ESRI® ArcGIS® Engine is a platform for building custom standalone geographic information system (GIS) applications that support multiple application programming interfaces (APIs), include advanced GIS functionality, and are built using industry standards.

This chapter will introduce you, the developer, to the ArcGIS Engine developer kit and the ArcGIS Engine Runtime, discussing how to use it and its different components.

Topics covered in this chapter include:

- an overview of ArcGIS 9
- introduction to ArcGIS Engine
- ArcGIS Engine users
- capabilities of ArcGIS Engine
- a description of this book
ArcGIS provides a scalable framework for implementing GIS for a single user or for many users on desktops and servers. This book focuses on building and deploying custom applications using ArcGIS Engine. It will be of greatest use to developers who want to embed mapping and GIS functionality in custom applications. It provides an overview of ArcGIS Engine, its components, and the possibilities ArcGIS Engine offers developers who want to build and deploy custom GIS applications and solutions. In addition, several scenarios are used to illustrate, with code examples, the various types of applications that can be developed with ArcGIS Engine.

**AN OVERVIEW OF ArcGIS 9**

ArcGIS 9 is an integrated family of GIS software products for building a complete GIS. It is based on a common library of shared GIS software components called ArcObjects™. ArcGIS 9 consists of four key parts:

- **ArcGIS Desktop**—an integrated suite of advanced GIS applications.
- **ArcGIS Engine**—embeddable GIS component libraries for building custom applications using multiple application programming interfaces.
- **ArcGIS Server**—a platform for building server-side GIS applications in enterprise and Web computing frameworks. Used for building both Web services and Web applications.
- **ArcIMS®**—GIS Web server to publish maps, data, and metadata through open Internet protocols.
Each of the GIS frameworks also includes the ArcSDE® gateway, an interface for managing geodatabases in numerous relational database management systems (RDBMS).

ArcGIS is a platform for building geographic information systems. ArcGIS 9 extends the system with major new capabilities in the areas of geoprocessing, 3D visualization, and developer tools. ArcGIS Engine and ArcGIS Server, developer-centric products, make ArcGIS a complete system for application and server development.

There is a wide range of possibilities when developing with ArcGIS. Developers can:

- Configure/Customize ArcGIS applications, such as ArcMap™ and ArcCatalog™.
- Extend the ArcGIS architecture and data model.
- Embed maps and GIS functionality in other applications with ArcGIS Engine.
- Build and deploy custom desktop applications with ArcGIS Engine.
- Build Web services and applications with ArcGIS Server.

The ArcGIS system is built and extended using software components called ArcObjects. ArcObjects includes a wide variety of programmable components ranging from fine-grained objects, such as individual geometry objects, to coarse-grained objects, such as a map object, that can be used to interact with existing ArcMap documents. These components aggregate comprehensive GIS functionality for developers.

ArcGIS 9 has a common developer experience across all ArcGIS products (Engine, Server, and Desktop). You, as a developer, can work with ArcObjects using standard programming frameworks to extend ArcGIS Desktop, build custom applications with ArcGIS Engine, and implement enterprise GIS applications using ArcGIS Server.

As noted previously, this book focuses on building and deploying custom applications using ArcGIS Engine. If you want to customize ArcGIS Desktop applications or work with ArcGIS Server, refer to the ArcGIS Desktop Developer Guide and the ArcGIS Server Administrator and Developer Guide.
The ArcGIS system is available in a number of programming frameworks including C++, Component Object Model (COM), .NET, and Java™.

Each of the ArcGIS product architectures built with ArcObjects represents alternative application development containers for GIS software developers, including desktops, embeddable engines, and servers.

ArcGIS Desktop includes a series of Windows® desktop application frameworks (for example, applications for map, catalog, toolbox, and globes) with user interface (UI) components. ArcGIS Desktop is available at three functional levels (ArcView®, ArcEditor™, and ArcInfo®) and can be customized and extended using the ArcGIS Desktop developer kit.

The software developer kit (SDK) for ArcGIS Desktop is included with ArcView, ArcEditor, and ArcInfo and supports the COM and .NET programming frameworks. Many developers apply the ArcGIS Desktop SDK to add extended functions, new GIS tools, custom user interfaces, and full extensions for improving professional GIS productivity of the ArcGIS Desktop applications.

ArcGIS Server defines and implements a set of standard GIS Web services (for example, mapping, data access, and geocoding) as well as supports enterprise-level application development based on ArcObjects for the server.
The ArcGIS Server developer kit enables developers to build central GIS servers to host GIS functions that are accessed by many users, perform back office processing on large central GIS databases, build and deliver GIS Web applications, and perform distributed GIS computing.

ArcGIS Engine, the focus of this guide, is a simple, application-neutral programming environment for ArcObjects. Its SDK provides a series of embeddable ArcGIS components that are used outside the ArcGIS Desktop application framework—for example, mapping objects are managed as a part of ArcGIS Engine, rather than in ArcMap. Using the ArcGIS Engine Developer Kit, developers can build focused GIS solutions with simple interfaces to access any set of GIS functions or embed GIS logic in existing user applications to deploy GIS to broad groups of users.
ArcGIS Engine is a complete library of embeddable GIS components for developers to build custom applications. Using ArcGIS Engine, you can embed GIS functions into existing applications, including Microsoft® Office products, such as Word and Excel, and build focused custom applications that deliver advanced GIS systems to many users.

ArcGIS Engine consists of a software developer kit and a redistributable runtime providing the platform for all ArcGIS applications. Since ArcGIS Engine is supported on Windows, Solaris, and Linux (Intel), developers can create cross-platform custom solutions for a wide range of users.

The five parts of ArcGIS Engine are outlined below:

1. **Base Services**—The core GIS ArcObjects required for almost any GIS application, such as feature geometry and display.
2. **Data Access**—ArcGIS Engine provides access to a wide variety of raster and vector formats including the power and flexibility of the geodatabase.
3. **Map Presentation**—ArcObjects for map creation and display with symbology, labeling, and thematic mapping capabilities including custom applications.
4. **Developer Components**—High-level user interface controls for rapid application development and a comprehensive help system for effective development.
5. **Extensions**—ArcGIS Engine Runtime is deployable with the standard functionality or with additional extensions for advanced functionality.

Each of these parts, including the extension functionality, is made available through the ArcGIS Engine Developer Kit. The ArcGIS Engine Runtime and its extensions, although integral factors in the development of a custom GIS application, specifically involve application deployment and are, therefore, considered separately.

**ArcGIS ENGINE DEVELOPER KIT**

The ArcGIS Engine Developer Kit is a component-based software development product for building and deploying custom GIS and mapping applications. The ArcGIS Engine Developer Kit is not an end user product, but rather a toolkit for application developers. It can be used to build basic map viewers or comprehensive and dynamic GIS editing tools. With the ArcGIS Engine Developer Kit, you, as a developer, have an unprecedented flexibility for creating customized inter-
faces for maps. You can use one of several supported APIs to create unique applications or combine ArcGIS Engine components with other software components to realize a synergistic relationship between maps and the information that users manage.

Using ArcGIS Engine, the map itself can be either an incidental element within or the central component of an application. If, for example, the focus of your application is a database with information about businesses, ArcGIS Engine can enable the application to display a form with a map highlighting the business location of interest when your user performs a query on the database.

The ArcGIS Engine Developer Kit provides access to a large collection of GIS components, or ArcObjects, that fall into the categories discussed earlier—base services, data access, and map presentation. Another part of ArcGIS Engine that was discussed, developer components, is also included in the SDK. These are value-added developer controls for creating a high-quality map user interface. The ArcGIS developer controls are available with each supported API and platform. The following ArcGIS controls, or visual components, are provided to assist with application development:

- MapControl
- PageLayoutControl
- SceneControl
- GlobeControl
- ToolbarControl
- TOCControl
- ReaderControl
- Collection of commands, tools, and menus for use with the ToolbarControl

Chapter 3, 'Developing with ArcGIS controls', discusses each of these visual components in detail.
The final component of ArcGIS Engine is its extensions. All applications built with the ArcGIS Engine Developer Kit require ArcGIS Engine Runtime, with the appropriate license, to execute successfully. ArcGIS Engine Runtime is the platform on which ArcGIS Desktop is built; this allows users of ArcGIS Desktop applications to execute custom applications based on ArcGIS Engine, if permitted by the ArcGIS Engine application developer. There are several ArcGIS Engine extensions ranging from standard to enterprise extensions.

**Standard ArcGIS Engine functionality**

The standard ArcGIS Engine Runtime provides the core functionality of all ArcGIS applications. This level of ArcGIS Engine Runtime provides the ability to work with several different raster and vector formats, map presentation and data creation, along with the ability to explore features by performing a wide range of spatial or attribute searches. This level also allows basic data creation, editing of shapefiles and simple personal geodatabases, and GIS analysis.

**Geodatabase Update extension**

The Geodatabase Update extension for ArcGIS Engine Runtime adds the ability to create and update a multiuser enterprise geodatabase managed with ArcSDE. This includes the ability to work with schemas and versioned geodatabases. The Geodatabase Update extension unlocks ArcGIS Engine Runtime with the necessary ArcObjects to run custom editing and advanced geodatabase solutions. These solutions include applications that deal with GIS data automation and compilation and the construction and maintenance of geodatabase features. The Geodatabase Update extension provides the ability to programmatically create geodatabase behaviors, such as topologies, subtypes, and geometric networks.

ArcGIS Engine developers with access to an RDBMS via ArcSDE are able to build and deploy multiuser editing applications to end users that have the ArcGIS Engine Runtime with the Geodatabase Update extension installed and configured.

**Other ArcGIS Engine extensions**

Three additional extensions are available for the ArcGIS Engine Runtime:

1. **Spatial extension** — The ArcGIS Engine Runtime Spatial extension provides a powerful set of functions that allow applications to create, query, and analyze cell-based raster data. This type of analysis allows your users to derive information about their data, identify spatial relationships, find suitable locations, and calculate the accumulated cost of traveling from one point to another. Other advanced applications that this extension supports include the calculation of slope, aspect, and contours against digital elevation models (DEMs).

2. **3D extension** — The 3D extension for ArcGIS Engine Runtime enables the visualization of data in 3D. This extension supplements standard ArcGIS
Chapter 1 • Introducing ArcGIS Engine

Overview of ArcGIS Engine

Engine with the components for viewing a surface from multiple viewpoints and determining what is visible from a chosen location. SceneControl and GlobeControl provide the interface for viewing multiple layers of 3D and global data for visualizing data, creating surfaces, and analyzing surfaces.

3. Network Analyst extension—The Network Analyst extension is new at version 9.1 and enhances the standard ArcGIS Engine Runtime by adding the capability of routing, service area analysis, and creating and managing network datasets. The Network extension allows developers to create and deploy powerful custom applications for transportation, emergency response, fire, military, and a host of other purposes.

The StreetMap USA extension functionality is no longer a separate extension for ArcGIS Engine but is included as part of the standard ArcGIS Engine Runtime. The StreetMap USA functions provide street-level mapping, address matching, and basic routing for the USA. StreetMap layers automatically manage, label, and draw features, such as local landmarks, streets, parks, water bodies, and other features, resulting in a rich cartographic street network for the USA.
Who can use ArcGIS Engine?

Many users require focused, lightweight access to GIS. They need much less than a complete GIS application, such as ArcView, yet require access to sophisticated GIS logic in their applications. In cases in which users need focused, customized access to GIS, ArcGIS Engine provides a lower-cost, lightweight option.

Standalone Application Developers

There are many potential users of GIS-enhanced applications who are not GIS professionals and are just not equipped to take advantage of the comprehensive tools available on the market without a steep learning curve. To provide spatial solutions to non-GIS users, developers need the ability to build domain-specific, easy-to-use applications that can incorporate the power of a comprehensive GIS into a user-friendly experience. These applications, if built from scratch, can be an overwhelming development effort and may not be time or cost-effective.

You can use the ArcGIS Engine Developer Kit to successfully build standalone applications. There is a wide variety of types of applications that can be built, ranging from graphical user interface (GUI) applications to command-line, batch-driven applications. GUI applications will make use of the extensive ArcGIS controls exposed in the developer kit. These controls include everything you need to build a sophisticated front-end application. You can leverage your chosen API to integrate the ArcGIS controls with other third-party components and create a unique user interface for your custom ArcGIS Engine application.

ArcGIS Desktop Users

ArcMap, one of the ArcGIS Desktop applications, is an excellent way to create data and author maps for use in custom applications. The MapControl and PageLayoutControl provided with ArcGIS Engine can work with the map documents created in ArcMap. SceneControl and GlobeControl can display documents.
authored in the ArcScene™ and ArcGlobe™ applications. Using the ArcGIS Desktop applications to create and manage maps used in custom applications can save you much development time and effort. ArcGIS Desktop also provides tools to build and manage geodatabases, shapefiles, and other forms of spatial data.

The underlying components of ArcGIS Desktop are the same ArcObjects components that make up ArcGIS Engine. This allows every ArcGIS Desktop user the ability to run ArcGIS Engine applications. You can develop applications based on ArcGIS Engine and deploy them to ArcGIS Desktop users or extend ArcToolbox™ with a custom toolset built with the ArcGIS Engine developer kit.

**ArcGIS Server Users**

ArcGIS Server administrators can provide server objects and Web services to ArcGIS Engine applications. This allows the integration of desktop functionality with server functionality. It is also important to remember that the GIS functionality exposed via the ArcObjects that compose ArcGIS Engine is the same in ArcGIS Server, meaning that ArcGIS Server, Engine, and Desktop have the same core ArcObjects.
The capabilities of ArcGIS Engine are extensive. As an ArcGIS Engine developer, you can implement these and many other functions using its developer kit:

- Display a map with multiple map layers, such as roads, streams, and boundaries.
- Pan and zoom throughout a map.
- Identify features on a map.
- Search for and find features on a map.
- Display labels with text from field values.
- Draw images from aerial photography or satellite imagery.
- Draw graphic features, such as points, lines, circles, and polygons.
- Draw descriptive text.
- Select features along lines and inside boxes, areas, polygons, and circles.
- Select features within a specified distance of other features.
- Find and select features with a Structured Query Language (SQL) expression.
- Render features with thematic methods, such as value map, class breaks, and dot density.
- Dynamically display real-time or time series data.
- Find locations on a map by geocoding addresses or street intersections.
- Transform the coordinate system of your map data.
- Perform geometric operations on shapes to create buffers; calculate differences; and find intersections, unions, or inverse intersections of shapes.
- Manipulate the shape or rotation of a map.
- Create and update geographic features and their attributes.

EDITING FEATURES

ArcGIS Engine developer kit enables you to build applications that create, modify, and remove vector-shaped features in a geodatabase or shapefile. The standard ArcGIS Engine Runtime is used to run applications that edit shapefiles or the simple features of a personal geodatabase. However, leveraging the full function of the enterprise geodatabase, the Geodatabase Update extension of the ArcGIS Engine Runtime is required.
You can extend the capabilities of ArcGIS Engine by adding the Spatial extension to ArcGIS Engine Runtime. This extension provides a broad range of powerful spatial modeling and analysis functions. You can create, query, map, and analyze cell-based raster data; perform integrated raster or vector analysis; derive new information from existing data; query information across multiple data layers; and fully integrate cell-based raster data with vector data in a custom ArcGIS Engine application.

For example, you can:

- Convert features (points, lines, or polygons) to raster.
- Create raster buffers based on distance or proximity from features or rasters.
- Generate density maps from point features.
- Derive contours, slope, viewshed, aspect, and hillshades.
- Perform grid classification and display.
- Use data from standard formats including TIFF, BIL, IMG, USGS DEM, SDTS, DTED, and many others.
3D VISUALIZATION AND MORE

The ArcGIS Engine Runtime 3D extension extends the capabilities of ArcGIS Engine even further by enabling you to build applications that effectively visualize and analyze surface and globe data using SceneControl and GlobeControl. You can create applications that view a surface from multiple viewpoints, query a surface, determine what is visible from a chosen location on a surface, and display a realistic perspective image by draping raster and vector data over a surface.

You can, for example:

- Display ArcScene and ArcGlobe documents.
- Perform interactive perspective viewing, including pan and zoom, rotate, tilt, and fly-through simulations, for presentation and analysis.
- Display real-world surface features, such as buildings.
- Perform viewshed and line-of-sight analysis, spot height interpolation, profiling, and steepest path determination.
NETWORK ANALYSIS

The Network extension to ArcGIS Engine is new at version 9.1 and provides developers with the capability to create applications that utilize network data in a variety of formats and creating and editing network datasets. The following network functions are available to developers:

- **Path**—Find a path through a set of network locations that minimizes some impedance (cost) attribute
- **Tour**—Determine the minimum-cost path to reach a series of stops; also determines the order in which the stops are visited.
- **Directions**—Generate a series of directions for the user.
- **Closest Facility**—Given a network location (an incident) finds the closest facilities.
- **Service Areas**—Find all network elements within a given distance from a network location.
Once you have the ArcGIS Engine Developer Kit installed, you will need to register your product before you can start developing custom applications. At the end of the installation of the ArcGIS Engine Developer Kit, the Software Authorization wizard will start. Follow the steps through the wizard to authorize ArcGIS Engine Developer Kit. The ESRI Customer Service Web site (http://service.esri.com) can also be used to obtain your authorization file. To use the Web site or the wizard, you will need to know your product registration number. With the ArcGIS Engine Developer installed and authorized for use, you are ready to get started. However, good applications require careful planning; working with ArcObjects is no exception. Before beginning your development, feel free to read through and use, as necessary, the discussions and checklists in this section. They are provided to help you formulate your plans and ensure you're getting started on the right foot.

**DETERMINING THE TYPE OF APPLICATION**

A wide variety of applications can be developed with ArcGIS Engine. These applications vary from simple consoles that perform operations, such as database editing and analyses, to more complex Windows applications that contain controls and visual components for user interaction and geographic data display. In general, there are three types of ArcGIS Engine applications:

1. Standalone, nonvisual applications, such as console and utility applications
2. Standalone, visual applications, such as Windows and control-based applications
3. Embedded applications, such as components that are inserted into existing applications

Ultimately, the type of application you develop will depend on the functional requirements of the project at hand.

**Checklist:**

- What type of application are you developing? Nonvisual, visual, or embedded?
- Do you plan to migrate the functionality to ArcGIS Desktop or ArcGIS Server products?
- What platform do you want to support now and in the future? Windows? Linux? Both?

**CHOOSING AN API AND DEVELOPMENT ENVIRONMENT**

Since ArcGIS Engine Developer Kit provides four developer APIs—COM, .NET, Java, and C++. The different APIs can be leveraged in several different supported development environments. ESRI recommends and supports the following integrated development environments (IDEs) or compilers when working with ArcGIS Engine.

**COM**

- Visual Basic 6 sp3 or later
- Visual C++ 6 sp3 or later

**.NET**

- Visual Studio .NET

**Java**

- WebSphere Studio

**C++**

- Visual Studio

Some examples of ArcGIS Engine applications are provided in Chapter 6, 'Developer scenarios'. Additional samples are included with the ArcGIS Developer Help system.
• Visual C++ (Visual Studio .NET 2003)
  .NET
• C# (Visual Studio .NET 2003 with .NET Framework 1.1)
• VB.NET (Visual Studio .NET 2003 with .NET Framework 1.1)
Java
• Eclipse v. 3.0 or 3.0.1
• JBuilder™ X
• NetBeans 3.6
C++ (Compilers)
• Visual C++ sp3 or later for Windows
• Visual C++ (VS.NET 2003) for Windows
• GCC 3.2 C++ for Linux (Intel)
• WorkShop 6 Update 2 for Sun Solaris

The environment you choose to develop with will ultimately depend on your programming skills, the functionality you wish to provide end users, and whether or not you are integrating with other existing applications or technologies.

Checklist:
☐ What development environment and language are you the most familiar with?
☐ Which ArcGIS Engine API do you plan to use?
☐ Which development environment and language is best suited for the type of the development you want to undertake?

DEVELOPING YOUR APPLICATION
At this point, assuming that a proper project development plan is in place, you are ready to dive into the ArcGIS Engine Developer Kit and start developing your application. You may want to start by identifying the libraries and objects that will be necessary to provide the functionality for the application. Use the developer help resources to assist you in this process, including the ArcGIS Developer Help system, the Developer Guide series, samples included in the help system, and the ESRI Developer Network site.

Checklist:
☐ Identify the ArcObjects functionality required.
☐ What ArcGIS Engine library references will be required?
☐ What ArcGIS license will be required to run the application?
☐ Are ArcGIS Engine extensions required?
☐ How do you plan to deploy the application?
☐ Have you implemented the correct license check-out code?
DEPLOYING YOUR APPLICATION

Application deployment is an issue that should be considered long before application development begins. ArcGIS Engine applications can be deployed in a number of ways, and it is possible to have a number of end user software and license configurations. Therefore, there are a number of issues that you need to consider.

Checklist:

☐ Will users already have ArcGIS Engine Runtime installed? No ESRI products installed?

☐ What ArcGIS license will your end users have on their systems? ArcInfo, ArcEditor, or ArcView? Which license will your application check for and use?

☐ How should you package and deploy the application?

☐ Will you need to provide new versions in the future?

☐ How will you distribute the application?

Chapter 5, ‘Licensing and deployment’, discusses the various aspects of this checklist.
This book, ArcGIS Engine Developer Guide, is an introduction for developers who want to build standalone GIS applications. This guide will help you, as the developer, become familiar with the ArcGIS Engine object model by introducing all the ArcGIS Engine developer kit components, discussing relevant aspects of building applications, introducing supported APIs, and providing developer scenarios that produce real-world GIS applications.

To serve the widest base of developers, most of the code samples provided within this book use the COM Visual Basic 6 API. However, the developer scenarios cover the full range of supported APIs, and a chapter is devoted to API-specific usages.

The first two chapters of this book provide an overview of ArcGIS Engine and its capabilities, including architecture and components. The remaining chapters focus on developing application usages of each particular supported API.

**CHAPTER GUIDE**

Chapter 1, ‘Introducing ArcGIS Engine’, gives developers an overview of the ArcGIS Engine product, its capabilities, and developer resources.

Chapter 2, ‘ArcGIS software architecture’, describes ArcGIS Engine architecture and how the software components interact inside the system.

‘Developing with ArcGIS controls’ is detailed in Chapter 3. It describes each of the controls and provides some considerations for their use in application development.

Chapter 4, ‘Developer environments’, introduces you to the multiple APIs supported by ArcGIS Engine. This chapter guides you through each API from the basics to advanced usage topics.

‘Licensing and deployment’ issues are addressed in Chapter 5. It details the licensing options and discusses deployment strategies for your application, including initialization and license checking.

Chapter 6, ‘Developer scenarios’, guides you through the creation and deployment of several types of standalone applications utilizing each of the supported APIs.

This book also contains a number of appendixes that provide detailed information about the object model diagrams available in the ArcGIS Developer Help system and additional developer resources.
The following topics describe some of the additional resources available to ArcGIS developers. More in-depth coverage on the resources available to developers is covered in Appendix B.

**ArcGIS DEVELOPER HELP SYSTEM**

The ArcGIS Developer Help system is an essential resource for both the beginning and experienced ArcObjects developers. It contains information on developing with ArcObjects including sample code, technical documents, and object model diagrams. In addition, it also serves as a reference guide containing information on every object within ArcObjects. The help system is available to Visual Basic, .NET, Java, and C++ developers. You can start the ArcGIS Developer Help system through the ArcGIS program group from the Windows Start button.

**THE ArcGIS DEVELOPER SERIES**

This book is one in a series of books for ArcGIS developers.

The ArcGIS Desktop Developer Guide is for developers who want to customize or extend one of the ArcGIS Desktop applications, such as ArcMap or ArcCatalog. Developers can use Visual Basic for Applications (VBA) to customize and either Visual Basic, Visual C++, or .NET to extend the applications.

The ArcGIS Server Administrator and Developer Guide is for developers who want to use ArcGIS Server to build custom server applications. Server developers can build Web services and Web applications that do simple mapping or include advanced GIS functionality. Several scenarios illustrate with code examples some of the different types of applications that can be developed using one of the multiple ArcGIS Server Developer Kits. This book also serves as the administration guide to ArcGIS Server.
DEVELOPER RESOURCES

ESRI DEVELOPER NETWORK ONLINE
ESRI Developer Network (EDN) online—http://edn.esri.com—is a central location to find and view developer-focused articles, code samples, and other resources related to ArcGIS, ArcIMS, ArcSDE, and ArcWeb Services. In addition, EDN provides a number of community-building areas intended to promote your collaboration and interaction with other GIS developers and ESRI staff. The site is continually updated, making it the most up-to-date reference for developers.

ESRI SUPPORT CENTER
The ESRI Support Center at http://support.esri.com contains software information, technical documents, samples, forums, and a knowledge base for all ArcGIS products.

ArcGIS developers can take advantage of the forums, knowledge base, and samples sections to aid in development of their ArcGIS applications.

TRAINING
ESRI offers a number of instructor-led and Web-based training courses for the ArcGIS developer. These courses range from introductory level for VBA to the more advanced courses in component development for ArcGIS Desktop, Engine, and Server.

For more information, visit http://www.esri.com and click the Training and Events tab.

The ESRI Virtual Campus can be found directly at http://campus.esri.com.