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All hands-on exercises are located in the first half of this manual.
Module 1: Introduction to GIS
GIS Basics & The ArcGIS Platform

Geospatial Technologies at Work: An Introduction to GIS
Brought to you by the Geospatial Training Program
UConn CLEAR

Welcome!

➢ Instructor Introductions
➢ Course Logistics
➢ Student Introductions
  ➢ Name
  ➢ Organization
  ➢ Role in organization
  ➢ GIS experience
  ➢ Goals and expectations for this class
Overall Learning Objectives

1) Understand basic GIS concepts
2) Learn how to visualize geographic data
3) Master the basics of attribute tables and map features
4) Learn how to create maps for publishing
5) Learn how to use GIS to answer questions

What to Expect

- Powerpoint presentations
- Instructor led “follow the leader” exercises
- On your own “cookbook” exercises
- Demos and discussion
- 10 minute “lightning round” talks
- Lightning round reference exercises
The Road Ahead

<table>
<thead>
<tr>
<th>Module</th>
<th>Presentation Topic</th>
<th>Exercise Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module 1: Introduction to GIS</td>
<td>1-1 - Introduction to GIS Introduction to ArcGIS</td>
<td>Follow the Instructor Exercise 1a - Hands on</td>
</tr>
<tr>
<td>Module 2: All about Data</td>
<td>2-1 - Where to Find Data (Lightning Talk) 2-2 - Data Types 2-3 - Understanding Spatial Reference</td>
<td>Exercise 2a – Hands on Exercise 2b – Hands on</td>
</tr>
<tr>
<td>Module 3: Working with Tables</td>
<td>3-1 - Introduction to Tables 3-2 – Working with Tables 3-3 – Selections &amp; Queries</td>
<td>Exercise 3a - Hands on Exercise 3b - Hands on Exercise 3c - Hands on</td>
</tr>
<tr>
<td>Module 4: Map Production</td>
<td>4-1 – Layer Symbology 4-2 - Adding Text &amp; Graphics 4-3 - Creating a Cartographic Output 4-4 - Data Driven Pages (Lightning Talk)</td>
<td>Exercise 4a - Hands On Exercise 4b - Hands on Exercise 4c - Hands on Reference Exercise 6c</td>
</tr>
<tr>
<td>Module 5: Data Manipulation</td>
<td>5-1 - Georeferencing (Lightning Talk) 5-2 - Editing &amp; Creating Data Layers 5-3 - Working with ArcToolbox</td>
<td>Reference Exercise 6f Exercise 5a - Hands on Exercise 5b - Hands on</td>
</tr>
<tr>
<td>Module 6: GIS Hodgepodge</td>
<td>6-1 - Adding XY Coordinates to ArcMap 6-2 - Mind Over Metadata 6-3 - Google Earth (KML) 6-4 - ArcGIS Online</td>
<td>Reference Exercise 6a Reference Exercise 6b Reference Exercise 6e Reference Exercise 6d</td>
</tr>
</tbody>
</table>

What is GIS?

Geographic Information System

A computer system that hold and uses data describing places on the earth’s surface.
Examples of Geographic Information

Physical features of phenomena:
rivers, roads, forests, earthquakes, canyons, vegetation, precipitation

Human features or phenomena:
population, disease, poverty, ethnicity, education, unemployment

What is GIS used for?

- Wetland regulation
- Community planning
- Crime mapping
- Site suitability analysis
- Land use analysis
- Forest management
- Water quality protection
- School bus routing
- Emergency response
- Hazard assessment
- Public health
- Service delivery
- Crop management
- Property assessment
- Land use permitting
- Open space planning
- Environmental research
- Infrastructure management

http://www.esri.com/what-is-gis/showcase
Geographic Data in a GIS

- Hardware
- Software
- Digital Data

GIS Functions

- Capture: Features & attributes
- Store: Vector & raster data
- Query: Find specific features
- Analyze: Answer questions
- Display: Visualize data
- Output: Maps, reports & graphs
**Vector Data Model**

**Points** (single X,Y coordinate)
*Examples: fire hydrants, buildings, utility poles*

**Lines** (ordered set of X,Y coordinates)
*Examples: power lines, road centerlines, streams*

**Polygons** (sets of X,Y coordinates that start and end at the same location)
*Examples: parcels, wetlands, lakes*

**Raster Data Model**

Geographic space is divided into an array of square areas called cells, grids, pixels or rasters.

To map “features” the entire area of a cell is classified as that feature type.

Detail is a function of cell size – smaller cells allow for greater detail.
**Essential Elements of GIS**

**Location & Shape**

<table>
<thead>
<tr>
<th>Latitude</th>
<th>Longitude</th>
<th>Parking</th>
<th>Open Year-round?</th>
<th>Water</th>
<th>Restroom</th>
</tr>
</thead>
<tbody>
<tr>
<td>41.7411</td>
<td>72.3822</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>41.7452</td>
<td>72.3896</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>41.7492</td>
<td>72.3486</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

**Descriptive Information**

- Parking Lot
- Roadside
- No parking

**Vector Data Samples**
GIS as a geo-relational database

Parcels with IDs displayed

Parcels with IDs displayed

Parcel attributes stored in a feature attribute table

<table>
<thead>
<tr>
<th>Parcel ID</th>
<th>Parcel Name</th>
<th>Street Address</th>
<th>Size (acres)</th>
<th>Value (AC19)</th>
</tr>
</thead>
<tbody>
<tr>
<td>101</td>
<td>Smith, James</td>
<td>100 Smith Ave</td>
<td>1.25</td>
<td>120,000</td>
</tr>
<tr>
<td>102</td>
<td>Johnson, Jane</td>
<td>200 Johnson St</td>
<td>1.75</td>
<td>150,000</td>
</tr>
</tbody>
</table>

Additional attributes stored in a related table (Excel, Access)

<table>
<thead>
<tr>
<th>PIN</th>
<th>Owner Name</th>
<th>Land Value</th>
<th>Building Value</th>
<th>Shape Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>101</td>
<td>Smith, James</td>
<td>120,000</td>
<td>150,000</td>
<td>0.5</td>
</tr>
<tr>
<td>102</td>
<td>Johnson, Jane</td>
<td>130,000</td>
<td>160,000</td>
<td>0.6</td>
</tr>
</tbody>
</table>

Using GIS to Analyze Spatial Relationships

Spatial analysis provides insight and additional information from existing data creating value-added products

Analyzing spatial relationships allows us to:

- Answer questions
- Predict future conditions
- Assess location suitability
Hurricane Storm Inundation Predictions

Example: Lower Connecticut River

- Which property owners are most at risk?
- How much property damage will result?
- What roads are under water?
- What evacuation routes are affected?
- Where should we avoid building new construction?
- Where should we preserve coastal wetlands?

Break for Questions
Jumping Right in to ArcGIS

Focus on Desktop GIS

Specific Functions:
- Visualization & Cartography
- Spatial Analysis
- Spatial Data Management

And also... Online GIS
- visualization
- sharing
- mobile

Jumping Right in to ArcGIS

Focus on Desktop GIS

Three license levels:
- Basic
- Standard
- Advanced

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What is ArcGIS Desktop?

ArcGIS Desktop = Mapping, Analysis & Management

ArcGIS Desktop

Mapping & Visualization
  - ArcMap
  - ArcGlobe
  - ArcScene

Tool & Analysis
  - ArcToolbox

Organization & Management
  - ArcCatalog

Focus on ArcMap & ArcCatalog

ArcMap
  - Go-to application. Create beautiful maps.
  - Visualize data layers
  - Edit features
  - Cartography
  - Geoprocessing
  - Data Analysis
  - Map Layouts, Publishing

ArcCatalog
  - Organize and catalog data.
  - Create geodatabases
  - Read and write metadata
  - Cut, copy, paste, delete, move data
  - Manage GIS servers
  - Search for and add content to ArcMap
ArcCatalog Two Ways

- **Stand-alone program**
  - Catalog Tab in ArcMap

**Stand Alone**

- Click on folder or geodatabase in Catalog Tree
- Contents of the folder or geodatabase are displayed here
- Change the appearance of items: large icons, small icons, details, thumbnails

Large Icons

Small Icons

Contents:
- STATE.shp

Details:

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Read/Write</th>
<th># of Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>STATE.shp</td>
<td>Shapefile</td>
<td>Y</td>
<td>650</td>
</tr>
</tbody>
</table>

Thumbnail
Preview Tab - Geography

Click on dataset in the Catalog Tree

The data will be displayed here

Choose to preview Geography or Table

Description Tab

Click on dataset in the Catalog Tree

The Description tab is used to view and edit a dataset’s metadata
Follow the Leader - ArcCatalog

1. Click the ArcCatalog icon on your desktop
2. Locate the C://GISEd10 Folder
3. Sort Contents
4. Preview a dataset
5. View Metadata
6. Create Catalog connection

On to ArcMap
ArcMap Basics – Blank Document

Main Menu

Tools Toolbar

Standard Toolbar

Table of Contents

Display Area

ArcMap Basics – Project File (.mxd)

Title Bar

Data Layers

Windows Explorer

.mxd = ArcMap project file
ArcMap Documents

ArcMap project file = “filename”.mxd

Map documents reference data layers and contain instructions on how those data layers are to be displayed in ArcMap. They DO NOT store actual data!

ArcMap Basics – Project File (.mxd)

Tools Toolbar

Data Layers

Navigation Tools

Add Data Button

Path to data source
ArcMap Details

- Table of Contents
- Data Frame
- Methods
- Layer List
- Data Layers
- Current Map Scale
- Display Area
- Catalog window
- Search Tool
- XY Location

Adding/Removing Toolbars

- To add or remove a toolbar, click on Customize>Toolbars
- A toolbar is “on” when checked

Tip: right click on header bar will also display toolbars
Moving & Docking Toolbars

The Standard Toolbar

- cut/copy/paste/delete/undo/redo
- open applications
- new/open/save/print
- Add data
- open Editor toolbar
- what’s this? tool
- Current map scale

Methods of scale entry:
- Type number, no separator
- 1: and a number
- Relative scale (e.g. 1 in = 1 mile)
- Numbers and words (e.g. one inch = 5 mi)
- Commas or no commas (e.g. 1,000 or 1000)
Introduction to GIS – Presentation Slides

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The Tools Toolbar
- zoom/pan/full extent/fixed zoom
- select elements
- measure
- route
- time slider
- go forward/back extent
- hyperlink
- HTML popup
- find
- go to XY
- viewer

Basic Tools
- identify
- select
- measure

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Adding a Data Layer to ArcMap

Add Data

Browse to a local or network drive or web server to find and add a data layer.

The Table of Contents

Functions:

- Lists all layers and tables in the map document
- Allows you to control the visibility of a layer
- Shows layer symbology
- Provides access to a layer’s attribute table
- Provides access to a layer’s properties window
- Allows you to organize data into one or more “data frames”
The Data Frame

- A Data Frame is a “container” for layers
- ArcMap supports multiple Data Frames in a single project
- Only one Data Frame can be active at a time
- Only one Data Frame can be visible at a time in Data View, however all Data Frames are visible in Layout View
- Layers can be dragged between Data Frames
- Data Frames have Properties

The Data Frame – Data View

A data frame is a container for layers

You can have multiple data frames in one project but only one can be active in data view
**The Data Frame – Layout View**

All data frames are visible in Layout View.

**Layers**

A layer references a dataset – a shapefile, a geodatabase feature class, CAD file, image, coverage, etc. Layers typically represent a single category of data such as parcels, wells, roads, soils or buildings.

Layers have:
- A data source
- Properties
- Attributes

Layers DO NOT store geographic data, they simply point to the data source.
Layers and Data References

- A data set is a feature class, shapefile or raster stored in a geodatabase or file on disk.
- A data set is represented by a layer in the TOC.
- Project files (.mxd) contain layers and layer properties but DO NOT contain actual data sets.
- A layer references the data set (points to it) and controls how the data set is displayed on your map. These display properties can be established through the Layer Properties window.

Absolute Path: C:\GISEd10\Boundary.shp
Relative Path: \GISEd10\Boundary.shp

Layers Have Properties

All aspects of a layer can be controlled through the layer’s Properties. These include:

- How to draw features (symbology)
- What features to draw (definition query)
- What data source the layer is based on
- Feature labels
- Scale dependency
- Attribute field properties

The Layer Properties dialog window will look different depending on what type of geographic data you are working with (shapefiles will look different from rasters and CAD datasets).
Layers Have Properties

Feature Layer Properties:
- General
- Source
- Selection
- Display
- Symbology
- Fields
- Definition Query
- Labels
- Joins & Relates
- Time
- HTML Popup

Layer Property Tabs
- General: layer description, credits, scale dependent drawing
- Source: view and change data source, view extent of data
- Selection: specify how selected features draw
- Display: layer transparency, MapTips, hyperlinks
- Symbology: control how features are rendered on your map
- Fields: Define field properties (aliases, number formats, visibility)
- Definition Query: specify a subset of features to be used & displayed
- Labels: label features, manage label classes & placement
- Joins & Relates: join or relate attribute table to other tables
- Time: used to specify the time properties of time aware layers
- HTML Popup: used to specify how pop-ups are generated when you click a feature to display information about it.
Saving Layer Properties

Layer Properties are saved in:

- The project file (.mxd)
- A layer file (.lyr)
- Marl_Zoning.shp

Both .mxd and .lyr files reference the actual dataset

---

ArcMap Basics – Live Demo
ArcMap Basics – Hands on Exercise

Exercise 1 a

- Getting to know the ArcMap Interface
- Working with Project Files (.mxd)
- Toolbars
- Adding Data
- Layer Properties
- Data Frames
- Finding Help
Module 2: All About Data

LT: Where to Find GIS Data

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Talking Points

1) Federal, State, Local resources for viewing and downloading GIS Data
2) Connect to data vs. download data?
Where’s the Data?

ArcGIS is the software.

But data (plus people, methods & procedures) drive the System.

Show me the data!

Federal Data Source – Data.gov

Data formats

location
topic
State Data Source - CTECO
http://cteco.uconn.edu

Data Download – CT DEEP, MAGIC
www.ct.gov/deep/gisdata
http://magic.lib.uconn.edu
Local Data Resources – COGs, Towns

Regional GIS

Municipal GIS

Connect or Download?

Connect to Data – Map services
- Hosted online, connect to via URL
- Mainly for display purposes only
- Limited user control
- No hard drive (local) storage

Download Data – Data files, formats, storage
- Physical download of geodata file(s)
- Requires desktop GIS software to use
- Local storage (can be significant)
- More functional within a desktop GIS
Module 2: All About Data
Working with Data Types

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Learning Objectives

1) Geographic data types
2) Shapefiles
3) The ESRI Geodatabase
4) ArcCatalog
5) Data Management
6) Connecting to Online Data
Geographic Data Types

<table>
<thead>
<tr>
<th>Esri Supported Data Formats (there are more)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ArcGIS Server geocode services</td>
</tr>
<tr>
<td>ArcGIS Server globe services</td>
</tr>
<tr>
<td>ArcGIS Server image services</td>
</tr>
<tr>
<td>ArcGIS Server map services</td>
</tr>
<tr>
<td>ArcInfo coverages</td>
</tr>
<tr>
<td>ArcIMS map services</td>
</tr>
<tr>
<td>DNG</td>
</tr>
<tr>
<td>DWG</td>
</tr>
<tr>
<td>DXF</td>
</tr>
<tr>
<td>ESRI Geodatabases</td>
</tr>
<tr>
<td>OGC WCS services</td>
</tr>
<tr>
<td>OGC WMS services</td>
</tr>
</tbody>
</table>

Geodata Models

**Vector Data Model**
- points, lines, polygons

**Raster Data Model**
- row, column, cell size, resolution
Shapefiles

A shapefile is a simple data format for storing the geometric location and attribute information of geographic features.

Shapefiles are made up of three or more files with specific file extensions.

- **.shp** – the main file that stores feature geometry
- **.sbn** and **.sbx** – store spatial indexes
- **.shx** – the index file that stores the index of the feature geometry
- **.prj** – stores coordinate system information
- **.dbf** – the dBASE table that stores the attribute features
- **.xml** – stores metadata information

A shapefile must have the same prefix and each associate file must be located in the same workspace (folder).

Shapefiles are Vector Data

- **Points** (single X,Y coordinate)
  - Examples: fire hydrants, buildings, utility poles

- **Lines** (ordered set of X,Y coordinates)
  - Examples: power lines, road centerlines, streams

- **Polygons** (sets of X,Y coordinates that start and end at the same location)
  - Examples: parcels, wetlands, lakes

A single shapefile can only contain one geometry type.
**Esri Geodatabase Feature Class**

- **Shapefile** - stable, cross-platform, no longer evolving
- **Geodatabase Feature Class** - utilizes the full potential of ArcGIS

**The Geodatabase**

The geodatabase is a native data structure for ArcGIS and is the primary data format for editing and data management.

At its most basic level, an ArcGIS geodatabase is a container for spatial and attribute data. It is a collection of geographic datasets of various types held in a common file system folder, Access database or a multilayer relational DBMS (Oracle, Microsoft SQL Server, PostgreSQL, Informix, or IBM DB2).
Advantages of Geodatabases

- Centralized data storage location
- Improved data integrity
- No size limitation
- Improved data entry and editing environment
- Increased performance - faster
- Multi-user database
- ESRI’s #1 supported format
- Evolving

File Geodatabase in Explorer

Geodatabase files should be accessed through ArcMap or ArcCatalog
Anatomy of a Geodatabase

- **Feature classes**
- **Raster datasets**
- **Tables**

<table>
<thead>
<tr>
<th>GIS Data</th>
<th>Geodatabase Dataset</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coverage</td>
<td>Feature dataset containing feature classes</td>
</tr>
<tr>
<td>Imagery</td>
<td>Imagery</td>
</tr>
<tr>
<td>Raster data (e.g., satellite images, air photos, scanned maps, and digital elevation models)</td>
<td>Raster dataset and/or raster dataset</td>
</tr>
<tr>
<td>CAD data</td>
<td>CAD data</td>
</tr>
<tr>
<td>Surface modeling or 3D data</td>
<td>Terrain</td>
</tr>
<tr>
<td>Utility network data (e.g., water systems, gas pipelines, and telecommunications networks)</td>
<td>Geometric network</td>
</tr>
<tr>
<td>Transportation network data (e.g., street networks)</td>
<td>Transportation network</td>
</tr>
<tr>
<td>GPS coordinates</td>
<td>GPS coordinates table of X, Y coordinates that can be generated into a feature class</td>
</tr>
<tr>
<td>Survey measurements</td>
<td>Survey measurements</td>
</tr>
</tbody>
</table>
Geodatabase Feature Classes

Feature classes are homogeneous collections of features. The most common types of geodatabase feature classes are: points, lines, polygons and annotation (map text).

- **Points** – features too small to be represented as lines or polygons. These are represented as a single XY location.
- **Lines** – represented by and ordered set of XY coordinates. Features that have length but no area.
- **Polygons** – represented by an ordered set of XY coordinates that begin and end at the same coordinate. An enclosed shape.
- **Annotation** – map text including properties for how the text is rendered. Can be linked to features.
File Geodatabase Admin

- ArcCatalog!
  - Create and manage a file geodatabase
  - Create/import/export feature classes, rasters, tables, other data types
  - Set up feature class subtypes, domains, relationship classes
    (not for this class)

Geodatabase Benefits

- Data organization
- Standardization
- Data Distribution
- Industry-specific data models (support.esri.com/datamodels)
- Common download format
Connecting to Data through the Web

New(er) paradigm of accessing GIS data over the Internet:

1. GIS user creates data in desktop
2. Creates a “service” of data hosted in the cloud. Accessible through a URL.
3. Service can be accessed using URL from various mapping platforms – desktop, web maps, web apps, mobile apps, etc.

Add ArcGIS Online Data (in ArcMap)
Example – CT ECO Map Services

http://www.cteco.uconn.edu/map_services.htm

Map Service in Desktop

Map Service (web)

DEEP Downloadable Data (stored locally)
LOTS of Web Enabled Data Out There!

The ArcGIS REST Services Directory

Services Directory allows you to browse the contents of an ArcGIS Server, link to metadata, and find information to help develop applications.

Often, organizations serving their GIS Data will direct users to the REST services directory for their server. It’s important to know how to use these services!
Examples

Hands on Exercise: All About Data

- Get to know ArcCatalog
- Exploring Data Types
- Working with File Geodatabases
- Connecting to Web Enabled Data
- Adding Content from ArcGIS Online
- Adding Data from a REST Endpoint
Questions?

Up next... Tables.
Module 2 – All About Data
Projections & Coordinate Systems

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Learning Objectives

1) What are Projections, Coordinate Systems?
2) The Spatial Reference
3) Data Frame and Feature Settings
4) ArcMap Tools – Defining and Converting

This presentation will not make you an expert (not even close).
Latitude and Longitude

In order to fix this, we need to convert our 3D sphere to a 2D map with the help of datums, coordinate systems and projections.

Transformation Components

The Datum – provides the reference for 2D and 3D models of the physical Earth.

The Coordinate System – a pair of axes superimposed on a map projection that is used to locate features on the map.

Map Projection – a mathematical function for converting the Earth's curved surface to a flat plane.
Datums

A datum characterizes the shape of the Earth's surface and is defined by specifying the origin of the coordinate system, the orientation of the coordinate system, and the dimensions of the ellipsoid.

The most common horizontal datum in use in the U.S. is the North American Datum of 1983 (NAD83). It's origin is located at the center of the earth's mass.

Coordinate Systems

Datum defines a standard point of reference (origin) for a coordinate system. The coordinate system acts as the frame of reference for location and plotting any feature on a map.

Two main types of Coordinate Systems:

- **Geographic Coordinate Systems** (Global latitude-longitude)
- **Planar or Cartesian Coordinate Systems** (State Plane, UTM)

Coordinate Systems provide the numbers to define your position on a globe or a map.
Map Projections

Map projections allow us to take a sphere and project it on a two-dimensional plane.

Because 3D surfaces cannot be displayed perfectly in a 2D space, some distortion can occur.

Examples: distance, direction, scale, area, conformality.

Projections in Detail

Projections attempt to project a sphere onto a flat map.

Common map projections are classified by the projection surface used to define them (conic, cylindrical, or planar). Samples from the ArcGIS help file:

- Conic (tangent)
- Cylindrical aspects
- Planar aspects
- Polar aspect (different perspectives)

Want more? Search “List of supported map projections”
**Projections - Types**

- **Mercator**
  - Direction: Suited for Navigation
- **Lambert Conformal Conic**
  - Shape: Suited for Cartography
- **Azimuthal Equidistant**
  - Distance: Suited for Road Atlas
- **Albers Equal-Area Conic**
  - Area: Suited for Land Management

Want more? Search “List of supported map projections”

---

**Defining it ALL.**

**Spatial Reference:** A more inclusive term describing everything required to enable each layer to reference locations on the earth’s surface in a common way. A spatial reference contains the projection, projection parameters, ellipsoid, datum, units of measure, and other spatial related properties.
Spatial Reference & ArcMap

The coordinate system (spatial reference) within ArcMap

Several spatial reference files supported by ArcMap

<table>
<thead>
<tr>
<th>Data Format</th>
<th>Spatial Reference Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>TIN</td>
<td>PRJ file</td>
</tr>
<tr>
<td>Coverage</td>
<td>World file</td>
</tr>
<tr>
<td>Grid file</td>
<td>AUX file</td>
</tr>
<tr>
<td>Shapefile</td>
<td>Within the geodatabase</td>
</tr>
<tr>
<td>CAD file</td>
<td></td>
</tr>
<tr>
<td>Image</td>
<td></td>
</tr>
<tr>
<td>Geodatabase</td>
<td></td>
</tr>
</tbody>
</table>

What the *.prj file contains

Why a Spatial Reference?

To line up correctly, layers must:
1. have the same coordinate system - or -
2. have their spatial references defined

Early versions of ArcView did not have the ability to read spatial reference files, all datasets had to be projected to the same coordinates system or their alignments would be off.

Layers with NAD27 and NAD83 coordinate values, but no spatial reference, might display like this.
Spatial Reference & ArcMap

Setting Coordinate Systems:

Three options:
1. Dataset has no "defined" spatial reference? = Define Projection Tool
2. Dataset has a different spatial reference than you want to “see” = Change Data Frame Properties! ▶ Layers
3. Dataset is in the wrong projection = Project Tool!

Define Projection
Use if layer has unknown or incorrect coordinate system
Coordinate Systems & ArcMap

Use to convert a layer from an existing coordinate system to another

Project

Different from “Define” – with Project you actually create a new dataset.

Coordinates: Additional Info

You may see warning messages if you combine layers with different coordinate systems, or if a layer’s spatial reference is unknown.

The warnings can usually be ignored, but combining projection types during an edit session can cause problems.

What if you don’t know the coordinate system for layers without a spatial reference?

First check any metadata for the file. If nothing is available, try defining common projections. Sometimes you can guess by displaying both and unknown and a known together (over time you begin to recognize the x/y values for your area).
Spatial Reference: Take Home Message

If your data have a spatial reference, ArcMap will know where to place features relative to the data frame’s coordinate system.

If your data lack a spatial reference, ArcMap will draw the X/Y coordinates but will be ignorant of where they are relative to the data frame’s coordinate system.

Questions?
Exercise 4a: Coordinates

Get ready to:

- Change the spatial reference of a Data Frame
- Define a layer’s spatial reference
- Use the Project tool to change a layer’s coordinate system
- Add common spatial references to “Favorites” list

Open C:\GISeD10\Projects\Projections_GTP.mxd
Module 3: Tables
Introduction to Tables

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Module 3: Tables

- A. Introduction to Tables
  - Exercise
- B. Working with Tables
  - Exercise
- C. Selections
  - Exercise
Introduction to Tables

- Opening a Table
- Anatomy of a Table
- Viewing Multiple Tables
- Field Properties
- Field Functions (sort, summarize, statistics)
- Selections and Queries
  - Selection in a Table
  - Selection using a Query
- Multi-part vs. Single Part

Tables contain the description of the geography

- Each layer has an attribute table
- Generally, attribute tables contain one record of descriptive data for each feature in the layer.
Opening the Attribute Table

Right-click on a Layer name and then click Open Attribute Table

Anatomy of a Table

- Tables contain rows
- Rows are called Records
- All rows in a table have the same columns
- Columns are called Fields
- Each column contains only one kind of data (integers, decimals, text, etc.)
### Anatomy of a Table

- **Table Options**
- **Record (Row)**
- **Field (Column)**
- **Field Name**
- **Cell**
- **Related Tables**
- **Selection Tools**

**Current Record**

<table>
<thead>
<tr>
<th>Decimal Text</th>
<th>Integer</th>
<th>Text</th>
</tr>
</thead>
</table>

### Viewing Multiple Tables

ArcMap opens tables in the Table Window. The Table Window is a container for all tables.

If a second table is opened, a tab is added.

**Arrange tables by:**
- Dragging into a docked position using the blue arrows
- Choose Arrange Tables on the Table Options menu
Field Properties

- Right-click over the field
- Change Field Alias name
- Hide field in table (does not delete field)
- Highlight the field in the table display
- Assign a default value
- Make read-only so field cannot be edited
- Change number format display

Field Properties in Layer Properties

Many of the field properties available through the table are also available from Layer Properties

- Right-click over the layer
- Choose Properties
- Choose the Fields tab
Field Properties in Layer Properties

- Turn all fields off (check)
- Turn all fields off (uncheck)
- Uncheck to hide field in table (does not delete field)
- Change the order of the fields in the table
- Change Field Alias name
- Highlight the field in the table display
- Change number format display
- Make read-only so field cannot be edited

Field Functions

Operate on a single Field (Column)

- Sorting
- Summarize
- Statistics
- Field Calculator
- Calculate Geometry
- Freeze/Unfreeze
Right-click over the field name and click Sort Ascending or Sort Descending.
Field Functions: Summarize

Right-click over the field

Summarize creates a new table based on your criteria. Here, we asked it to add all the sq. mile attributes and summarize them by the county.

Field Functions: Statistics

Right-click over the field

You can change the statistics field from within the Statistics box.
Field Functions: Freeze/Unfreeze

Right-click over the field

Note: You can select multiple columns by holding down the Keyboard Ctrl Key and clicking with the left mouse button. You can then freeze/unfreeze the selected columns.

Right-click on the field name and select Freeze/Unfreeze. The column will be moved to the left and won’t scroll when the table is scrolled left/right. You can freeze more than one column.

Table Options: Create Graph

- Many choices for setting up a graph
- Graphs interact with the input data (colors from map are passed to the graph, etc.)

Right-click over final graph

Selected features on the map and table are also selected on the graph.
**Table Options: Reports**

**Report wizard:**
- Select input fields
- Choose all records or selected records
- Determine how data is grouped
- Determine how data is sorted and summarized
- Choose layout and style
- Determine if all records or only selected records should only be showed,
- Modify design and much more

- Saved
- Exported as htm, pdf, text, excel
- Added to ArcMap layout

---

**Introduction to Tables**

- Opening a Table
- Anatomy of a Table
- Viewing Multiple Tables
- Field Properties
- Field Functions (sort, summarize, statistics)
- Selections and Queries
  - Selection in a Table
  - Selection using a Query
- Multi-part vs. Single Part
What is a ...

- **Selection**
  A subset of the features in a layer or records in a table

- **Many ways to select**
  - Inside the table
  - Inside the map
  - Queries

Why Create a Selection/Query?

- To retrieve and examine attribute data
- To answer simple questions
- To create summary statistics
- To create a new feature class or shapefile
- To focus an analysis on appropriate features
- To select features based on spatial relationships with other layers
Select is all over the place!

Tables  Identify Tool  Layer Properties  Feature Selection Tools  ArcToolbox Tools

Anatomy of a Table: Selection

Switch Selection  Select By Attributes  Zoom to Selected  Clear Selection

A selection is subset of features in a layer, or records in a table.

Selected Records  Show All Records  Show Selected Records

A selection is subset of features in a layer, or records in a table.
Select in the Table: Click Rows

- Left-click on the row
- Click and drag OR hold down SHIFT to select multiple, consecutive records
- Hold the Control key to select multiple, non-consecutive records

Select in the Table

- Switch Selection
- Select All
- Clear Selection
Select by Attributes

You control the Selection Method
- Create new selection
- Add to current selection
- Remove from current selection
- Select from current selection

Selection query entered in the form of
field operator value
"County" = "Middlesex"

Select Based on Attributes (QUERY)

1) choose the layer from your map
2) double-click the field you want to use
3) click an operator
4) click “get unique values” then double-click the value

This query will select all the towns greater than 35 sq. miles.
"TOTAL_SQMI" > 35
Select Based on Attributes (QUERY)

1) choose the layer from your map
2) double-click the field you want to use
3) click an operator
4) click “get unique values” then double-click the value

This query will select all the towns greater than 35 sq. miles.

“TOTAL_SQMI” > 35

Advancing Queries

Multiple attributes

“TOTAL_SQMI” > 35 AND “COUNTY” = “Hartford”

Other operators and wildcards

“TOWN” LIKE ‘East%’

Calculations

“LAND_SQMI” / “TOTAL_SQMI” > 0.99
Query Syntax

- CAPITAL denotes field name
- Strings (text) must be in ‘single quotes’
- Syntax varies depending on what is being queried, for example:
  - “AREA” Field name in a file geodatabase, shapefile, dBase table, and others
  - [AREA] Field name in personal geodatabase
  - AREA Field name ArcSDE database

Most Common Mistake:
Correct: “TOWN” = ‘Haddam’ OR “TOWN” = ‘Middletown’
Incorrect: “TOWN” = ‘Haddam’ OR ‘Middletown’

Use HELP for lots more information and specifics

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Multipart vs. Single Part Features

**Multipart features** - a place or thing that has more than one part but is defined as one feature because it references one set of attributes.

**Single part**
Each feature has a table record

**Multipart**
Many features share a table record
To Review

- Opening a Table
- Anatomy of a Table
  - Rows, columns and selections
- Field Properties
  - Alias names
  - Hiding or showing fields
  - Number format
- Field Functions
  - Sorting
  - Summarize
  - Statistics
  - Freeze/Unfreeze
- Selections
  - Why create a selection?
  - Select using tables
  - Select using attributes (aka Queries)
  - Advanced Queries and Syntax
- Shapefile vs. Geodatabases
- Multi-part vs. Single Part

Table Basics – Q & A

Up next... Working with Tables
Module 3: Tables

Working with Tables

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Module 3: Tables

- A. Introduction to Tables
  - Exercise

B. Working with Tables
  - Exercise

C. Selections
  - Exercise
Working with Tables

➢ Add a Field
➢ Delete a Field
➢ Calculate Geometry
➢ Field Calculator
➢ Add an External Table
➢ Join Table
➢ Related Table

**Distinction:** these topics CHANGE the data in the table by adding or deleting data, or calculating new data.

The previous presentation only VIEWED or ARRANGED the data in the table.

---

Add a Field

If you are going to be doing calculations, it is a good idea to add a field and use it rather than changing values in an original field. That way, if you make a mistake, you won’t lose the original data.

---

If you are going to be doing calculations, it is a good idea to add a field and use it rather than changing values in an original field. That way, if you make a mistake, you won’t lose the original data.
Delete a Field

Right-click over the field

Careful – You can't undo a delete field operation. Once it’s gone it’s gone!

Calculate Geometry

Right-click over the field
Select the geometry that will be calculated.
Select the unit.

The Calculate Geometry tool allows you to access the geometry of the features in a layer. The tool can calculate coordinate values, lengths, and areas, depending on the geometry of the input layer.
**Field Calculator**

Right-click over the field

Equation or Value is entered here

**Tip:** Syntax matters!
- Double-click on the Fields to add them to the equation box.
- Pay careful attention to quotes "" and parens ().
- If you use the same equation frequently, save it.
- Help can be very helpful!

---

**Add an External Table**

- Data tables that are not associated with a layer can be added to ArcMap
- Use the Add Data button to add tables
- ArcMap will switch to the List By Source view
- Tables can be dbase files, delimited text files, excel files or Info tables.
Open the table

- Attribute tables are opened by right-clicking on the table name
- Tables are listed in the List By Source view
- Table Properties
  Right-click and select Properties
  Fields tab same as discussed in earlier presentation

**Note:** When you switch to List By Drawing Order the tables will not be visible.

---

Join Tables

Joining two tables appends the attributes from one table to the other table based on a common field.

**Tip:** The name of the Join field doesn’t have to be the same but the two fields must be the same data type (numbers to numbers, text to text, etc.).
Join Tables

In the Table of Contents, right-click over the layer and select Joins and Relates.

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Joined Data

You have:
1) Parcel layer with map/block/lot attributes
   - Parcel boundaries change infrequently
2) Excel spreadsheet with map/block/lot column
   - Owner information changes frequently

Why Use a Join?
- The excel file can be maintained outside of ArcMap
- Each time the ArcMap document is opened, the join is reestablished
- The new information will be reflected on the map
Relating tables defines a relationship between two tables, based on a common field, but doesn’t append the attributes to one another. Instead, the related data can be accessed when working with the layer’s attributes.

Relate is useful for one-to-many or many-to-many relationships.

Create the Relate:

In the Table of Contents, right-click over the layer and select Joins and Relates.

Access the Relate:

After setting up the relate (left)
- Open the Layer’s Table
- Select record(s) of interest
- Click the Related Tables button
- Select the Relate (here, Relate1)
Saving Joins and Relates

When you save a map containing joins and relates

- ArcMap saves the definition of how the two attribute tables are linked rather than saving the linked data itself
- The next time you open your map, ArcMap reestablishes the join or relate by reading the tables
- Any changes to the source tables are automatically included and reflected on the map

To permanently append joined data to a layer, export the file and save with a new name. Right-click over the layer, select Data, then Export Data. The new file will include all the attributes.

Advantages of geodatabase tables

Over shapefile tables

- Area and perimeter fields are updated
  In a shapefile table, area needs to be recalculated after geoprocessing or other changes.

- Attribute Domains
  Specify a list or range of valid values for attribute columns. Helps ensure the integrity of attribute values.

- Relationship Classes
  Build relationships between two tables using a common key.

- Subtypes
  Manage a set of attribute subclasses in a single table. This is often used on feature class tables to manage different behaviors on subsets of the same feature types.

- Versioning
  Manage long update transactions, historical archives, and multiuser editing required in GIS workflows.
To Review

- Adding table fields
- Deleting table fields
- Calculate Geometry
- Field Calculator
- Adding and opening external tables
- Table Joins
- Table Relates

Hands On Exercise

**Table Basics:**
- Explore Attribute Tables
- Field Properties
- Add/Remove Fields
- Calculate Areas
- Join Tables
Working With Tables – Q & A

Up next...Selections and Queries
Module 3: Working with Tables

Selections

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Module 3: Tables

- A. Introduction to Tables
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  - Exercise

Selection - A subset of the features (in a layer AND records in a table)
Selection Using the Map

- Selectable Layers and Settings
- Interactive Feature Selection Tools
- Select Based on Location
- Select Using Graphics
- Post-selection: Now What?
  - Bookmark
  - "Use Selected Features"
  - Create Graph or Report
  - Export

Selectable Layers

- Selected – lists layers that currently have selected features.
- Selectable – lists layers that are selectable.
- Not Selectable – lists the layers that cannot be selected from using the interactive selection tools.

Tip: By default, all layers are selectable.
Other Selection Settings

These settings apply to all methods of selecting

Interactive Feature Selection Tools

- Works only on selectable layers
- Disabled if no layers are selectable
- Click on individual features or click and drag around multiple features to select.

Tip: To select multiple features in multiple clicks as you use these tools, hold down SHIFT.
Select Based on Location

Select features from towns that intersect Selected features of roads

(Rt 91 is selected)

Select Using Graphics

Selects features according to whether they fall inside the selected graphic(s)

1) Draw graphics using the tools in the Drawing toolbar
2) Selection menu > Select By Graphics

- Example: "how many parcels would be affected by a proposed pipeline?"
- Works on layers that are selectable
- Disabled if no graphics are currently selected or if no layers are currently set as selectable
Selection is often
An intermediate step

Post-selection: “Use Selected Features”

Many tools and processes throughout
ArcMap and ArcToolbox have a checkbox
✔️ Use Selected Features
Post Selection: Export Table

- Creates a new file that contains just the table (no feature class or shapefile)
- Multiple format choices:
  - Geodatabase table
  - dBase table (for shapefiles and excel)
- Tables can be used in future analyses

Post-selection: Export Shapefile or Feature Class

- Right-click over layer in the Table of Contents
- Use Export to create a new file that is smaller than the original.
  - For example:
    - All towns within a county
    - All parcels in a subdivision
    - All tributaries of a stream
- Choose shapefile or feature class output
To Review

**Selectable Layers**
**Selection Settings**
**Select using Interactive Feature Selection Tools**
**Select using Graphics**
**Select based on Location**

Q & A

**Post-selection**
- Statistics and Viewing
- “Use Selected Features”
- Export

Hands On Exercise

**Selections and Queries:**
- Work with Excel file in ArcMap
- Multiple methods for Selecting features
- Selection Options
- Definition Queries
- Create new data from selected features
Module 4: Map Production
Symbology and Thematic Maps

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Module 4: Map Production

- Symbology and Thematic Maps
- Hands On Exercise
- Labels, Text and Graphics
- Hands On Exercise
- Layouts
- Hands On Exercise
Symbology and Thematic Maps

- Examples of Symbology
- How to edit symbolization
- Making thematic maps
- Classifying data
- Saying layer files
- Layer packages

Legend Examples: Points

Single Symbol
When data are first added to ArcMap, features are all symbolized the same.

Symbolized
You can use attribute values to assign different symbols to classes of data. In this example wells are symbolized based on the field “Wellstatus.”
Legend Examples: Lines

- **Single Symbol**
  - ROADS symbolized based on the field ROUTECLASS.

Legend Examples: Polygons

- **Single Symbol**
  - TOWNS symbolized based on the field COUNTY.
Default Symbols

When you add data to ArcMap, a default symbol (single symbol) is used to draw all features in the layer.

Click on a symbol in the ArcMap Table of Contents to open the appropriate Symbol Selector.

Symbol Selectors

Points
Lines
Polygons
Polygon Symbol Selector

There are many options for changing the symbol:

1. Choose a premade symbol.
2. Make variations of the premade or default symbol.
   - Polygon symbols include a fill color, an outline color and an outline width. Change these by clicking on the buttons under Options.
3. Make big changes to a symbol with Edit Symbol.

Symbol Selector: Edit Symbol

TIP: Symbol selector allows you to build most any symbol you can dream up.

Change
- Fill and type (solid, gradient, line, picture, etc.)
- Foreground color
- Background color
- Outline color and line type
- Size
- Much more
Symbol Selector: Edit Symbol

The symbol is built using Layers. Each layer is changed separately.

Symbology is a Layer Property

Default symbology is Single Symbol

Controls how overlapping symbols are handled

Current Symbol

Transparency

Only appears in the layout

Text in TOC
Thematic Map: Categories: Unique Values

Unique Values should be used when symbolizing fields that have a small number of values. Usually 10 or 12 is a good cut-off, such as counties or planning regions. Unique Values is not appropriate for numeric fields (such as area) or discrete fields with lots of values (such as towns with 169 records).

Click on the column headings to access more symbolization and labeling options.

Select many values by holding down the Ctrl key while clicking on them with the mouse.

Right-click on a symbol, value or label to open more choices.
Thematic Map: Quantities: Graduated Colors

1. Choose Graduated Colors
2. Value is the field from the table
3. Choose field for normalization, if desired. For example, normalizing population by area maps population density.
4. Choose color ramp
5. Classification method chooses how many and where the breaks are made in the quantitative data.
6. Format labels

Thematic Maps: Quantities: Classify

1. Select method which determines where the class breaks are made
2. Select the number of classes
3. Drag breaks or type in values to change where class breaks are
Thematic Maps: Quantities: Classify

- Features
  - Single Symbol
  - Categories
  - Unique Values
  - Unique Values, many fields
  - Match to symbols in a style
- Quantities
  - Graduated Colors
    - Graduated Symbols
    - Proportional Symbols
    - Dot Density
- Charts
  - Pie
  - Bar/Column
  - Stacked
- Multiple Attributes
  - Quantity by Category
Import Symbology

Use the import button to use symbology from

A layer already in the map

A legacy ArcView 3.x AVL file (ArcView Legend File)

A Layer File .lyr (coming up next)

Layer Files

- Layer Files store symbolization, labels, and other layer properties.
- They can be created and then used to quickly restore and/or share a dataset’s symbology.
- Layer Files DO NOT store geographic data; they only store a pathname to the data.
- A Layer File without Source Data is useless.
Layer Files

All parameters entered on each tab in Layer Properties is saved with the Layer File

- **General**: Name, description, display scales
- **Source**: Pathname to the data source
- **Selection**: Set how to display selected features
- **Display**: Map tips, scale symbols, transparency, hyperlinks
- **Symbology**: Methods to classify and symbolize features
- **Fields**: Primary display field, set aliases, field visibility, formats
- **Definition Query**: Create a query to subset data
- **Label**: How to label features, label placement, formats, scales
- **Joins & Relates**: Establish links to other tables
- **HTML Popup**: Turns on HTML popup window & characteristics

Layer Files: How

1. Add data to ArcMap. Defaults to single symbol symbology.
2. Open Layer Properties and change desired settings on all tabs.
3. Right-click over Layer in the TOC and choose Save As Layer File.
4. .lyr file is created
5. Add .lyr file to ArcMap
6. Share Layer File AND Source Data
Layer File: Missing Data Source

1. Add a Layer File

2. Layer shows in the TOC but doesn’t draw and has an !

3. Click on ! to open the Set Data Source box.

4. Layer File has Source Data and draws.

Layer Packages

- Saves a Layer with its Source Data
- Larger file size than just a Layer because it contains the Source Data
- .lpk file extension
- To use the Layer Package
  - In ArcCatalog, right-click over the Layer Package and Unpack
  - Starting with ArcCatalog, drag the Layer Package to ArcMap
Layer Packages: How

1. Right-click over Layer in the TOC and choose Create Layer Package.
2. Select a file name and location for saving the Layer Package.
3. Validate
4. Any errors will show. To fix, right-click over the error and choose Change General Layer Properties. Fix the problem.
5. After Validation is successful, the Share button is enabled. Click Share.
6. The Layer Package, .lpk is created.
7. Share the Layer Package.

TIP: Multiple layers can be included in the Layer Package. Hold the CTRL key while selecting layers in the TOC before choosing Create Layer Package.

Map Document Properties

- The default geodatabase you work with most in this document.
- After setting it, use the shortcut to default database.
- Default is unchecked so full paths to data are stored.
  C:\GISEd10\Shapes\TOWNS.shp
- If box is checked, pathnames stored are relative to the current location of the mxd.
  LocationOfMXD\shapes\TOWNS.shp.
- Relative paths is useful when sharing documents. ArcGIS will resolve the paths to the data sources relative to the document’s current location, rather than by full paths that include a drive letter or machine name.
- Creates a thumbnail for ArcCatalog. Thumbnail is static.
To Review

- Default single symbol symbology
- Symbol Selectors: Points, Lines and Polygons
- Symbology as a Layer Property
- Symbology: Unique Values
- Symbology: Quantities
- Data Classification
- Other Symbology Choices
- Import Symbology
- Layer Files
- Layer Packages

Symbology and Thematic Maps – Q & A
Hands On Exercise

- Set Map Document Properties
- Single Symbol Symbology
- Thematic Maps
- Classifying Data
- Creating Layer (.lyr) files
Module 4: Map Production
Labels, Graphics & Annotation

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Learning Objectives

1) Dynamic feature based labels
   - Layer Properties Labels tab
   - Label Classes
   - Label Expressions

2) Reference Scales

3) Graphic text objects

4) Graphic feature objects

5) Geodatabase map annotation
Dynamic Feature Based Labels

Labels are a Property of a Layer

Setting Up Layer Properties

Turn on labels

What features are labeled?

What does the text say?

What does the text look like?

Where are the labels placed?

At what scale do the labels turn on/off?

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Basic Labels

Features on map are being labeled using the value in the TOWN field.

Label Placement Properties

How to deal with duplicates:

- Duplicate Labels
- Remove duplicate labels
- These are labeled on feature
- These are labeled on feature set
Setting a Reference Scale

A Reference Scale allows labels or graphics to be scaled proportionally with the map scale of a Data Frame.

This means the labels and graphics will scale up/down when you zoom in/out on your map.
Setting a Reference Scale

Steps to setting a Reference Scale:
1. Set properties of Label through Layer Properties
2. Zoom in on map until labels appear at appropriate size
3. Right click on Data Frame name and select Reference Scale>Set Reference Scale

You can also zoom to a reference scale and clear a reference scale from this menu

Using a Label Expression

A Label Expression allows you to add text from more than one attribute field
Using a Label Expression

Using a Label Expression

[TOWN] & vbCrLf & "Square Miles = " & [TOTAL_SQMI]

Label Classes

Label Classes allow you to label features from the same layer differently

Example: the ROADS layer has four values in the ROUTECLASS field
Creating a Label Class

1. Define Method
2. Create Class
3. Define Class using SQL Query
4. Select Field for Text String
5. Define Text Symbol
6. Set Placement Properties & Scale Range

The Good & Bad of Labels

The GOOD:
- Labels are a quick and easy way to add descriptive text to your map
- ArcMap dynamically generates and places text labels for you

The BAD:
- Label positions are generated automatically
- Labels are not selectable
- You cannot edit the display properties of individual values

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Graphic Text & Shape Elements

Graphic elements can be added to your map from the Draw toolbar.

- **Graphic tools**
  - Rectangle
  - Polygon
  - Circle
  - Ellipse
  - Line
  - Curve
  - Fill Land
  - Marker

- **Text tools**
  - New Text
  - Spined Text
  - Label
  - Callout
  - Polygon Text
  - Rectangle Text
  - Circle Text

Text and Graphic Elements

Selected text element

Selected graphic element

Element Properties
- Symbology
- Location
- Size & Position
Advanced Formatting

This is a line of text.

This is a formatted line of text.

Graphic Label Tool

Label Tool on the Draw Toolbar

The Label tool allows you to click on a map feature and automatically label it using the value for the layer’s label field.

The label will be symbolized based on the layer’s Label settings.

Labels function as graphics and can be edited individually.
Manipulating Graphics

Draw Toolbar

Graphics Toolbar

Right-click!

Geodatabase Annotation

Annotation are text elements that are stored as a feature class in a geodatabase

Each annotation element is a feature that has its own spatial (X,Y) location, text string and properties

This means they can each be edited independently of one another and can be used in multiple map documents
Two Types of Annotation

Geodatabase
- Annotation is stored as a special type of feature class inside a geodatabase
- All features in an annotation feature class will have their own text string, XY location and properties
- Standard or Feature-linked annotation: Standard annotation are pieces of geographically placed text that are not associated with other features in the geodatabase. Feature linked annotation* is directly linked to the features that are being annotated by a geodatabase relationship class.

Map Document
- Annotation stored within the Map Document (.mxd)
- Organized using annotation groups which can be created using the Draw Toolbar
- Useful if you have a relatively small amount of editable text and text that will be used in a single map.

*An ArcEditor or ArcInfo license is required to create and edit feature linked annotation.

Standard Geodatabase Annotation

Streets layer with three label classes

Standard annotation class will be added to TOC
Standard Geodatabase Annotation

Annotation features are edited using the Editor toolbar

Live Demo – Labels, Graphics and Annotation
Hands On Exercise

Labels, Text, Graphics and Annotation:

- Dynamic Labels
- Label Properties
- Graphic Shapes and Text
- Geodatabase Annotation

Questions?

Up next...Layouts!
Module 4: Map Production
Layouts & Cartographic Design

Learning Objectives

1) ArcMap Layouts
2) Map Templates
3) Cartographic Elements
4) Map Export and Dynamic PDFs
5) Map Packages
Layout View in ArcMap

Layout View is where you create and design a map for printing or export

Layout mode provides a “virtual” page for you to add content including Data Frames, titles and text boxes, legends, scale bar, images, graphs, etc.

The “virtual” page can be set up for standard page sizes to plotter size outputs

Layouts can be exported to various image formats as well as interactive Adobe PDFs

Layout Toolbar

Tools work on the Layout page they do not change the map scale!
Cartographic Components

What Makes a Good Map?

- Geographic data
- Title
- Legend
- Scale Bar
- North Arrow
- Context
- Images and Graphics
- Composition

Map Templates

A Map Template is a map document from which new documents can be created. They make it easy to reuse or standardize a layout on a series of maps.

Saved templates will be available under “My Templates”

C:\Users<user>\AppData\Roaming\ESRI\Desktop10.0\ArcMap\Templates
Map Templates

Templates are also available from the Layout Toolbar

Layout View – Adding Map Elements

Cartographic components can be added from the Insert dropdown menu in Layout View

- Title
- Text box
- Dynamic Text
- Legend
- North Arrow
- Scale Bar
- Pictures (images)
- Objects (graphs, etc)
Key Components – Title & Text

Text tools:
- Add Title (Insert menu)
- Add Text (Insert menu)
- Text tools (Draw toolbar)

Key Components - Legend

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Key Component – Scale Bar

Choose a style

Format Properties

Key Component – North Arrow

Choose a style

Format Properties
Other Cartographic Components

- Picture
- Data Frame
- Graphic & Text elements
- Neat Line

Modifying Elements

- Elements are selectable
- Easy to move, reshape and modify
- Double-click to open Properties
Exporting a Map

File > Export Map

.bmp
.jpg
.pdf
.png
.tif
.gif
.svg
.emf
.eps
.ai

Export to PDF

Save to PDF

Specify Advanced Options
Export to PDF – Analysis Tools

PDF Layers
Click on eye to turn on/off

Export to PDF – Analysis Tools

Geospatial Location Tool
Export to PDF – Analysis Tools

Measuring Tool

Object Data Tool
Map Packages

A Map Package file (.mpk) contains a Map Document (.mxd) and the data referenced by the layers it contains, packaged into one convenient, portable file.

Cartography Resources

ESRI Mapping Center  http://mappingcenter.esri.com/
  - Map examples
  - Downloadable styles, models & scripts
  - “Ask a Cartographer” FAQs
  - Blog

ColorBrewer2  http://colorbrewer2.org/
  - Web tool for selecting color schemes for thematic maps
  - Provides 35 schemes with CMYK, RGB, Hex, Lab and HSV specs

Forums and Blogs:
  Making Maps  http://makingmaps.net/
  Cartogrammer  http://www.cartogrammar.com/
  Cartography 2.0  http://cartography2.org/
Hands On Exercise

Cartographic Design – Layouts:
- Working in Layout View
- Working with multiple Data Frames
- Cartographic Components
- Adding Map Elements
- Exporting to PDF
- Map Packages

Questions?

Up next... Layouts!
Module 4: Map Production

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Data Driven Pages

Data Driven Pages allow you to quickly create a series of layouts of pages from a single map document.

An Index Layer divides the map into sections based on each index feature and generates one page per index features
Data Driven Pages

Data Driven Pages Setup

Setup Window

Required Elements for DDP:
- Data Frame
- Index Layer
- Name Field
- Sort Field

Data Driven Pages Toolbar
Navigating Data Driven Pages

Dynamic Text

Exporting Data Driven Pages

Export to PDF Options
Questions?

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Module 5 – Data Manipulation

Georeferencing

Assigning coordinates from a known reference system, such as latitude/longitude, UTM, or State Plane, to a raster (image) or a planar map.

Georeferencing raster data allows it to be viewed, queried, and analyzed with other geographic data.
Why Georeference?

Data Source
Raster Data

Problem
No spatial reference information

Inadequate spatial reference information

Result
Raster data doesn’t line up with other GIS data

Solution
Georeference!

Reference Data

- Required to georeference.
- Source can be GPS points or good GIS data where features can be seen in both the raster and the reference.
- The reference should cover the entire area of the image to be georeferenced.
- Georeferenced data is only as accurate as the data to which it is aligned (if the reference stinks, so will the georeferenced image!).
Terminology

**Georeferencing:** The process of assigning map coordinates to image data (grid of the image does not change)

**Registration:** The process of making an image conform to another image (a map coordinate system is not necessarily involved)

**Rectification:** The process of transforming the data from one grid system into another grid system using geometric transformation

- Involves georeferencing because map projections are associated with map coordinates.
- Because the pixels of the new grid may not align with the pixels of the original grid, the pixels must be resampled.

**Orthorectification:** A form of rectification that corrects for terrain displacement and can be used if there is a DEM of the study area

Process

- **On the reference**, identify a series of **ground control points (GCPs)** with known coordinates
- **Link** the locations of these points to the un-rectified raster
- **Control points** are used to build a **polynomial transformation** that will convert the raster dataset from its existing location to the spatially correct location
First Order Transformations

Translation is a simple displacement (shift) of the entire map by a certain offset distance along one or both axes.

Scaling is a simple multiplication of the X and Y units by some constant.
- For example, maps having the same projection but different units (meters vs. feet).

Rotation
- Rarely required when dealing with data in known coordinate systems.
- Almost always necessary when georeferencing a scanned map.

The plane is moved as a unit but the plane itself does not change.

Higher Order Transformations

Polynomial Transformation (2nd order, 3rd order).
Transforms straight lines into curved ones.
The higher order of the polynomial, the more curvy the result.
Requires resampling.
Step 1: Add Data

Turn on Georeferencing Toolbar

Add the image to be georeferenced

• Study the area covered

Add reference data and zoom to layer

---

Step 1: Add Data

Zoom to general area

Fit image to display
Step 2: Roughly Line Up Datasets

Zoom and Fit to Display

- If SMALLER, zoom Out and Fit to Display
- If LARGER, zoom In and Fit to Display

Scale, Rotate, and Shift until lined up

Slide Note: Helpful Viewing Tools

Magnifier Window
Slide Note: Helpful Viewing Tools

Layer Transparency
Turn on Effects Toolbar
Choose layer and user slider to change transparency

Ground Control Points (GCPs)

- GCPs define the transformation equation.
- More is not always better.
- Should be spread across the image and as close to each corner as possible.
- Choose points that don’t change such as road intersections.
- Avoid water and vegetative features that change over time.
- Need at least 3 points for 1st order and 6 points for 2nd order transformations.
Step 3: Add Control Points

Zoom so you can see the desired point on the raster and reference

Click Add Control Points button

It is possible to have the reference layer off, click the raster, turn the reference on (click checkbox) and then click the point on the reference.

Step 4: Evaluation

Look at GCPs in Links Table

Residual Error
- Compares the actual location of the map coordinate to the transformed position in the raster. Residual error is this distance.

Total RMS Error
- Computed by taking the root mean square (RMS) sum of all the residuals.
- Describes how consistent the transformation is between the different control points.
Step 4: Evaluation

Compare transformations

1\textsuperscript{st} order if the raster dataset needs to be stretched, scaled and rotated

2\textsuperscript{nd} order if the raster dataset needs to be bent or curved

Step 5: Iterations

If points have too high a residual or the line on the image is too long (indicates image and reference parts are far apart), remove

Add more points

Continue to evaluate and edit
**Step 6: Acceptance**

**Georeference**
- Saves the transformation information with the raster dataset.
- Creates a new file with the same name as the raster dataset, but with an .aux file extension. It also creates a world file for .tif and .img files.

**Rectify**
- Permanently transforms the raster dataset after georeferencing.
- Creates a new raster dataset that is georeferenced to map coordinates. Can save this in GRID, TIFF, or IMAGINE format.

**Why Rectify?**
- ArcMap doesn’t require rectification to display raster with other spatial data.
- Rectify if you want to use the image with another software package that doesn’t recognize the external georeferencing information created by ArcMap.

---

**The Result**

**Data that lines up!**
Module 5: Data Manipulation
Introduction to Digitizing and Editing

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Learning Objectives

1) What is Digitizing and Editing?
2) Basics of creating points, lines, polygons
3) The ArcGIS editor interface
4) The edit session work flow
5) Tools and Tips
6) A few advanced concepts (tip of iceberg)

Disclaimer: This module will not make you an expert
What is Digitizing?

**Digitizing** - the process of converting information into a digital format

**Digitizing in GIS** - the process of converting geographic data either from a hardcopy or a scanned image into digital data (vector or raster)

---

**Hard-copy digitizing**

- uses a special table surface with a system for converting positions on its surface into digital x,y coordinates in the computer

**Heads up digitizing**

- draw identifiable features using the mouse or other input device (i.e. pen tablet) directly over orthophotographs, satellite imagery, or scanned maps

**Automated Tools**

- analyze pixels from imagery and attempt to create vector
- has improved considerably over the years
- often require a lot of post editing (clean up)
Digitizing Features - Points

**Points**

- Simplest form of editing
- Left click on a location to add a point
- Points can also be added by typing the coordinates

Digitizing Features - Lines

**Lines**

- Have a start and end point
- Vertices in between
- Feature construction tools are activated when creating lines
Digitizing Features - Polygons

Polygons

- Include the same tools for line features, plus
  - closure, overlap, cutting, shapes, and advanced auto-complete operations
- Multiple tools are available while editing

Editing in ArcGIS – Workflow

Add data to ArcMap and set up mxd → 1. Turn on Editor toolbar → 2. Start an edit session → 3. Choose a workspace to edit → 4. Choose a feature template and construction tool from the Create Features window → 5. Set up additional editing properties or options, such as snapping → 6. Create a new feature → 7. Add or edit attributes for the feature → 8...Repeat

Save Edits → Stop Editing
Editing

1. Turn on the Editor toolbar
2. Start Editing
3. Choose a workspace to edit

A “pencil” indicates they are part of the same editable folder.

Editing

4. Choose a feature template and construction tool from the Create Features window

- A Feature Template defines all the information required to create a feature:
  - the layer where a feature will be stored
  - the attributes a feature is created with
  - the default tool used to create that feature
- If a template is not present when editing starts, one is created for each layer in the current editing workspace
- Templates are saved in the map document (.mxd) and the layer file (.lyr)
Editing

4. Choose a feature template and construction tool from the Create Features window.

5. Set up additional editing properties or options, such as snapping.
   - A depressed button means that option is enabled.
   - When within the snapping distance, the mouse changes to show the type of snap and the layer.
Digitizing - Points

6. Create a new feature
- Left-click on the location
- Right-click for options

Digitizing - Lines

6. Create a new feature
- Left-Click to add a point to start
- Left-click to add each vertex
- Double-Click to end a line segment
Digitizing – Polygons

6. Create a new feature
- Left-Click to add a point to start
- Left-click to add each vertex
- Double-Click to close a polygon

Digitizing – Feature Construction

• The Feature Construction mini toolbar may follow you around
• Provides advanced options (parallel, perpendicular, etc.)
• Press TAB to make it visible, TAB again to turn it off
**Tips During Digitizing**

- **Use the Scroll wheel WHILE digitizing**
  - Scroll down = zoom in
  - Scroll up = zoom out
  - Hold scroll wheel = pan
- **Pin or Un-pin windows**
- **You are only working on a SKETCH until you save edits**
- **Press the space bar to temporarily disable snapping**
- **Set the polygon symbology so that the fill is see-through (transparent, hatched)**

**Editing Attributes**

- **Edit the attributes during an edit session**
- **First select a feature or features**
- **Enter attribute information**
- **The attribute table can also be edited**
Editing Attributes

- If geodatabase subtypes have been set up, there will be a pick list

- Advantages – faster editing, less error

Editing – Saving

- Save Edits as you go
- Edits cannot be undone (make backup copies)
- When finished, Stop Editing
Editing – Advanced Concepts

- Shortcuts (Function Keys, etc.)
- Copy/Paste from other layers
- Magnifier, Viewer Windows
- Edit Sketch Properties
- Feature Templates
- Construction Methods (cutting, reshape, trace...)
- Construction Tools (auto-complete polygon, circles...)
- Advanced Editing Toolbar
- Topology
- Coordinate Geometry
- Parcel Editor
- Editing Annotation, and more...

Editing in ArcGIS – Workflow

1. Turn on Editor toolbar
2. Start an edit session
3. Choose a workspace to edit
4. Choose a feature template and construction tool from the Create Features window
5. Set up additional editing properties or options, such as snapping
6. Create a new feature
7. Add or edit attributes for the feature
8. Save Edits

Stop Editing
Questions?

Hands on Exercise: Digitizing

- Prepare for editing
- Start an edit session
- Set up snapping
- Digitize points (pools), lines (roads and driveways), polygons (roofs)
- Edit vertices
- Add attribute data
- Cut a polygon (add new parcels to town layer)
Module 5: Data Manipulation

ArcToolbox

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Module 5: Data Manipulation

- Digitizing
  - Digitizing Exercise
- ArcToolbox
  - ArcToolbox Geoprocessing Exercise
Outline

- **ArcToolbox**
- **Analysis Tools**
  - Extract Toolbox > Clip Tool
  - Proximity Toolbox > Buffer Tool
  - Overlay Toolbox > Union Tool
  - Spatial Join Tool
  - Intersect Tool

- **Data Management Tools**
  - Generalization Toolbox > Dissolve Tool

**ArcToolbox**

Tools to perform various types of spatial analyses are accessed through Toolbox.

ArcToolbox can be opened from both ArcCatalog and ArcMap.

REMEMBER
Basic license has fewer tools than advanced license.
Introduction to GIS – Presentation Slides

**Geoprocessing Menu**

- Open ArcToolbox
- Search
- Settings that influence tools and outputs

**Tools**

- Each tool does a specific process.
- Usually several tools are necessary to complete an analysis.
- It is helpful to first know what you want in the end and then to think about which combination of tools will get you there.
- Most tools create a NEW output file
Clip

Extracts input features that overlay the clip features.

Use clip to cut out a piece of one feature class using one or more of the features in another feature class as a “cookie cutter.” This is particularly useful for creating a new feature class that contains a geographic subset of the features in another, larger feature class.

Data that will be clipped

The “cookie cutter”

New dataset
Clip – Recalculate Area

After running Clip, most area measurements will have to be recalculated.

Use Calculate Geometry (inside the table).

Recalculating Area and Length Values

Polygon feature classes in a geodatabase have two fields that are maintained by ArcMap – Shape_Length and Shape_Area. These fields store the area and perimeter in map units of all polygon features and automatically are updated whenever feature geometry changes.

Line feature classes in a geodatabase have just a Shape_Length field that stores the length in map units of each line feature and automatically is updated.
**Buffer Tool**

- **Buffer**: a zone of specified distance around a feature or set of features. Buffers are used for proximity analysis.

- **Examples**
  - Which streams are located within 500’ of a road?
  - How many homes are within 20 miles of a nuclear power plant?
  - What is the zoning within 300 meters of a limited access highway?

---

**Buffer with Dissolve Option**

- **Input Data**
- **Output Data**
- **Distance and Units**
- **Dissolve?**

Overlap areas are joined together

Selected Points
Buffer without Dissolve Option

Same inputs as previous slide.

Output includes overlapping polygons.

Buffer Using Field Option

Buffer width based on Setback Attribute.
Union

Overlays two or more polygon datasets and combines all features into a new dataset. Attributes from all inputs are preserved in the output.

Select Input Feature
Must have two or more input layers

Output Feature
Minimum distance between vertices

Tolerance units for min distance between vertices

Union output contains attributes from all inputs
**Intersect**

Overlays two datasets and combines the areas/features common to both into a new dataset. Attributes from both input datasets are preserved in the output dataset. Input form same as for Union.

**Spatial Join**

A Spatial Join appends the attributes of a layer to a target layer based on spatial relationships that you specify and creates a new layer.
Spatial Join

Join now contains attributes from the point dataset and the underlying polygon of the surficial materials layer.

A point-to-point spatial join will join the data from the closest point. EXAMPLE: Join the wastewater discharge sites to wells.

Dissolve

The Dissolve Tool removes boundaries between adjacent polygons when the attribute value is the same on both sides. Dissolve can be used to generalize data - to create larger features from a collection of smaller features.
Dissolve

Selecting Dissolve Field(s) lets you determine what field(s) are dissolved on and saved to the output file.

Choose 1 or more dissolve fields

Specify Summary fields and statistic type

Exercise Overview: Answer Questions

For a Marlborough Subdivision:

How much of the subdivision as a whole is covered by wetlands?

How many parcels in the subdivision have wetlands?

What percentage of each parcel in the subdivision is covered by wetlands?

How many parcels have more than 50% wetlands?

How many buildings are partially or fully inside the 100 foot buffer zone?
Exercise Overview

- **Clip** the Marlborough soils data by the subdivision boundary.
- **Dissolve** the soils so that the wetland soils all belong to one class. In Connecticut, wetlands are determined solely by soil type.
- **Export** the wetland polygons to a new layer. This is one way to get rid of the non-wetland areas.

Exercise Overview

- **Buffer** the wetlands to create and determine the 100 foot buffer zone.
- **Use the Union tool** with wetlands and parcels in order to determine how much of each parcel is covered by wetlands. This requires several table functions also.
- **Use the Intersect tool** to determine how many buildings are partially or fully inside the 100 foot buffer zone.
To Review

- Accessing ArcToolbox
- Geoprocessing menu
- Customizing ArcToolbox
- Clip Tool and recalculate area
- Buffer Tool
  - With dissolve
  - Without dissolve
  - Field option for multiple widths
  - Multiple ring
- Union Tool
- Intersect Tool
- Spatial Join
- Dissolve
- Exercise Overview

Tools – Q & A
Module 6 – Lightning Talks

LT – Working with XY Data

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Talking Points

1) What is “XY” Data
2) Data sources and formats
3) Using the Add XY Tool in ArcMap
4) XY Event Layers
What is XY Data?

XY Data is location data stored in a table or text file which can be imported to ArcMap and displayed geographically using the XY coordinates stored in the file.

Comma Separated Values (CSV) text file

<table>
<thead>
<tr>
<th>Lat</th>
<th>Long</th>
<th>Descrip</th>
<th>Discarded</th>
</tr>
</thead>
<tbody>
<tr>
<td>41.634845592931</td>
<td>-72.4576685780788</td>
<td>Encampment 1952</td>
<td></td>
</tr>
<tr>
<td>41.60838021549477</td>
<td>-72.438013148194</td>
<td>Established village site, 1986</td>
<td></td>
</tr>
<tr>
<td>41.6278645027156</td>
<td>-72.4245676662333</td>
<td>Encampment, 1924</td>
<td></td>
</tr>
<tr>
<td>41.6278645027156</td>
<td>-72.4245676662333</td>
<td>Encampment, 1924</td>
<td></td>
</tr>
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<tr>
<td>41.6278645027156</td>
<td>-72.4245676662333</td>
<td>Encampment, 1924</td>
<td></td>
</tr>
</tbody>
</table>

Excel Table

<table>
<thead>
<tr>
<th>Lat</th>
<th>Long</th>
<th>Desc</th>
</tr>
</thead>
<tbody>
<tr>
<td>41</td>
<td>634845592931</td>
<td>Encampment 1952</td>
</tr>
<tr>
<td>41</td>
<td>60838021549477</td>
<td>Established village site, 1986</td>
</tr>
<tr>
<td>41</td>
<td>6278645027156</td>
<td>Encampment, 1924</td>
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</tr>
<tr>
<td>41</td>
<td>6278645027156</td>
<td>Encampment, 1924</td>
</tr>
</tbody>
</table>

Source Data

- Comma or tab delimited text files, Excel files or .dbf tables
- Other delimiters can be set up through ArcMap properties
- First line must contain field names
- Field names should not contain dashes, spaces or brackets
- Following rows should contain feature coordinate and attribute values
**Add XY Data in ArcMap**

1. **File > Add Data > Add XY Data**

   - **Source data**
   - **Coordinate Fields**
   - **Coordinate System**

---

**XY Event Layer**

- An XY Event layer references the original data source.

---

- **Table has no Object ID Field**
- OIDs are necessary to perform certain functions like querying, selecting, and editing features.
- To create an OID field, you must export the Event Layer to a new shapefile or feature class.
Questions?
Module 6 – Lightning Talks

LT – Metadata

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Talking Points

1) What is Metadata and why is it important?
2) Viewing Metadata
3) Writing Metadata
Metadata Overview

Metadata is the component of data that describes its contents.

Three components of GIS Data

- Spatial
- Metadata
- Non-spatial or attributes

How do we know the details?

<table>
<thead>
<tr>
<th>Date</th>
<th>Latitude</th>
<th>Longitude</th>
<th>Chlor</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/22/2011</td>
<td>32.677</td>
<td>-117.896</td>
<td>210</td>
</tr>
</tbody>
</table>

Chlor (chlorophyll a concentration) measured in ug/L

Latitudes and longitudes were collected using a Trimble...

Why Bother with Metadata?

- Provides a standardized way to document data and avoid loss of information when key people leave an organization
- Provides information to help determine the data’s suitability for a particular use
- Provides detailed information about the overall dataset and about the attributes for features
- Provides a basis for searching for geospatial data either based on geography or content
Examples of Metadata

What’s In Metadata?

- Map Scale
- Projection
- Coordinate System
- Geographic extent
- Symbolization
- Publication Date
- Completeness
- Documentation
- Resolution
- Accuracy
- QA/QC Standards
- Author

Map collar of USGS Topo.
Metadata in ArcGIS

Editing Metadata in ArcCatalog

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Questions?
Learning Objectives

1) Better understanding of KML files and their use
2) Converting to and from KML (KMZ) format
3) Tips for conversion
KML Files – Used For??

KML: KML stands for Keyhole Markup Language. Before Google Earth - there was Keyhole.

The KML has become a primary open source format for displaying geographic data in mapping programs and “3d” mapping environments.

What is a KML?

KMLs are text based files that follow XML (eXtensible Mark-up Language) format rules. If they follow the rules, various computer programs can then process the data.

Google Earth, Google Maps, ArcGIS Explorer, ArcGlobe, etc. will read KML files.
How to make a KML

You can create KMLs:
- from scratch using a text editor
- with software to convert your existing data
- export from Google Earth or Google Maps
- GPS apps often use/save to KML

ArcMap has several built-in tools for converting your data to and from the KML (or KMZ) format.

What is KMZ? KMZ files are zipped KML files, basically to help reduce the size for transport over the internet. You don’t need to do this, but if you were to change the *.KMZ extension to *.ZIP you could then unpack the file directly with software like WinZip. The result would be one (or more) KML files.

ArcMap KML Tools

ArcMap has several built-in tools for converting your data to and from the KML (or KMZ) format. Earlier versions of Arc relied on scripts you could download.

ArcGlobe can read KML/KMZ files directly. ArcMap requires Conversion tools. The KML Tools are:
- From KML – KML to Layer
- To KML – Layer to KML and Map to KML
Conversion Tips: KML

- Avoid converting large vector files
- Make a selection and export to a temporary feature
- Set the feature layer colors for intended goal
- Reduce the fields to only those you want to show
- Experiment with various layer types (pt, line, poly)

Questions?
Module 6 – Lightning Talks

LT – ArcGIS Online

Geospatial Technologies at Work: An Introduction to GIS
Brought to you by the Geospatial Training Program
UConn CLEAR

Talking Points

1) What is ArcGIS Online
2) ArcGIS Accounts - Free and Paid
3) ArcGIS Online
   1) Search for data
   2) Upload your data
   3) Make a web map
   4) Share a web map
What is ArcGIS Online

ArcGIS Online is Esri’s cloud based solution for GIS. Includes tools for uploading data, creating new data, making custom web maps, sharing maps and data and creating web applications.

Esri launches ArcGIS.com in 2010
• Many revisions. Quarterly updates.
• Free Public Accounts (limited, non-commercial use only)
• ArcGIS Online for Organizations launched June 2012

AGOL Accounts
- Free “Public” Accounts for not for profit work
- Subscription based “Organization” accounts
  - “free” if you are up to date on desktop license & maintenance agreement
  - $2500/yr for 5 user accounts
  - More tools, additional functions, personalized website
  - Advanced functions cost “credits”
GIS in the Cloud

Desktop GIS

Data

Analysis

Tools

AGOL Maps and Applications

Themes, Pascack and Southeast Coast Major Bank-Stream Flow Classifications

Web GIS

"Apps"

Interactive Maps

Collaboration

Data

Tools

Sharing
**AGOL Story Maps**

http://clear.uconn.edu/storymaps

https://storymaps.arcgis.com

---

**The AGOL Map Viewer**

Details: view layers & legend

Add layers to map

Change the basemap

Measure features

Bookmark

Zoom tools

Driving directions / find address or place

Make your own map

Home > My Map

save / share / print

Find address or place

View layers & legend

About this map

Contents of map

Legends

Add more to your map.

Add map notes to share features on the map.

Display description text, images, and links for easy reference at a pop-up.

Save and share your map.

Give your map a name and description then share it with other people.
Introduction to GIS – Presentation Slides

**Basemap Options & Add Data**

*Select a basemap*

- Imagery
- Imagery with Streets
- Topographic
- Terrain with Lakes
- Light Gray Imagery
- National Geodetic Vertical Datum of 1988

- Search ArcGIS Online
- Add Existing Layers
- Add a Map Service from URL
- Add a spatial dataset from your local computer
- Create a graphic layer on your map

**Adding CT ECO Map Services**

cتكوapp2.uconn.edu
- Vector map services
cتكوapp3.uconn.edu
- Image services
Adding Shapefiles

Add Layer from File

- Zipped shapefile
- Delimited text file (csv or txt)
- GPS file (gpx)

1000 feature limit!

Adding Map Notes & Pop Ups
Questions?
Wrap Up & Review

Geospatial Technologies at Work: An Introduction to GIS
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Revisiting Our Learning Objectives

1) Understand basic GIS concepts
2) Learn how to visualize geographic data
3) Master the basics of attribute tables and map features
4) Learn how to create maps for publishing
5) Learn how to use GIS to answer questions
We Covered a LOT of Ground!

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Follow Up Email

- GISeD10 data folder download
- Link to free 60 day ArcGIS software
- Info about the CT GIS User Network and Listserv
- Course survey

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## Thank You, Happy Mapping!

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