in the same directory.
  2. INFO files are the database attributes that accompany the digital map element files in a coverage.
  3. A folder containing one or more coverages is termed a “workspace” in ArcInfo lexicon
- iii. Geodatabases
  1. A new data model developed for ArcGIS. All map elements, feature classes, and attribute data are stored in a relational database file format.
    - a. Personal Geodatabase – for use by individuals, compatible with MS Access software environment
    - b. Enterprise Geodatabase – for use by multiple, network users; uses server-based relational database management systems (RDBMS) such as ORACLE or SQL-Server
  2. ArcSDE = Arc spatial database engine – software that links enterprise geodatabases to ArcMap and Arc Catalog

- iv. Layer Files – DOES not contain actual spatial data, but is a “pointer” file that references the data source, downloads data into ArcMap, and formats the map layers for appearance and style.
  - 1. Several spatial data files can be combined into a single “layer file”
- v. Raster Data - Raster data records spatial information in a regular grid or matrix organized as a set of rows and columns. Each cell within this grid contains a number representing a particular geographic feature, such as soil type, elevation, land use, slope, etc. Raster data is commonly, but not exclusively, used to store information about geographic features that vary continuously over a surface, such as elevation, reflectance, groundwater depths, etc. ARC/INFO grids are raster data. Image data is a form of raster data in which each cell or pixel stores a value recorded by an optical or electronic device.

Raster data is highly dependent on the resolution of the regular grid in which it is recorded. The size of the cells in the grid is fixed, so as you zoom in on raster data displayed on a view, you will eventually see the shape of the cells.

- vi. Tables – spreadsheet tables (e.g. in Excel) that are not linked to digital map elements, may be stored in a \*.dbf or \*.txt format.
- vii. Grids – raster data format developed by ESRI for use in ArcInfo and ArcMap; requires use of the “Spatial Analyst” extension
- viii. TINS and DEMs – raster-based elevation models of the Earth’s surface. The attribute associated with georeferenced grid cells is land elevation.

#### IV. Introduction to Metadata

- a. ‘data about the data’: who created, where did it come from, what coordinate system in being used in georeferencing, what to the attribute fields mean, etc.
- b. Metadata standards managed by Federal Geographic Data Committee (FGDC)
- c. Metadata is critical to make the GIS meaningful and to understand what the data is about.