Fundamentals of Azure

Second Edition

Microsoft Azure Essentials

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PUBLISHED BY

Microsoft Press

A division of Microsoft Corporation

One Microsoft Way

Redmond, Washington 98052-6399

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ISBN: 978-1-5093-0296-3

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*To my wife, Sonja, and sons, Aidan and Logan; I love you more than words can express. I could not have written this book without your immense support and patience.*

—Michael S. Collier

*I dedicate this book to the many people who helped make this the best book possible by reviewing, discussing, and sharing their technical wisdom. I especially want to mention Neil Mackenzie, who is always willing to share his encyclopedic knowledge of Azure with me, and whose tech reviews were incredibly helpful. I’d also like to mention Jennelle Crothers, without whom networking would be a complete mystery to me.*

—Robin E. Shahan

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Introduction

Microsoft Azure is Microsoft's cloud computing platform, providing a wide variety of services you can use without purchasing and provisioning your own hardware. Azure enables the rapid development of solutions and provides the resources to accomplish tasks that may not be feasible in an on-premises environment. Azure's compute, storage, network, and application services allow you to focus on building great solutions without the need to worry about how the physical infrastructure is assembled.

This book covers the fundamentals of Azure you need to start developing solutions right away. It concentrates on the features of the Azure platform that you are most likely to need to know rather than on every feature and service available on the platform. This book also provides several walkthroughs you can follow to learn how to create VMs and virtual networks, websites and storage accounts, and so on. In many cases, real-world tips are included to help you get the most out of your Azure experience.

In addition to its coverage of core Azure services, the book discusses common tools useful in creating and managing Azure-based solutions. The book wraps up by providing details on a few common business scenarios where Azure can provide compelling and valuable solutions, as well as a chapter providing overviews of some of the commonly used services not covered in the book.

Who should read this book

This book focuses on providing essential information about the key services of Azure for developers and IT professionals who are new to cloud computing. Detailed, step-by-step demonstrations are included to help the reader understand how to get started with each of the key services. This material is useful not only for those who have no prior experience with Azure, but also for those who need a refresher and those who may be familiar with one area but not others. Each chapter is standalone; there is no requirement that you perform the hands-on demonstrations from previous chapters to understand any particular chapter.

**Assumptions**

We expect that you have at least a minimal understanding of virtualized environments and virtual machines. There are no specific skills required overall for this book, but having some knowledge of the topic of each chapter will help you gain a deeper understanding. For example, the chapter on virtual networks will make more sense if you have some understanding of networking, and the chapter on databases will be more useful if you understand what a database is and why you might use one. Web development skills will provide a good background for understanding Azure Web Apps, and some understanding of identity will be helpful when studying the chapter on Active Directory.

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This book might not be for you if…

This book might not be for you if you are looking for an in-depth developer or architecture-focused discussion on a wide range of Azure features, or if you are looking for details on other public or private cloud platforms.

Organization of this book

This book explores six foundational features of the Microsoft Azure platform, along with insights on getting started with Azure, management tools, and common business scenarios. This book also includes a chapter with overviews of some of the more commonly used services, such as HDInsight (Azure’s Hadoop service) and Service Bus, but there are many services in the Azure platform that are not in the scope of this book, such as Azure Batch, Data Lake Analytics, and Azure DNS, just to mention a few. To learn about all of the services available in the Azure platform, start your journey at http://azure.microsoft.com. Also, there is a web application that shows the many services of Azure and allows you to drill down to learn move. See http://aka.ms/azposterapp.

The topics explored in this book include:

∙ **Getting started with Azure**: Understand what cloud computing is, learn about Azure Resource Manager and Role-Based Access Control, visit the management portals, learn about billing, find out how you can contribute to the Azure documentation and code samples.

∙ **Azure App Service and Web Apps**: Learn about the Azure App Service, consisting of Web Apps, Logic Apps, Mobile Apps, API Apps, and Function Apps. We will focus on Web Apps and how they work with the App Service and App Service plans, covering the topic from deployment to monitoring and scaling.

∙ **Virtual Machines**: Explore the basic features of Azure Virtual Machines, including how to create, configure, and manage them.

∙ **Storage**: Read about the basics of Azure Storage, including blobs, tables, queues, and file shares, as well as some of the options available such as Premium Storage and Cool Storage.

∙ **Virtual Networks**: Learn the basics of virtual networks, including how to create one, and why a virtual network might be necessary. This also covers site-to-site and point-to-site networking, as well as ExpressRoute.

∙ **Databases**: Explore two relational database options available in Azure: Azure SQL Database and SQL Server in Azure Virtual Machines.

∙ **Azure Active Directory**: Explore basic features of Azure AD, including creating a directory, users and groups, and using the application gallery.

∙ **Management Tools**: Explore three common tools for working with Azure: Visual Studio 2015 and the Azure SDK, Azure PowerShell cmdlets, and the Cross-Platform Command-Line Interface

∙ **Additional Azure services**: Get an overview about Azure services not covered in the book that may be fundamental to you now or in the future, such as Azure Service Fabric and Azure Container Service.

∙ **Business Scenarios**: Explore five common scenarios for utilizing Azure features: development and test, hybrid, application and infrastructure modernization, and Azure Mobile Apps, and Machine Learning.

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Conventions and features in this book

This book presents information using conventions designed to make the information readable and easy to follow:

∙ To create specific Azure resources, follow the numbered steps listing each action you must take to complete the exercise.

∙ There are currently two management portals for Azure: the Azure portal at https://portal.azure.com and the Azure classic portal at http://manage.windowsazure.com. In most cases, the book uses the Azure portal, but the Azure classic portal may be used for those features that have not been migrated to the newer portal yet, such as Azure Active Directory.

∙ Boxed elements with labels such as “Note” or "See Also" provide additional information.

∙ A plus sign (+) between two key names means that you must press those keys at the same time. For example, “Press Alt+Tab” means that you hold down the Alt key while you press Tab.

∙ A right angle bracket between two or more menu items (e.g., File Browse > Virtual Machines) means that you should select the first menu or menu item, then the next, and so on.

System requirements

For many of the examples in this book, you need only Internet access and a browser (Internet Explorer 10 or higher) to access the Azure portals.

Chapter 2, "Azure App Service and Web Apps," and Chapter 4, "Azure Storage," use Visual Studio to show concepts used in developing applications for Azure. For these examples, you will need Visual Studio. The system requirements are:

∙ Windows 7 Service Pack 1, Windows 8, Windows 8.1, Windows 10, Windows Server 2008 R2 SP1, Windows Server 2012, or Windows Server 2012 R2

∙ Computer that has a 1.6GHz or faster processor (2GHz recommended)

∙ 1 GB (32 Bit) or 2 GB (64 Bit) RAM (Add 512 MB if running in a virtual machine) ∙ 4 GB of available hard disk space

∙ 5400 RPM hard disk drive

∙ DirectX 9 capable video card running at 1024 x 768 or higher-resolution display ∙ DVD-ROM drive (if installing Visual Studio from DVD)

∙ Internet connection

After installing Visual Studio, you must also install the Azure Tools and SDK for the language of your choice from https://azure.microsoft.com/tools/.

The system requirements for the Azure SDK that are not included in the Visual Studio system requirements are as follows:

∙ IIS7 with ASP.NET and WCF HTTP Activation, Static Content, IIS Management Console, and HTTP Redirection

∙ Web Deployment Tools 2.1 or up

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∙ Internet Explorer 10 or higher

Depending on your Windows configuration, you might require Local Administrator rights to install or configure Visual Studio 2015.

Downloads

Some of the chapters in this book include exercises that let you interactively try out new material learned in the main text. Chapter 4, “Azure Storage,” has PowerShell scripts; Chapter 5, “Virtual Networks,” has PowerShell scripts and a Resource Manager template. These can be downloaded from the following page:

https://aka.ms/FundAzure2e/downloads

Follow the instructions on the target page to download the code sample files.

| **Note** To use the PowerShell scripts, you need to have Azure PowerShell installed. This article explains how to install and configure Azure PowerShell:  https://azure.microsoft.com/documentation/articles/powershell-install-configure/. |
| --- |

**Using the code samples**

The code samples are stored within a unique .ZIP file, “FundAzure2E.ZIP,” which can be downloaded to your computer and unzipped so that you can use them with the exercises in this book.

∙ Samples for Chapter 4, “Azure Storage,” are in the Chapter4\_PowerShellScripts folder in the ZIP file. This includes the PowerShell scripts for both Blob storage and File Storage. You can open, edit, and run these using the PowerShell ISE.

∙ Samples for Chapter 5, “Azure Virtual Networks,” are in the folder

“Chapter5\_PowerShellScripts\_And\_Templates.” This includes both the Resource Manager templates used to create and modify a virtual network and the PowerShell script used to create a point-to-site VPN Network. To use the Resource Manager templates, please follow the instructions provided in the chapter. You can open, edit, and run the PowerShell script with PowerShell ISE.

Acknowledgments

The Azure community is made up of many people bound together by this one technology. We are honored to be members of this community, and we thank you for your help and support. We would like to especially thank Neil Mackenzie, Mike Wood, and Mike Martin, as well as Byron Tardif, Ashwin Kamath, and Rajesh Ramabathiran from the Azure App Service team for their detailed technical reviews and feedback. All of them provided additional insights that greatly enhanced the overall quality and value of this book.

Special thanks to the team at Microsoft Press for their unwavering support and guidance on this journey. It was a pleasure to work with our editors, Devon Musgrave and Carol Dillingham. Thanks to Chris Norton for helping us through the final edit cycles.

Most importantly, we are profoundly grateful to our families and friends for their love, encouragement, and patience. Many nights and weekends were sacrificed in the writing of this book.

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Errata, updates, & support

We’ve made every effort to ensure the accuracy of this book. You can access updates to this book—in the form of a list of submitted errata and their related corrections—at:

http://aka.ms/FundAzure2e/errata

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C H A P T E R 1

Getting started with Microsoft Azure

The purpose of this ebook is to help you understand the fundamentals of Microsoft Azure so you can hit the ground running when you start using it.

With an Azure account, you can work through the demos in this book and use them as hands-on labs. If you don’t have an Azure account, you can sign up for a free trial at azure.microsoft.com. If you have an MSDN subscription, you can activate the included Azure benefits and use the associated monthly credit. You can also check out Purchase Options at https://azure.microsoft.com/pricing/purchase-options/ and Member Offers at https://azure.microsoft.com/pricing/member-offers/ (for members of MSDN, the Microsoft Partner Network, BizSpark, and other Microsoft programs).

1 CHAPTER 1 | Getting started with Microsoft Azure

What is Azure?

The following will give an overview of Azure, which is Microsoft’s cloud computing platform.

**Overview of cloud computing**

Cloud computing provides a modern alternative to the traditional on-premises datacenter. A public cloud vendor is completely responsible for hardware purchase and maintenance and provides a wide variety of platform services that you can use. You lease whatever hardware and software services you require on an as-needed basis, thereby converting what had been a capital expense for hardware purchase into an operational expense. It also allows you to lease access to hardware and software resources that would be too expensive to purchase. Although you are limited to the hardware provided by the cloud vendor, you only have to pay for it when you use it.

Cloud environments provide an online portal experience, making it easy for users to manage compute, storage, network, and application resources. For example, in the Azure portal, a user can create a virtual machine (VM) configuration specifying the following: the VM size (with regard to CPU, RAM, and local disks), the operating system, any predeployed software, the network configuration, and the location of the VM. The user then can deploy the VM based on that configuration and within a few minutes access the deployed VM. This quick deployment compares favorably with the previous mechanism for deploying a physical machine, which could take weeks just for the procurement cycle.

In addition to the public cloud just described, there are private and hybrid clouds. In a private cloud, you create a cloud environment in your own datacenter and provide self-service access to compute resources to users in your organization. This offers a simulation of a public cloud to your users, but you remain completely responsible for the purchase and maintenance of the hardware and software services you provide. A hybrid cloud integrates public and private clouds, allowing you to host workloads in the most appropriate location. For example, you could host a high-scale website in the public cloud and link it to a highly secure database hosted in your private cloud (or on-premises datacenter).

Microsoft provides support for public, private, and hybrid clouds. Microsoft Azure, the focus of this book, is a public cloud. Microsoft Azure Stack is an add-on to Windows Server 2016 that allows you to deploy many core Azure services in your own datacenter and provides a self-service portal experience to your users. You can integrate these into a hybrid cloud through the use of a virtual private network.

**Comparison of on-premises versus Azure**

With an on-premises infrastructure, you have complete control over the hardware and software that you deploy. Historically, this has led to hardware procurement decisions focused on scaling up; that is, purchasing a server with more cores to satisfy a performance need. With Azure, you can deploy only the hardware provided by Microsoft. This leads to a focus on scale-out through the deployment of additional compute nodes to satisfy a performance need. Although this has consequences for the design of an appropriate software architecture, there is now ample proof that the scale-out of commodity hardware is significantly more cost-effective than scale-up through expensive hardware.

Microsoft has deployed Azure datacenters in over 22 regions around the globe from Melbourne to Amsterdam and Sao Paulo to Singapore. Additionally, Microsoft has an arrangement with 21Vianet, making Azure available in two regions in China. Microsoft has also announced the deployment of Azure to another eight regions. Only the largest global enterprises are able to deploy datacenters in this manner, so using Azure makes it easy for enterprises of any size to deploy their services close to their customers, wherever they are in the world. And you can do that without ever leaving your office.

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For startups, Azure allows you to start with very low cost and scale rapidly as you gain customers. You would not face a large up-front capital investment to create a new VM—or even several new VMs. The use of cloud computing fits well with the scale fast, fail fast model of startup growth.

Azure provides the flexibility to set up development and test configurations quickly. These deployments can be scripted, giving you the ability to spin up a development or test environment, do the testing, and spin it back down. This keeps the cost very low, and maintenance is almost nonexistent.

Another advantage of Azure is that you can try new versions of software without having to upgrade on-premises equipment. For example, if you want to see the ramifications of running your application against Microsoft SQL Server 2016 instead of Microsoft SQL Server 2014, you can create a SQL Server 2016 instance and run a copy of your services against the new database, all without having to allocate hardware and run wires. Or you can run on a VM with Microsoft Windows Server 2012 R2 instead of Microsoft Windows Server 2008 R2.

**Cloud offering**

Cloud computing usually is classified in three categories: SaaS, PaaS, and IaaS. However, as the cloud matures, the distinction among these is being eroded.

**SaaS: Software as a service**

SaaS is software that is centrally hosted and managed for the end customer. It usually is based on a multitenant architecture—a single version of the application is used for all customers. It can be scaled out to multiple instances to ensure the best performance in all locations. SaaS software typically is licensed through a monthly or annual subscription.

Microsoft Office 365 is a prototypical model of a SaaS offering. Subscribers pay a monthly or annual subscription fee, and they get Exchange as a Service (online and/or desktop Outlook), Storage as a Service (OneDrive), and the rest of the Microsoft Office Suite (online, the desktop version, or both). Subscribers are always provided the most recent version. This essentially allows you to have a Microsoft Exchange server without having to purchase a server and install and support Exchange—the Exchange server is managed for you, including software patches and updates. Compared to installing and upgrading Office every year, this is much less expensive and requires much less effort to keep updated.

Other examples of SaaS include Dropbox, WordPress, and Amazon Kindle.

**PaaS: Platform as a service**

With PaaS, you deploy your application into an application-hosting environment provided by the cloud service vendor. The developer provides the application, and the PaaS vendor provides the ability to deploy and run it. This frees developers from infrastructure management, allowing them to focus strictly on development.

Azure provides several PaaS compute offerings, including the Web Apps feature in Azure App Service and Azure Cloud Services (web and worker roles). In either case, developers have multiple ways to deploy their application without knowing anything about the nuts and bolts supporting it. Developers don’t have to create VMs, use Remote Desktop Protocol (RDP) to log into each one, and install the application. They just hit a button (or pretty close to it), and the tools provided by Microsoft provision the VMs and then deploy and install the application on them.

**IaaS: Infrastructure as a service**

An IaaS cloud vendor runs and manages server farms running virtualization software, enabling you to create VMs that run on the vendor’s infrastructure. Depending on the vendor, you can create a VM

3 CHAPTER 1 | Getting started with Microsoft Azure

running Windows or Linux and install anything you want on it. Azure provides the ability to set up virtual networks, load balancers, and storage and to use many other services that run on its infrastructure. You don’t have control over the hardware or virtualization software, but you do have control over almost everything else. In fact, unlike PaaS, you are completely responsible for it.

Azure Virtual Machines, the Azure IaaS offering, is a popular choice when migrating services to Azure because it enables the “lift and shift” model for migration. You can configure a VM similar to the infrastructure currently running your services in your datacenter and migrate your software to the new VM. You might need to make tweaks, such as URLs to other services or storage, but many applications can be migrated in this manner.

Azure VM Scale Sets (VMSS) is built on top of Azure Virtual Machines and provides an easy way to deploy clusters of identical VMs. VMSS also supports autoscaling so that new VMs can be deployed automatically when required. This makes VMSS an ideal platform to host higher-level microservice compute clusters such as for Azure Service Fabric and the Azure Container Service.

**Azure services**

Azure includes many services in its cloud computing platform. Let’s talk about a few of them.

∙ **Compute services** This includes the Azure Virtual Machines—both Linux and Windows, Cloud Services, App Services (Web Apps, Mobile Apps, Logic Apps, API Apps, and Function Apps), Batch (for large-scale parallel and batch compute jobs), RemoteApp, Service Fabric, and the Azure Container Service.

∙ **Data services** This includes Microsoft Azure Storage (comprised of the Blob, Queue, Table, and Azure Files services), Azure SQL Database, DocumentDB, StorSimple, and the Redis Cache.

∙ **Application services** This includes services that you can use to help build and operate your applications, such as Azure Active Directory (Azure AD), Service Bus for connecting distributed systems, HDInsight for processing big data, Azure Scheduler, and Azure Media Services.

∙ **Network services** This includes Azure features such as Virtual Networks, ExpressRoute, Azure DNS, Azure Traffic Manager, and the Azure Content Delivery Network.

When migrating an application, it is worthwhile to have some understanding of the different services available in Azure because you might be able to use them to simplify the migration of your application and improve its robustness. It is impossible for us to cover everything in this book, but there are some services we felt you should know about. Chapter 9, “Additional Azure services,” provides a list of these services and a brief description of each of them.

The new world: Azure Resource Manager The Azure Resource Manager is the new methodology for deploying resources.

**What is it?**

Since it went into public preview, the Azure Service Management (ASM) deployment model has been used to deploy services. In the Azure portal, services managed with ASM are referred to as *classic*. In 2015, Microsoft introduced the Resource Manager deployment model as a modern, more functional replacement for ASM. The Resource Manager deployment model is recommended for all new Azure workloads.

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These deployment models are often referred to as *control planes* because they are used to control services, not just to deploy them. This is different from a data plane, which manages the data used by a service.

Typically, your running Azure infrastructure will contain many resources, but some of the resources will be related to one another in some way, such as all being the component services required to run a web application. For example, you might have two VMs running the web application, using a database to store data, and residing in the same virtual network. With Resource Manager, you deploy these assets into the same resource group and manage and monitor them together. You can deploy, update, or delete all of the resources in a resource group in one operation.

In this example, the resource group would contain the following:

∙ VM1

∙ VM2

∙ Virtual network

∙ Storage account

∙ Azure SQL Database

You can also create a template that precisely defines all the Resource Manager resources in a deployment. You can then deploy this Resource Manager template into a resource group as a single control-plane operation, with Resource Manager in Azure ensuring that resources are deployed correctly. After deployment, Resource Manager provides security, auditing, and tagging features to help you manage your resources.

**Why use Resource Manager?**

There are several advantages to using Resource Manager. The deployment is faster because resources can be deployed in parallel rather than sequentially as they are in ASM. The Resource Manager model enables each service to have its own service provider, and they can update it as needed independently of the other services. Azure Storage has its own service provider, VMs have their own service provider, and so on. With the ASM model, all services had to be updated at one time, so if one service was

finished and the rest were not, the one that was ready had to wait on the others before it could be released. Here are some of the other major advantages to the Resource Manager model:

∙ Deployment using templates

∙ You can create a reusable (JSON) template that can be used to deploy all of the resources for a specific solution in one fell swoop. You no longer have to create a VM in the portal, wait for it to finish, then create the next VM, and so on.

∙ You can use the template to redeploy the same resources repeatedly. For example, you may set up the resources in a test environment and find that it doesn’t fit your needs. You can delete the resource group, which removes all of the resources for you, then tweak your template and try again. If you only want to make changes to the resources deployed, you can just change the template and deploy it again, and Resource Manager will change the resources to conform to the new template.

∙ You can take that template and easily re-create multiple versions of your infrastructure, such as staging and production. You can parameterize fields such as the VM name, network name, storage account name, etc., and load the template repeatedly, using different parameters.

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∙ Resource Manager can identify dependencies in a template but allows you to specify additional dependencies if necessary. For example, you wouldn’t want to deploy a virtual machine before creating the storage account for the VHD files that are used for the OS and data disks.

∙ Security

∙ You can use the new Role-Based Access Control (RBAC) to control access to the resources in the group. For example, you can assign the Owner role to a user, giving that user full administrative privileges to those resources in the group but not to other resources in the subscription. Other roles include Reader (you can read anything except secrets) and Contributor (you can do most anything except add or revoke access).

∙ Billing

∙ To help organize all of the resources in a subscription for billing purposes, you can assign tags to each resource and then retrieve all of the billing information for a specific tag.

For example, if one department owns a web application and several related components, you can assign the same tag to all of those resources. Then, you can retrieve the billing for that department by retrieving the billing for that tag.

| **Note** If you apply a tag to a resource group, the resources in the group do not inherit that tag. You have to apply the tag to each individual resource. |
| --- |

**Maximize the benefits of using Resource Manager**

Microsoft has several suggestions to help you maximize the use of the Resource Manager model when working with your applications and components.

∙ Use templates rather than using scripting like PowerShell or the Azure Command-Line Interface (CLI). Using a template allows resources to be deployed in parallel, making it much faster than using a script executed sequentially.

∙ Automate as much as possible by leveraging templates. You can include configurations for various extensions like PowerShell DSC and Web Deploy. This way, you don’t need any manual steps to create and configure the resources.

∙ Use PowerShell or the Azure CLI to manage the resources, such as to start or stop a virtual machine or application.

∙ Put resources with the same lifecycle in the same resource group. In our example above, what if the database is used by multiple applications? If that’s true, or if the database is going to live on even after the application is retired or removed, you don’t want to re-create the database every time you redeploy the application and its components. In that case, put the database in its own resource group.

**Resource group tips**

You can decide how to allocate your resources to resource groups based on what makes sense for you and your organization. A resource group is a logical container to hold related resources for an application or group of applications. These tips should be considered when making decisions about your resource group:

∙ As noted before, all of the resources in a group should have the same lifecycle. ∙ A resource can only be assigned to one group at a time.

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∙ A resource can be added to or removed from a resource group at any time. Note that every resource must belong to a resource group, so if you remove it from one group, you have to add it to another.

∙ Most types of resource can be moved to a different resource group at any time. ∙ The resources in a resource group can be in different regions.

∙ You can use a resource group to control access for the resources therein.

**Tips for using Resource Manager templates**

Resource Manager templates define the deployment and configuration of your application. They are used to deploy an application and all of its component resources repeatedly.

You can divide the deployments in a set of templates and create a master template that links in all of the required templates.

Templates can be modified and redeployed with updates. For example, you can add a new resource or update configuration information about a resource in a template. When deployed again, Resource Manager will create any new resources it finds and perform updates for any that have been changed. You will see this in Chapter 5, “Azure Virtual Networks,” where you deploy a template defining a VNet with two subnets. Then, you add a third subnet and redeploy the template, and you can see the third subnet appear in the Azure portal.

Templates can be parameterized to allow you more flexibility in deployment. This is what allows you to use the same template repeatedly but with different values, such as VM name, virtual network name, storage account name, region, and so on.

You can export the current state of the resources in a resource group to a template. This can then be used as a pattern for other deployments, or it can be edited and redeployed to make changes and additions to the current resource group’s resources.

Here is an example of a JSON template. Deploying this template will create a storage account in West US called mystorage. This is parameterized; you can include a parameter file that provides the values for newStorageAccountName and location. Otherwise, it will use the defaults.

{

"$schema": "http://schema.management.azure.com/schemas/2015-01-01/deploymentTemplate.json#", "contentVersion": "1.0.0.0",

"parameters": {

"newStorageAccountName": {

"type": "string",

"defaultValue": "mystorage",

"metadata": {

"description": "Unique DNS Name for the Storage Account where the Virtual Machine's disks will be placed."

}

},

"location": {

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"type": "string",

"defaultValue": "West US",

"allowedValues": [

"West US",

"East US"

],

"metadata": {

"description": "Restricts choices to where premium storage is located in the US." }

}

},

"resources": [

{

"type": "Microsoft.Storage/storageAccounts",

"name": "[parameters('newStorageAccountName')]",

"apiVersion": "2015-06-15",

"location": "[parameters('location')]",

"properties": {

"accountType": "Standard\_LRS"

}

}

]

}

The classic deployment model

Let’s talk a bit about what came before Resource Manager. These resources are now referred to as *classic*. For example, you can have storage accounts, virtual machines, and virtual networks that use the classic deployment model. The classic and Resource Manager models are not compatible with each other. The classic resources cannot be seen by the Resource Manager resources, and vice versa. For example, the PaaS Cloud Services feature of Azure is a classic feature, so you can only use it with storage accounts that are classic storage accounts. The exception to that rule is that you can use classic storage accounts to host Resource Manager VMs. This will make it easier to migrate your VMs from the classic deployment model to the Resource Manager deployment model.

Note that this means you may log into the classic Azure portal and see classic resources but not see Resource Manager resources, and vice versa.

| **Note** There are two versions of the portal. The production portal is the Azure portal at https://portal.azure.com. Most features have been moved to the Azure portal, with some exceptions such as Azure Active Directory (Azure AD). The previous portal is called the classic Azure portal (https://manage.windowsazure.com), and it can still be used to manage Azure AD and to configure and scale classic resources such as Cloud Services. |
| --- |

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You can migrate your assets from the classic to the Resource Manager deployment model.

∙ For storage accounts, you can use AzCopy to copy blobs, files, and tables to a new Resource Manager storage account. Note that tables must be exported from the classic account and then imported into the Resource Manager account.

∙ For virtual machines, you can shut them down and copy their VHD file to a new Resource Manager storage account and then use the VHD file to re-create the VM.

∙ For virtual networks, you can re-create them as Resource Manager VNets.

∙ There is also a migration service that is in public preview. Microsoft recommends using this only for nonproduction workloads at this time. For more information, check out this article: https://azure.microsoft.com/documentation/articles/virtual-machines-windows-migration-classic resource-manager/

PowerShell changes for the Resource Manager and classic deployment models

Chapter 8, “Management tools,” talks about some of the tools available to use with Azure, including the Azure PowerShell cmdlets and the Azure CLI.

One of the other changes made when the Azure team created the Resource Manager model was to create PowerShell cmdlets that work just for the Resource Manager model. They did this by appending “Rm” to “Azure” in the name of the cmdlets. For example, to create a classic storage account, you would use the *New-AzureStorageAccount* cmdlet. To create a Resource Manager storage account, you would use the *New-AzureRmStorageAccount* cmdlet.

Microsoft did this so you could easily tell which kind of resource you were creating. Also, this ensures that scripts that are currently being used will continue to work. Each time you deploy a Resource Manager resource, you have to specify the resource group into which it should be placed. Also, some of the cmdlets for Resource Manager (such as creating a VM) have more details than their counterparts in the classic model.

One last note: for storage accounts, the only PowerShell cmdlets impacted are on the control plane, such as those for creating a storage account, listing storage accounts, removing a storage account, and so on. All of the PowerShell cmdlets used to access the actual objects in storage—blobs, tables, queues, and files—remain unchanged. So once you are pointed to the right storage account, you’re good to go.

Role-Based Access Control

In this section, we’ll take a look at Role-Based Access Control (RBAC) to understand how you can use it to manage the security for your Resource Manager resources.

**What is it?**

In addition to the Resource Manager deployment model that allows you to group and manage your related resources, Microsoft introduced RBAC, providing fine-grained control over the operations and scope with which a user can perform a control-plant action. The previous methodology (classic) only allows you to grant either full administrative privileges to everything in a subscription or no access at all.

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With Resource Manager, you can grant permissions at a specified scope: subscription, resource group, or resource. This means you can deploy a set of resources into a resource group and then grant permissions to one or more specific users, groups, or service principal. Those users will only have the permissions granted to those resources in that resource group. This access does not allow them to modify resources in other resource groups. You can also give a user permission to manage a single VM, and that’s all that user will be able to access and administer.

In addition to users, Azure RBAC also supports service principals that formally are identities representing applications, but informally are used by RBAC to allow automated processes to manage Resource Manager resources. To grant access, you assign a role to the user, group, or service principal. There are many predefined roles, and you can also define your own custom roles.

**Roles**

Each role has a list of Actions and Not Actions. The Actions are allowed, and the Not Actions are excluded. See https://azure.microsoft.com/documentation/articles/role-based-access-built-in-roles/ for the full list of roles and their Actions and Not Actions.

For example, there is a role called Contributor. With this role, a user can manage everything except access. This role has the following Actions and Not Actions:

∙ Actions: \* 🡪 Can create and manage resources of all types

∙ Not Action: Microsoft.Authorization/\*/Write 🡪 Can’t create roles or assign roles ∙ Not Action: Microsoft.Authorization/\*/Delete 🡪 Can’t delete roles or role assignments Let’s take a look at some of the most common roles.

∙ **Owner** A user with this role can manage everything, including access. This role has no Not Actions. This is synonymous with Co-Administrator in the classic deployment model.

∙ **Reader** A user with this role can read resources of all types (except secrets) but can’t make changes. This role will allow someone to look at the properties of a storage account, but it won’t let that person retrieve the access keys.

∙ **SQL DB Contributor** A user with this role can manage SQL databases but not their security related policies.

∙ **SQL Security Manager** A user with this role can manage the security-related policies of SQL Servers and databases.

∙ **Storage Account Contributor** A user with this role can manage storage accounts but cannot manage access to the storage accounts. This means the user with this role can’t assign any roles to any users for the storage account. Note that the user with this role *can* retrieve the access keys for the storage account, which means they have full access to the data in the storage account.

∙ **Virtual Machine Contributor** A user with this role can manage virtual machines but can’t manage the VNet to which they are connected or the storage account where the VHD file resides. Note that this role *does* include access to the storage account keys, which is needed to create the container for the VHD files as well as the VHD files themselves.

These are only a few of the many roles that can be assigned to a user, a group of users, or an application.

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**Custom roles**

If none of the built-in roles and no combination of the built-in roles provides exactly what you need, you can create a custom role. You can do this using PowerShell, the Azure CLI, or the REST APIs. Once you create a custom role, you can assign it to a user, group, or application for a subscription, resource group, or resource. Custom roles are stored in the Azure AD and can be shared across all subscriptions that use the same Active Directory.

For example, you could create a custom role for monitoring and restarting virtual machines. Here are the Actions you would assign to that role:

∙ Microsoft.Storage/\*/read

∙ Microsoft.Network/\*/read

∙ Microsoft.Compute/\*/read

∙ Microsoft.Compute/virtualMachines;/start/action

∙ Microsoft.Compute/virtualMachines/restart/action

∙ Microsoft.Authorization/\*/read

∙ Microsoft.Resources/subscriptions/resourceGroups/read

∙ Microsoft.Insights/alertRules/\*

∙ Microsoft.Insights/diagnosticSettings/\*

∙ Microsoft.Support/\*

Note that as requested, this role can only start and restart virtual machines. It can’t create them or delete them.

A convenient way to create a custom role is to download the definition of an existing role and use that as a starting point. When you create a custom role, you also need to specify in which subscriptions it can be used—at least one must be specified.

In the next section, we’ll see how to assign roles to users for a resource group and how to give full administrative privileges for a subscription to a user.

The Azure portal

An online management portal provides the easiest way to manage the resources you deploy into Azure. You can use this to create virtual networks, set up Web Apps, create VMs, define storage accounts, and so on, as listed in the previous section.

As noted earlier in this chapter, there are currently two versions of the portal. The production portal is the Azure portal at https://portal.azure.com. Most features have been moved to the Azure portal, with some exceptions such as Azure AD. The previous portal is called the classic Azure portal (https://manage.windowsazure.com), and it can still be used to manage Azure AD and to configure and scale classic resources such as Cloud Services.

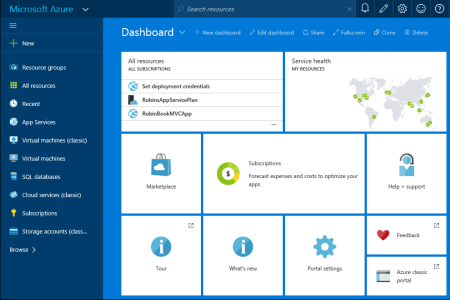
In most cases, you will be using the Azure portal, so that’s what we’re going to focus on in this book. All of the resources that use the Resource Manager deployment model can only be accessed in the Azure portal.

Let’s take a look at the Azure portal and how you navigate through it.

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**Dashboard and hub**

The Azure portal is located at https://portal.azure.com. When you open this the first time, it will look similar to Figure 1-1.

Figure 1-1 Azure portal.

This is called your Dashboard. The column on the left is called a hub; it shows you a core set of options such as Resource Groups, All Resources, and Recent. The other items on this hub are resources you have selected and/or used before. For example, I have recently created some App Services and VMs. You can click any of these, and it will show the resources you have for that type. For example, if you click SQL Databases, it will show a list of your SQL Databases.

You can customize the list of resources that show up in that left hub. If you click Browse, you will see a selection screen showing all of the options, and you can select which ones you want to appear, as displayed in Figure 1-2.

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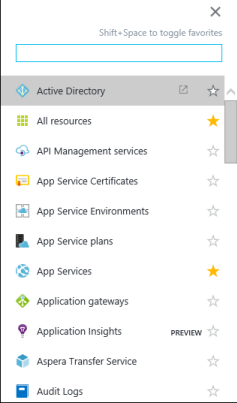


Figure 1-2 Configure default hub in the Azure portal.

The area on the right with the tiles is called your Dashboard. You can customize this by adding tiles, removing tiles, resizing tiles, and so on by selecting Edit Dashboard, as shown in Figure 1-3.

Figure 1-3 How to edit the Dashboard in the Azure portal.

As you create resources, you can choose to pin them to the Dashboard, and it will add them to this section.

There are a couple of default tiles on the Dashboard that are of interest.

∙ **All Resources** Clicking this will bring up a list of all of your resources.

∙ **Service Health** This shows the health of the regions around the world. If you click this, it will show a list of the regions, and you can select one to get more detailed information.

∙ **Marketplace** This will take you directly to the Marketplace blade where you can search for and add resources.

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∙ **Subscriptions** This shows the subscriptions that can be managed by the account you are using. You can select a subscription and see the billing information for the current month. If you have a starting credit, this will show the amount of credit left. Accounts having starting credit include MSDN accounts and BizSpark accounts.

∙ **Help + Support** This takes you to the blade where you can submit a new support request and manage the requests you have already put in. It also provides links to the MSDN forums and StackOverflow where you can post questions.

Now, let’s look at the icons in the upper-right corner of the Azure portal, as shown in Figure 1-4. 

Figure 1-4 Notifications, settings, etc. in the Azure portal.

From left to right, here’s what these icons mean:

∙ Clicking the bell shows notifications from this session. For example, if you create a new VM, when it’s finished, it will put a notification here.

∙ Clicking the pencil puts the Dashboard into edit mode, just like clicking Edit Dashboard above.

∙ Clicking the gear icon brings up the Settings screen for the portal, where you can do things like enable or disable toast notifications, set the default language, and so on.

∙ Clicking the smiley face will show a dialog you can use to send feedback to the portal team.

∙ Clicking the question mark will show a drop-down menu allowing you to create a new support request, view your current support requests, and so on.

∙ The last field shows the account you have used to log into the portal. If you administer more than one subscription, this will show the list of Azure ADs to which the user belongs. You can click this to sign out, change your password, or submit an idea.

**Creating and viewing resources**

As you make selections, the portal scrolls to the right. The separate sections that get opened are called blades.

Click New in the main hub. You see a categorized list of the resources available, as shown in Figure 1- 5. This is a new blade.

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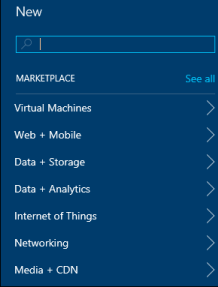


Figure 1-5 Creating a new resource in the Azure portal.

If you click See All, it will take you to the Azure Marketplace. The Marketplace contains all of the resources that you can use in Azure. This includes everything from VM images, which are certified before being made available, all of the SQL Server options, and Web Apps. It also includes applications such as Drupal and WordPress. To add any resource, you can search for it, then select it to add it to your Azure subscription.

You can also select a category on this blade. It will show the list of resources valid for that category, and you can then select which one you want to create. For example, to create a VM, you would click the Virtual Machines category; to create a storage account or a SQL Server, you would click Data + Storage.

Once you have created some resources, there are several ways to view them. Let’s look back in the main hub (Figure 1-1), which has two helpful options—Resource Groups and All Resources.

**View by resource group**

Use this option to see all of your resources by resource group. Click Resource Groups, and you see a blade like Figure 1-6 showing all of your resource groups.

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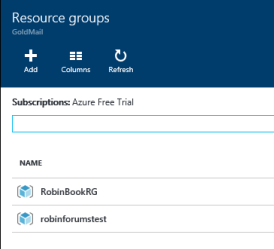
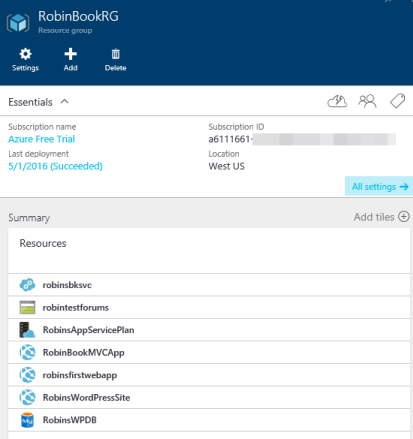


Figure 1-6 Screenshot showing all of your resource groups in the Azure portal.

Next, select one of the resource groups, and it shows all of the resources deployed to that group (Figure 1-7).

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Figure 1-7 List of resources in the selected resource group.

You can click any of the resources here, and they will be displayed in a new blade.

Click All Settings to show the Settings blade (Figure 1-8). From there, you can look at the costs by resource, view the deployment history of the resources, set tags and locks, and manage what users have access to this resource group.

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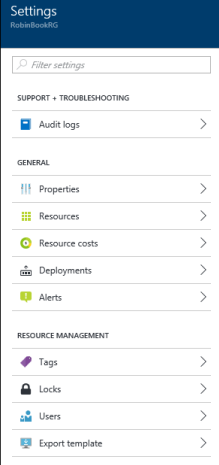


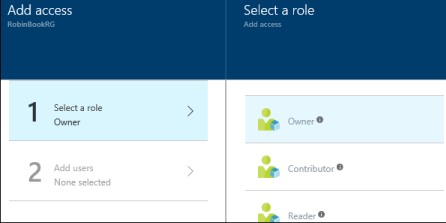
Figure 1-8 Settings blade when looking at resources in a resource group.

This is where you can use RBAC to control access to all of the resources in the same resource group at one time by assigning roles to users. The user has to be set up in the Azure AD, which is done in the classic Azure portal (https://manage.windowsazure.com).

Let’s give VM Contributor access to another user account. This is granting the ability to manage the VMs but not the ability to manage the access to the VMs. So this new user could not grant access to anybody else. If you want someone to have full administrative privileges of all the resources in the resource group, you can grant that user the Owner role.

In the Users blade, click Add. You are prompted to select the role you want the user to have (Figure 1- 9).

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Figure 1-9 Select a role to assign to a new user.

Look through the list and find the Virtual Machine Contributor role and select it. The Add Access blade highlights Add Users and shows a list of users to the right from which to select (Figure 1-10). Select an account and then click Select at the bottom of the blade.

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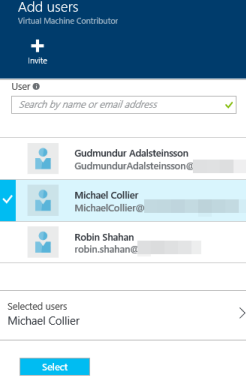
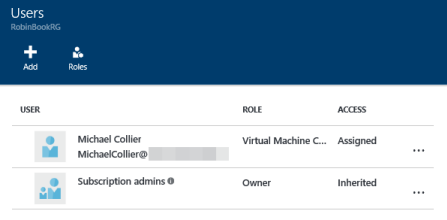


Figure 1-10 Select a user to add.

Next, click OK on the Add Access blade. It returns to the Users screen, which now reflects the user(s) added and their roles (Figure 1-11).

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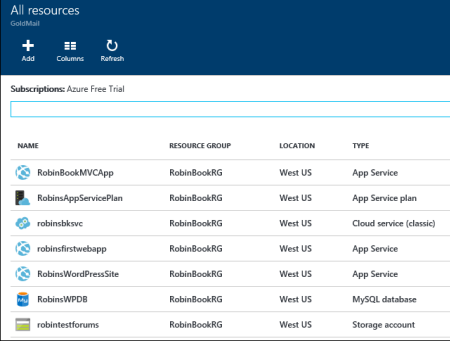
Figure 1-11 List of users and their assigned roles.

I added the Virtual Machine Contributor role for Michael Collier. This means that Michael Collier now has the ability to manage the VMs in that resource group.

**View by resource**

Back in the main hub (Figure 1-1), let’s look at the other view of our resources. Click All Resources. This shows exactly what you expect—a list of all your resources (Figure 1-12). You can edit the columns by selecting Columns. I’ve added the Type column because I can never remember what all of the icons mean.

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Figure 1-12 List of resources in the subscription.

Clicking any resource brings up a blade for that specific resource.

Subscription management and billing

In this section, we’ll look at the subscription types available and how to manage access to your subscription, as well as how to check your current billing balance.

**Available subscriptions**

There are several different kinds of subscriptions providing access to Azure services. You must have a Microsoft account (created by you for personal use) or a work or school account (issued by an administrator for business or academic use) to access these subscriptions.

Let’s take a look at the most common subscriptions:

∙ **Free accounts** The link to sign up for a free account is on the front page of azure.com. This gives you a $200 credit over the course of 30 days to try out any combination of resources in Azure. If you exceed your credit amount, your account will be suspended. At the end of the trial, your services will be decommissioned and will no longer work. You can upgrade this to a pay-as you-go subscription at any time.

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∙ **MSDN subscriptions** If you have an MSDN subscription, you get a specific amount in Azure credit each month. For example, if you have a Visual Studio Enterprise with MSDN subscription, you get $150 per month in Azure credit.

If you exceed the credit amount, your service will be disabled until the next month starts. You can turn off the spending limit and add a credit card to be used for the additional costs. Some of these costs are discounted for MSDN accounts. For example, you pay the Linux price for VMs running Windows Server, and there is no additional charge for Microsoft Servers such as Microsoft SQL Server. This makes MSDN accounts ideal for development and test scenarios.

For more information and to see the available MSDN subscription tiers, check out http://azure.microsoft.com/pricing/member-offers/msdn-benefits-details/. Note that these subscriptions are to be used for development and testing, not for production.

∙ **BizSpark accounts** The BizSpark program provides a lot of benefits to startups, not the least of which is access to all of Microsoft’s software for development and test environments for up to five MSDN accounts. In addition to these benefits, you get $150 in Azure credit for each of those five MSDN accounts, and you pay reduced rates for several of the Azure services, such as Windows Virtual Machines.

For more information, check out http://azure.microsoft.com/offers/ms-azr-0064p/.

∙ **Pay-as-you-go** With this subscription, you pay for what you use by attaching a credit card or debit card to the account. If you are an organization, you can also be approved for invoicing.

For more information, check out http://azure.microsoft.com/offers/ms-azr-0003p/.

∙ **Enterprise agreements** With an enterprise agreement, you commit to using a certain amount of services in Azure over the next year, and you pay that amount ahead of time. The commitment that you make is consumed throughout the year. If you exceed the commitment amount, you can pay the overage in arrears. Depending on the amount of the commitment, you get a discount on the services in Azure.

For more information, check out http://azure.microsoft.com/pricing/enterprise-agreement/.

**Share administrative privileges for your Azure subscription**

Once you have signed up for an Azure subscription, you can give administrative access to additional Microsoft accounts. This is done differently depending on whether you are using the classic Azure portal or the Azure portal. If you want the new account to be able to administer the subscription in both portals, you must make sure it has been given access in each portal. You want to do this if you need someone to administer the Azure AD for the subscription or if the subscription contains classic resources.

As we discussed previously, the Azure portal uses RBAC, and the classic Azure portal does not. This means in the classic Azure portal, you can *only* grant full administrative (co-admin) access to an account.

**Add administrative privileges in the Azure portal**

We just saw how to grant administrative privileges to a resource group in the Azure portal. Granting administrative privileges is almost the same process, except instead of selecting a resource group, you select the subscription.

Go to the hub (the selector on the far left) and select Subscriptions, then select the Subscription to which you want to add an administrator. Click Settings to go to the Settings blade, and then select Users.

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From the Users blade, you can use the same process we used before. Click Add, select the Owner role this time, select the user to whom you want to grant this role, and click OK to add the user to the RBAC settings for the subscription. They will show up in the Users blade with the user’s new permission.

If you want to grant access to one specific resource, you can select the resource from the All Resources blade, go to Settings > Users, and add a user and role exactly the same way.

**Granting administrative privileges in the classic Azure portal**

To grant administrative access to an account in the classic Azure portal, add the user’s account as a co-administrator to the subscription. This account will have all of the same privileges as the owner of the original subscription, but it does not allow the user to change the service administrator or to add and remove other co-administrators.

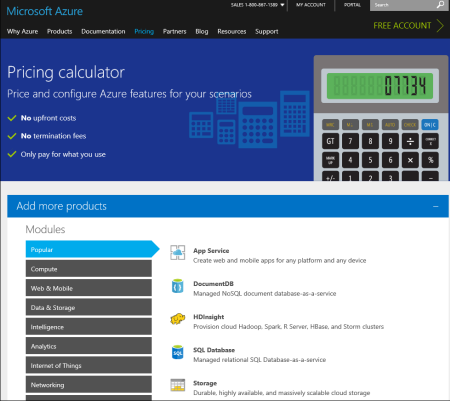
By using the classic Azure portal with administrative access, the user can access and maintain classic resources, such as classic storage accounts. There are also some Resource Manager resources that the account can impact, such as Web Apps. However, this user can’t see storage accounts and virtual machines created with the Resource Manager deployment model.

Note that co-administrators are automatically added to the Subscription Admin RBAC role.

**Pricing calculator**

Pricing for your Azure infrastructure can be estimated by using the pricing calculator found at http://azure.microsoft.com/pricing/calculator/ (Figure 1-13).

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Figure 1-13 The pricing calculator.

The pricing for each service in Azure is different. Many Azure services provide Basic, Standard, and Premium tiers, usually with several price and performance levels in each tier, allowing you to select an appropriate performance level for your use of the service. As you change the selections, the pricing estimate is provided on the right side of the page. You can look at each feature separately or select several resources to estimate multiple features together.

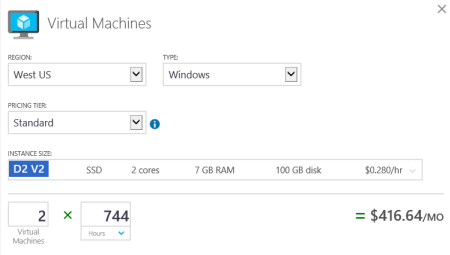
Let’s create a pricing example for two virtual machines and a storage account with 500 GB of data. **1.** Click Compute > Virtual Machines. A message appears saying it has been added. **2.** Click Data & Storage > Storage. A message appears saying it has been added.

**3.** Now, scroll to the bottom of the page, and you see it has added Virtual Machines and Storage. It also shows the total for all the resources you’ve specified.

**4.** On the Virtual Machines tile, set the Region to the one closest to you and set Type to Windows (other options include Linux). Next, set the Pricing Tier to Standard. Then, check the drop-down list on instance size and select a D2 V2. If we set the storage to Premium storage, this will also work for DS2 V2 VMs because the pricing is identical for D2 and DS2 VMs. D2 VMs use Standard storage; DS2 VMs use Premium storage.

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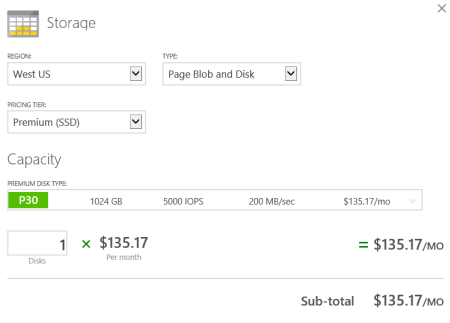
Next, set the number of virtual machines to 2 (Figure 1-14). This shows an estimated cost for having those two virtual machines.

Figure 1-14 Calculating pricing on two virtual machines.

**5.** On the Storage tile, set the Region. Set Type to Page Blob and Disk, indicating that we are going to use this storage account to store the VHD files for our virtual machines. Set the Pricing Tier to Premium (SSD). Select the P30 disk. If you are deploying VMs, you want to use Premium storage for the best reliability and speed; Premium storage only uses SSDs. This will give an estimated cost

for that configuration (Figure 1-15).

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Figure 1-15 Calculating pricing on storage.

**6.** Now if you look at the total section, it gives a total estimated cost for the two virtual machines and the storage (Figure 1-16).



Figure 1-16 Calculating total cost of selected resources.

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**7.** If you click Export Estimate, it will export all of the data to an Excel spreadsheet.

The pricing calculator can be helpful in estimating your Azure costs for new projects you want to add or for an entire infrastructure design.

| **Note** The overall pricing plan page does not include variations by region, but you can find those if you go to the individual service pricing pages at http://azure.microsoft.com/pricing/ and select the service in which you’re interested. At that point, you can also select the specific region. |
| --- |

**Viewing billing in the Azure portal**

An important component of using Azure is being able to view your billing information. If you have an account that allows you a certain amount of credit, it’s nice to know how much you have left and to view where the costs are accumulating. To see your current usage, click the Subscriptions tile in the Dashboard of the Azure portal (Figure 1-17).



Figure 1-17 The Subscriptions tile on the Dashboard of the Azure portal.

Click this tile to go to the Subscriptions blade, then select the subscription you want to examine. The Subscriptions blade is displayed. On the bottom of that blade is a tile showing the amount left before you hit the cap, what the starting credit was, and the burn rate (Figure 1-18).

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Figure 1-18 The overall cost information for the selected subscription.

We can see that for the account displayed above, the cap is $150 (starting credit), and $98.52 of that has been used so far. Underneath this graphic is the cost by resource. This account is taken up by the small web app that is running, but if there are VMs, storage accounts, and so on, the total cost of each resource would be displayed here (Figure 1-19).

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Figure 1-19 The cost by resource for the selected subscription.

If you click the graphic, it will show the resource costs by resource in a new blade (Figure 1-20). Figure 1-20 The details of the cost by resource for the selected subscription.

The ability to view the billing information on a regular basis is helpful when managing the costs for your Azure subscription. If you have a subscription with a monthly credit, you can tell when you’re

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getting close to the cap. You can also tell where your costs are accumulating. Also, if you provision some VMs and forget they’re out there, you’ll be able to see them because they will have billing associated with them.

**Azure Billing APIs**

In addition to viewing the billing in the portal, you can access the billing information programmatically through the Azure Billing REST APIs for a specific subscription. There are two APIs that you can use.

∙ The Azure Usage API enables you to retrieve your usage data. You can fine-tune the billing usage information retrieved to be grouped by resource if you have used the resource tags that can be set through most of the Settings screens. For example, you can tag each of the resources in a resource group with a department name or project name, then track the costs specifically for that one tag.

∙ The Azure RateCard API enables you to list all of the resources that you can use, along with the metadata and pricing information about each of those resources.

To get you started, there are Billing API code samples on GitHub that you can download and try out. They are located here: https://github.com/Azure/BillingCodeSamples.

Azure documentation and samples

In this section, we’ll talk about the Azure documentation and samples, including where you can find them and how you can contribute bug fixes, changes, or even entirely new articles and samples to the Azure community.

**Documentation**

The Azure documentation can be found at http://azure.microsoft.com. This is the conceptual documentation, which explains the services, how they work, how to use them, and so on. The reference documentation is on MSDN (http://msdn.microsoft.com). For example, the documentation for the REST APIs is on MSDN, and it shows every command and all of their options.

All of the conceptual documentation at azure.microsoft.com resides on GitHub. You can contribute to the documentation by adding articles or modifying articles to include information you believe will be helpful to others. To view the contributor guide and the current documentation, please go to https://github.com/Azure/azure-content.

**Samples**

In addition to the documentation, there are many Azure samples to help you get started with Azure, also stored in GitHub. For example, Azure Storage has getting-started samples for .NET and Java for Blob storage, Table storage, Queue storage, and File storage. You can use these samples to help you, and you can also contribute to this repository. These samples can be found here: http://github.com/azure-samples*.*

For the Resource Manager resources, there is a repository of quick start templates available here: https://github.com/Azure/azure-quickstart-templates*.* This has templates for creating many resources such as the Azure Content Delivery Network, Azure Key Vault, virtual machines, virtual networks, and storage accounts.

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C H A P T E R 2

Azure App

Service and

Web Apps

In this chapter, we take a look at the Azure App Service, consisting of Web Apps, Logic Apps, Mobile Apps, API Apps, and Function Apps. We focus on Web Apps and how they work together with the App Service. We create a web app and publish it to Azure. We also look at the options for prebuilt web apps offered by Azure.

App Service and App Service plans

Before we talk about Web Apps, let’s talk about App Service and the App Service plans.

**What is an App Service?**

The App Service is a service that hosts one of five kinds of applications:

∙ Web Apps

∙ Mobile Apps

∙ Logic Apps

∙ API Apps

∙ Function Apps

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Each app runs in its own app service. When you look in the Azure portal to see your website, you will look for the app service in which it is running. It conveniently has the same name as the app it’s hosting.

**So what is an App Service plan?**

An App Service plan defines the capacity and resources to be shared among one or more app services that are assigned to that plan.

The following are some of the criteria you can define when creating an App Service plan. ∙ Location (such as West US)

∙ Instance count

∙ Pricing tier (such as Free, Standard, or Premium) providing distinct settings for a variety of performance and service capabilities:

∙ Number of cores or instance size

∙ Amount of memory

∙ Amount of storage

∙ Maximum number of instances

∙ Autoscaling options (depends on tier—automatic, manual, or none)

When you deploy your app service for the first time, you specify which App Service plan you want to use. At deployment time, you can select an App Service plan you have created or create a new App Service plan.

**How does this help you?**

With infrastructure as a service (IaaS), you can create your own virtual machines (VMs), deploy your apps to them, and deal with the IIS setup and application pools and so on. Then, every time you change an app, you have to deploy it to all the VMs again. If you scale it out, and you have four VMs or eight VMs, it just becomes more onerous. With IaaS, you are responsible for the continuing management of your service. Using App Service plans enables you to run multiple applications on one set of VMs, even if each of the applications is deployed separately.

For example, let’s say you have five websites and three mobile apps that you want to host. You could run each one on its own VM, which would require 8 VMs. If you wanted redundancy (recommended), that would require 16 VMs. Even if you select small instances, the cost adds up really quickly. Plus, you have to scale each set of VMs separately.

If you could run those eight applications on the same set of two VMs, it would be more cost-effective and easier to manage. This is what using App Service plans does for you. You set up one App Service plan with a specific VM size, number of instances, etc. Then, you deploy the eight applications, specifying the same App Service plan for each one. This results in all eight applications running on that same set of two VMs. You can deploy and update each application as needed—you don’t have to update them all at the same time.

When you create your App Service plan, the resources you requested are allocated for you. When you deploy an app to that App Service plan, it simply deploys the applications to those allocated resources.

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If you decide you want to have four VMs instead of two, you simply go to the Azure portal and modify the App Service plan, changing the number of instances from two to four. It will create two more VMs and deploy your apps to them for you. If you are using small VMs and want to scale up to medium VMs, you can simply modify the Pricing Tier in the App Service plan, and it will scale up.

With web apps running in an app service using an App Service plan, the management is handled for you, and you can easily scale up and out just by changing the settings of the App Service plan.

**How to create an App Service plan in the Azure portal**

Now, I’ll show you how to create an App Service plan using the Azure portal. Later, I’ll show you how to create a web app and deploy it to an app service using that App Service plan.

**1.** Log in to the Azure portal.

**2.** Click New, then click See All, as displayed in Figure 2-1.

Figure 2-1 Go to the Marketplace to search for a resource to add.

**3.** It opens the search screen for the Marketplace (Figure 2-2). Type **app service plan** in the search box and press Enter.



Figure 2-2 The input screen for searching the Marketplace.

**4.** Select App Service Plan in the search results, as shown in Figure 2-3.

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Figure 2-3 The search results for App Service plan.

**5.** Click Create on the App Service Plan blade displayed in Figure 2-4.

Figure 2-4 Click Create to create a new App Service plan.

**6.** After you see something similar to the App Service Plan blade displayed in Figure 2-5, you can define the parameters for your App Service plan.

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Figure 2-5 The fields to be filled in for your new App Service plan.

∙ **App Service Plan** This is what you would like to name your App Service plan. Make this something you can recognize when you want to use the plan later.

∙ **Subscription** If you have multiple Azure subscriptions administered by this account, this will have a drop-down list of subscriptions, and you can select which one to use.

∙ **Resource Group** Resource groups provide a logical container for a related set of resources. For example, you could put all of the resources you create for this book in the same resource group. When you’re finished, you can delete the resource group, and it will deallocate and remove all of those resources for you. Let’s create a new resource group for our App Service plan; later in this chapter, we will create a web app and assign it to our App Service plan. Leave the value as +New and specify the name of your new resource group. It’s recommended that you specify something that indicates what the resources are used for.

∙ **Location** This is the Azure region where the resource group will be hosted. This includes metadata such as audit logs, where each resource in the group resides. This can be different from the resources themselves; this is important for those who care about where data is hosted—for example, those in countries with data sovereignty laws. Also, Resource Manager operations are

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sourced through this region, so you typically want it to be the same as most of the resources in the group. For our example, select the region closest to you.

∙ **Pricing Tier** Click this field to see your choices. The new blade (displayed in Figure 2-6) shows the recommended pricing plans. This is a subset of all of the available pricing tiers. If you want to see all of the plans, click View All on this blade. The pricing plan lets you specify the amount of storage, scalability, backup choices, and so on.

Figure 2-6 The Pricing Tier blade.

Select the S1 Standard pricing plan and then click Select at the bottom of the blade. Now, your App Service Plan blade should display the pricing plan you selected.

**7.** Select the check box on the bottom of the App Service Plan blade that says Pin To Dashboard. This will pin a tile to the Dashboard showing your App Service plan, providing easy access to it. Now, click Create. It creates the plan and adds a tile to your Dashboard.

**8.** After the App Service plan is created, you can click the tile on the Dashboard and modify it. You can also see what apps are using that plan. After the web app is created and deployed, I’ll show you how to scale the apps by scaling the App Service plan.

At this point, you can create one or more app services, such as a web app, and assign them to that App Service plan. They will all run on the same VMs.

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Creating and deploying Web Apps

Now that you understand App Services and App Service plans, I’ll show you what a Web App is, discuss some of its features, and then talk about the various options you have for creating one. Then, I’ll show you how to use a couple of those options to create and deploy a Web App.

**What is a Web App?**

A Web App is a web application that is hosted in an App Service. The App Service is the managed service in Azure that enables you to deploy a web application and make it available to your customers on the Internet in a very short amount of time. As noted above, you don’t directly support the VMs on which your web app runs; they are managed for you. In fact, you don’t have access to those underlying VMs.

Supported languages include .NET, Java, PHP, Node.js, and Python. In addition to creating your own web app, there are several web applications available to use as a starting point, such as WordPress, Umbraco, Joomla!, and Drupal.

You can use continuous deployment with Team Foundation Server (TFS), GitHub, TeamCity, Jenkins, or BitBucket so that every time you commit a change, a new version of the web app is deployed.

Scaling is done by scaling the App Service plan to which the web app belongs. You can scale the number of instances in and out on demand. You can configure autoscaling so Azure will scale it in or out for you depending on specific performance measures such as CPU percentage. You can also publish your website to multiple locations and use the Azure Traffic Manager to handle the routing of the traffic to the location nearest to your customer.

For diagnostics, you can gather performance statistics, application logging, web server logging, IIS logs, and IIS Failed Request logs. If you’re using Microsoft Visual Studio, you can even remotely debug your application while it is running in the cloud.

In short, there are many features available when using Web Apps to make it easy for you to deploy, manage, and troubleshoot a web application.

**Options for creating Web Apps**

There are multiple options for creating a Web App and deploying the content to an app service. Let’s look at a few of these, including the following.

∙ **Azure Marketplace** This contains all of the resources you can deploy in Azure. I’ll show you how you can use this to create Web Apps from preexisting templates such as WordPress.

∙ **Visual Studio Code** This is a free, open source, cross-platform code editor with debugging capabilities.

∙ **Visual Studio** This is Microsoft’s full-featured development IDE.

**Marketplace**

There are many pre-created websites and templates in the Azure Marketplace that you can use. To see all of the options available, log into the Azure portal and click New > Web + Mobile > See All. This shows the Marketplace blade filtered for Web and Mobile apps, as displayed in Figure 2-7.

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Figure 2-7 Options in the Azure Marketplace for Web and Mobile apps.

If you scroll down on the page, you can see the categories. At the end of any row, clicking More will show additional options in that category. Here are just a few of the choices available:

∙ **Web Apps** Web App, Web App + SQL, Web App + MySQL, WordPress, and Umbraco CMS ∙ **Blogs + CMSs** Joomla!, Drupal, DNN, Orchard CMS, Umbraco CMS, and MonoX

∙ **Starter Web Apps** ASP.NET, HTML5, Node.js, PHP, Apache Tomcat, and some examples like the Bakery web app and the Java Coffee Shop web app

**Visual Studio Code**

Visual Studio Code (VS Code) is a free, open source code editor with support for development operations such as debugging, task running, and version control. It runs on Windows, OS X, and Linux.

VS Code makes debugging easier, providing IntelliSense code completion and easy code refactoring. It integrates with Git and also package managers, repositories, and various build tools.

VS Code has built-in support for Node.js, JavaScript, and TypeScript. Using extensions, you can use VS Code to debug languages such as C#, C++, Python, Ruby, and PowerShell. There is also tooling for web technologies such as HTML, CSS, JSON, and Markdown.

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Using the Azure portal, you can set your web app to get the source code from OneDrive, Dropbox, or a local code repository such as GitHub or Visual Studio Team Service. If you enable continuous deployment for your WebApp, updates will be published automatically when changes are made to your source repository.

You can download Visual Studio Code for Windows, Linux, or Mac here:

https://code.visualstudio.com/#alt-downloads*.*

**Visual Studio**

Visual Studio is a full development environment, giving you the ability to create many different kinds of applications including, but not limited to, ASP.NET MVC applications, .NET client applications, Windows Communication Foundation (WCF) services, Web APIs, and Cloud Services, using languages such as C#, C++, VB, F#, and XAML.

With Visual Studio, you can create a new web application and publish it to an app service in Azure. I’ll show you how to do this in an upcoming demo.

**Demo: Create a web app by using the Azure Marketplace**

Let’s take a look at how to create a web app from one of the templates available in the Azure Marketplace.

**1.** Log into the Azure portal. As seen in Figure 2-8, click New on the left side of the page, then click See All.

Figure 2-8 Go to the Marketplace Search blade.

**2.** This brings up the search screen for the Marketplace. All resources that can be deployed to Azure are listed in the Marketplace, including virtual machines, virtual networks, storage accounts, web apps, and so on. As shown in Figure 2-9, type in **WordPress** and press Enter to perform the search.

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Figure 2-9 Search for WordPress.

**3.** You see a list of matches, as displayed in Figure 2-10.

Figure 2-10 The search results for WordPress.

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**4.** Select the row with WordPress from publisher WordPress. This shows you the blade for WordPress; click Create at the bottom to create a WordPress site. You now see a blade where you can start configuring your WordPress site, as displayed in Figure 2-11.



Figure 2-11 Create a WordPress website.

**5.** Now, start filling in the fields on this blade:

∙ **App Name** This is used to create the URL to access your web app.

∙ **Subscription** If the account you are using is associated with multiple subscriptions, select the subscription you want to use.

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∙ **Resource Group** This is a way of grouping multiple resources that are related to one another, such as a web app and a database. Select the resource group you used for the App Service plan you created earlier.

∙ **App Service Plan** Select the App Service plan you created earlier in this chapter.

∙ Click Database to see the database settings, as shown in Figure 2-12. WordPress uses MySQL by default. Set your Database Name and Type (Shared or Dedicated). For Location, select the same region in which your app is going to run. Click Pricing Tier and select the least expensive, which at this time is Mercury. Click OK to save the database settings.



Figure 2-12 Specify database settings.

∙ Back on the WordPress Settings blade for your new website, click Legal Terms. If you agree with the Legal Terms, click OK at the bottom of that screen, which will set Legal Terms to Accepted.

∙ You can use Web App Settings (Optional) to set the WordPress-specific settings shown in Figure 2-13; this is optional.

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Figure 2-13 Fill in App Settings (optional).

∙ Back on the WordPress blade, select the check box to pin the web app to your Dashboard, then click Create. Azure will create the WordPress site for you.

**6.** After Azure has finished publishing the web app, click the tile on your Dashboard to open its properties, as displayed in Figure 2-14. To open the site, click the URL. You are prompted for the rest of the details needed to create your WordPress site, such as language, site title, username, password, and email address. After all the fields are filled in, click the Install WordPress button. After the WordPress installation is finished, you’re ready to go.

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Figure 2-14 Open your new WordPress site by clicking its URL.

| **Note** When your web app is created, Azure also creates an Application Insights instance. Application Insights is an analytics service that monitors your live application. It can help you resolve performance issues and understand how your application is used. Application Insights is outside the scope of this book. For more information, check out the Getting Started article about Application Insights: https://azure.microsoft.com/documentation/articles/app-insights-overview/.  You can see the Application Insights instances in the All Resources blade; it will have the same name as your web app, but it will be a different resource type. My list of resources is displayed in Figure 2-15; the ones with the rectangle around them are the Application Insights instances. Note that they have a different icon from the Web Apps. Simply select those Application Insights resources and delete them. (When you select that resource, it will open a bunch of blades. Just close them until you get back to the first one, and select Delete from that blade.) |
| --- |

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| Figure 2-15 The Application Insights instances are created automatically when you create a web app. |
| --- |

**Demo: Create an ASP.NET website in Visual Studio and deploy it as a web app**

To perform this tutorial, you must have Visual Studio 2013 or Visual Studio 2015 installed and the most recent version of the Azure Tools and SDK.

Create a new web application with Visual Studio by following these steps:

**1.** Open Visual Studio. Select File > New > Project.

**2.** Select ASP.NET Web Application; the dialog box for creating a project appears, as shown in Figure 2-16. On the right side of the dialog box, clear the Add Application Insights To Project check box. This will prevent the creation of a separate Application Insights instance for this web application.

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Figure 2-16 Create an ASP.NET Web Application; deselect Application Insights.

**3.** Specify the Name of the application and the Location for the solution, then click OK.

**4.** When prompted to select the type of ASP.NET application to create, select MVC from the list of ASP.NET Templates, as shown in Figure 2-17. Clear the Host In The Cloud check box. You will set that up separately. Click OK to continue.

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Figure 2-17 Select an MVC application and clear the Host In The Cloud check box.

**5.** Visual Studio will create a basic ASP.NET MVC application that runs “as is.” You can modify it later to make it your own.

**6.** Now, publish this web application to an App Service in Azure and assign it to the App Service plan created earlier in this chapter. You will create the App Service when you publish the web app the first time. Right-click the website and select Publish (Figure 2-18).

Figure 2-18 Step 1 for publishing the web application.

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**7.** The Publish Web dialog box will be displayed. Select the Microsoft Azure App Service (Figure 2- 19).

Figure 2-19 Select the Microsoft Azure App Service for the publish target.

**8.** You will be prompted for your subscription name. You may be prompted again to enter the credentials for your Azure subscription. If the correct account is not displayed, click it to show a drop-down list and add an account if necessary. When the correct account is selected, select the Subscription and be sure the View is set to Resource Group. Open the Resource Group, and you will see the resources that have been set up already. In Figure 2-20, you can see the web apps that I have already created. To publish this application to a new web app, click New.

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Figure 2-20 Make sure the right account and subscription are selected; show the resources by group.

**9.** The Create App Service dialog box (Figure 2-21) appears next. Remember that an App Service is simply the host for a Web App, Mobile App, Logic App, API App, or Function App. You’ll create a new App Service to host your MVC web application here.

Figure 2-21 Create an App Service to host the MVC application.

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∙ Set the Web App Name. This will be used for the URL for the web app, so select it wisely. ∙ Select the Subscription.

∙ Select the Resource Group. If you use the one you created at the beginning of this chapter, then when you’re done, you can delete that Resource Group and all of your resources will be removed.

∙ Last, select the App Service plan that you created earlier in this chapter. This application will be hosted on the same VMs as the other web app(s) you have placed in that plan.

Click Create to create the App Service.

If you look in the Azure portal now, you will see your App Service has been created.

**10.** Now let’s use Web Deploy to publish our web app to our app service. After creating the app service, the Publish Web dialog box will be displayed (Figure 2-22). You can use the default values.

Figure 2-22 Publish settings for the MVC application.

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**11.** Click Validate Connection to make sure the information is correct. After it validates, click Next to go to the next dialog box (Figure 2-23).

Figure 2-23 Settings used when publishing the MVC application.

**12.** This dialog box lets you set the Configuration to Debug or Release and provide a connection string to a database if needed. Note that if you are going to use remote debugging on your web app, you will want to select the Debug configuration. Click Next to reach the final page (Figure 2- 24).

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Figure 2-24 Publish the MVC application.

**13.** You can preview your site here. When you’re finished, click Publish to deploy the web application to the App Service. It will open your web application in the default browser after it is published.

When you make changes to your website, you can go through this same process to publish the website again. Note that it will only publish the files that have been added or modified.

Configuring, scaling, and monitoring Web Apps

Now that you’ve created a web app, assigned it to an App Service plan, and deployed it, let’s take a look at the configuration in the portal and how to scale your web application.

**Configuring Web Apps**

Log into the Azure portal and go to the web application you created and deployed from Visual Studio earlier. The primary blade should look like Figure 2-25.

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**Figure 2-25** Web App blade.

**The Essentials section**

Let’s start with the icons across the top of the Web App blade and look at what they are used for.

∙ **Settings** This opens a new blade called Settings. This displays by default when you first open the Web App blade, and is the same blade you see when you click All Settings.

∙ **Tools** This opens the Tools blade, which provides access to Performance testing, Process Explorer, Performance monitoring, and so on. It also provides access to the Kudu console, which is helpful for troubleshooting and analysis.

∙ **Browse** This opens your web app in your default browser.

∙ **Stop/Start** This option starts and stops the web app.

∙ **Swap** This option swaps the versions deployed to two different deployment slots. For example, if you have a production slot and a staging slot, you can publish your web app to staging and test it. When you’re satisfied with it, you can promote it to production by using the Swap option. When you’re sure everything is working okay, you can remove the staging version.

∙ **Restart** This restarts your web app.

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∙ **Delete** This removes the web app.

∙ **Get Publish Profile** This retrieves the information needed to publish a web app from Visual Studio.

∙ **Reset Publish Profile** This resets the publishing credentials and invalidates the old credentials. These credentials are used for FTP and Git access.

In the Essentials area, it shows the settings provided when creating the web app: the Resource Group, Location, Azure Subscription ID, the URL of the website, and the name of the App Service plan being used. It also shows the credentials for FTP’ing into the web app in case you want to deploy new files via FTP.

Click Settings to open the Settings blade. Let’s take a closer look at some of the options on this blade. **The Settings blade: General**

Figure 2-26 shows the General section of the Settings blade.



Figure 2-26 General section on the web app’s Settings blade.

Let’s take a look at the General settings we can configure on this blade.

∙ **Quick Start** This brings up some resources you can use to learn more about Web Apps. There are links to install Visual Studio and the Microsoft Azure SDK, links to reset your deployment credentials, and links to tutorials, forums, samples, etc.

∙ **Properties** This shows some of the same values that are in the Essentials blade: the URL, the mode (Standard), the outbound IP addresses, the FTP settings, and so on.

∙ **Application Settings** These are values that apply to your web app.

The top of the Application Settings blade shown in Figure 2-27 lets you set things like the .NET Framework version, PHP version, etc.

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Figure 2-27 Application Settings blade for the web app.

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Let’s look at what some of these settings are used for:

∙ **.NET Framework Version** If your web app is a .NET application, this will denote the major version being used. Values available are 3.5 and 4.6.

∙ **PHP, Java, and Python Versions** If using one of these technologies, this allows you to set the version to be run for the App Service. PHP 5.4, 5.5, 5.6, and 7.0 are supported. Java 7 and 8 are supported. For Python, versions 2.7 and 3.4 are supported.

∙ **Platform** This indicates whether your web app runs on a 32-bit platform or a 64-bit platform. Note that you cannot select 32-bit for Free websites.

∙ **Always On** By default, webpages are unloaded after being idle for a certain amount of time. If you need your webpage to be live and active all of the time, set this to On.

∙ **Debugging** These settings allow you enable and disable remote debugging. If set to On, you can then select which version of Visual Studio you want to use to perform the debugging. Be sure to specify the Debug configuration when you publish your web app if you want to perform remote debugging.

Other settings farther down this blade include the list of default documents, handler mappings, and virtual applications and directories.

**The Settings blade: App Service plan**

This is the App Service Plan section of the Settings blade (Figure 2-28).



Figure 2-28 App Service Plan section on the web app’s Settings blade.

These are the App Service plan settings you can configure on this blade.

∙ **App Service Plan** This shows which App Service plan is used by the web app. This will show the settings for that App Service plan, which are the same values you see if you choose your App Service plan from All Resources on the main menu of the Azure portal.

∙ **Scale Up (App Service Plan)** This lets you change the pricing tier for the plan. Each pricing tier provides different values for the number of cores, amount of memory, amount of storage, and so on.

∙ **Scale Out (App Service Plan)** This is where you can set up autoscaling for your App Service plan and all of its app services. For example, you can ask it to increase the number of VMs if your CPU percentage reaches 90 percent and stays there for X number of minutes. We’ll take a closer look at this in the “Scaling Web Apps” section later in this chapter.

∙ **Change App Service Plan** This enables you to select a different App Service plan or create a new one.

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**The Settings blade: Publishing**

Figure 2-29 shows the Publishing section of the Settings blade for a web app. 

Figure 2-29 Publishing section on the web app’s Settings blade.

Here is what each of the Publishing settings is for:

∙ **Deployment Source** This is where you can choose a source such as Git, GitHub, OneDrive, Bitbucket, Dropbox, or Visual Studio Team Services to be used for continuous deployment.

∙ **Deployment Slots** This lets you publish multiple versions of your web app to different URLs. For example, you can set one up and call it *staging*, then publish interim changes to it. After you’ve tested the new version thoroughly, you can put the new version in production by swapping the deployment slot called *staging* with production.

∙ **Deployment Credentials** This lets you set the user name and password for use with Git and FTP deployment.

There are additional sections for Mobile Apps, WebJobs, and Routing, and a section that enables you to set up a custom domain and SSL bindings.

**Monitoring Web Apps**

Let’s take a look at the many ways you can monitor your application. If you’re not already there, log into the Azure portal and go to the blade for your web application. Below the properties of the web app is a pane showing the default Monitoring. You can click Edit in that pane to see all of the metrics you can add to that chart and set the time range to be displayed and the type of chart (Figure 2-30).

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Figure 2-30 Specify the metrics to display on the chart.

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In the Settings blade, you can check out your diagnostics in the Site Metrics Per Instance option. This shows overall metrics for your web app as well as metrics for each instance that is running. You can ask to see the last 24 hours, the last hour, or the last 5 days. This is graphed for you.

You can also see the metrics for all of the apps running in your App Service plan by selecting App Service plan Metrics Per Instance. This has the same settings as the option for your site (24 hours, etc.), but the numbers are combined metrics for all of the apps running.

Another option is Live HTTP Traffic, which will show what’s going on currently with the web app, showing Request count, HTTP 5xx responses, and HTTP 4xx responses.

Using the Diagnostics Logs setting, you can enable and disable the different kinds of diagnostics logging for your web app, as shown in Figure 2-31. This includes any logging that the application may do, as well as IIS requests and Failed requests. You can FTP into the site to check the logs; the FTP information is also displayed on that blade.

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Figure 2-31 Enable or disable the logging.

**Scaling Web Apps**

Let’s go to the Settings blade and look at the scaling options.

| **Note** You don’t scale the web app specifically; you scale the App Service plan, which scales all of the apps running in app services that use that plan. |
| --- |

Scale Up will allow you to select a different pricing tier. This lets you increase the VM size, providing a different amount of memory, storage, etc. that we saw when we originally set up the App Service plan.

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Let’s take a closer look at scaling out your App Service plan. Figure 2-32 shows the Scale Setting blade that you see when you click Scale Out.

Figure 2-32 Scale Setting blade used for scaling out.

**Scaling out manually**

On the blade displayed in Figure 2-32, you can specify the number of instances that you want to run by either editing the text box with the number in it or dragging the slider over to the right. Figure 2- 33 shows an example requesting that the App Service plan should be scaled out to six instances. This means all apps running in app services that are assigned to that plan will now have six instances.

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Figure 2-33 Manually scaling out to six instances.

Scaling manually isn’t practical unless you’re sure your apps will run consistently all of the time. What if you have an application used by a small company, and usage is only high from 8 AM to 5 PM? Do you set it to handle the usage during the day and let it run at that size through the night? It would make more sense to scale down the apps in the evening when there’s less usage.

What if you just want to use a simple plan of increasing the instance size when your CPU percentage reaches a specific value, and decrease when the CPU percentage goes back down? You can monitor the app service for these conditions and scale it manually, but wouldn’t it be better if you could set it to scale up and down automatically? Figure 2-34 shows the options for Scale By in a drop-down list.

Figure 2-34 Options for scaling out.

You can see that you now have two more options. One is for scaling by CPU Percentage, and other option lets you put in specific rules for scaling.

**Scaling by CPU Percentage**

Let’s take a look at the CPU Percentage scale settings, shown in Figure 2-35.

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Figure 2-35 Scale by CPU Percentage.

This will allow you to scale up or down depending on the CPU Percentage. You can set the lowest number of instances and the highest number of instances as well as the CPU Percentage value where you want the autoscaling to occur. In the case displayed in Figure 2-35, the web app will run on a minimum of two instances and a maximum of six instances. The autoscaling uses standard Microsoft Insights autoscaling, creating an upper and lower bound rule that you can view using the Resource Explorer in the Microsoft.Insights resource for the App Service. It waits 10 minutes between each scaling action.

In our case here, when the CPU Percentage reaches 80 percent and stays there for at least 10 minutes, it will start scaling up the instances until the CPU Percentage is below the limit or it reaches the maximum number of instances. When the CPU Percentage is below the limit, it will scale down until it reaches the minimum number of instances.

| **Note** When talking about autoscaling, the average CPU percentage used to scale up or down is the average across all of the VMs running in that App Service plan. This is also true for the other metrics you can use. |
| --- |

You can also set up notifications so it will email you when it starts scaling up and configure a webhook to be run. Webhooks allow you to route the notification to other systems. For example, you could have a service that sends you an SMS message when the scaling begins.

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**Scaling by schedule and performance rules**

The third option allows you to set your own rules. You can set a schedule telling when to scale out and in, and you can even combine that with a performance metric. This is very useful when you want to be really specific about how your app scales out and in. For example, let’s say that rather than accepting the default amount of time a value is exceeded before a scaling operation starts, you want to set it to a specific value like 20 minutes, or you want to scale using a different performance metric. You can do this by using this third setting, as shown in Figure 2-36.

Figure 2-36 Custom scaling rules.

This comes with a default profile called Default, Scale 1-1. Let’s edit that profile and then define a rule that will specify that the App Service plan should scale out when the average CPU Percentage is greater than 80 percent for more than 17 minutes, and scale in when it averages less than 50 percent for 12 minutes. (I’m using odd numbers rather than the defaults here so you can pick out the numbers on the screen.) Click Default, Scale 1-1 to change the default profile as displayed in Figure 2-37. After setting up the profile, you’ll add the rules.

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