Chapter 8 – GIS Training and Education

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Enterprise-wide Training on Three Tiers of Geographic Information Systems (GIS)

Training will be an integral part of Spotsylvania County’s GIS implementation strategy. Tier 1 users (i.e., staff members responsible for the creation/maintenance of GIS databases in the ArcGIS 9 environment) should take the weeklong ArcGIS class (*ArcGIS I* and *ArcGIS II*). The *ArcGIS classes teach functionality for ArcInfo 9, ArcEditor 9, and ArcView 9. *ArcGIS I classes can be provided on-site by ESRI or ESRI Authorized Instructors. The *ArcGIS II class is currently only available through ESRI, onsite or at ESRI offices.

Tier 2 users (ArcView 9) should be provided, at a minimum, with the two-day *ArcGIS I* training class. This will include an introduction to the base functionality of the software, from data management to desktop level analysis. Students can either travel to an ESRI office for this training, or hire an ESRI Authorized Instructor to teach *ArcGIS I* on-site (recommended – more cost efficient).

Tier 3 users will receive customized training sessions on each individual application that is developed. These applications are very intuitive and user-friendly. One to two hours of training on each application will be sufficient. This training can be performed either on or off-site.

Training Classes

Introduction to ArcGIS I – for ArcView 9, ArcEditor 9, and ArcInfo 9 (two days)

Overview

This two-day course introduces participants to ArcGIS and provides the foundation for becoming a successful ArcView, ArcEditor, or ArcInfo user. Participants learn how to use ArcMap, ArcCatalog, and ArcToolbox and explore how these applications work together to provide a complete GIS software solution. The course covers fundamental GIS concepts as well as how to create, edit, and work with georeferenced spatial data. Participants learn how to manipulate tabular data, query a GIS database, and present data clearly and efficiently using maps and charts.

Audience

This course is for those who are new to ArcGIS or to geographic information systems in general.
Goals

• Display feature and tabular data
• Work with georeferenced spatial data
• Query features using logical expressions
• Find features using spatial relationships
• Edit spatial and attribute data
• Associate tables with joins and relates
• Produce maps, reports, and graphs

Topics covered

• ArcGIS overview: Capabilities and applications; Interacting with the interface; Basic display
• Spatial data concepts: Representing spatial data and descriptive information
• ArcGIS data model: Geodatabases; Shapefiles; Coverages; Feature types; Attributes
• GIS software: Components; Functions; Applications
• Spatial coordinate systems and map projections: Georeferencing data; What map projections are; How ArcMap works with map projections
• Querying data: Selecting and identifying features; Creating reports and graphs
• Map displays: Creating; Symbolizing; Scaling; Adding map elements

Prerequisites and recommendations

Participants should know how to use windowing software. This course provides the fundamental ArcGIS knowledge and experience needed to enroll in Introduction to ArcGIS II (for ArcView 9, ArcEditor 9, and ArcInfo 9) as well as several other ESRI courses. Many of the topics covered in this course are similar to those in Migrating from ArcView 3.x to ArcView 9. Participants who complete this course should not enroll in Migrating from ArcView 3.x to ArcView 9. Participants who have worked with prior versions of ArcView and want to learn about ArcView 9 applications should take Migrating from ArcView 3.x to ArcView 9.

Introduction to ArcGIS II – for ArcView 9, ArcEditor 9, and ArcInfo 9 (three days)

Overview

This three-day course follows Introduction to ArcGIS I (for ArcView 9, ArcEditor 9, and ArcInfo 9) and continues to present important concepts and functionality for successfully working with ArcGIS. With further exploration of ArcMap, ArcCatalog, and ArcToolbox, participants focus on spatial analysis, automation of spatial and attribute data, editing, and advanced options for cartographic display and reports. Hands-on exercises teach ArcGIS procedures in the context of solving real-world problems. Examples and exercises use data from a variety of application areas. A portion of the class is reserved for carrying out an analysis project and applying many of the new skills and techniques learned in this course. Participants conduct queries, perform spatial analysis, and present their results in a hard-copy map and report.
Audience
This course is designed for those with fundamental knowledge of ArcGIS and geographic information systems in general.

Goals
- Perform spatial analysis
- Manage geographic data
- Perform geocoding
- Automate data through heads-up digitizing
- Convert data from other formats
- Edit spatial and attribute data
- Create and use metadata
- Produce high-quality maps and reports

Topics covered
- Spatial analysis and data management: Buffers; Spatial overlays; Extracting features for analysis; Analytical methods and tools
- Geocoding and display of locations from tabular data: Address geocoding; Display of points from x,y coordinates
- Editing: Tools for creating and editing spatial data; Editing attribute data; Spatial adjustment
- Data automation: Data sources; Digitizing; Data conversion
- Project management: Database organization; File and directory naming conventions; Creating and using metadata
- Cartography: Advanced symbology and labeling

Prerequisites and recommendations
This course is for those who have completed Introduction to ArcGIS I (for ArcView 9, ArcEditor 9, and ArcInfo 9) or Migrating from ArcView 3.x to ArcView 9 (instructor-led or Web-based course). If one of the prerequisite courses is not completed, a participant should have comparable experience with ArcGIS before taking this course. The course also provides participants with the fundamental ArcGIS knowledge and experience needed to enroll in Building Geodatabases I (for ArcEditor 9 and ArcInfo 9).

Building Geodatabases I (three days)
Overview
This three-day course details the capabilities of the geodatabase and how to migrate existing data to build a geodatabase for ArcGIS 9. Participants learn how to create, use, edit, and manage spatial and attribute data stored in the geodatabase. Discussion topics include loading data into the geodatabase; defining appropriate topology rules; and maintaining data integrity through subtypes, attribute domains, and relationship classes. Instruction will be given on loading existing data from coverages, shapefiles, and computer-aided design (CAD) formats to create new point, line, polygon, and annotation feature classes.

Audience
This course is for spatial data managers who have a basic understanding of ArcGIS desktop applications and are ready to use the geodatabase. New and existing data managers waiting to migrate to the geodatabase will benefit from this course.

Goals
- Load data into the geodatabase from a variety of formats
• Set spatial reference and spatial domain
• Build a topology in the geodatabase
• Apply the appropriate topological rules for data
• Use the appropriate attribute rules for data with subtypes and domains
• Edit topological data
• Generate relationship classes
• Create and use rules for relationship classes and attribute data entry
• Produce and edit annotation

Topics covered
• Introduction to the geodatabase: Data storage options; Geodatabase structures and permissions; Enterprise vs. personal geodatabase; Geodatabase tables in a database management system (DBMS)
• Building a geodatabase: Designing the geodatabase; Defining its structure; Creating a new schema; Loading data from shapefiles, CAD files, and coverage point, line, polygon, region, and annotation features
• Understanding spatial domain: Precision vs. accuracy; Geodatabase coordinate storage
• Geodatabase topology: Topology management in the geodatabase; Building a topology; Setting the properties of a topology; Setting appropriate topological rules; Fixing topological errors; Editing topological data
• Relationship classes: Creating relationship classes; Setting relationship class properties; Using relationships in ArcMap; Relationship rules; Validation; Simple vs. composite relationships
• Attribute validation rules: Subtypes and domains; Creating subtypes; Editing subtypes in ArcMap; Creating domains; Editing with domains in ArcMap; Coded value vs. range domains; Subtypes and relationship rules

Prerequisites and recommendations
Prior knowledge of the geodatabase is not required; however, participants should complete Introduction to ArcGIS I and II (for ArcView 9, ArcEditor 9, and ArcInfo 9), or What's New in ArcInfo 9 (previously offered instructor-led course or currently available Web-based course), or have equivalent knowledge. Participants should not take this course if they have completed the previously offered course, Creating and Managing Geodatabases (for ArcEditor 9 and ArcInfo 9).

Building Geodatabases II (two days)
Overview
This new two-day course extends the content of Building Geodatabases I (for ArcEditor 9 and ArcInfo 9) by discussing the advanced capabilities for modeling and working with linear features in the geodatabase. Discussion topics include creating, editing, and performing analyses on geometric networks; managing linear referenced data for displaying data that occurs along linear features; and migrating coverage arcs, routes, and events to the geodatabase.

Audience
This course is for spatial data managers who work with linear features and are ready to take advantage of the geometric network and linear referencing capabilities of the geodatabase.

Goals
• Build and perform analyses on geometric networks
Set rules for editing and analyzing on geometric networks
Build route systems in the geodatabase
Edit route systems
Dynamically locate events on route systems

Topics covered
Geometric networks: Storing a network; Simple vs. complex network features; Logical network; Flow on a geometric network; Performing network analysis; Network weights; Restricting the area of a trace; Complex edges; Building a geometric network; Setting network rules; Validating connectivity rules
Linear referencing: Linear referencing basics; Creating routes; Storing routes in the geodatabase; Hatching routes; Rules for editing routes; Tools for editing routes; Displaying route anomalies; Reroute events; Advanced route events options; Transforming events

Prerequisites and recommendations
Participants should complete Building Geodatabases I (for ArcEditor 9 and ArcInfo 9) or have equivalent knowledge.

ArcSDE Administration for SQL Server (5 days)
Overview
This five-day course prepares Microsoft SQL Server™ database administrators for implementing ArcSDE by building their own individual ArcSDE servers. Participants learn how to configure SQL Server to support ArcSDE, install and configure ArcSDE, load vector and raster data, monitor and optimize queries, and manage a multiversioned geodatabase. Topics from Introduction to ArcSDE using ArcInfo 8 are included in this course; participants do not need to attend that class first.

Throughout the class, effective methods for planning and managing storage, memory, and I/O are emphasized. Participants learn to monitor access to their ArcSDE database by using ArcSDE and DBMS tools. Based on these results, a discussion follows on the guidelines to adjust resource allocation as database usage changes. Management of ArcSDE for access from ArcInfo clients, including multiversioned viewing and editing, is highlighted, while managing ArcInfo geodatabases on an ArcSDE system is covered in detail. The course focuses on understanding how ArcSDE software interacts with SQL Server and proposes solid strategies for maintaining an enterprise GIS database.

Audience
This course is for experienced SQL Server database administrators who need to manage ArcSDE databases and clients. Participants should have at least six months prior experience working with Microsoft SQL Server.

Goals
Configure SQL Server to support ArcSDE
Install and configure ArcSDE
Create vector feature classes and raster datasets
Configure, create, and monitor application server, direct, and OLE DB connections
Customize storage for ArcSDE vector and raster data
Monitor and optimize query access
Manage a multiversioned geodatabase
**Topics covered**

- ArcSDE installation: Evaluating the SQL Server configuration; Preparing SQL Server to use ArcSDE; Installing ArcSDE; Starting and stopping the ArcSDE server; Exploring ArcSDE system tables; Configuring ArcSDE and SQL Server on separate hosts
- Data loading: Creating storage space; Creating users and assigning privileges; Calculating a spatial domain; Creating vector feature classes from coverages and shapefiles; Creating raster datasets from image files; Building raster catalogs and mosaics; Estimating storage needs; Examining feature class components; Customizing storage with the DBTUNE table
- Monitoring data access: Creating application server, direct, and OLE DB connections; Monitoring connections with ArcSDE and SQL Server tools; Tracing client queries; Reporting system I/O
- Optimizing data access: Analyzing spatial index performance; Creating a group layer; Creating a spatial view; Working with overview and magnify windows, raster wire frames, scale-dependent layers, and thumbnails
- Managing a multiversioned geodatabase: Registering feature classes as versioned; Choosing version privileges; Reconciling and posting changes between versions; Compressing the state tree; Monitoring changes to the adds, deletes, and system tables

**Prerequisites and recommendations**

Participants in this course should have experience with the following:

- SQL Server database administration or application development
- Administering a Windows operating system
- Managing database storage
- Creating SQL Server users and assigning their privileges
- Designing tables, indexes, constraints, and triggers
- Using spatial and tabular data from a GIS application
- SQL

**Introduction to ArcIMS (three days)**

**Overview**

This three-day course introduces participants to ArcIMS—an integrated approach for creating and maintaining geography-based Web sites. ArcIMS offers powerful capabilities in an easy-to-use framework, changing the way users can access and interact with Internet mapping and GIS data. Class participants gain hands-on experience using ArcIMS to build, utilize, and customize Internet mapping applications. This course also empowers participants with a conceptual overview of how GIS mapping works on the Internet.

**Audience**

This course is for those who are new to ArcIMS and want to learn how to use ArcIMS to create and serve maps on the Internet.

**Goals**

- Author and design ArcIMS Viewers
- Utilize client functionality
- Introduce site administration
- Understand ArcXML structure
- Customize ArcIMS Viewers
- Install ArcIMS and explore its architecture
Topics covered

- ArcIMS overview: What is ArcIMS?; Introducing multitier architecture; Creating an ArcIMS Viewer; Using ArcIMS Manager Applications
- ArcIMS Author: Adding layers with Catalog; Supported data formats; Setting layer properties; Scale factors; Labeling; Rendering; Geocoding properties; Stored queries; Saving map configuration files
- Designing ArcIMS Viewers: Creating ArcIMS Services; Using ArcIMS Designer; ArcIMS Viewer output
- ArcIMS Viewers: HTML Viewer; Java Standard Viewer; Java Custom Viewer; ArcExplorer—Java Edition; Client tools
- ArcIMS Administrator: ArcIMS Spatial Servers; Virtual Servers; Instances; Refreshing ArcIMS Services; Site properties and configuration; Introducing ArcMap Server, Metadata Server, and Route Server
- Collaborative tools: Adding layers; Changing layer properties; Viewer configuration files; MapNotes and EditNotes; Using Geography Network
- Understanding ArcXML: What is XML?; HTML vs. XML; ArcXML syntax; Map configuration files; Requests and responses; ArcXML Programmer's Reference Guide; Customizing map display using ArcXML
- ArcIMS Viewer customization: File structure; Frame layout; Customizing the interface (colors, titles, toolbars); Generic browser and user options; Editing ArcIMSParam.js; Using JavaScript™ with ArcIMS; Introducing the Java Viewer Object Model
- ArcIMS architecture and installation: ArcIMS components; Web servers; Servlets; ArcIMS Application Server and connectors; Configuring ArcIMS; ArcIMS installation process

Prerequisites and recommendations

Although prior use of ArcGIS, ArcView, ArcInfo, or MapObjects is helpful in understanding GIS concepts, it is not a requirement. Similarly, those with an understanding of Internet programming and Web-based protocols have an advantage; however, experience with these is not required.

**ArcIMS Administration (two days)**

**Overview**

This two-day course teaches ArcIMS server administrators the things that make big differences in ArcGIS server performance, security, and reliability. Participants learn how to tune their ArcIMS Services, set up a secure server, apply hardware sizing considerations, perform distributed installations, and work with ArcSDE databases. Throughout the class, effective methods for planning and managing ArcIMS in an enterprise network environment are emphasized. Participants learn how to deploy ArcIMS to make their site a success. Participants also learn important networking skills and the knowledge needed to operate and maintain an ArcIMS server. A review of security strategies is supported with indepth discussions of ArcIMS interprocess communication necessary for firewall configuration. Hands-on exercises teach advanced installation and configuration techniques with distributed installations. Participants create, configure, and monitor connections to ArcSDE servers. The course describes how ArcIMS software interacts with ArcSDE and proposes solid strategies for improving performance.
Audience
This course is intended for ArcIMS server administrators who need more understanding of how ArcGIS server technology works behind the scenes to keep it running smoothly.

Goals
- Troubleshoot faulty ArcIMS Services
- Understand security issues
- Enable the Secure Sockets Layer (SSL) and HTTPS
- Authenticate ArcIMS Services
- Optimize map configuration files
- Perform a distributed installation
- Understand ArcSDE architecture and connections
- Work with vector and raster data in ArcSDE

Topics covered
- Network communication: Describe the Internet protocols that will be the vocabulary for the remainder of the course; Examine each from the standpoint of ArcIMS; How they work; How they can go wrong; Typical problems
- Security: Describe common security strategies using the inherent capabilities of the operating system; Discuss firewall technologies, packet filtering, proxy services, network address translation, and virtual private networks; Discuss firewall architecture best practices and implications to ArcIMS; SSL and HTTPS; ArcIMS Service authentication
- Installation and configuration: Practical distributed configurations; Load balancing spatial servers; Using multiple Web servers; Creating server clusters
- Service tuning: Response time; Scale-dependent rendering; Generalization; Image types; Map projections; Image directories; Spatial indexes
- ArcIMS sizing: Hardware considerations; Network bandwidth guidelines; Application server queuing
- ArcSDE architecture and connections: ArcSDE software architecture; Setting up an ArcSDE server using ArcIMS; Creating ArcSDE application server and direct connections; Serving a versioned geodatabase with ArcIMS
- ArcSDE vector data: ArcSDE feature class storage architecture; Serverside data loading using ArcSDE command line utilities; Organizing and managing privileges; Managing spatial and attribute indexes for optimal display and query performance; Presenting data using spatial views; Generalizing data for small-scale display using sdegroup
- ArcSDE raster data: ArcSDE raster data storage architecture; Loading images using ArcSDE command line utilities; Creating seamless mosaics; Creating multirow rasters

Prerequisites and recommendations
It is recommended that participants complete Introduction to ArcIMS or have equivalent experience with the terms and concepts used in ArcIMS. General knowledge of TCP/IP networking principles is assumed. No ArcSDE experience is required. Participants for this course should have experience with the following:
- Administering a Windows operating system
- Creating ArcIMS Services
- Authoring and designing ArcIMS Web sites
- Managing site administration
- Installing ArcIMS
- ArcIMS architecture
**Tier 3 applications**

The cost of all Tier 3 applications (GIS Browsers) includes training for selected personnel. Enterprise-wide training of Tier 3 applications can be conducted by the GIS Specialist.

Tier 3 application training should cover the following topics/functionality:

- Brief overview of GIS
- Zoom and pan functionality
- Map extents
- Feature identification
- Map production/printing
- Reports (as needed)
- Spatial queries (as needed)
- Exporting maps
- Saving projects

In addition to the aforementioned topics/functionality, Tier 3 users should receive additional training specific to individual workflows or modules, such as work order request mapping and tracking or public notification via mapping module.

**GIS Applications Training Matrix**

<table>
<thead>
<tr>
<th>Class</th>
<th>Site</th>
<th>Trainer</th>
<th>Days</th>
<th>Year of Training</th>
<th>Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction to ArcGIS I</td>
<td>On</td>
<td>ESRI Authorized Trainer</td>
<td>2</td>
<td>1</td>
<td>Planning</td>
</tr>
<tr>
<td>Introduction to ArcGIS II</td>
<td>On</td>
<td>ESRI</td>
<td>3</td>
<td>1</td>
<td>GIS Division, Utilities, Planning</td>
</tr>
<tr>
<td>Building Geodatabases I</td>
<td>Off</td>
<td>ESRI</td>
<td>3</td>
<td>1</td>
<td>GIS Division</td>
</tr>
<tr>
<td>Building Geodatabases II</td>
<td>Off</td>
<td>ESRI</td>
<td>2</td>
<td>1</td>
<td>GIS Division</td>
</tr>
<tr>
<td>ArcSDE Administration for SQL Server</td>
<td>Off</td>
<td>ESRI</td>
<td>5</td>
<td>1</td>
<td>GIS Manager</td>
</tr>
<tr>
<td>Introduction to ArcIMS</td>
<td>Off</td>
<td>ESRI</td>
<td>3</td>
<td>1</td>
<td>GIS Manager, Webmaster</td>
</tr>
<tr>
<td>ArcIMS Administration</td>
<td>Off</td>
<td>ESRI</td>
<td>2</td>
<td>1</td>
<td>GIS Manager, Webmaster</td>
</tr>
<tr>
<td>Edulog</td>
<td>Off</td>
<td>Edulog</td>
<td>1</td>
<td>2</td>
<td>Schools, GIS Manager</td>
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<tr>
<td>Tier 3 Applications</td>
<td>On</td>
<td>GIS Software, Services Provider, Internal</td>
<td>1</td>
<td>1,2,3</td>
<td>Various</td>
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### Recommended Number of Personnel for ArcGIS I and II Training

<table>
<thead>
<tr>
<th>Department/Division</th>
<th>ArcGIS I</th>
<th>ArcGIS II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fire, Rescue, and Emergency Management</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Information Services (GIS Division)</td>
<td>8</td>
<td>8</td>
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<tr>
<td>Planning Department</td>
<td>7</td>
<td>7</td>
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<tr>
<td>Sheriff’s Office</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Utilities Department</td>
<td>6</td>
<td>2</td>
</tr>
</tbody>
</table>

### Education & Participation

An important part of professional GIS education is not only formal training classes, but attending GIS conferences. GIS conferences allow attendees to attend workshops and seminars (some free, some at additional cost), and to interact with other GIS professionals from around the region, state, country, and world. Important conferences that should be attended by County staff (at the GIS Manager’s discretion, within budgetary limitations) include:

**ESRI International User Conference**
August 7-11, 2006  
San Diego, California  
(http://www.esri.com)

**Who Should Attend?**
- The ESRI User Conference is open to all ESRI software users including:
  - New Users
  - Experienced Users
  - User Group Members
  - Coordinators
  - Programmers
  - Specialists
  - Analysts
  - Technicians
  - First Responders
  - Information Technology and Industry Solutions Managers
  - Project Managers
  - Department Heads
  - Division Chiefs
  - Executive Directors
  - Faculty
  - Elected Officials
  - Board Members
  - Chairpersons
  - NGO Representatives
  - Local, Regional, National, and International Committee Members

**Topics Covered**
- Application Success Stories
- Lessons Learned
- Data Standards
- Data Migration
- Data Access
- Project Applications
- Software Development
- Complimentary Technology
• Mandates
• Grant Programs
• Collaborative Projects
• Initiatives

**Urban and Regional Information Systems Association (URISA)**
*Annual Conference and Exposition*
September 26-29, 2006
Vancouver, British Columbia (http://www.urisa.org)

The URISA Annual Conference offers a unique multidisciplinary approach, with sessions led by industry leaders, powerful keynote presentations, panels, roundtable discussions and networking meetings you won't find anywhere else.

This conference is vital to professionals concerned with the effective application of information technology in all state and local government agencies, including:
  • Community & Economic Development
  • Emergency Management/Public Safety
  • Environmental Management
  • Land Records
  • Public Works
  • Tax Assessment
  • Transportation Planning
  • Urban Planning & Design
  • Utilities

**Geospatial Information and Technology Association (GITA)**
*Annual Conference and Exhibition*
Tampa, Florida
April 23-26, 2006
(http://www.gita.org)

GITA's Annual Conference and Exhibition is the premier educational event for professionals involved in geospatial information technologies, including automated mapping/facilities management (AM/FM), geographic information systems (GIS), supervisory control and data acquisition (SCADA), and related geospatial technologies. Conference 29 will provide attendees with better ways to plan, design, manage, and maintain their systems and operations.

This year's conference theme, *No Barriers: Connected. Responsive. Prepared.* — reflects the fact that professionals in geospatial technology must respond to growing business needs to prepare for dynamic situations.