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Mastering ArcGIS Enterprise Administration

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Install, configure, and manage ArcGIS Enterprise to publish, optimize, and secure GIS services



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Chapter 1. ArcGIS Enterprise Introduction and Installation

Since the release of ArcGIS 9 in 2004, ArcGIS Server has continued to grow and evolve. This evolution is ongoing and evident in the latest release of the ArcGIS platform, ArcGIS 10.5, released in December 2016. With the release of any new software version, comes changes in system requirements, licensing, and functionality. The 10.5 release of ArcGIS 10.5, now known as ArcGIS Enterprise, brought a substantial number of changes to administrators and users of this vastly popular and pervasive geographic information systems software package. At the time of this writing, ArcGIS Enterprise is at version 10.5.1, a quality improvement release set loose in the wild in the summer of 2017. This book will focus on ArcGIS Enterprise version 10.5.1. We will refer to both 10.5 and 10.5.1 versions, as many of the newest features were released at 10.5.

To fully understand how to install ArcGIS Enterprise, it is first important to know the structure of ArcGIS Enterprise, what it is and isn't, its different components, and, new to ArcGIS Enterprise at 10.5, server roles. This chapter will help you do just that; you will learn what ArcGIS Enterprise 10.5.1 is, how it differs from previous versions of ArcGIS, and how to install and initially configure the key components of ArcGIS Enterprise.

By the end of this chapter, you will be comfortable with the structure of ArcGIS Enterprise and capable of confidently installing and configuring it in your own environment.

In this chapter, we will cover the following topics:

- What is ArcGIS Enterprise and how is it different from previous versions of ArcGIS?
- What are the four components of ArcGIS Enterprise and how do they work together?
- What are server roles and how do they function?
- Installation and configuration of the following:
    - ArcGIS Server
    - Portal for ArcGIS
    - ArcGIS Web Adaptors for both ArcGIS Server and Portal for ArcGIS
    - ArcGIS Data Store

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Introduction to ArcGIS Enterprise 10.5.1

ArcGIS Enterprise 10.5.1 is the latest version of the ArcGIS Server product line from Esri. Released in summer 2017, ArcGIS Enterprise represents a substantial shift in how ArcGIS Server and its components are structured, licensed, and deployed.

How ArcGIS Enterprise 10.5.1 is different

ArcGIS Enterprise 10.5.1 is a complete web GIS in your own infrastructure, whether on-premises, in the cloud, or a combination of the two. At 10.5.1, ArcGIS for Server now becomes ArcGIS Enterprise, consisting of the following four major components:

- ArcGIS Server
- Portal for ArcGIS
- ArcGIS Data Store
- ArcGIS Web Adaptor

The underlying technologies behind these components remain the same as in previous versions, with enhancements.

Also new at ArcGIS Enterprise 10.5 were licensing roles. Prior to 10.5, ArcGIS Server was licensed with varying levels and editions. Roles at 10.5 offer differing capabilities and types of services that can be published.

Components of ArcGIS Enterprise 10.5.1

The ArcGIS Enterprise product line consists of four software components that are designed to work together. These are as follows:

- **ArcGIS Server**: These are the core web services component to share maps authored in ArcGIS Desktop and ArcGIS Pro and perform geospatial analysis over the internet.
- **Portal for ArcGIS**: This allows users in your organization to share data, maps, and other geospatial content through application authoring (including Web AppBuilder) and hosting capabilities. Through federation with ArcGIS Server, Portal becomes the identity store for ArcGIS Enterprise, allowing for a single management point for access and authorization. Think of Portal for ArcGIS as an on-premises version of ArcGIS Online.
- **ArcGIS Data Store**: This is an application that will locally store your Portal's feature layer data, caches, and big data.
- **ArcGIS Web Adaptor**: This allows you to expose your ArcGIS Server through your organization's standard website and port, letting you easily share your map services over the internet. When paired with IIS and Active Directory, the Web Adaptor provides a smooth method for authentication and access using **Integrated Windows Authentication** (**IWA**).

A base ArcGIS Enterprise deployment consists of ArcGIS Server, Portal for ArcGIS, ArcGIS Data Store, and the Web Adaptor.

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Server roles and extensions

New to ArcGIS Enterprise 10.5 was the concept of roles. Roles provide added functionality to ArcGIS Enterprise as deployed in your own infrastructure. Need to serve out and analyze imagery, rasters, or remotely sensed data? ArcGIS Image Server, formerly known as the Image Server Extension, allows you to serve massive imagery collections on the fly. At ArcGIS Enterprise 10.5.1, there are five licensing roles:

- GIS Server
- Image Server
- GeoEvent Server
- GeoAnalytics Server
- Business Analyst Server

Each server role requires its own instance of ArcGIS Server and a dedicated hardware resource; it is no longer recommended to deploy multiple roles to a single server for performance concerns. Many of these roles can also be deployed as distributed servers, allowing for the spreading out of processing across multiple servers.

GIS Server

The GIS Server role is core ArcGIS Server; it is the role that provided many of the ArcGIS Server capabilities prior to ArcGIS Enterprise 10.5. ArcGIS GIS Server is still offered in three editions, with each successive edition offering additional functionality:

- **Basic**: This manages your geodatabase and public feature services (without the ability to edit); it cannot be deployed with Portal for ArcGIS.
- **Standard**: This is everything in Basic, plus the ability to edit feature services and publish geoprocessing services from any tool included in ArcGIS Desktop Standard or ArcGIS Pro Standard; it can be implemented with Portal for ArcGIS.
- **Advanced**: This is everything in Standard, plus the ability to publish geoprocessing services from any tool included in ArcGIS Desktop Advanced or ArcGIS Pro Advanced. It also includes additional geostatistical and Spatial Analyst tools, and it can be implemented with Portal for ArcGIS.

Image Server

With ArcGIS Image Server, formerly known as Image Server Extension, large collections of satellite imagery, aerial photos, and rasters can be served dynamically on the fly. Image Server can also run raster processing models allowing distributed analysis of imagery and rasters.

GeoEvent Server

GeoEvent Server, known as the GeoEvent Extension prior to 10.5, enables the integration of real-time data into your enterprise GIS from a variety of sources and sensors. With GeoEvent Server, you can stream event data to client applications, view feature statuses with the Operations Dashboard for ArcGIS, filter geoevents, and detect and analyze the spatial proximity of events with geofences. With GeoEvent Server, real-time data can be published to a spatiotemporal big data store.

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GeoAnalytics Server

With ArcGIS GeoAnalytics Server, new at 10.5, big data analysis can be distributed across multiple ArcGIS Server machines, allowing users to perform analyses more quickly on even larger amounts of data than before.

Business Analyst Server

ArcGIS Business Analyst Server, when used with ArcGIS Enterprise, enables your organization to host business analyst-based capabilities such as site analytics and custom reporting. Business Analyst Server also allows you to host the Esri GeoEnrichment service on-premise and behind your firewall.

Licensing

As in previous versions of ArcGIS Server, Enterprise is broken down by editions and levels.

ArcGIS Enterprise editions

As discussed earlier in this chapter, ArcGIS GIS Server is offered in three editions, with each successive edition offering additional functionality--Basic, Standard, and Advanced. Let's examine these editions a bit closer.

Basic edition

ArcGIS GIS Server Basic edition includes geodatabase management and the ability to publish read-only feature services. Also included are the geodata service and geometry service. Web editing is not available and this edition cannot be federated with Portal for ArcGIS. No ArcGIS Server extensions are available for purchase and implementation at the Basic edition.

Standard edition

The Standard edition of ArcGIS GIS Server adds all GIS web service types (cached map and image, dynamic map, feature, geocoding, geoprocessing, image from a single raster, print, and schematic) offered by the ArcGIS GIS Server. Geoprocessing services can utilize any tool included with ArcGIS Desktop Standard. The Standard edition can be deployed with Portal for ArcGIS, allowing hosted layer types such as feature layers, scene layers, and tile layers. Most ArcGIS Server extensions are available for purchase and implementation at the Standard edition.

Advanced edition

The Advanced edition includes everything at the Standard edition plus the ability to publish geoprocessing models and scripts utilizing any tool included in ArcGIS Desktop Advanced. The ArcGIS Network Analyst for Server extension is included, and all Server Extensions are available for purchase and implementation. Portal for ArcGIS can be implemented with the Advanced edition.

Levels of ArcGIS Enterprise

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There also exist two *levels* of ArcGIS Enterprise--ArcGIS Enterprise and ArcGIS Enterprise Workgroup.

ArcGIS Enterprise level

The ArcGIS Enterprise level is designed for medium to large-sized teams. At this level, enterprise geodatabases are utilized with ArcGIS Enterprise allowing an unlimited number of simultaneous connections to the database. This level comes with one four-core processor license and is scalable with additional two-core add-on packs.

ArcGIS Enterprise Workgroup level

The ArcGIS Enterprise Workgroup level is designed for smaller teams and organizations, allowing a maximum of 10 simultaneous connections to workgroup and file geodatabases; enterprise geodatabases are not supported. The base ArcGIS Enterprise deployment (Server, Portal, Web Adaptor, or Data Store) must be deployed all in one on a single machine with up to four cores. Server roles have a maximum of four cores--no add-on two-core packs are available.

Named user entitlements

Licensing for ArcGIS Enterprise 10.5.1 is like licensing at 10.4. With your purchase of ArcGIS Enterprise is included a set of named user entitlements to be used within Portal for ArcGIS. A named user is a specified user for running ArcGIS Pro or a Premium App through ArcGIS Online of Portal for ArcGIS. The number of entitlements you receive depends on the edition and level of ArcGIS Enterprise purchased by your organization. Named user entitlements also differ for licensing under an **Enterprise Licensing Agreement** (**ELA**), education site license, or any other special licensing agreement with Esri.

The following are the named user entitlements:

ArcGIS Enterprise Advanced Edition		ArcGIS Enterprise Workgroup Advanced Edition	
30 L1	50 L2	0 L1	10 L2
ArcGIS Enterprise Standard Edition		ArcGIS Enterprise Workgroup Standard Edition	
30 L1	5 L2	0 L1	5 L2

Note

ArcGIS Enterprise with GIS Server Basic cannot be deployed with Portal for ArcGIS; therefore, named users are not available in this edition.

Level 1 (**L1**) users are content viewers who can only view content shared with them through the organization. L1 users cannot own items or edit items. **Level 2** (**L2**) users can view, create, edit, and share content and can be assigned into the Portal roles of `User`, `Publisher`, and `Administrator`. L1 access is no different than public anonymous (*Share with Everyone*), but allows named users to participate in focused sharing through groups.

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Installing ArcGIS Server

ArcGIS Server installation at 10.5.1 is very similar to installation at 10.4 and will be a familiar process for many.

System and hardware requirements

The following is a high-level overview of some of the more important system and hardware requirements of ArcGIS Server 10.5. Consult the official ArcGIS Server 10.5 online documentation for further information and an exhaustive list of all requirements.

Operating systems

ArcGIS Server is supported on Windows Server 2012 R2 Standard and Datacenter; Windows Server 2012 Standard and Datacenter; Windows Server 2008 R2 Standard, Enterprise, and Datacenter; and Windows Server 2008 Standard, Enterprise, and Datacenter. Flavors of Windows 10, 8.1, and 7 are also supported *for basic testing and application development only, not for production environments*. Throughout this book, we will focus on ArcGIS Server on Windows.

ArcGIS GIS Server, GeoEvent Server, Image Server, or Business Analyst for Server are recommended to have 8 GB of RAM *per unique license role* in a production environment. ArcGIS Server requires a minimum of 10 GB of available disk space.

Ports

ArcGIS Server...

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Installing Portal for ArcGIS

As stated earlier, you can think of Portal for ArcGIS as being like an on-premise version of ArcGIS Online. Portal for ArcGIS is a website hosted on your network that serves as a repository for and gateway to your GIS data and content.

System and hardware requirements

Before diving into installation, let's first talk about system requirements. These have changed since earlier versions, so refer to the online documentation carefully for details and ensure that your hardware meets the minimum requirements.

Operating systems

Portal for ArcGIS is supported on Windows Server 2016 Standard and Datacenter 64-bit; Windows Server 2012 R2 Standard and Datacenter 64-bit; Windows Server 2012 Standard and Datacenter 64-bit; Windows Server 2008 R2 Standard, Enterprise, and Datacenter 64 bit; and Windows Server 2008 Standard, Enterprise, and Datacenter 64 bit. Windows 10, 8.1, and 7 64-bit are also supported *for basic testing and application development only, not for production environments*.

> ## Note
>
> Portal for ArcGIS is not supported on the 32-bit operating systems.

Hardware

Portal for ArcGIS 10.5 requires one four-core...

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Installing ArcGIS Data Store

ArcGIS Data Store is an application to host data within your Portal. It provides a relational data store for your Portal's hosted feature data, a tile cache data store for storing your Portal's hosted scene layer caches, and a spatiotemporal big data store for storing observational data to use with ArcGIS GeoEvent Server and to store results generated from ArcGIS GeoAnalytics Server.

Some of the benefits of the ArcGIS Data Store include the following:

- **Publishing large numbers of hosted feature layers**: The ArcGIS Data Store relational data store can efficiently host thousands of feature layers with a smaller memory footprint, thus requiring less resources
- **Archiving high volume, real-time data**: With ArcGIS GeoEvent Server, you can use a spatiotemporal big data store to archive GeoEvent observation data

System and hardware requirements

As with the other components of ArcGIS Enterprise, system and hardware, minimum requirements must be met.

Operating systems

ArcGIS Data Store is supported on Windows Server 2016 Standard and Datacenter 64-bit; Windows Server 2012 R2 Standard and Datacenter 64-bit; Windows Server...

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Summary

ArcGIS Enterprise 10.5 brings many changes to the world of ArcGIS Server and Portal for ArcGIS. Portal is now a core component along with ArcGIS Server, Data Store, and the Web Adaptor. The concept of server roles is introduced at 10.5, with former extensions now becoming added functionality to ArcGIS Enterprise as deployed in your own infrastructure. Installation of ArcGIS Enterprise consists of installing and configuring the core components. These components can live internally in your own infrastructure on physical or virtual hardware, in the cloud, or a combination of the two. Configuration options abound and it is important to find the optimal setup for your organization's needs. Now that core software is installed, next, in Chapter 2, *Enterprise Geodatabase Administration*, we will look at how to go about creating, configuring, loading data into, and maintaining an enterprise geodatabase.

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Chapter 2. Enterprise Geodatabase Administration

At the heart of any good enterprise GIS system lives a clean, tidy, and performant enterprise geodatabase. The geodatabase is the core of a strong GIS system; without data, you have nothing. Likewise, a poorly installed, configured, or maintained geodatabase leads to disappointing applications for end users. Proper installation, configuration, tuning, maintenance, and administration of the geodatabase is crucial to the health and usability of a GIS.

Before we can cover enterprise geodatabase administration, we first need to discuss what makes an enterprise geodatabase; how we install, create, or enable one; how we connect to it; and how we load data into it. Also, keep in mind that, in no way can we cover all aspects of Enterprise geodatabase administration in one chapter; an entire book could be dedicated just to this topic. Instead, this chapter will highlight several aspects of installing, configuring, and maintaining an SQL Server enterprise geodatabase. Keep in mind that many of the principles covered can be applied to other RDBMSs as well.

After the completion of this chapter,...

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What constitutes an enterprise geodatabase?

A geodatabase is a spatially-enabled database. Within the ArcGIS Enterprise framework, there are three types of geodatabases:

- **Personal geodatabase**: This uses Microsoft Access for data storage, and it has a size limit of 2GB.
- **File geodatabase**: This uses the file system folder for storage of GIS datasets; each dataset can be 1TB in size. If not using an enterprise geodatabase, this is the recommended file-based storage type.
- **Enterprise geodatabase**: This uses a **relational database management system** (**RDBMS**) for data storage, supports multiple simultaneous user connections, and is limited in size by the RDBMS.

Personal and file geodatabases are intended for single users and small workgroups with one writer and multiple readers, where concurrent user connections eventually degrade performance with more and more readers. File geodatabases can have only one editor per feature dataset, stand-alone feature class, or table. For medium to large organizations needing multiple writers and larger numbers of concurrent readers, an enterprise geodatabase is the optimal choice.

Using an enterprise geodatabase...

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Relational database management system installation and configuration

The first step in setting up an enterprise geodatabase is to install your RDBMS. In many organizations, this is handled by someone in the IT department, such as a database administrator or systems administrator. If so, try to work with them as much as possible for the setup of your RDBMS; not only will you build a stronger working relationship with them, you will further understand how your RDBMS was installed and configured.

For this book, we will be using SQL Server 2014 Standard Edition SP2 as our RDBMS. As always, consult the documentation of your RDBMS for detailed installation and configuration instructions.

RDBMS installation

RDBMS installations can be quite lengthy with dozens of steps. For this reason, we will not cover *every* step in the SQL Server 2014 installation, but instead touch on those points that might be tricky or otherwise important regarding our GIS system. Remember to check your RDBMS documentation regarding system requirements. Some items to ensure are completed during your SQL Server installation:

- If you have a non-OS drive to install on,...

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Creating or enabling an enterprise geodatabase

To create a geodatabase, you must use ArcGIS Desktop licensed at either Standard or Advanced level, ArcGIS Pro Standard or Advanced, or a Python script on a machine with the proper level of Desktop or Pro installed. There are two ways to create an enterprise geodatabase in SQL Server, depending upon your level of access to the database:

- You create the enterprise geodatabase using the Create Enterprise Geodatabase geoprocessing tool. Here, you are both the SQL Server database and geodatabase administrator. This option applies if you installed SQL Server and/or you have `sysadmin` access to the SQL Server instance.

  ## Note

  In SQL Server, the database administrator owns everything in the entire SQL Server instance. The geodatabase administrator, on the other hand, owns only the objects within a geodatabase.

- Your SQL Server administrator creates the database and the geodatabase administrator (you) creates the geodatabase.

Let's break down these options in further detail.

Note

For either of the following scenarios, you will need an ArcGIS Server (Enterprise Advanced or Enterprise Standard) keycodes...

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Connecting to the geodatabase

Now that we have a shiny new enterprise geodatabase, we need to connect to it. A connection allows us to use, manage, and administer the geodatabase. Before we can connect, there are a few items to configure.

To allow connections from machines other than the SQL Server machine itself, we must ensure that remote connections to the database server are allowed. To do this, first open SQL Server Management Studio on your database server and log in with the `sysadmin` credentials. In the **`Object Explorer`** pane, right-click on the database server and go to **`Properties`**. In the **`Properties`** window, select the **`Connections`** page. Under remote server connections, ensure that **`Allow remote connections to this server`** are checked. Click on **`OK`**.

Next, open SQL Server Configuration Manager and under **`SQL Server Network Connection`**, select **`Protocols for <your server>`**. Ensure that **`TCP/IP`** is enabled. Right-click on **`TCP/IP`** and go to **`Properties`**. Select the **`IP Address`** tab and scroll down to the **`IPALL`** section. Note the TCP port listed here; `1433` is the default port for SQL Server. If your instance of SQL Server is running on a...

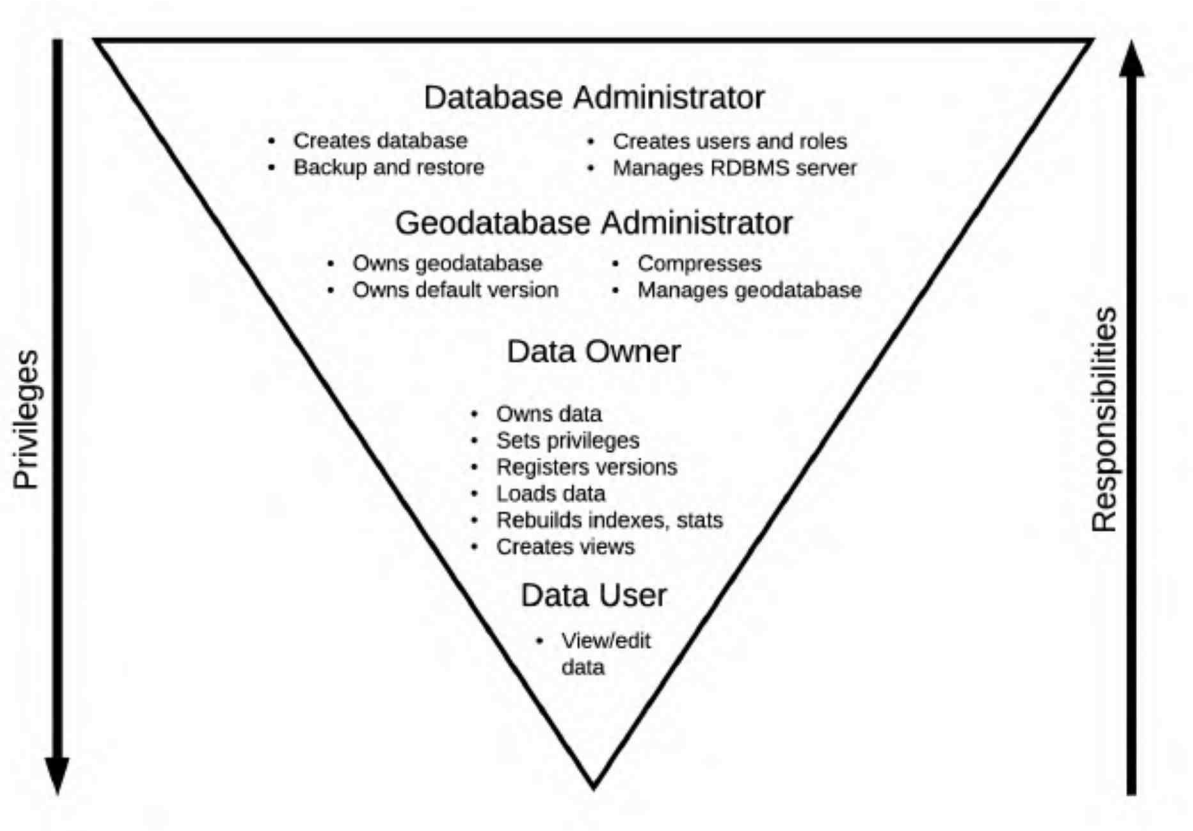
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Users, roles, and privileges

Within the geodatabase, there is a hierarchy of users, with each level being based on what actions the user can perform. We have talked at length about the most powerful two of these users, the database administrator and geodatabase administrator. These users are vital to the creation, management, and maintenance of the enterprise geodatabase. As the following diagram shows, with great power, there must also come great responsibility. Database administrators and geodatabase administrators are both powerful accounts with far-reaching privileges. The following diagram shows that with increased privileges in the database, come increased responsibilities:

Note

Remember that the geodatabase administrator account should never own data in the geodatabase.



The data owner account

Another important account is the data owner; this account owns the schema and therefore the data, sets privileges, performs maintenance tasks, and probably most importantly, loads data into the geodatabase. For the data owner account, it is best to create a *headless* user account, an account that is not assigned to any person. If...

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Loading data

For our purposes here, loading data refers to initially creating datasets in a geodatabase. Any user with proper edit privileges can insert data into an existing feature class or table. Loading data into the geodatabase is a task typically reserved for those with access to the data owner account credentials. Data should always be loaded (and feature classes and tables created) under the data owner account; in other words, the user loading the data must be connected to the geodatabase as the data owner.

Note

Never load data while connected as the `sde` user; this will make the `sde` account the owner of that data.

There are many ways to load data into the geodatabase, and these vary based on the format of the source data. Let's discuss some of these methods where they are applicable, and their pros and cons.

Storage

Before discussing data loading, we should briefly touch on storage, the primary role of an enterprise database. Each RDBMS supported by ArcGIS Enterprise has its own mechanisms for storing the spatial component of geographic data (the geometries). For SQL Server, starting with ArcGIS 10.4, the default mechanism is...

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Database maintenance

A well-maintained geodatabase is a performant geodatabase. Database maintenance requirements vary from system to system, but there are several routine tasks that need to be carried out on all systems.

Backups

Although not necessary for performance, database backups taken on a routine schedule are crucial to the safety, integrity, and security of your system. Not only do database backups protect you from data loss in the event of system failure, they also protect you in the case of data corruption. Database backups are typically scheduled and handled by the database administrator, but it should also be the responsibility of the geodatabase administrator to ensure that this process is in place and carried through.

Just as important as taking the backups, is to routinely, yet randomly, *test* your database backups. This entails restoring backups to a different SQL Server instance to ensure that the backups are valid and current. This also keeps the staff current on the protocols for backup restoration in the case of an actual emergency.

Statistics

Keeping database statistics updated is crucial for maintaining query...

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Summary

A GIS is only as good as the data that powers it. Geodatabase administration is crucial in keeping a well maintained, performant geodatabase that users will be able to utilize efficiently. In this chapter, we discussed how to create a geodatabase, connect to it, create accounts for users to access it, load data into it, manage user privileges, manage user connections, and perform routine maintenance. Next up in Chapter 3, *Publishing Content*, we will look at using our data in published content in ArcGIS Server.

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Chapter 3. Publishing Content

Once ArcGIS Server, Portal for ArcGIS, Data Store, and the Web Adaptor are installed and configured, and the geodatabase has data in it, it is time to publish content in the form of services. Services are at the core of ArcGIS Server, ArcGIS Online, and Portal for ArcGIS. Many different service types can be published, with map services, feature services, geoprocessing services, and image services being the most prevalent and popular.

Much like in Chapter 2, *Enterprise Geodatabase Administration*, where we dug into what makes up a geodatabase, here, we will first ask ourselves *What exactly is a service?* before we discuss the service types we can publish with ArcGIS Server. Also, before we can publish services, we must register our data sources with ArcGIS Server, so we will discuss what this is and how to do it. Next, we will examine service properties and settings, publish services, and finally, talk about how we can extend services with server-object extensions and server-object interceptors.

After finishing this chapter, you will be familiar with some of the different types of services that can be...

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Service types

Many different types of services can be published to ArcGIS Enterprise, each performing a unique task within the ecosystem. All ArcGIS Enterprise services are authored in ArcMap or ArcGIS Pro. Many different service types exist; here, we will focus on several of the most common ones. Consult the ArcGIS Server online documentation for a more extensive list of the available service types.

What is a service?

Before going any further, let's discuss just what exactly a service *is*. At its core, ArcGIS Server operates on a spatially enabled **service-oriented architecture**, or **SOA**. With an SOA, *services* are provided by application components through a protocol over a network. For ArcGIS Server, the services are map services, feature services, and so on; the application component providing the service is ArcGIS Server, the protocol is HTTP, and the network could be an intranet, the internet, or both. With ArcGIS Server, think of services as a representation of that service from where it came. Therefore, a map service is a representation of the ArcMap MXD or ArcGIS Pro Map that it was published from and a geoprocessing service is...

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Publishing services

With ArcGIS Enterprise, information can be shared as services published not only to ArcGIS Server, but also to ArcGIS Online and Portal for ArcGIS.

Publishing to ArcGIS Server

Publishing data and processes to ArcGIS Server is a common methodology employed by many organizations to share information. Publishing content to ArcGIS Server allows your services to be consumed internally within your organization and, if you choose, externally, either as public-facing unsecured services or secured services available through authentication.

Creating an ArcGIS Server connection

To publish a service to ArcGIS Server, you must have a publisher or higher (administrator) connection to ArcGIS Server. This connection can be made either prior to service publication or during the service publication process; it is more convenient to have these types of connections made and saved before you need them. With a publisher connection, you can publish GIS resources, configure and publish draft services, and add, delete, start, and stop ArcGIS Server services. With an administrative connection, you can do everything you can with a publisher...

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Managing service data

For a service to display data, it must be able to access that data. This applies to ArcGIS Server, Portal for ArcGIS, and ArcGIS Online services. Vector data can be stored in an enterprise or file geodatabase; raster data can be stored in an enterprise or file geodatabase or on disk.

Making data accessible to ArcGIS Server

Your ArcGIS Server machines need to be able to access your data. To do this, follow these three rules:

1. Store your data where your ArcGIS Server machines can see it and access it. Here there are several options:
    - **Store data locally on each ArcGIS Server machine**: This is not an optimal solution, especially if you have multiple machines in your server site. This can be beneficial for performance, but not for maintenance.
    - **Store data in a shared directory**: Many organizations do this already; share data on a network drive using a **Universal Naming Convention** (**UNC**) path, such as `\\server\folder\data`. This has its merits in that if used properly, UNC paths provide a uniform, consistent method to reference data from anywhere on your network. The biggest drawback to this method is network latency; traffic...

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Publishing to the ArcGIS Data Store

Data can be added and published to the Data Store in several ways. We will discuss a few of those methods here. Data can be added to Portal and then published to a feature service--feature services can be published from ArcMap, and feature services can be published from ArcGIS Pro.

Publishing a CSV file

A CSV file with either an address field or latitude/longitude in decimal degrees can be added to Portal and subsequently published as a feature service. Features are published in the Web Mercator coordinate system.

Note

Portal reads the first 10 rows of the CSV file to determine the data type and maximum length to use for each field in the hosted feature layer. Once these field types and lengths are set, any subsequent rows that do not match the types and lengths will not be included in the hosted feature layer. Pre-process your CSV to make sure records with the longest fields are in the first 10 rows. If your file has fields that contain mixed numeric and text fields, move one of those to the top as well so Portal sets it as a text field (numbers can be written to text fields, but text cannot be...

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Extending services

Using **Server object extensions** (**SOEs**) and **Server object interceptors** (**SOIs**), it is possible to extend ArcGIS Server map and image services with custom Java or .NET code that is executed on the GIS server through a client application.

Server object extensions

An SOE creates new service operations to *extend* the base functionality of a map or image service. SOEs are appropriate if you need to expose custom functionality that is not available in any other manner or that needs to be executed quickly. An example use-case for an SOE would be a situation where an ArcObjects code must be used to accomplish a task that cannot be done with a geoprocessing task. Before embarking on developing an SOE, look closely to see if out-of-the-box tools can accomplish the task at hand. Also, remember that custom Python scripts can accomplish many tasks that only a few years ago were attainable only by using through ArcObjects.

Server object interceptors

SOIs enable you to change the behavior of existing map or image service operations, such as the behavior of a query or map image request. This is done by *intercepting* the requests of the...

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Summary

This was an important chapter, as we discussed the publication of services, a key component in ArcGIS Enterprise. A wide range of service types can be published with various capabilities to ArcGIS Server, Portal for ArcGIS, and ArcGIS Online, allowing organizational data and information to be easily shared and managed. These capabilities each have their own array of settings and properties, all of which can be changed and tuned for your needs. An important step in the process is determining where your data needs to reside and managing service data sources. We also touched lightly on several ways to add and publish data to Portal for ArcGIS. Next, we will dive into Portal for ArcGIS and discuss how to leverage Portal to manage your organization's content, groups, and users and how those users access information.

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Chapter 4. ArcGIS Server Administration

ArcGIS Server is literally and figuratively a core component of ArcGIS Enterprise; literally, in the sense that it is one of the four components of Enterprise; figuratively, in the sense that the functionalities it provides are central to the principles behind web GIS. Knowing this, it is easy to see the importance and grasp the gravity of ArcGIS Server administration.

Just as with every other component of ArcGIS Enterprise, a well-maintained and clean ArcGIS Server environment lends to an efficient and smooth-running site. There are many interfaces in ArcGIS Server administration, and we will discuss them all here. From **ArcCatalog** to **ArcGIS Server Manager** to the **REST Administrator**, these all provide different windows in ArcGIS Server from which you can perform varying levels of tasks. Sometimes, for quick tasks, these can be accomplished through ArcCatalog (many tasks that can be completed in ArcGIS Server Manager can also be completed through an administrative connection in ArcCatalog) and other fine-grained settings can only be accessed through the REST Administrator.

We can by no means...

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Connecting to an ArcGIS Server site

Before any administrative tasks can be completed, we need to first know where and how to connect to our administrative interfaces.

Accessing ArcGIS Server Manager

Since the earliest days of ArcGIS Server, ArcGIS Server Manager has been the central, web-based management tool for ArcGIS Server. When we installed ArcGIS Server in Chapter 1, *ArcGIS Enterprise Introduction and Installation*, we were presented with ArcGIS Server Manager after the initial site setup. Depending on your Web Adaptor configuration, there are several ways to access ArcGIS Server Manager in a web browser, such as the following:

- From the ArcGIS Server machine, ArcGIS Server Manager can be accessed at `https://localhost:6443/arcgis/manager`. A shortcut to ArcGIS Server Manager at this URL is also installed with ArcGIS Server and can be found under the Windows Start menu as **`ArcGIS Server Manager`**.
- From another machine on the internal network, ArcGIS Server Manager can be accessed using the server name instead of `localhost`, such as `https://servername:6443/arcgis/manager`.
- If, during your Web Adaptor configuration, you choose to **`Enable...`**

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A quick tour of the configuration store and ArcGIS Server directories

The ArcGIS Server configuration store, commonly referred to as the **config store**, is a directory of files (many of which are JSON formatted) that contain all the essential properties of the server site, including clusters, machines, services, web adaptors, and security to name a few--in short, the configuration. For this reason, the config store is a crucial piece of ArcGIS Server and should be treated with great care and respect. If possible, the configuration store should reside in a redundant location. In a single server site, the config store typically resides on the same machine that is running ArcGIS Server. In a multiple machine site setup, the config store is required to be stored in a location accessible by all ArcGIS Server machines, such as a network share. If desired, and the hardware resources are available, the config store can even be isolated on its own file server.

The location of the config store can be changed at any time to accommodate growth of your site and changes in your architecture. When starting out with ArcGIS Server, you may only have...

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Carrying out administrative tasks

Now that we have discussed the different methods to connect the admin interfaces to ArcGIS Server, let's cover some administrative tasks and scenarios, and how we can tackle them.

Adding and removing machines from an ArcGIS Server site

ArcGIS Server machines are the work horses of your server site. The beauty of ArcGIS Server is that it is fully scalable, meaning that, if in the future you need to add more processing power to your site, you can simply add another ArcGIS Server machine to help distribute the workload. To add a machine to your existing site, it is recommended to provision the new machine to have the exact specs of existing servers in the site. Some of the requirements of a new machine that must be the same as the other ArcGIS Server machines in the site include the following:

- Same operating system
- Same hardware specs (RAM, processor, and more)
- Same version number of ArcGIS Server
- Same licence
- Same ArcGIS Server account (domain is best)

Other requirements include the following:

- It must be able to read/write to the site's config store and server directories
- It must be able to communicate with...

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Summary

Administration is a crucial task that must be diligently carried out. A properly maintained and administered ArcGIS Server site will run efficiently, smoothly, and dependably. In this chapter, we started at the ground floor and learned about how to access administrative functions through ArcGIS Server Manager, ArcCatalog, and the REST Admin. We looked at a wide array of administrative tasks from log settings, backup and restore, and resetting and changing the ArcGIS Server primary site account. We then dove into the ArcGIS Server REST Admin and learned how to navigate around to work with tokens, manage services, system settings, logs, and data settings. We will soon use our familiarity with the REST Admin in Chapter 7, *Scripting Administrative Tasks*, where we will interact with the REST Admin through Python scripts, allowing us to automate administrative tasks. However, first, in the next chapter, we will look at Portal for ArcGIS administration.

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Chapter 5. Portal for ArcGIS Administration

With the release of ArcGIS Enterprise 10.5, Portal for ArcGIS, referred to as **Portal** here, became a first-class citizen, joining the ranks of ArcGIS Server and becoming a fully integrated, standard component of the Esri platform. Using Portal, your users can create, edit, and share web maps and web mapping applications. GIS content can be searched, shared, and accessed in ArcGIS Desktop and ArcGIS Pro. When ArcGIS Server is federated with your Portal, Portal provides an interface and a window into your ArcGIS Server content. Even without federation, Portal still provides an intuitive ArcGIS Online-like experience and central access point into your enterprise GIS. In many organizations, Portal is *the* method used to interact with the enterprise GIS. Also, administrative tasks for Portal determine and set which base content and templates are available to your users and how they interact with these resources. For these reasons, it is easy to see how important a task Portal administration is.

In this chapter, we will look at the different interfaces and methods that can be used to...

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Connecting to Portal

Just as with ArcGIS Server in the last chapter, there are multiple methods available to connect to and access Portal administrative tasks. We will first discuss the two standard ways Esri provides. Later in this chapter, in *Administering through the Portal REST Administrative Directory* section, we will discuss other windows into Portal administrative functions.

Accessing Portal through the standard web interface

The standard Portal web interface (`https://www.yourdomain.com/portal`) is how most users will interact with Portal; it is also how you can access it for a portion of your administrative duties. How you access the Portal web interface depends on your configuration and whether you are accessing Portal externally through the Web Adaptor or on the internal network, bypassing the Web Adaptor. If the former, then the URL you use will look like the following:

```
https://<FQDN>/<webadaptor/home/
```

In our case, it would be like this:

https://www.masteringageadmin.com/portal/home/.

If the latter, the URL will look like the following:

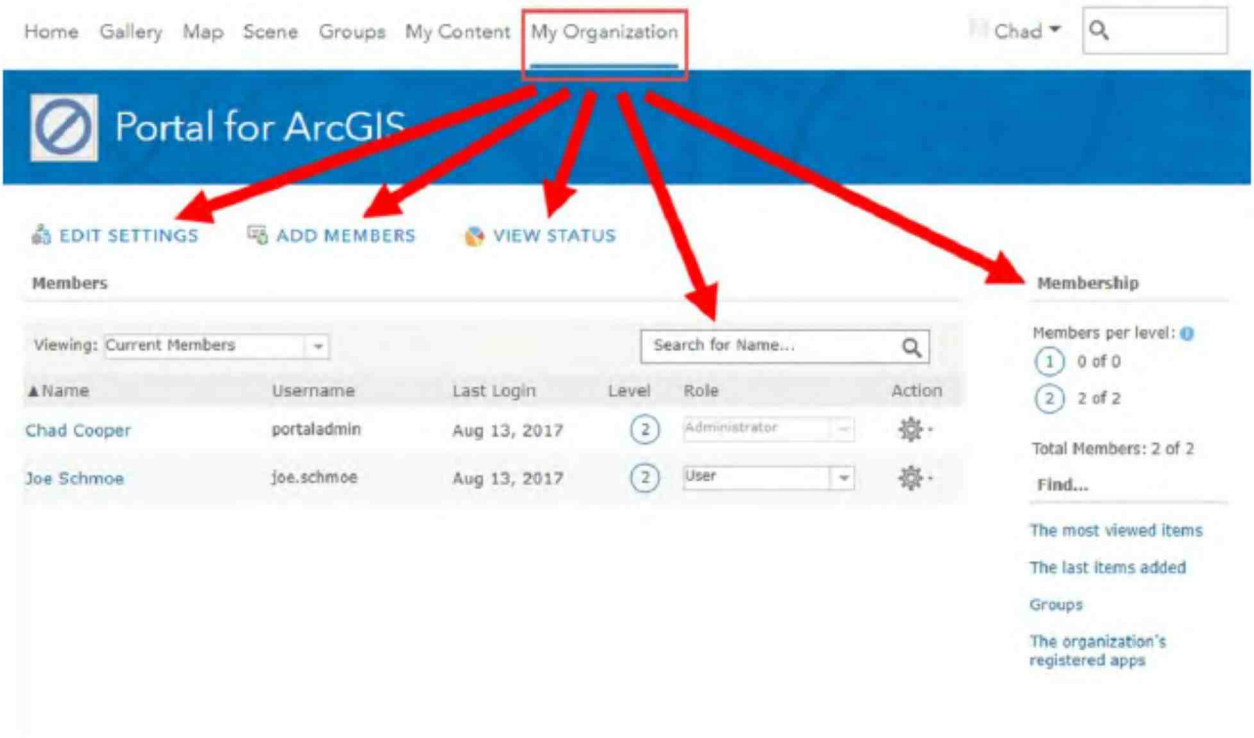
```
https://<FQDN>:7443/arcgis/home/.
```

In our case, it would be this:

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Administering through the web interface

As an administrator in Portal, you have access to administrative functions under **My Organization**, where there are links to **EDIT SETTINGS**, **ADD MEMBERS**, and **VIEW STATUS**. Under **My Organization**, you can also search for users and view/manage users, as well as viewing information regarding your named user allotments:



Changing the look and feel of your Portal

When your Portal is first configured and launched, it has a generic appearance, as illustrated in the following screenshot:

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Fortunately, this look can be upgraded easily in the Portal settings. To edit the home page of your Portal, log in as an administrative user and perform the following steps:

1. Go to **`My Organization`** | **`General`**.
2. If you want a description (the second gray box in the preceding figure), add one in the **`Description`** section and check the **`Show description toward bottom of Home Page`** checkbox. You can add text, images, and links. You also have full control over the HTML.
3. In the right menu, go to **`Home Page`**. To fully customize your Portal home page, change the following items:

- **`Background Image`**: You can remove this, go with the provided one, or...

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Administering through the Portal REST Administrative Directory

Just like ArcGIS Server, Portal has a REST backend from which all administrative tasks can be performed.

We previously covered how the web interface for ArcGIS Server is a frontend to the ArcGIS Server REST API, and Portal is no different. We also covered services and how REST calls are made to the API. With all that covered, let's dive in and look at some of the administrative actions that can be performed in the Portal REST Admin.

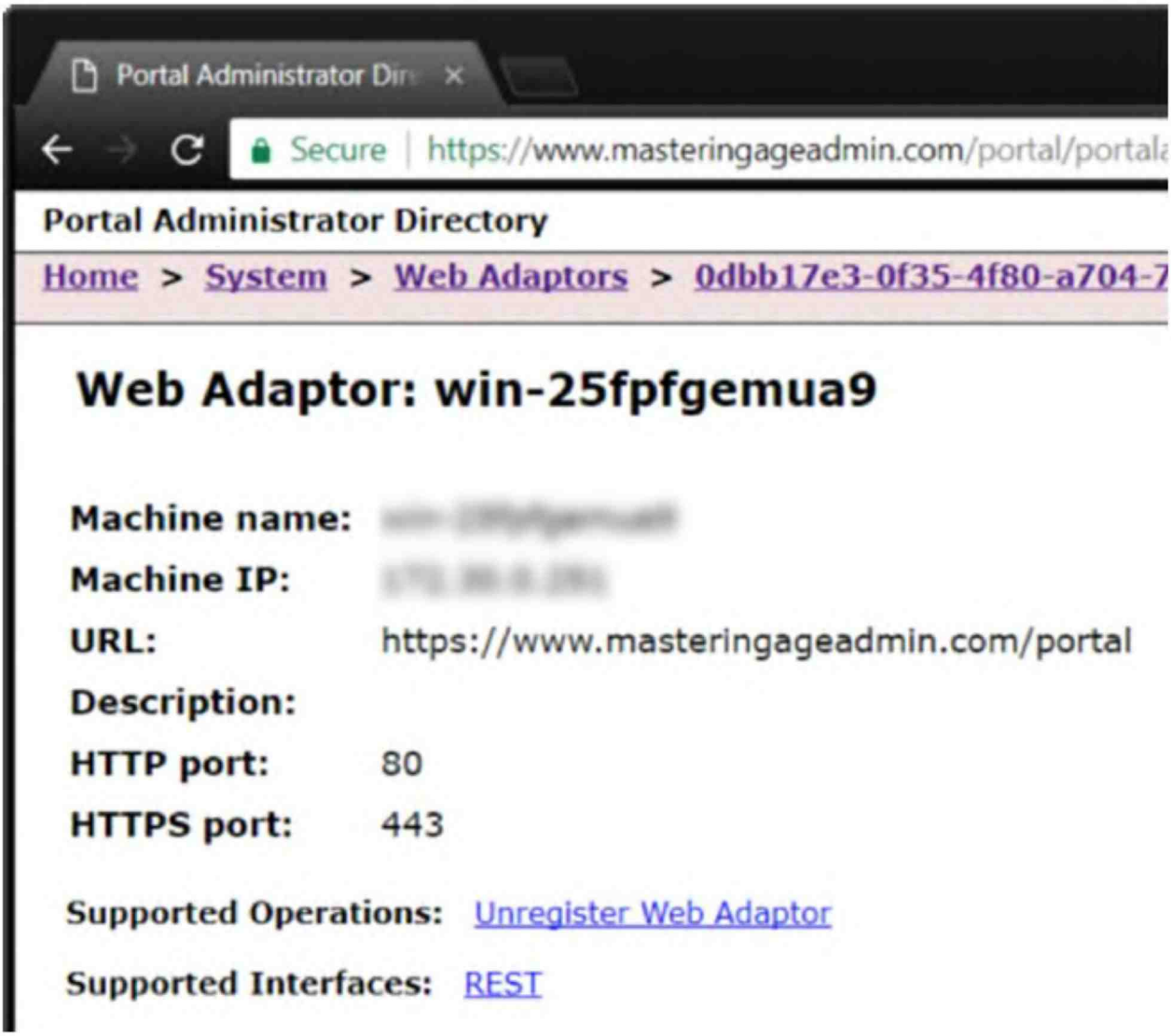
System properties

Portal system properties include items such as Web Adaptors and licensing. Information about these items can be viewed, and each has operations to make configuration changes.

Web Adaptor

To get to your Portal Web Adaptor in Portal Admin, go to **`Home`** | **`System`** | **`Web Adaptors`** | **`<web adaptor ID>`**. If you've examined the Web Adaptor settings in the ArcGIS Server REST Administrator, then this should look familiar to you. Here, you can see **`Machine Name`**, **`Machine IP`**, **`URL`**, and the ports associated with your Web Adaptor:

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Here, there is a link to the `Unregister Web Adaptor` operation, but there is also a hidden operation here, just as there...

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Backing up Portal

ArcGIS Enterprise ships with a Java utility called `webgisdr` that can be used to back up and restore portal items and settings, GIS services and settings, and the ArcGIS Data Store managed database (relational data store) and hosted scene layer cache (tile cache data store). When using the `webgisdr` utility, there are requirements and considerations:

- The utility requires Java 1.7+ to run. The `JAVA_HOME` operating system environmental variable must be set to the Java installation directory on the machine that `webgisdr` will run from.
- The utility is version dependent, meaning that the deployment you restore *must* be the same version from which the backup was created.
- The utility can create both full and incremental backups, where an incremental contains all changes made since the last full backup.
- The utility does not back up the following (backup of these items is discussed shortly):
    - Map service cache tiles and hosted tile layer caches
    - File-based and enterprise data sources used by web services, such as file geodatabases or file-based imagery
    - Spatiotemporal data stores
- Backups require *substantial* disk space. A deployment...

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Changing the Portal for ArcGIS account

Just as with ArcGIS Server, you can (and trust me, one day you *will* need to) reset or change the Portal for an ArcGIS service account. One difference is that the tool to do this for Portal is not located on the Windows Start menu as it is for ArcGIS Server. Instead, it is an executable file utility located at `<Portal installation directory>\tools\ConfigUtility` on the Portal machine. Like the Configure ArcGIS Server Account tool, `ConfigurationUtilityCL.exe` sets the account (domain or local) to run the Portal service and grants the account privileges on Portal system folders and files. `ConfigurationUtilityCL.exe` uses the following syntax:

```
configureserviceaccount.bat --username mydomain\username --password password -writeconfig
c:\temp\config.xml
```

The available parameters for the utility are the following:

- `username`: This is the username of the Portal service account.
- `password`: This is the password for the Portal service account.
- `writeconfig`: This is optional. It is a path to the configuration file to be saved so the same configuration can be applied in future runs of the utility.
- `readconfig`: This is...

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Management tools

In addition to using the administrative settings in Portal and the Portal Admin, there are solutions available to assist in managing your Portal content.

AGO Assistant

ArcGIS Online Assistant, or AGO Assistant for short, is a web application created and hosted by Esri that can be found at https://ago-assistant.esri.com/. Esri calls it *A swiss army knife for your ArcGIS Online and Portal for ArcGIS accounts*, which sums it up quite well. AGO Assistant uses the ArcGIS REST API to work with content in ArcGIS Online and Portal for ArcGIS through a simple interface. Some of the tools available include viewing the underlying JSON for any item in your Portal or ArcGIS Online (a personal favorite of mine), copying content from one account to another (Portal to Portal, AGO to AGO, Portal to AGO, or vice versa!), and updating service URLs in web maps and applications (another huge timesaver). Let's take a look at some ways to use AGO Assistant for administrative purposes.

Accessing AGO Assistant

To access the AGO Assistant for your Portal, go to https://ago-assistant.esri.com/ and select **`Log in to Portal for ArcGIS`**. You can log...

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geo jobe Admin Tools

Admin Tools by geo jobe (http://www.geo-jobe.com/) is a suite of tools designed to help streamline ArcGIS Online and Portal for ArcGIS Administration. Much like AGO Assistant, Admin Tools uses the REST API on its backend to perform administrative tasks. Tasks can be performed individually on a single item or multiple tasks can be chained together and performed in bulk on multiple items. Admin Tools is used by over 4,000 users worldwide and comes in three versions:

- **Admin Tools (Free)**: This version can be used free of cost, but offers limited, but still incredibly useful, functionality such as copy, move, and delete items, update owner and sharing properties, and import and export users from CSV and JSON.
- **Admin Tools (Pro)**: This version offers the same functionalities as the free version, but adds additional functionalities for a fee. Additional functionalities here include viewing item dependencies, updating web map URLs, cross-organizational cloning, and importing of groups and items from CSV and JSON.
- **Admin Tools (Portal)**: This version is essentially Admin Tools Pro, but for Portal for ArcGIS instead of ArcGIS...

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Summary

In this chapter, we covered quite a bit of content regarding Portal administration. We showed how to access Portal through both its web interface and Portal Admin. Then, we looked at how to change the public appearance and style of your Portal. Managing content is an especially important topic, which we covered in detail, ranging from customizing basemaps, to configuring the map viewer, to configuring utility services such as printing. The creation of a custom ArcGIS Server print service was also discussed in great detail, as this is an item that almost every organization needs and wants. Next, we moved on to using the Portal REST Admin for administration, covering the Web Adaptor, licensing, and logs. Backing up your Portal is an important administrative task, and we covered it using the `webgisdr` utility, along with a Windows batch script to cover both Portal and non-Portal file-based data that also needs backing up. We then discussed how to change the Portal service account, and finished by talking about the ArcGIS Online Assistant and how it can aid greatly in administration tasks for Portal. Next up is security, in

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Chapter 6. Security

Security is quite possibly the most important yet least discussed aspect of any enterprise system, GIS included. The security of your ArcGIS Enterprise system should be a paramount concern warranting significant consideration. As an administrator, the security and integrity of your deployment should always be on your mind. ArcGIS Enterprise has many different security patterns that can be utilized by organizations of all sizes. In this chapter, we will discuss several security patterns ranging from simply utilizing the ArcGIS Server built-in user store to federating ArcGIS Server with Portal, and on to enabling **Integrated Windows Authentication** (**IWA**) and ultimately **Single Sign-On** (**SSO**). Security is a very deep subject, full of an astounding number of details. Covering every aspect surrounding security in ArcGIS Enterprise would constitute a book of its own; however, when we are finished with this chapter, you will understand the following:

- The fundamentals of security and identity stores in ArcGIS Enterprise
- What different security patterns are available with ArcGIS Enterprise and the pros and cons of each
- Why...

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Security basics

I'm going to say this again--security is a big deal; it's a big deal regardless of the size or nature of your organization. Whether you are an international organization of 20,000 people or a small business of 10 people, if you discount the security and integrity of your systems, it's not a matter of *if* you will be compromised, but *when*.

Now, I'm not trying to fearmonger, I'm simply stating the facts--there are parties that will compromise your system for no reason other than the fact that *they were able to do it*. As an administrator, it is your job to do everything within your powers and abilities to keep those parties from infiltrating your system.

Password strength

When talking security, little things can make a big difference. Passwords are one of those things. Considered by most to be a necessary evil, passwords are an essential first line of defense to your system and are the most widely used form of authentication throughout the world. We all know our passwords should be *strong*, but what does that really mean?

Password entropy

Password entropy is the measurement of how unpredictable a password is and is based on...

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ArcGIS Server security

Now that we have gotten some general security items out of the way, let's discuss ArcGIS Server security.

Fundamentals of ArcGIS Server security

In an abstract sense, security is a simple concept; by securing an IT system (such as your GIS system), we are protecting it from harm, either accidental or intentional, that could come as the result of unauthorized access. With that said, let's start with looking at how ArcGIS Server is initially configured upon post-installation, and ways we can further strengthen the security of the deployment.

The post-installation scene

After a fresh new installation of ArcGIS Server, you have a simple system:

- There is only one account in ArcGIS Server--the primary site account (PSA) that was specified upon site creation
- All admin and publishing services are secured
- All services are publicly accessible (no security is set up yet, so any service that gets published is open to the public by default)

For an internal-only development or testing environment that is not public-facing, these settings can be sufficient. However, for any production, public-facing or a highly-secured...

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Portal security

Portal is the window into your GIS system and has many settings for keeping it secure.

Fundamentals of Portal security

Security for Portal for ArcGIS is just as important as ArcGIS Server security. Portal is just that, a portal into your data, services, maps, and applications.

Web-tier authentication

Web-tier authentication occurs at the web server tier. If your organization uses Active Directory, you can use IWA to enable an automatic or single sign-on experience through web-tier authentication using the ArcGIS Web Adaptor for **Internet Information Services** (**IIS**). Likewise, if your organization uses LDAP, it can be used with ArcGIS Server with your Web Adaptor deployed to a Java application server such as Apache Tomcat or IBM WebSphere.

> ## Note
>
> With web-tier authentication, administration must be allowed through the Web Adaptor. This allows users in the enterprise identity store to publish services from ArcGIS Desktop on their local PCs. To publish, they must connect to ArcGIS Server using the Web Adaptor URL.

The post-installation scene

Like with ArcGIS Server, Portal has a standard security setup after installation, as...

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Using Portal with ArcGIS Server

Portal for ArcGIS became an integral piece of ArcGIS Enterprise starting at the 10.5 release, making it more practical than ever to use Portal with ArcGIS Server.

Benefits

If you've used ArcGIS Server and ArcGIS Online for any amount of time, it's easy to see how combining the powers of Portal with ArcGIS Server can make for easier administration. Using Portal with ArcGIS Server provides the following benefits:

- Portal can help you organize your content and enables discovery within not only your organization, but outside of it as well, using galleries, groups, and searching.
- Portal can help control access to your ArcGIS Server services. This is known as **federation** and is a big deal these days. We will discuss this further later in this chapter.
- Portal can help your organization reach a wider audience by publishing data, maps, and ultimately apps out as web services. Again, discoverability.

Let's look at some of the ways Portal can be used with ArcGIS Server.

Integration

Like many other features of ArcGIS Enterprise, Portal and ArcGIS Server can be integrated at various levels, depending on your...

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Updates

Another oftentimes ignored and always annoying security-related task is software and operating system updates. No one likes them, everyone is bothered by them, and most of us put them off like a trip to the dentist. Windows updates especially seem to be the worst about this. I can't tell you how many times I've had Windows updates seemingly start on their own at the worst possible time, like when trying to shut my system down before boarding a plane at the last second. And don't even get me started about Microsoft Office for Mac, but that's a whole other story.

In all seriousness, keeping your software and operating system up-to-date is important for several reasons, as updates do the following:

- Add new features
- Remove old features
- Update drivers
- Deliver bug fixes--important
- Fix security holes--the most important

Running old or even not-so-old but unpatched software can be a dangerous game to play, *trust me*. Remember, earlier in this chapter when I said it's not a matter of *if* you will get compromised, but when, and perhaps even for no real reason? Let me tell you a story.

Years ago, probably a good 13 or so now, I had a personal...

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Lefkovitz, N.B. and Danker, J.M., Privacy Authors, NIST Special Publication 800-63B, Digital Identity Guidelines, Appendix A - Strength of Memorized Secrets. National Institute of Standards and Technology, https://pages.nist.gov/800-63-3/sp800-63b.html#SP800-131A, retrieved 9/6/2017.

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Summary

Security reigns supreme in any IT system; ignore it and you will pay the consequences. We started this chapter with some security basics on the importance of password strength and management. Next, we dug into how ArcGIS Server security is initially configured and what can be done to further secure it, covering some security best practices and the identity stores and authentication methods that can be employed by ArcGIS Server. We did the same for Portal security next, covering some best practices, identity stores, authentication, and how to implement Integrated Windows Authentication. The different methods to integrate ArcGIS Server with Portal were discussed along with why and how to federate ArcGIS Server with Portal. Finally, we ended the chapter with a short discussion on the importance of applying software updates to your system. Next up in Chapter 7, *Scripting Administrative Tasks* we will roll up our sleeves and look at how we can use Python to script ArcGIS Enterprise administration.

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Chapter 7. Scripting Administrative Tasks

As an administrator, you will more than likely be responsible for your entire GIS system--infrastructure, such as application servers, database servers, web servers, and all the software, data, and processes that go along with that infrastructure. Having all of this to deal with, you need to be crafty and come up with as many ways as possible to save time and effort, and this is where scripting comes into play. Python (https://www.python.org) has quickly become the de facto standard scripting language of the Esri platform. Considering that Python is literally everywhere in the ArcGIS Enterprise ecosystem (and many other non-Esri systems as well for that matter), knowing how to script with Python is a necessary skill for almost anyone doing any sort of technical work with ArcGIS Enterprise.

This chapter assumes some familiarity and experience with Python. If you are new to Python, there are resources on the internet to help you in the form of tutorials, blogs, and discussion forums. This chapter will cover using Python 2.x with the Esri `arcpy` and `portalpy` modules. We will also use Node.js...

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Working with data

Data is something that nearly everyone works with daily. As an administrator, you might not work with data as much as others, but there are plenty of administrative tasks that revolve around data.

Loading data into a geodatabase

Loading data into geodatabases may or may not fall under your duties as an ArcGIS Enterprise administrator, but the following script demonstrates a few handy Pythonic methods. This is also a common task that can take on many forms. For our example here, we will simulate the loading of data from an enterprise geodatabase into a publication file geodatabase. Let's say that our web services do not have access to the enterprise geodatabase, so we need a read-only copy of that data that can hydrate our web services. However, we cannot have stale, out-of-date data in our publication geodatabase, so we need the publication data updated every day. This is a perfect example of a need that can be met with Python and `arcpy`.

Before we get into the script, there is a helper input file required for this script. As we see will soon in our script, with Python it is incredibly easy to read a text file into...

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Working with ArcGIS Server services

We've talked about services at great length so far, but let's turn our attention to working with those services programmatically. Anyone can go to a REST endpoint and click and pick around; let's look at how we can dig a bit deeper to get more out of our services.

Interrogating a REST endpoint with curl and Node.js

A couple of years back, I needed to interrogate some services at a REST endpoint to get information about the fields and aliases in the service layers. What I really needed was a list of each field name and its alias, preferably separated by a comma; basically, I wanted a CSV file. Something made me think of using curl (https://curl.haxx.se) to query the REST endpoint to get at the JSON behind the service, but then I had to parse the JSON. Well, the JSON format is based on a subset of the JavaScript programming language, so I wondered if Node.js could parse the JSON. I eventually ran across the `json` npm package, which is a command-line tool for working with JSON. To follow along, you will need to do the following:

1. Install curl from https://curl.haxx.se/download.html. Scroll down to the...

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ArcGIS Server error monitoring and reporting

Monitoring and reporting have always been a shortcoming of ArcGIS Server; there just really isn't any sort of out-of-the-box notification system to let you know when things are not going smoothly. We discussed the ArcGIS Server logs in Chapter 4,*ArcGIS Server Administration*, and how they can be accessed through ArcGIS Server Manager, but that's the problem--to check the logs, you must log into the Server Manager, query the logs, and view the results. Do you *really* have time to do that every day? I didn't think so. Let's look at a script that queries the ArcGIS Server logs for you and not only reports back the results, but it sends them to you in an email. This script is adapted from an example script by Esri that reports map draw events. The original script can be found at http://server.arcgis.com/en/server/latest/administer/windows/example-query-the-arcgis-server-logs.htm or by searching the ArcGIS Enterprise online documentation for **`example: query the arcgis server logs`**. Our modified script, `query_logs.py`, can be found on GitHub at https://github.com/chadcooper/mage. Let's cover the...

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Working with Portal through Python

Since the ArcGIS APIs are RESTful, they can be programmatically accessed by any language that can make a web request. Python makes this very simple to do, and for that reason, virtually, all code samples that you will find from Esri are in Python, as are their wrapper libraries.

PortalPy

PortaPy is a Python 2.7 module written by Esri that installs with Portal into the Portal installation directory on your Portal server but is also available on Esri's GitHub account (https://github.com/Esri/portalpy). PortalPy can run from any machine with Python 2.7 installed, meaning you can configure this on your local PC that more than likely has ArcGIS Desktop installed, which comes with Python 2.7.x.

Installation and configuration

To work with `PortalPy` from your local PC, you'll have to install the module. To do so, complete the following steps:

1. On your PC, create a directory called `portalpy` (mine is `C:\Projects\portalpy`).
2. Go to the `Esri GitHub portalpy` repository and download `PortalPy`. Unzip the archive so `portalpy.py` sits at the root of the `portalpy` directory you just created on your local PC.
3. On your PC, create...

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Summary

We covered a lot of ground in this chapter. Knowing how to use scripting to your advantage is quickly shifting from being a non-essential, nice to have talent to a required skill for technical GIS positions. Hopefully, after reading this chapter and seeing just a few of the many ways Python can be used to script within the ArcGIS ecosystem, it's easy to see why Python skills are so important. From geodatabase administration to ArcGIS Server to Portal, all have administrative tasks that can be scripted with Python. With the REST API, if it can be reached through a URL, it can be scripted. The Python Standard Library has everything needed to query our ArcGIS Server logs and send emails with error reports (my favorite part of this chapter). We also looked at the Portal for the ArcGIS command-line utilities and how to utilize them to create Portal users programmatically. Next, in Chapter 8, *The ArcGIS Python API*, we will use the ArcGIS API for Python, a very powerful library to access and work with your GIS. I feel the ArcGIS API for Python is one of the most exciting things to come out of Redlands in quite a few years, and...

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Chapter 8. The ArcGIS Python API

The beta 2 version of the ArcGIS API for Python was released in September 2016. Since then, there have been several more releases leading up to the 1.2.4 version that is available at the time of this writing. Esri describes the API as "*a powerful, modern, and easy to use Pythonic library to perform GIS visualization and analysis, spatial data management and GIS system administration tasks that can run both in an interactive fashion, as well as using scripts*". The API was designed with analysts, developers, power users, content publishers, administrators, and data scientists in mind and allows full access to your web GIS. In this chapter, we will cover how to install, configure, and use the ArcGIS API for Python. We will look at how to use the API to do the following:

- Changing web map service URLs
- Creating a web map inventory
- Replicating content
- Managing users and groups
- Working with features

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What is the ArcGIS API for Python?

The ArcGIS API for Python was conceived at the 2015 Esri International User Conference. The project, codenamed **Geosaurus**, was initiated to design and implement a Pythonic web GIS API that would be powerful, modern, and easy to use. So, what exactly does that mean?

Let's look at some of the defining terms and how they relate to the usability of the API:

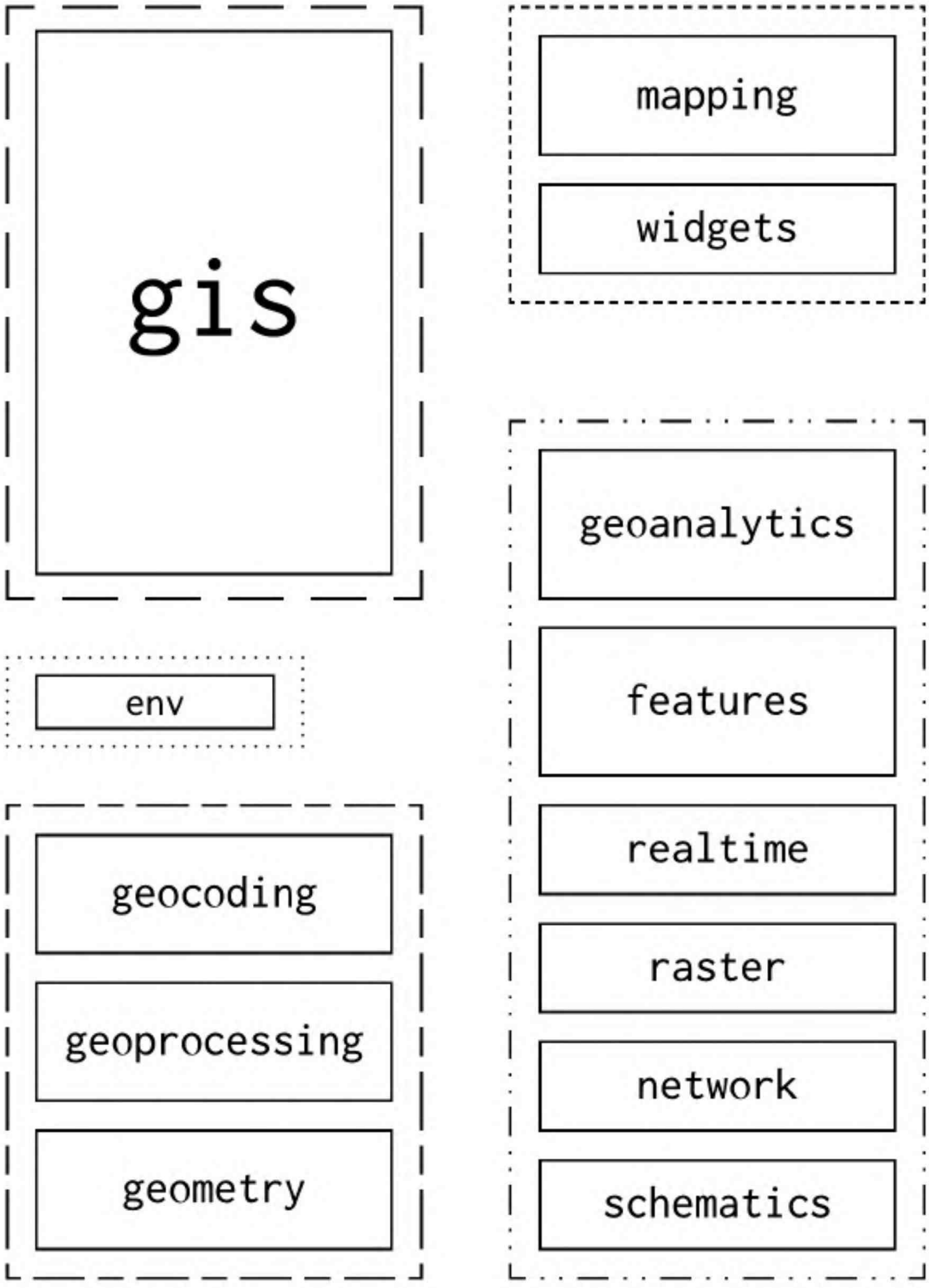
- **Powerful**: The API is powerful, in that it allows you to work with all aspects of your web GIS, where a web GIS can be either ArcGIS Online or Portal for ArcGIS. With the API, you can create, manage, and use GIS resources such as web layers, web maps, users, and groups.
- **Modern**: The API is modern, in that it is built for Python 3 and integrates easily with libraries such as pandas, NumPy, and the SciPy ecosystem of libraries.
- **Easy to use**: Ease of use is one of Python's greatest virtues, and Esri went to great strides to build the API with usability in mind.
    - **Interactivity**: The API comes ready to work well within the Jupyter Notebook (http://jupyter.org/), which is an open source web application where you write and execute live code, visualizations (web...

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How the API is structured

The API is contained in and distributed as the `arcgis` package. The `arcgis` package is composed of 13 (at the time of this writing) modules, each one focused on a different aspect of the GIS. The following diagram shows the modules and how they can be grouped together by functionality:

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Let's briefly discuss what each of these modules does for us:

- **gis**: This provides an entry point in the GIS hosted within ArcGIS Online or Portal for ArcGIS. It manages users, groups, and content. It's a very important module for

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administrators.

- **env**: This stores environmental and global settings, such as the currently active GIS, the default geocoder, and output spatial reference.
- **geocoding**: This provides functionality for geocoding.
- **geoprocessing**: This allows us to import geoprocessing toolboxes as native Python modules, making the functions in the tools callable.
- **geometry**: This provides functions for working with geometries and converting them between different representations.
- **mapping**: This provides components for visualization and analysis with web maps, web scenes, and map image layers.
- **widgets**: This is also for visualization...

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Getting set up to use the API

There are several ways to use the ArcGIS API for Python, either through an interactive live Sandbox or by installing it in your environment in one of several ways. Let's discuss a few of the more common installation methods.

Note

The ArcGIS API for Python has no Esri software dependencies (such as is the case with `arcpy`, where you must have Desktop or ArcGIS Server installed), so it can be installed on Windows, macOS, or Linux.

Try it live

Many of you may be familiar with the ArcGIS Solutions Gallery (http://solutions.arcgis.com/gallery), formerly known as *Try It Live*, a collection of live sample sites and applications provided by Esri. The ArcGIS Solutions Gallery is a great place to find and sample hundreds of ready-to-use applications, products, and solutions from Esri. The ArcGIS API for Python has a similar offering, a live Sandbox in the form of a temporary Jupyter Notebook browser session environment that can found at https://notebooks.esri.com/. Here, you can browse through sample code, view guides, and view API presentations and their content. For anyone getting started with the API, this...

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Working with services

As an administrator, you will need to manage services of all sorts. We've already covered methods of administering services using ArcGIS Server Manager and with the REST API. In this section, we'll look at ways to work with services and items through the ArcGIS API for Python.

Changing web map service URLs

The web is a dynamic environment, there's no denying that. Consequently, URLs to resources you reference in your applications are going to change. When they are your URLs, you usually know about it in advance and can have time to plan for the change. The big surprises come when a URL to an item that isn't yours changes. You usually find out about these through a phone call or email from a user telling you that your application is busted. So, what's an admin to do in a case like this? We've looked at ways to handle URL changes with ArcGIS Online Assistant. However, accomplishing this same task with the ArcGIS API for Python is easy to do as well.

Let's say that we have some older web maps that reference externally-facing ArcGIS Server services that, at one time, were served out over HTTP, but the provider has...

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Working with users and groups

We've covered working with services and items such as web maps, but you'll also need to manage users and groups as well. Examples we have utilized so far in this chapter have shown how the ArcGIS API for Python abstracts away much of the minutiae of connecting to Portal or ArcGIS Online and allows you to just get to work. User and group management is no different; we connect just as we have in previous examples to gain access.

Managing users

In Chapter 7, *Scripting Administrative Tasks*, we used PortalPy to pull user information out of our Portal. We can do the same thing with the ArcGIS API for Python, but in a modern, Pythonic fashion. Let's look at how we can easily pull user information from Portal:

```
import collections
import time
import pandas as pd
from arcgis.gis import GIS
```

After we've imported the libraries we will need, we create a connection to our GIS and then perform a search for users whose username does not begin with `esri_`. Note how we use the bang (`!`) symbol as a `NOT` operator:

```
gis = GIS("https://www.masteringageadmin.com/portal",
          "portaladmin",...
```

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Working with features

Earlier in this chapter, we briefly covered all the modules in the ArcGIS API for Python. Many of these modules are geared toward analysts and data scientists, but, as an administrator, you will still occasionally get your hands in some data processing. The ArcGIS API for Python has capabilities to both update and overwrite feature layers.

Publishing and overwriting a feature layer

In this example, we will use an Excel workbook to keep track of project locations and statuses. We will then push a worksheet from that workbook out to CSV and update a hosted feature service with that CSV. A scenario like this allows end users to update the feature service using an existing (and very common) workflow, keeping track of data, assets, and so on, in an Excel workbook. Users will be updating the feature service without even knowing they are doing so, simply by keeping the Excel worksheet up-to-date. Let's look at how this code will be laid out.

Publishing the initial feature layer

First, we will import the libraries we need and connect them to our GIS instance, as follows:

```
import pandas as pd
from arcgis.gis...
```

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Summary

For anyone working with Python on the Esri platform, the ArcGIS API for Python is one of the most exciting things to come along in quite a few years. The API is well-structured, easy to set up, and even easier to use. By abstracting away much of the overhead typically involved in working with the REST API, the ArcGIS API for Python allows you to get more done with less code in less time. In this chapter, we looked at how to get set up to use the API. We also wrote code to change map service URLs and create a web map inventory. We scratched the surface of the pandas library, showing how to use DataFrames, one of the most prevalent data structures in pandas, to not only display data in a Jupyter Notebook but also how to use DataFrames as methods to move data into the GIS. Next, we looked at ways to interrogate users and groups in the GIS and methods to work with and manage them. Finally, we looked at how the ArcGIS API for Python lets us work with features and how easy it is to translate data from an Excel workbook to a feature service in the GIS. The ArcGIS API for Python is the future of Python on the Esri...

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Chapter 9. ArcGIS Enterprise Standards and Best Practices

Standards and best practices could easily be the second and third most important topics around ArcGIS Server, after security, of course. In fact, many of the standards and best practices we will discuss in the chapter impact security. Regardless of industry, standards and best practices are topics that no one typically wants to discuss or implement, but that everyone could benefit *greatly* from.

In this chapter, we will cover many topics, some of them briefly, some a bit more in depth. Regarding standards, we will talk about the following topics:

- Storage locations for your data and how to keep things tidy and neat
- Naming conventions for items such as the following:
    - Database connections
    - Folders
    - Services
    - Map document internals

Best practices will be a longer section, covering topics such as the following:

- Accounts and credentials
- Map documents and how to optimize settings for performance
- Map service settings and how to optimize settings for availability
- Print services' do's and don'ts
- How to make scripting easier
- Storage best practices

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Why are standards and best practices needed?

Standards and best practices are often misinterpreted as rules and let's face it, no one liked rules as a child, and no one likes them as adults. Instead of rules, think of them as guidance; guidance that can help you and your team (if you have one) work more efficiently with less frustration and confusion. A system set up and maintained with standards and best practices over the years is a much simpler system to upgrade once the newest version of ArcGIS Enterprise comes out. Also, with standards and best practices in place, it is easier to bring new employees on board and get them familiar with the environment.

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Standards

Before going any further, let's define just what exactly a standard is. A **standard** is a level of quality or attainment. When a standard is in place, it provides a target to shoot for or an expected way that something should be done. By enacting, having, and, most importantly, enforcing standards, you can make administration and management of your ArcGIS Enterprise environment all that much easier by providing consistency. Let's explore some ideas for standards and how they can affect your environment.

Storage locations

Where and how you store your data is important. No one likes to have to hunt for data, dig through directories, and no one especially likes the dreaded broken data source. With a little bit of planning and diligence, your data can be accessible and easy to get to (for those with access). The following are some things to keep in mind when storing data on disk:

- Never, ever store data in `My Documents` or anywhere under a user profile on Windows (for example, `C:\Users\ccooper\...`). Profiles get corrupted, people leave and their profiles get deleted, and, most importantly, the profile is only available to that...

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Best practices

Best practices can be defined as professional procedures that are accepted or prescribed as being correct or most effective. We've talked about best practices throughout this book without even knowing it. Let's cover some specific best practices that can help your ArcGIS Enterprise system run smoothly and efficiently.

Credentials

We covered password strength at length in Chapter 6, *Security*. Let's talk more about service accounts and some best practices around them.

Service accounts

ArcGIS Server, Portal for ArcGIS, and Data Store for ArcGIS all run as Windows services, but what exactly is a service? A service is a program that runs in the background and executes with no user interaction. Most services are typically configured to start automatically with Windows. A service account is a Windows user account that exists solely to provide a security context for a Windows service and determines the service's ability to access local and network resources. In other words, the service account that a service runs under controls what the service can and cannot access.

Esri recommends using domain-level accounts as the ArcGIS...

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Summary

Throughout this book, we have discussed ArcGIS Enterprise at length, and how to install, configure, and secure it. In this chapter, we discussed standards and best practices, which are often seen as rules, and no one likes to be told what to do. The key to working with standards and best practices is to think of them as guidance brought to you by those before you who have learned things the hard way. This is the knowledge that is being passed down to you to make your system run smoother and more efficiently. Many standards are common sense, especially those related to naming; it's enacting and sticking to the standard that requires work. Best practices are the same way; enacting and sticking with them is the only way to ensure that they work. Finally, the importance of documenting your system and workflows cannot be overstated enough; documentation is not only for others, but it is also for yourself, intended to help you remember why something was set up the way it was, for example. In the next chapter, the final chapter of this book, we will look at troubleshooting ArcGIS Enterprise issues when they arrive. Many of the...

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Chapter 10. Troubleshooting ArcGIS Enterprise Issues and Errors

Sooner or later, issues are going to come up in your ArcGIS Enterprise system. Knowing how to effectively and efficiently troubleshoot errors and issues and put out fires when they arise is an important and necessary skill of an ArcGIS Enterprise administrator. Effective troubleshooting is a fine art that can truly only be mastered with years of experience. Always keep in mind that Enterprise GIS systems are complex and intertwined, often reaching out beyond the borders of the GIS system itself. Knowing what to look for where in the system will go a long way in helping resolve issues. In this chapter, you will learn how to roll up your sleeves, dig in, and methodically, calmly, and patiently determine what is causing the issue at hand and how to best fix it.

In this, our final chapter, we will focus on the following topics:

- Using logs to help troubleshoot issues
- Different issues you may come across during installation and configuration
- Permissions issues
- Troubleshooting scripts
- Tools available to help with troubleshooting and testing

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Keeping your cool

One of the first things you must do while working on an issue is to remain calm. I fully realize that in many cases, this is much easier said than done. However, remaining calm and collected will help you focus on the task at hand. Panic, or anger for that matter, is only going to clutter your brain and cloud your judgment, decreasing your effectiveness to properly work on the issue. Likewise, limit distractions; if the issue is important enough, ignore all other emails, set your phone to silent, set your instant messenger status to do not disturb--do anything you can to improve your focus. Don't be afraid to tell (or ask politely, if the case may be) people to leave you alone as you are currently working an important issue. I work with a project manager who, when I am working on an issue on a project, will ask me "*Do you need anything from me or should I just leave you alone?*", knowing that I can work better if left to focus and I will reach out to him if I do indeed need anything from him. Remember that the key here is that you need to be able to focus on the issue to be able to resolve it as quickly and...

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Gathering information

It's not working.

You've probably heard this a few times from users. Very rarely will a user send you a message regarding an issue that tells you what they are truly experiencing with an application, dataset, and so on. Keep in mind that they aren't as intimately familiar with all the aspects and functionalities of your system; they might only use one tool in one application, so when that one facet isn't working right for them, they see it as broken, and that's fine. Part of your job is to calmly and politely walk through their workflow with them and find out exactly what they were doing when things didn't go as they expected. Sometimes, this can be done over email; sometimes, it might be best to do it over a phone call; and, sometimes you might need to look over their shoulder to watch them reproduce the issue. However you do it, you need to translate *it's not working* into some actionable information that you can then use to start working on the issue. Some things to find out from the user reporting the issue are mentioned here:

- What exactly were they doing when the error/issue occurred? Get them to describe...

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Using available resources

I've been in this line of work for quite a few years now and work on issues on regular basis. Very rarely do I come across an issue that, after a few minutes of Googling, returns no results. In other words, chances are, you aren't the first person to have this problem, so if you don't immediately know what the issue is or have a resolution, Google any error codes or messages to see what first comes up. With Esri error codes, you can usually search for something like `esri 001369`, where `001369` is the error code you are dealing with. Be careful here though, as you can riffle through dozens and dozens of help forum posts for certain errors (such as `001369` mentioned earlier) and get absolutely nowhere, as some error codes and messages can be ambiguous or even a red herring for something else that is actually going on. If you start to see lots of help forum posts on the error code or message, but the cases reported seem to be all over the place and there are no real solutions, step back and reassess. It's very easy to get sucked into reading these and it ends up being a complete waste of time as you get no...

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Using the logs

We have discussed this already, but I'll reiterate--the most important thing to remember about using ArcGIS Server and Portal for ArcGIS logs is to *remember to check them*. Now, just because an issue or error is being experienced doesn't necessarily mean that a SEVERE event will get logged, or even a warning for that matter. When this happens, change the log level to VERBOSE or perhaps even DEBUG, repeat the workflow that is causing the issue, and see if anything interesting gets logged that could be a precursor to the actual error you are trying to track down.

Note

Always remember to change your log level back to your default setting after you change it for troubleshooting purposes.

In Chapter 4, *ArcGIS Server Administration*, and Chapter 5, *Portal for ArcGIS Administration*, we covered logging administration. Let's discuss using the logs a little more.

ArcGIS Server logs

The best way to view the ArcGIS Server logs is to log in to **`ArcGIS Server Manager`** as an administrator and go to **`Logs`** in the header menu. This takes you to the **`View Log Messages`** page where you can query the logs by level, time, source, and machine.

Let's...

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Tracking issues

Keeping track of issues that occur within your system can be a lifesaver. The software for doing this is commonly referred to as an **issue tracker**. There are plenty of issue trackers out there to choose from; some are open source and free, some are fee-based commercial but are products. At GISinc, all of our teams use an enterprise issue tracker, and it is downright indispensable for our team. Some reasons to consider using an issue tracker include the following:

- **Accountability**: With issues logged over time, you have a record of what you have been dealing with and spending your time on.
- **Historical reference**: Logging issues consistently and with details gives you a reference to look back through. This could, quite possibly, be the most important reason to have an issue tracker. I can't tell you how many times I've had an issue come up, only to ask myself *Haven't we seen this before?*. I search through the issue tracker for the error code or message, and sure enough, there's a past issue with the same error, often with a resolution.
- **Transparency**: Other individuals within your organization who can see what is going on can...

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Installation and configuration issues

Sometimes, unfortunately, it seems like you cannot even get your system up and running initially without running into issues. The ArcGIS Enterprise ecosystem is much more complex and involves many more components than it did just a few years ago.

To get your system initially set up, all these components need to communicate with one another to work together. Here are some items to be aware of when doing your initial configuration of ArcGIS Enterprise.

Web Adaptor issues

Issues can arise from incorrect configuration of your Web Adaptors for both ArcGIS Server and Portal. If you can access a resource bypassing the Web Adaptor (getting to the ArcGIS Server REST endpoint over port 6443 or Portal over port 7443, for example), chances are your **`Web Adaptor`** needs to be reconfigured or perhaps even uninstalled/reinstalled. Let's consider a Portal Web Adaptor that perhaps isn't functioning as expected. To get to your Portal **`Web Adaptor`**, follow these steps:

1. Log on to your **`Portal Admin`** as an administrator.
2. Go to **`System`** | **`Web Adaptors`** | **`<web adaptor ID>`**, and you will see something like the following. Note the

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Permissions issues

Like any other complex system that is constantly accessing resources, ArcGIS Enterprise relies on having proper access to these required resources. Permissions errors are by far some of the most prevalent sources of issues with ArcGIS Enterprise and they also happen to be some of the most difficult to diagnose. What's worse is that permissions issues typically spring up out of nowhere; one day things are working fine, the next day, your entire site is down.

What to look for

With permissions issues, look for anything that might seem like it's related to ArcGIS Server not being able to access something it needs. Permissions issues can manifest in a multitude of ways, but some to look for include the following:

- The ArcGIS Server Windows service will not start (has the password on the ArcGIS Server account expired?)
- ArcGIS Server services will not start (permissions on the configuration store could be out of sorts)
- ArcGIS Server services cannot be stopped nor deleted (configuration store permissions)

What to do to fix permissions issues

Just like with any other error, you want to ask yourself *Did anything change to...*

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Web browser considerations

Ever since the days of Netscape Navigator and well, any version of Internet Explorer, dealing with web browsers and their different acceptances of standards, bugs, and quirks has been a challenge.

If you've ever done any sort of web development or design work, you know how important it is to test your sites in multiple browsers. Sometimes things look or even behave or function differently, usually not for the better. Well, the same goes in GIS. Got something in an application that you think should look right, but it just doesn't? Try another browser and see what you get.

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Passwords

We've talked at great length about passwords throughout this book multiple times, so much in fact that you're probably sick of hearing about them. Here's one last tip:

Make sure you are using the right password.

Not able to access something and you're stumped as to why? Step back and make sure you are using the right password. For that matter, make sure you are using the right username as well. I cannot tell you how many times I have done this over the years, and every time I feel just as ridiculous as the first time. Sometimes all you can do is laugh about it. Seriously, though, the more credentials you have in your collection, the more confusing it gets, and the easier it is to use the wrong ones. Again, this is where a password manager can really save your sanity and up your bus factor as well. By utilizing a password manager, you can use shortcut keys to copy/paste passwords without even having to really know them.

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Scripts

As we discussed earlier, scripting is a vital component to an efficient, smooth-running Enterprise GIS system. Scripts, however, typically rely on inputs and outputs that are fixed and well-known; once something goes wrong with those inputs or outputs, errors can start to pop up. Knowing how to best evaluate, diagnose, and resolve script issues quickly is an important skill for any ArcGIS Enterprise administrator.

Troubleshooting in production

Before we go any further here, let's discuss where you should troubleshoot. When something goes wrong with your scripted process in production, you may be tempted to quickly try and troubleshoot the problem there, in your production environment.

Note

Be very careful troubleshooting in production!

Troubleshooting an issue in production can be risky. I'm not going to say not to do it because many GIS shops only have production and don't have the luxury of test and development environments. However, if you must troubleshoot in production, try to isolate your outputs as much as you can.

For example, if your script writes data out to your production enterprise geodatabase, try to have a second...

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Tools to help you

Most of the time, unless the issue at hand is immediately resolvable, you will need a tool or utility of some sort to help you determine what is going on with your issue. We've already discussed using logs, `print` statements, and debuggers to help you resolve issues, but what do you do when the issue is with a web application or a call to a web service? There are plenty of ways to tackle those issues as well; let's take a look at a few.

Browser dev tools

All modern browsers now come with some flavor of development tools, or *dev tools* as they are commonly referred to. With dev tools, you can perform a variety of tasks, such as view the source of a page, debug and step through the code of a site, or watch network traffic to see what happens as the code executes, to name a few. Internet Explorer, Firefox, and Chrome, all have dev tools, but here we will be discussing Chrome's dev tools, as they are some of the easiest, most complete, and most intuitive to learn and use.

Note

Don't let the dev tools intimidate you. My son was inspecting pages and checking out the JavaScript behind them in Chrome when he was in the fourth...

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Outage and issue scenarios

Now that we have talked about some of the more common issues you might see and ways to address them, let's play through a scenario that could and does happen in the real world. We will look at a situation where a user tells you that your website is down.

Scenario - the website is down

If this hasn't happened to you already, it will soon enough; a user sends you an email that says nothing more than `The GIS website is down`. What's the first thing to do in this situation? Anyone remember? That's right--don't panic. Now that we've kept our cool, let's work our way through this issue.

Note

What we are about to cover is, by no means the absolute right way to troubleshoot an issue, as there is no silver bullet when it comes to this sort of a task. The following scenario is meant more to provide ideas on the many avenues that can be taken when troubleshooting ArcGIS Enterprise issues.

Vague and ambiguous emails like this from users are often the norm. Remember that your users are using your applications for specific reasons, so no two users view those applications in the same light. That said, you must first...

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Summary

Errors happen, even in the best kept and most well-groomed of environments. Being prepared, remaining calm, assessing the situation, and determining the best path to take to resolution are all key to quickly and effectively solving ArcGIS Enterprise issues when they arise. In this, our final chapter, we pooled a vast array of knowledge together that we discussed throughout this book. Becoming a master troubleshooter takes time; the more issues you see, the better you will become at recognizing, diagnosing, and resolving them. Always remember to stay calm and focused, gather as much information as you can, and check your logs. When those don't quite cut it, remember there is a wide selection of tools out there that can help you save time and get your ArcGIS Enterprise environment back up and running smoothly again.

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