

# DevOps for ASP.NET Core Developers



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Refer changelog for the book updates and community contributions.

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## Credits

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#### Welcome

Welcome to the Azure Development Lifecycle guide for .NET! This guide introduces the basic concepts of building a development lifecycle around Azure using .NET tools and processes. After finishing this guide, you'll reap the benefits of a mature DevOps toolchain.

## Who this guide is for



You should be an experienced ASP.NET Core developer (200-300 level). You don't need to know anything about Azure, as we'll cover that in this introduction. This guide may also be useful for DevOps engineers who are more focused on operations than development.

This guide targets Windows developers. However, Linux and macOS are fully supported by .NET Core. To adapt this guide for Linux/macOS, watch for callouts for Linux/macOS differences.

## What this guide doesn't cover

This guide is focused on an end-to-end continuous deployment experience for .NET developers. It's not an exhaustive guide to all things Azure, and it doesn't focus extensively on .NET APIs for Azure services. The emphasis is all around continuous integration, deployment, monitoring, and debugging. Near the end of the guide, recommendations for next steps are offered. Included in the suggestions are Azure platform services that are useful to ASP.NET Core developers.

## What's in this guide

#### **Tools and downloads**

Learn where to acquire the tools used in this guide.

#### **Deploy to App Service**

Learn the various methods for deploying an ASP.NET Core app to Azure App Service.

#### Continuous integration and deployment with Azure DevOps

Build an end-to-end continuous integration and deployment solution for your ASP.NET Core app with GitHub, Azure DevOps Services, and Azure.

#### **Continuous integration and deployment with GitHub Actions**

Build an end-to-end continuous integration and deployment solution for your ASP.NET Core app with GitHub, GitHub Actions, and Azure, including code scanning for security and quality using CodeQL.

#### Monitor and debug

Use Azure's tools to monitor, troubleshoot, and tune your application.

#### Next steps

Other learning paths for the ASP.NET Core developer learning Azure.

## Additional introductory reading

If this is your first exposure to cloud computing, these articles explain the basics.

- What is Cloud Computing?
- Examples of Cloud Computing



- What is laaS?
- What is PaaS?

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## Tools and downloads

Azure has several interfaces for provisioning and managing resources, such as the <u>Azure portal</u>, <u>Azure</u> <u>CLI</u>, <u>Azure PowerShell</u>, <u>Azure Cloud Shell</u>, and Visual Studio. This guide takes a minimalist approach and uses the Azure Cloud Shell whenever possible to reduce the steps required. However, the Azure portal must be used for some portions.

### Prerequisites

The following subscriptions are required:

- Azure If you don't have an account, get a free trial.
- Azure DevOps Services your Azure DevOps subscription and organization is created in Chapter 4.
- GitHub If you don't have an account, sign up for free.

The following tools are required:

- <u>Git</u> A fundamental understanding of Git is recommended for this guide. Review the <u>Git</u> <u>documentation</u>, specifically <u>git remote</u> and <u>git push</u>.
- <u>.NET Core SDK</u> Version 2.1.300 or later is required to build and run the sample app. If Visual Studio is installed with the **.NET Core cross-platform development** workload, the .NET Core SDK is already installed.

Verify your .NET Core SDK installation. Open a command shell, and run the following command:

:::{custom-style=CodeBox} dotnetcli dotnet --version :::

## Recommended tools (Windows only)

 <u>Visual Studio</u>'s robust Azure tools provide a GUI for most of the functionality described in this guide. Any edition of Visual Studio will work, including the free Visual Studio Community Edition. The tutorials are written to demonstrate development, deployment, and DevOps both with and without Visual Studio.

Confirm that Visual Studio has the following workloads installed:

- ASP.NET and web development
- Azure development

- .NET Core cross-platform development

## Deploy an app to App Service

<u>Azure App Service</u> is Azure's web hosting platform. Deploying a web app to Azure App Service can be done manually or by an automated process. This section of the guide discusses deployment methods that can be triggered manually or by script using the command line, or triggered manually using Visual Studio.

In this section, you'll accomplish the following tasks:

[!div class="checklist"]

- Download and build the sample app.
- Create an Azure App Service Web App using the Azure Cloud Shell.
- Deploy the sample app to Azure using Git.
- Deploy a change to the app using Visual Studio.
- Add a staging slot to the web app.
- Deploy an update to the staging slot.
- Swap the staging and production slots.

## Download and test the app

The app used in this guide is a pre-built ASP.NET Core app, <u>Simple Feed Reader</u>. It's an ASP.NET Core Razor Pages app that uses the Microsoft.SyndicationFeed.ReaderWriter API to retrieve an RSS/Atom feed and display the news items in a list.

Feel free to review the code, but it's important to understand that there's nothing special about this app. It's just a simple ASP.NET Core app for illustrative purposes.

From a command shell, download the code, build the project, and run it as follows.

#### Note

Linux and macOS users should make appropriate changes for paths, for example, using forward slash (/) rather than back slash (\).\*

1. Clone the code to a folder on your local machine.

:::{custom-style=CodeBox} console git clone https://github.com/dotnet-architecture/simple-feed-reader/ :::

2. Change your working folder to the *simple-feed-reader* folder that was created.

:::{custom-style=CodeBox} console cd .\simple-feed-reader\SimpleFeedReader :::

3. Restore the packages, and build the solution.

:::{custom-style=CodeBox} dotnetcli dotnet build :::

4. Run the app.

:::{custom-style=CodeBox} dotnetcli dotnet run :::



5. Open a browser and navigate to http://localhost:5000. The app allows you to type or paste a syndication feed URL and view a list of news items.



6. Once you're satisfied the app is working correctly, shut it down by pressing Ctrl+C in the command shell.

## Create the Azure App Service Web App

To deploy the app, you'll need to create an App Service <u>Web App</u>. After creation of the Web App, you'll deploy to it from your local machine using Git.

- 1. Sign in to the <u>Azure Cloud Shell</u>. Note: When you sign in for the first time, Cloud Shell prompts to create a storage account for configuration files. Accept the defaults or provide a unique name.
- 2. Use the Cloud Shell for the following steps.
  - a. Declare a variable to store your web app's name. The name must be unique to be used in the default URL. Using the \$RANDOM Bash function to construct the name guarantees uniqueness and results in the format webappname99999.

::::{custom-style=CodeBox} console webappname=mywebapp\$RANDOM :::

b. Create a resource group. Resource groups provide a means to aggregate Azure resources to be managed as a group.

:::{custom-style=CodeBox} azurecli az group create --location centralus --name AzureTutorial :::

The az command invokes the <u>Azure CLI</u>. The CLI can be run locally, but using it in the Cloud Shell saves time and configuration.

c. Create an App Service plan in the S1 tier. An App Service plan is a grouping of web apps that share the same pricing tier. The S1 tier isn't free, but it's required for the staging slots feature.

:::{custom-style=CodeBox} azurecli az appservice plan create --name \$webappname -resource-group AzureTutorial --sku S1 :::

d. Create the web app resource using the App Service plan in the same resource group.

:::{custom-style=CodeBox} azurecli az webapp create --name \$webappname --resourcegroup AzureTutorial --plan \$webappname :::

e. Set the deployment branch to main in the appsettings configuration.

:::{custom-style=CodeBox} azurecli az webapp config appsettings set --name \$webappname --resource-group AzureTutorial --settings DEPLOYMENT\_BRANCH=main :::

f. Set the deployment credentials. These deployment credentials apply to all the web apps in your subscription. Don't use special characters in the user name.

:::{custom-style=CodeBox} azurecli az webapp deployment user set --user-name REPLACE\_WITH\_USER\_NAME --password REPLACE\_WITH\_PASSWORD ::: g. Configure the web app to accept deployments from local Git and display the *Git deployment URL*. **Note this URL for reference later**.

:::{custom-style=CodeBox} azurecli echo Git deployment URL: \$(az webapp deployment source config-local-git --name \$webappname --resource-group AzureTutorial --query url -- output tsv) :::

h. Display the *web app URL*. Browse to this URL to see the blank web app. **Note this URL for reference later**.

:::{custom-style=CodeBox} console echo Web app URL: http://\$webappname.azurewebsites.net :::

- 3. Using a command shell on your local machine, navigate to the web app's project folder (for example, \*.-feed-reader). Execute the following commands to set up Git to push to the deployment URL:
  - a. Add the remote URL to the local repository.

:::{custom-style=CodeBox} console git remote add azure-prod GIT\_DEPLOYMENT\_URL :::

b. Push the local default branch (*main*) to the *azure-prod* remote's deployment branch (*main*).

:::{custom-style=CodeBox} console git push azure-prod main :::

You'll be prompted for the deployment credentials you created earlier. Observe the output in the command shell. Azure builds the ASP.NET Core app remotely.

4. In a browser, navigate to the *Web app URL* and note the app has been built and deployed. Additional changes can be committed to the local Git repository with git commit. These changes are pushed to Azure with the preceding git push command.

## Deployment with Visual Studio

#### Note

This section applies to Windows only. Linux and macOS users should make the change described in step 2 below. Save the file, and commit the change to the local repository with git commit. Finally, push the change with git push, as in the first section.\*

The app has already been deployed from the command shell. Let's use Visual Studio's integrated tools to deploy an update to the app. Behind the scenes, Visual Studio accomplishes the same thing as the command line tooling, but within Visual Studio's familiar UI.

- 1. Open *SimpleFeedReader.sln* in Visual Studio.
- 2. In Solution Explorer, open *Pages.cshtml*. Change <h2>Simple Feed Reader</h2> to <h2>Simple Feed Reader V2</h2>.
- 3. Press Ctrl+Shift+B to build the app.
- 4. In Solution Explorer, right-click on the project and click **Publish**.

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- 5. Visual Studio can create a new App Service resource, but this update will be published over the existing deployment. In the **Pick a publish target** dialog, select **App Service** from the list on the left, and then select **Select Existing**. Click **Publish**.
- 6. In the **App Service** dialog, confirm that the Microsoft or Organizational account used to create your Azure subscription is displayed in the upper right. If it's not, click the drop-down and add it.
- 7. Confirm that the correct Azure **Subscription** is selected. For **View**, select **Resource Group**. Expand the **AzureTutorial** resource group and then select the existing web app. Click **OK**.

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Visual Studio builds and deploys the app to Azure. Browse to the web app URL. Validate that the <h2> element modification is live.

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## Deployment slots

Deployment slots support the staging of changes without impacting the app running in production. Once the staged version of the app is validated by a quality assurance team, the production and staging slots can be swapped. The app in staging is promoted to production in this manner. The following steps create a staging slot, deploy some changes to it, and swap the staging slot with production after verification.

- 1. Sign in to the <u>Azure Cloud Shell</u>, if not already signed in.
- 2. Create the staging slot.
  - a. Create a deployment slot with the name *staging*.

:::{custom-style=CodeBox} azurecli az webapp deployment slot create --name \$webappname --resource-group AzureTutorial --slot staging :::

b. Set the deployment branch to main in the appsettings configuration.

:::{custom-style=CodeBox} azurecli az webapp config appsettings set --name \$webappname --resource-group AzureTutorial --slot staging --settings DEPLOYMENT\_BRANCH=main :::

c. Configure the staging slot to use deployment from local Git and get the **staging** deployment URL. **Note this URL for reference later**.

:::{custom-style=CodeBox} azurecli echo Git deployment URL for staging: \$(az webapp deployment source config-local-git --name \$webappname --resource-group AzureTutorial -- slot staging --query url --output tsv) :::

d. Display the staging slot's URL. Browse to the URL to see the empty staging slot. **Note this URL for reference later**.

:::{custom-style=CodeBox} console echo Staging web app URL: http://\$webappnamestaging.azurewebsites.net :::

- 3. In a text editor or Visual Studio, modify *Pages/Index.cshtml* again so that the <h2> element reads <h2>Simple Feed Reader V3</h2> and save the file.
- 4. Commit the file to the local Git repository, using either the **Changes** page in Visual Studio's *Team Explorer* tab, or by entering the following using the local machine's command shell:

:::{custom-style=CodeBox} console git commit -a -m "upgraded to V3" :::

- 5. Using the local machine's command shell, add the staging deployment URL as a Git remote and push the committed changes:
  - a. Add the remote URL for staging to the local Git repository.

:::{custom-style=CodeBox} console git remote add azure-staging <Git\_staging\_deployment\_URL> :::

b. Push the local default branch (*main*) to the *azure-staging* remote's deployment branch (*main*).

:::{custom-style=CodeBox} console git push azure-staging main :::

Wait while Azure builds and deploys the app.

6. To verify that V3 has been deployed to the staging slot, open two browser windows. In one window, navigate to the original web app URL. In the other window, navigate to the staging web app URL. The production URL serves V2 of the app. The staging URL serves V3 of the app.

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Retrieve Feed							
© 2017 - SimpleFeedReader							

7. In the Cloud Shell, swap the verified/warmed-up staging slot into production.

:::{custom-style=CodeBox} azurecli az webapp deployment slot swap --name \$webappname --resource-group AzureTutorial --slot staging :::

8. Verify that the swap occurred by refreshing the two browser windows.

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## Summary

In this section, the following tasks were completed:

- Downloaded and built the sample app.
- Created an Azure App Service Web App using the Azure Cloud Shell.
- Deployed the sample app to Azure using Git.
- Deployed a change to the app using Visual Studio.
- Added a staging slot to the web app.
- Deployed an update to the staging slot.
- Swapped the staging and production slots.

In the next section, you'll learn how to build a DevOps pipeline with Azure Pipelines.

## Additional reading

- Web Apps overview
- Build a .NET Core and SQL Database web app in Azure App Service
- <u>Configure deployment credentials for Azure App Service</u>
- Set up staging environments in Azure App Service

# Continuous integration and deployment with Azure DevOps

#### Note

This section details continuous integration and deployment with Azure DevOps. You can achieve that with GitHub Actions as well. GitHub Actions is a workflow engine built into GitHub that can also be used for continuous integration and deployment. To follow the guide for building and deploying to Azure using GitHub, complete the **Publish the app's code to GitHub** and **Disconnect local Git deployment** sections below and then proceed to the <u>GitHub Actions section</u>.

In the previous chapter, you created a local Git repository for the Simple Feed Reader app. In this chapter, you'll publish that code to a GitHub repository and construct an Azure DevOps Services pipeline using Azure Pipelines. The pipeline enables continuous builds and deployments of the app. Any commit to the GitHub repository triggers a build and a deployment to the Azure Web App's staging slot.

In this section, you'll complete the following tasks:

[!div class="checklist"]

- Publish the app's code to GitHub
- Disconnect local Git deployment
- Create an Azure DevOps organization
- Create a team project in Azure DevOps organization
- Configure a self-hosted agent if necessary
- Create a build definition
- Create a release pipeline
- Commit changes to GitHub and automatically deploy to Azure
- Examine the Azure Pipelines pipeline

## Publish the app's code to GitHub

- 1. Open a browser window, and navigate to https://github.com.
- 2. Click the + drop-down in the header, and select New repository:



- 1. Select your account in the **Owner** drop-down, and enter *simple-feed-reader* in the **Repository name** textbox.
- 2. Click the **Create repository** button.
- 3. Open your local machine's command shell. Navigate to the directory in which the *simple-feed-reader* Git repository is stored.
- 4. Rename the existing origin remote to upstream. Execute the following command:

:::{custom-style=CodeBox} console git remote rename origin upstream :::

5. Add a new *origin* remote pointing to your copy of the repository on GitHub. Execute the following command:

:::{custom-style=CodeBox} console git remote add origin https://github.com/<GitHub\_username>/simple-feed-reader/ :::

6. Publish your local Git repository to the newly created GitHub repository. Execute the following command:

::::{custom-style=CodeBox} console git push -u origin main :::

7. Open a browser window, and navigate to https://github.com/<GitHub\_username>/simple-feed-reader/. Validate that your code appears in the GitHub repository.

## Disconnect local Git deployment

Remove the local Git deployment with the following steps. Azure Pipelines (an Azure DevOps service) both replaces and augments that functionality.

1. Open the <u>Azure portal</u>, and navigate to the *staging (mywebapp<unique\_number>/staging)* Web App. The Web App can be quickly located by entering *staging* in the portal's search box:

#### ${f ho}$ Search resources, services, and docs

Click **Deployment Center**. A new panel appears. Click **Disconnect** to remove the local Git source control configuration that was added in the previous chapter. Confirm the removal operation by clicking the **Yes** button.

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- 1. Navigate to the *mywebapp* App Service. As a reminder, the portal's search box can be used to quickly locate the App Service.
- 2. Click **Deployment Center**. A new panel appears. Click **Disconnect** to remove the local Git source control configuration that was added in the previous chapter. Confirm the removal operation by clicking the **Yes** button.

#### Create an Azure DevOps organization

- 1. Open a browser, and navigate to the <u>Azure DevOps organization creation page</u>.
- 2. Select New organization
- 3. Confirm the information, and then select **Continue**.
- 4. Sign in to your organization at any time, https://dev.azure.com/{yourorganization}

### Create a team project in Azure DevOps organization

- 1. Choose the organization, and then select New project.
- 2. Enter the project name as *MyFirstProject* and select the **Visibility** as *Private*
- 3. Select Create project.

For more information, see Create a project

## Configure a self-hosted agent if necessary

To build your code or deploy your software using Azure Pipelines, you need at least one agent. In Azure Pipelines, you can run parallel jobs on either **Microsoft-hosted** or **self-hosted** agent. But with the recent change in Azure Pipelines free grant of parallel jobs is temporarily disable for the public projects.For more details, refer <u>Configure and pay for parallel jobs</u>.

Go to **Organization Settings** and then **Pipelines** > **Parallel jobs**. If you see value **0** under **Microsoft-hosted** that means you need a **Self-hosted** agent to run your pipeline.

Public   Free	projects	
	Microsoft-hosted (i) View in-progress jobs	<b>O</b> Parallel jobs
	Self-hosted (i) View in-progress jobs	Unlimited Parallel jobs

You can create that by following details mentioned in <u>Self-hosted agents</u>. After successful configuration, you'll be able to see available agent under **Organization Settings** > **Agent pools** > **{youragentname}** 

Jobs Agents Details Security Settings Maintenance History				
Name	Last run	Current status	Agent version	Enabled
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## Configure the Azure Pipelines pipeline

There are three distinct steps to complete. Completing the steps in the following three sections results in an operational DevOps pipeline.

#### Grant Azure DevOps access to the GitHub repository

1. In your project, navigate to the **Pipelines** page. Then choose the action to create a new pipeline:



1. Use Use the classic editor to create the pipeline.



1. Select the **GitHub** option from the **Select a source** section::



1. Authorization is required before Azure DevOps can access your GitHub repository. Enter *GitHub connection* in the **Connection name** textbox. For example:

(i) We need your authorization	to access your repositories
Connection name * scottaddie GitHub connectio	on
Authorize using OAuth	Or Authorize with a GitHub personal access token

 If two-factor authentication is enabled on your GitHub account, a personal access token is required. In that case, click the **Authorize with a GitHub personal access token** link. See the <u>official GitHub personal access token creation instructions</u> for help. Only the *repo* scope of permissions is needed. Otherwise, click the **Authorize using OAuth** button.

- 2. When prompted, sign in to your GitHub account. Then select Authorize to grant access to your Azure DevOps organization. If successful, a new service endpoint is created.
- 3. Click the ellipsis button next to the **Repository** button. Select the */simple-feed-reader* repository from the list. Click the **Select** button.
- 4. Select the default branch (*main*) from the **Default branch for manual and scheduled builds** drop-down. Click the **Continue** button. The template selection page appears.

#### Create the build definition

1. From the template selection page, enter *ASP.NET Core* in the search box:



- 1. The template search results appear. Hover over the **ASP.NET Core** template, and click the **Apply** button.
- 2. The **Tasks** tab of the build definition appears. Select the self-hosted **Agent pool** if you have created that in the earlier step.

Tasks Variables Triggers Options Retention History 🛛 🗟 Save & queue 🗸 🌱	Discard ≡ Summary ▷ Queue ····	2
Pipeline		
E= Get sources O suptoreosimple-feed-reader ⊉ main	Name * My-FirstProject-ASP.NET Core (.NET Framework)-CI	
Agent job 1 +	Agent pool* ()   Pool information   Manage 12 Default	~ U
Use NuGet 4.1 Pi NuGet tool installer	Parameters O   🗣 Unlink all	
NuGet restore	Path to solution or packages.config * 🕤	
Build solution Visual Studio build	Artifact Name * 📀	
Visual Studio Test	drop	
Publish symbols path ●      index source and publish symbols		
Publish Artifact Publish build artiflets		

> [!NOTE]

> If you are using MS-hosted agent then select the \*Hosted > Azure Pipelines\* from drop down.

- 1. Click the **Triggers** tab.
- 2. Check the **Enable continuous integration** box. Under the **Branch filters** section, confirm that the **Type** drop-down is set to *Include*. Set the **Branch specification** drop-down to *main*.

	Enable continuous integration
$\Box$	Batch changes while a build is in progress

#### Branch filters

Туре	Branch specification	
Include $\checkmark$	main	Û
+ Add		
Path filters		

+ Add

These settings cause a build to trigger when any change is pushed to the default branch (\*main\*) of the GitHub repository. Continuous integration is tested in the [Commit changes to GitHub and automatically deploy to Azure](#commit-changes-to-github-and-automatical) section.

1. Click the **Save & queue** button, and select the **Save** option:



1. The following modal dialog appears:

Select folder *		
λ		
Comment		

Use the default folder of \*\\\*, and click the \*\*Save\*\* button.

#### Create the release pipeline

1. Click the **Releases** tab of your team project. Click the **New pipeline** button.

Cverview	
🕄 Boards	
😢 Repos	
Pipelines	
uta Pipelines	
🚊 Environments	n 👷 📕
Releases	
📟 Task groups	No release pipelines found
<ul> <li>Deployment groups</li> </ul>	Automate your release process in a few easy steps with a new pipeline
👗 Test Plans	New pipeline
Artifacts	

The template selection pane appears.

1. From the template selection page, enter *App Service Deployment* in the search box:

Select	a template	Azure App Service	Deploy 🗙		
Or start with an 👜 Empty job					
Feature	d				
	Azure App Service deployment Deploy your application to Azure App Service. Choose from Web App on Windows, Linux, containers, Function Apps, o WebJobs.	n r			
Others					
	Azure App Service deployment with continuous monitoring Deploy your Web applications to Azure App Service and enable continuous monitoring using Application Insights.	2			
	Azure App Service deployment with slot Deploy your Azure Web App to a staging slot and swap slots to deploy to production.	2			
Ś	Azure App Service deployment with tests and performance tests Deploy your Azure Web App and run tests or cloud-based web performance tests.	5			
Ŷ	Azure Service Fabric Compose deployment Deploy a Docker Compose application to a Service Fabric cluster.	:			
$\Delta$	Azure Service Fabric deployment Deploy an Azure Service Fabric application.				

1. The template search results appear. Hover over the **Azure App Service Deployment with Slot** template, and click the **Apply** button. The **Pipeline** tab of the release pipeline appears.

#### All pipelines > **▼** New release pipeline

Pipeline ① Tasks ~ Variables	Retention Options History	
Artifacts   + Add	Stages   + Add $\sim$	
+ Add an artifact	Stage 1 A O 1 job, 2 tasks	

1. Click the Add button in the Artifacts box. The Add artifact panel appears:

Add artifact				
Source type	Git	GitHub	<b>F</b> Team Found	
S more artifact types ∨ Project * (i)				
MyFirstProject				$\sim$
Source (Build definition	n) * (i)			
This setting is serviced				~
This setting is required.				
Add				

- 1. Select the **Build** tile from the **Source type** section. This type allows for the linking of the release pipeline to the build definition.
- 2. Select *MyFirstProject* from the **Project** drop-down.
- 3. Select the build definition name, *MyFirstProject-ASP.NET Core-CI*, from the **Source (Build definition)** drop-down.
- 4. Select *Latest* from the **Default version** drop-down. This option builds the artifacts produced by the latest run of the build definition.

- 5. Replace the text in the **Source alias** textbox with *Drop*.
- 6. Click the **Add** button. The **Artifacts** section updates to display the changes.
- 7. Click the lightning bolt icon to enable continuous deployments:

Artifacts   + Add
Geo Drop
Schedule not set

With this option enabled, a deployment occurs each time a new build is available.

- 1. A **Continuous deployment trigger** panel appears to the right. Click the toggle button to enable the feature. It isn't necessary to enable the **Pull request trigger**.
- 2. Click the **Add** drop-down in the **Build branch filters** section. Choose the **Build Definition's default branch** option. This filter causes the release to trigger only for a build from the GitHub repository's default branch (*main*).
- 3. Click the **Save** button. Click the **OK** button in the resulting **Save** modal dialog.
- 4. Click the **Stage 1** box. An **Stage** panel appears to the right. Change the *Stage 1* text in the **Stage name** textbox to *Production*.

Stages   $+$ Add $\vee$	Stage Production	iii Delete $\Diamond$ Move $\vee$ $\cdots$
& Production       A       I job, 2 tasks	Properties へ Name and owners of the stage Stage name	
	Production Stage owner	

1. Click the **1 phase, 2 tasks** link in the **Production** box:



The \*\*Tasks\*\* tab of the environment appears.

- 1. Click the **Deploy Azure App Service to Slot** task. Its settings appear in a panel to the right.
- 2. Select the Azure subscription associated with the App Service from the **Azure subscription** drop-down. Once selected, click the **Authorize** button.
- 3. Select *Web App* from the **App type** drop-down.
- 4. Select *mywebapp/* from the **App service name** drop-down.
- 5. Select *AzureTutorial* from the **Resource group** drop-down.
- 6. Select *staging* from the **Slot** drop-down.
- 7. Select **Run on agent**\* under **Tasks**. On the right pane, you'll see **Agent Job**.
- 8. Select the self-hosted **Agent pool** if you have created that in the earlier step.

Production	Agent job 🛈	Remove	
Run on agent     + Ⅲ       ■ Run on agent     + Ⅲ       Openory Azure App Service to Slot     Azure App Service deploy	Display name * Run on agent Agent selection A		
Anage Azure App Service - Slot Swap Azure App Service manage	Agent pool ()   Pool information   Manage C Default ~ ~	U	
	Demands () Name Condition Value		
	+ Add Execution plan ~		

#### > [!NOTE]

> If you are using MS-hosted agent then select the \*Hosted > Azure Pipelines\* from drop down.

- 1. Click the **Save** button.
- 2. Hover over the default release pipeline name. Click the pencil icon to edit it. Use *MyFirstProject-ASP.NET Core-CD* as the name.



1. Click the **Save** button.

# Commit changes to GitHub and automatically deploy to Azure

- 1. Open SimpleFeedReader.sln in Visual Studio.
- 2. In Solution Explorer, open *Pages.cshtml*. Change <h2>Simple Feed Reader V3</h2> to <h2>Simple Feed Reader V4</h2>.
- 3. Press Ctrl+Shift+B to build the app.
- 4. Commit the file to the GitHub repository. Use either the **Changes** page in Visual Studio's *Team Explorer* tab, or execute the following using the local machine's command shell:

:::{custom-style=CodeBox} console git commit -a -m "upgraded to V4" :::

5. Push the change in the default branch (*main*) to the *origin* remote of your GitHub repository. In the following command, replace the placeholder {BRANCH} with the default branch (use main):

:::{custom-style=CodeBox} console git push origin {BRANCH} :::

The commit appears in the GitHub repository's default branch (*main*). You'll be able to see the commit history in https://github.com/<GitHub\_username>/simple-feed-reader/commits/main.

The build is triggered, since continuous integration is enabled in the build definition's **Triggers** tab:



1. Navigate to the **Pipelines**. You'll see the CI pipeline details and monitor each steps if you drill down **Jobs** details.



1. Similarly, go to the **Releases** tab to see the details of CD pipeline. You can always drill down further to see more details of each step.



1. Once the build succeeds, a deployment to Azure occurs. Navigate to the app in the browser. Notice that the "V4" text appears in the heading:

SimpleFeedReader
Simple Feed Reader - V4
Enter a feed URL:
Retrieve Feed
© 2017 - SimpleFeedReader

## Examine the Azure Pipelines pipeline

#### **Build definition**

A build definition was created with the name *MyFirstProject-ASP.NET Core-CI*. Upon completion, the build produces a *.zip* file including the assets to be published. The release pipeline deploys those assets to Azure.

The build definition's Tasks tab lists the individual steps being used. There are five build tasks.

#### i → MyFirstProject-ASP.NET Core (.NET Framework)-CI

Tas	ks	Variables	Triggers	Options	Retention	History		🗄 Save & qu	ueue $\vee$	5 1
Pip Buile	eliı d pip	ne Jeline								
37	Get Ω₅	<b>SOURCES</b> ughosneo/simp	le-feed-reader	r 🎖 mair	r					
Ag ≣⊺	ent Run (	: <b>job 1</b> on agent							+	
1		Use NuGe P NuGet tool	t 4.4.1 installer							
1		NuGet rest NuGet	tore							
N	J	Build solut Visual Studio b	t <b>ion</b> uild							
J		Test Assen Visual Studio Te	n <b>blies</b> est						0	
•	1	Publish syn Index sources a	mbols pat and publish syr	<b>h</b> mbols						
1		Publish Ar Publish build a	tifact <sup>rtifacts</sup>							
1.	<b>Re</b> de	<b>estore</b> — Exe fault packag	ecutes the o ge feed used	dotnet resto d is nuget.c	ore command org.	d to restore	e the ap	op's NuGet p	ackages.	The

- Build Executes the dotnet build --configuration release command to compile the app's code. This --configuration option is used to produce an optimized version of the code, which is suitable for deployment to a production environment. Modify the *BuildConfiguration* variable on the build definition's Variables tab if, for example, a debug configuration is needed.
- 3. Test Executes the dotnet test --configuration release --logger trx --results-directory <local\_path\_on\_build\_agent> command to run the app's unit tests. Unit tests are executed within any C# project matching the \*\*/Tests/.csproj glob pattern. Test results are saved in a .trx file at the location specified by the --results-directory option. If any tests fail, the build fails and isn't deployed.

[!NOTE] To verify the unit tests work, modify *SimpleFeedReader.Tests.cs* to purposefully break one of the tests. For example, change Assert.True(result.Count > 0); to Assert.False(result.Count > 0); in the Returns\_News\_Stories\_Given\_Valid\_Uri method. Commit and push the change to GitHub. The build is triggered and fails. The build pipeline status changes to **failed**. Revert the change, commit, and push again. The build succeeds.

- 4. Publish Executes the dotnet publish --configuration release --output <local\_path\_on\_build\_agent> command to produce a .*zip* file with the artifacts to be deployed. The --output option specifies the publish location of the .*zip* file. That location is specified by passing a <u>predefined variable</u> named \$(build.artifactstagingdirectory). That variable expands to a local path, such as \*c:\_work\1, on the build agent.
- Publish Artifact Publishes the *.zip* file produced by the Publish task. The task accepts the *.zip* file location as a parameter, which is the predefined variable
   \$(build.artifactstagingdirectory). The *.zip* file is published as a folder named *drop*.

Click the build definition's **Summary** link to view a history of builds with the definition:



On the resulting page, click the individual build for more details.

MyFirstProject-ASP.NET Core (.NET Framework)-Cl  Runs Branches Analytics		Edit Run pipeline :
Description	Stages	
#20210420.5 Update Index.cshtml ⊘ Individual CI for 🚱 1 <sup>3</sup> ma£n 🕴 97c8s2b 🖄	0	13 19m ago ⓒ 41s
#20210420.4 Update Index.cshtml ⊘ Individual CI for 🊱 🖹 masin 🕴 d.1077bb 🖄	0	변형 36m ago ① 40s
#20210420.3 Update Index.cshtml Ø Individual CI for @ ₽ main \$ 5802b8e Ø	0	සී 40m ago ල 1m 0s
#20210420.2 Update Index.cshtml ♂ Individual CI for ۞ ₽ main ◊ cb034f7	0	ট3 1h ago ⓒ 41s

A summary of this specific build is displayed. Click the **published** link, and notice the *drop* folder produced by the build is listed:

#20210420.5 Update Index.cshtml     on MyFirstProject-ASP.NET Core (.NET Framework)-CI	td by release		Run new :
ummary Releases			
Triggered by 💱 sughosneo			View change
Repository and version Ω sughosneo/simple-feed-reader	Time started and elapsed	Related © 0 work items	Tests and coverage
<sup>®</sup> main ∮ 97c0a2b	© 41s	〒1 published: 1 consumed	
Name Consumed		Size	
> 🖬 drop		906 KB	
			± Download artifacts ⓑ Copy download URL

Use the ellipsis and click on **Downloads artifacts** links to inspect the published artifacts.

#### **Release pipeline**

A release pipeline was created with the name *MyFirstProject-ASP.NET Core-CD*:

Pipeline	Tasks $\vee$	Variables	Retention	Options	History		
Art	tifacts   +	Add	Stages	+ Add	~	 	
	<b>i</b> Drop	Æ		لي 2 P 1	roduction job, 2 tasks	8	
ζ	Schedul not set	e					

The two major components of the release pipeline are the **Artifacts** and the **Stages**. Clicking the box in the **Artifacts** section reveals the following panel:

Artifacto   + Add	Stagos   + Add ~	Artifact	🗓 Delete 😶
		Project * (j)	
£	& Produc	MyFirstProject	
Drop	A 1 job, 2 t	Source (build pipeline) * (i)	
<u></u>		MyFirstProject-ASP.NET Core (.NE	T Framework)-Cl
Schedule not set		Default version * (i)	
		Latest	×

The **Source (Build definition)** value represents the build definition to which this release pipeline is linked. The *.zip* file produced by a successful run of the build definition is provided to the *Production* environment for deployment to Azure. Click the *1 phase, 2 tasks* link in the *Production* environment box to view the release pipeline tasks:

Pipe	line	Tasks $\vee$	Variables	Retention	Options
Pro Deplo	ducti	ON process			
Pha Ru	se1 in on a	gent			+
K	De P⊡	ploy Azure Azure App Servi	e App Servic	e to Slot	
<b>C</b>	Ma Azu	anage Azur Ire App Service	r <b>e App Servi</b> <sub>Manage</sub>	ce - Slo	

The release pipeline consists of two tasks: *Deploy Azure App Service to Slot* and *Manage Azure App Service - Slot Swap*. Clicking the first task reveals the following task configuration:

Pipeli	ne	Tasks $\vee$	Variables	Retention	Options H
Prod Deploy	luctio	D <b>n</b> process			
Phas Rur	e1 1 on ag	gent			+
	De ₽ª A	ploy Azure Azure App Servi	e App Servic	e to Slot	
<b>E</b>	Ma Azur	nage Azur re App Service I	re App Servi Manage	ce - Slo	

The Azure subscription, service type, web app name, resource group, and deployment slot are defined in the deployment task. The **Package or folder** textbox holds the *.zip* file path to be extracted and deployed to the *staging* slot of the *mywebapp<unique\_number>* web app.

Clicking the slot swap task reveals the following task configuration:

Azure App Service Manage 🛈	
Version 0.* 🗸	
Display name *	
Manage Azure App Service - Slot Swap	
Azure subscription * 🛈   Manage 🖪	
Visual Studio Enterprise $\checkmark$	$\bigcirc$
Action (i)	
Swap Slots	$\sim$
App Service name * (i)	
mywebapp11857 V	$\bigcirc$
Resource group * (i)	
AzureTutorial 🗸	$\bigcirc$
Source Slot * (i)	
staging $\checkmark$	$\bigcirc$
✓ Swap with Production ③	
Preserve Vnet (i)	

The subscription, resource group, service type, web app name, and deployment slot details are provided. The **Swap with Production** check box is checked. Consequently, the bits deployed to the *staging* slot are swapped into the production environment.

## Additional reading

- <u>Create your first pipeline with Azure Pipelines</u>
- Build and .NET Core project
- Deploy a web app with Azure Pipelines
# Continuous integration and deployment with Azure DevOps

#### Note

This section details continuous integration and deployment with Azure DevOps. You can achieve that with GitHub Actions as well. GitHub Actions is a workflow engine built into GitHub that can also be used for continuous integration and deployment. To follow the guide for building and deploying to Azure using GitHub, complete the **Publish the app's code to GitHub** and **Disconnect local Git deployment** sections below and then proceed to the <u>GitHub Actions section</u>.

In the previous chapter, you created a local Git repository for the Simple Feed Reader app. In this chapter, you'll publish that code to a GitHub repository and construct an Azure DevOps Services pipeline using Azure Pipelines. The pipeline enables continuous builds and deployments of the app. Any commit to the GitHub repository triggers a build and a deployment to the Azure Web App's staging slot.

In this section, you'll complete the following tasks:

[!div class="checklist"]

- Publish the app's code to GitHub
- Disconnect local Git deployment
- Create an Azure DevOps organization
- Create a team project in Azure DevOps organization
- Configure a self-hosted agent if necessary
- Create a build definition
- Create a release pipeline
- Commit changes to GitHub and automatically deploy to Azure
- Examine the Azure Pipelines pipeline

# Publish the app's code to GitHub

- 1. Open a browser window, and navigate to https://github.com.
- 2. Click the + drop-down in the header, and select **New repository**:

	+
New repository	
Import repository	
New gist	
New organization	

- 1. Select your account in the **Owner** drop-down, and enter *simple-feed-reader* in the **Repository name** textbox.
- 2. Click the **Create repository** button.
- 3. Open your local machine's command shell. Navigate to the directory in which the *simple-feed-reader* Git repository is stored.
- 4. Rename the existing *origin* remote to *upstream*. Execute the following command:

:::{custom-style=CodeBox} console git remote rename origin upstream :::

5. Add a new *origin* remote pointing to your copy of the repository on GitHub. Execute the following command:

:::{custom-style=CodeBox} console git remote add origin https://github.com/<GitHub\_username>/simple-feed-reader/ :::

6. Publish your local Git repository to the newly created GitHub repository. Execute the following command:

:::{custom-style=CodeBox} console git push -u origin main :::

7. Open a browser window, and navigate to https://github.com/<GitHub\_username>/simple-feed-reader/. Validate that your code appears in the GitHub repository.

# **Disconnect local Git deployment**

Remove the local Git deployment with the following steps. Azure Pipelines (an Azure DevOps service) both replaces and augments that functionality.

1. Open the <u>Azure portal</u>, and navigate to the *staging (mywebapp<unique\_number>/staging)* Web App. The Web App can be quickly located by entering *staging* in the portal's search box:



- 1. Click **Deployment Center**. A new panel appears. Click **Disconnect** to remove the local Git source control configuration that was added in the previous chapter. Confirm the removal operation by clicking the **Yes** button.
- 2. Navigate to the *mywebapp* App Service. As a reminder, the portal's search box can be used to quickly locate the App Service.
- 3. Click **Deployment Center**. A new panel appears. Click **Disconnect** to remove the local Git source control configuration that was added in the previous chapter. Confirm the removal operation by clicking the **Yes** button.

# Create an Azure DevOps organization

- 1. Open a browser, and navigate to the <u>Azure DevOps organization creation page</u>.
- 2. Select New organization
- 3. Confirm the information, and then select **Continue**.

4. Sign in to your organization at any time, https://dev.azure.com/{yourorganization}

# Create a team project in Azure DevOps organization

- 1. Choose the organization, and then select **New project**.
- 2. Enter the project name as *MyFirstProject* and select the **Visibility** as *Private*
- 3. Select **Create project**.

For more information, see Create a project

# Configure a self-hosted agent if necessary

To build your code or deploy your software using Azure Pipelines, you need at least one agent. In Azure Pipelines, you can run parallel jobs on either **Microsoft-hosted** or **self-hosted** agent. But with the recent change in Azure Pipelines free grant of parallel jobs is temporarily disable for the public projects.For more details, refer <u>Configure and pay for parallel jobs</u>.

Go to **Organization Settings** and then **Pipelines** > **Parallel jobs**. If you see value **0** under **Microsoft-hosted** that means you need a **Self-hosted** agent to run your pipeline.

# 

You can create that by following details mentioned in <u>Self-hosted agents</u>. After successful configuration, you'll be able to see available agent under **Organization Settings** > **Agent pools** > **{youragentname}** 

Jobs Agents Details Security Settings Maintenance History				
Name	Last run	Current status	Agent version	Enabled
• Online	Yesterday	Idle	2.185.1	On On

# **Configure the Azure Pipelines pipeline**

There are three distinct steps to complete. Completing the steps in the following three sections results in an operational DevOps pipeline.

#### Grant Azure DevOps access to the GitHub repository

1. In your project, navigate to the **Pipelines** page. Then choose the action to create a new pipeline:



Automate your build and release processes using our wizard, and go from code to cloud-hosted within minutes.



1. Use Use the classic editor to create the pipeline.

Connect		Select	Configure	Review	1
New pip Whe	eline ere is yo	ur code	?		
8	Azure Repos C Free private Git i	Git YAML repositories, pull	requests, and code search		
	Bitbucket Clou Hosted by Atlass	ad YAML			
0	GitHub YAMI Home to the wo	rld's largest com	munity of developers		
0	GitHub Enterp The self-hosted	version of GitHub	AML Enterprise		
•	Other Git Any generic Git	repository			
	Subversion Centralized versi	on control by Ap	ache		
Use the	classic editor to	create a pipel	ine without YAML.		

1. Select the **GitHub** option from the **Select a source** section::



1. Authorization is required before Azure DevOps can access your GitHub repository. Enter *GitHub connection* in the **Connection name** textbox. For example:



- 1. If two-factor authentication is enabled on your GitHub account, a personal access token is required. In that case, click the **Authorize with a GitHub personal access token** link. See the <u>official GitHub personal access token creation instructions</u> for help. Only the *repo* scope of permissions is needed. Otherwise, click the **Authorize using OAuth** button.
- 2. When prompted, sign in to your GitHub account. Then select Authorize to grant access to your Azure DevOps organization. If successful, a new service endpoint is created.
- 3. Click the ellipsis button next to the **Repository** button. Select the */simple-feed-reader* repository from the list. Click the **Select** button.
- 4. Select the default branch (*main*) from the **Default branch for manual and scheduled builds** drop-down. Click the **Continue** button. The template selection page appears.

#### Create the build definition

1. From the template selection page, enter *ASP.NET Core* in the search box:



The template search results appear. Hover over the **ASP.NET Core** template, and click the **Apply** button.

1. The **Tasks** tab of the build definition appears. Select the self-hosted **Agent pool** if you have created that in the earlier step.

Tasks Variables Triggers Options Retention History 🛛 🗟 Save & queue 🗸 🤊	Discard 🗏 Summary 🗅 Queue …
Pipeline	
3 <sup>™</sup> Get sources Ω suproment/imple-feed-reader P main	Name * MyFirstProject-ASP.NET Core (NET Framework)-CI
Agent job 1 +	Agent pool * ()   Pool information   Manage 12
Use NuGet 4.4.1 Po NuGet tool installer	Parameters O   92 Unlink all
NuGet restore	Path to solution or packages.config * 🐵
Build solution Visual Studio build	Artifact Name * 💿
Visual Studio Test	drop
Publish symbols path Index sources and publish symbols	
Publish Artifact Publish pull artifacts	

> [!NOTE]

> If you are using MS-hosted agent then select the \*Hosted > Azure Pipelines\* from drop down.

- 1. Click the **Triggers** tab.
- 2. Check the **Enable continuous integration** box. Under the **Branch filters** section, confirm that the **Type** drop-down is set to *Include*. Set the **Branch specification** drop-down to *main*.

Enable continuous in Batch changes while	tegration a build is in progress
Branch filters	
Туре	Branch specification
Include $\lor$	main 💼
+ Add	
Path filters + Add	

These settings cause a build to trigger when any change is pushed to the default branch (\*main\*) of the GitHub repository. Continuous integration is tested in the [Commit changes to GitHub and automatically deploy to Azure](#commit-changes-to-github-and-automatical) section.

1. Click the **Save & queue** button, and select the **Save** option:



1. The following modal dialog appears:

	>
Save	Cancel
	Save

Use the default folder of \*\\\*, and click the \*\*Save\*\* button.

## Create the release pipeline

1. Click the **Releases** tab of your team project. Click the **New pipeline** button.

	Overview	
=	Boards	
8	Repos	
*	Pipelines	
i de cara	Pipelines	
<u>_</u>	Environments	n 👷 📥
\$\$? II\	Releases Library	
æ	Task groups	No release pipelines found
•••	Deployment groups	Automate your release process in a few easy steps with a new pipeline
Å	Test Plans	New pipeline
4	Artifacts	

The template selection pane appears.

1. From the template selection page, enter *App Service Deployment* in the search box:



1. The template search results appear. Hover over the **Azure App Service Deployment with Slot** template, and click the **Apply** button. The **Pipeline** tab of the release pipeline appears.

l pipelines > 🕈 New eline ① Tasks ∨ Variable	release pipeline es Retention Options History
Artifacts   $+$ Add	• Stages   + Add $\checkmark$
+ Add an artifact	<pre></pre>
G Schedule not set	

1. Click the Add button in the Artifacts box. The Add artifact panel appears:

Add artifact	
Source type	
Git GitHub Team Found	
3 more artifact types 🗸	
Project * ①	
MyFirstProject	$\sim$
Source (Build definition) * 🕢	
	~
① This setting is required.	
Add	

- 1. Select the **Build** tile from the **Source type** section. This type allows for the linking of the release pipeline to the build definition.
- 2. Select *MyFirstProject* from the **Project** drop-down.
- 3. Select the build definition name, *MyFirstProject-ASP.NET Core-CI*, from the **Source (Build definition)** drop-down.
- 4. Select *Latest* from the **Default version** drop-down. This option builds the artifacts produced by the latest run of the build definition.
- 5. Replace the text in the **Source alias** textbox with *Drop*.
- 6. Click the **Add** button. The **Artifacts** section updates to display the changes.
- 7. Click the lightning bolt icon to enable continuous deployments:

Artifacts   + Add
<i>⊈</i> Drop
C Schedule not set

With this option enabled, a deployment occurs each time a new build is available.

- 1. A **Continuous deployment trigger** panel appears to the right. Click the toggle button to enable the feature. It isn't necessary to enable the **Pull request trigger**.
- 2. Click the **Add** drop-down in the **Build branch filters** section. Choose the **Build Definition's default branch** option. This filter causes the release to trigger only for a build from the GitHub repository's default branch (*main*).
- 3. Click the **Save** button. Click the **OK** button in the resulting **Save** modal dialog.
- 4. Click the **Stage 1** box. An **Stage** panel appears to the right. Change the *Stage 1* text in the **Stage name** textbox to *Production*.

Stages   $+$ Add $\vee$	Stage Production	Î Delete ↓ Move ∨ ····
A Production A I job, 2 tasks	區 Properties へ Name and owners of the stage Stage name	
	Production	
	Stage owner	

1. Click the **1 phase, 2 tasks** link in the **Production** box:

Stages   + Ado	l v	
R R	Production ① 1 job, 2 tasks	8

The \*\*Tasks\*\* tab of the environment appears.

- 1. Click the **Deploy Azure App Service to Slot** task. Its settings appear in a panel to the right.
- 2. Select the Azure subscription associated with the App Service from the **Azure subscription** drop-down. Once selected, click the **Authorize** button.
- 3. Select *Web App* from the **App type** drop-down.
- 4. Select *mywebapp/* from the **App service name** drop-down.
- 5. Select *AzureTutorial* from the **Resource group** drop-down.
- 6. Select *staging* from the **Slot** drop-down.
- 7. Select **Run on agent**\* under **Tasks**. On the right pane, you'll see **Agent Job**.
- 8. Select the self-hosted **Agent pool** if you have created that in the earlier step.

Production Deployment process		Agent job 🕕				🗊 Remove
Run on agent I Run on agent	+ 🎚	Display name *				
Deploy Azure App Service to Slot Azure App Service deploy		Run on agent Agent selection				
Manage Azure App Service - Slot Swap Azure App Service manage		Agent pool ()   Pool information   Manage 12				
		Default				<u> </u>
		Demands (i)				
		Name	Condition	Value		
		+ Add				
		Execution plan A				

> [!NOTE]

> If you are using MS-hosted agent then select the \*Hosted > Azure Pipelines\* from drop down.

- 1. Click the **Save** button.
- 2. Hover over the default release pipeline name. Click the pencil icon to edit it. Use *MyFirstProject-ASP.NET Core-CD* as the name.

٩	MyF	FirstProject /	MyF	irst	$\sim$	Dashbo	ards	Code	Work	Build an
Bui	lds	Releases	Libr	ary	Tas	k Groups	Dep	loyment (	Groups	
А	ll de	efinitions	>	Ŷ	Myl	FirstPro	ject	-ASP.N	ET Cor	e-CD

1. Click the **Save** button.

# Commit changes to GitHub and automatically deploy to Azure

- 1. Open SimpleFeedReader.sln in Visual Studio.
- 2. In Solution Explorer, open *Pages.cshtml*. Change <h2>Simple Feed Reader V3</h2> to <h2>Simple Feed Reader V4</h2>.
- 3. Press Ctrl+Shift+B to build the app.
- 4. Commit the file to the GitHub repository. Use either the **Changes** page in Visual Studio's *Team Explorer* tab, or execute the following using the local machine's command shell:

:::{custom-style=CodeBox} console git commit -a -m "upgraded to V4" :::

5. Push the change in the default branch (*main*) to the *origin* remote of your GitHub repository. In the following command, replace the placeholder {BRANCH} with the default branch (use main):

:::{custom-style=CodeBox} console git push origin {BRANCH} :::

The commit appears in the GitHub repository's default branch (*main*). You'll be able to see the commit history in https://github.com/<GitHub\_username>/simple-feed-reader/commits/main.

The build is triggered, since continuous integration is enabled in the build definition's **Triggers** tab:



1. Navigate to the **Pipelines**. You'll see the CI pipeline details and monitor each steps if you drill down **Jobs** details.



1. Similarly, go to the **Releases** tab to see the details of CD pipeline. You can always drill down further to see more details of each step.



1. Once the build succeeds, a deployment to Azure occurs. Navigate to the app in the browser. Notice that the "V4" text appears in the heading:

SimpleFeedReader
Simple Feed Reader - V4
Enter a feed URL:
Retrieve Feed
© 2017 - SimpleFeedReader

# **Examine the Azure Pipelines pipeline**

#### **Build definition**

A build definition was created with the name *MyFirstProject-ASP.NET Core-CI*. Upon completion, the build produces a *.zip* file including the assets to be published. The release pipeline deploys those assets to Azure.

The build definition's Tasks tab lists the individual steps being used. There are five build tasks.

# i → MyFirstProject-ASP.NET Core (.NET Framework)-CI

Task	s Variables	Triggers	Options	Retention	History		Save & queu	e 🗸	51	
Pip Build	Pipeline									
3= ( (	Get sources ) sughosneo/simp	ple-feed-reader	r 🎖 mai	n						
Age ≣ R	e <b>nt job 1</b> un on agent							+		
6	Use NuGe P NuGet tool	t <b>4.4.1</b> installer								
2	NuGet res	tore								
×	Build solur Visual Studio b	tion <sup>build</sup>								
Л	Test Asser Visual Studio T	n <b>blies</b> <sup>Test</sup>						0		
Ē	Publish sy Index sources	mbols pat and publish syn	<b>h</b> mbols							
1	Publish Ar Publish build a	<b>tifact</b> ertifacts								
1.	<b>Restore</b> — Ex default packag	ecutes the o ge feed use	dotnet resto d is nuget.c	ore command org.	d to restore	e the app	's NuGet pack	kages. 1	Гhe	

- Build Executes the dotnet build --configuration release command to compile the app's code. This --configuration option is used to produce an optimized version of the code, which is suitable for deployment to a production environment. Modify the *BuildConfiguration* variable on the build definition's Variables tab if, for example, a debug configuration is needed.
- 3. **Test** Executes the dotnet test --configuration release --logger trx --results-directory <local\_path\_on\_build\_agent> command to run the app's unit tests. Unit tests are executed within any C# project matching the \*\*/Tests/.csproj glob pattern. Test results are saved in a .trx file at the location specified by the --results-directory option. If any tests fail, the build fails and isn't deployed.

[!NOTE] To verify the unit tests work, modify *SimpleFeedReader.Tests.cs* to purposefully break one of the tests. For example, change Assert.True(result.Count > 0); to Assert.False(result.Count > 0); in the Returns\_News\_Stories\_Given\_Valid\_Uri method. Commit and push the change to GitHub. The build is triggered and fails. The build pipeline status changes to **failed**. Revert the change, commit, and push again. The build succeeds.

- 4. Publish Executes the dotnet publish --configuration release --output <local\_path\_on\_build\_agent> command to produce a .*zip* file with the artifacts to be deployed. The --output option specifies the publish location of the .*zip* file. That location is specified by passing a <u>predefined variable</u> named \$(build.artifactstagingdirectory). That variable expands to a local path, such as \*c:\_work\1, on the build agent.
- Publish Artifact Publishes the *.zip* file produced by the Publish task. The task accepts the *.zip* file location as a parameter, which is the predefined variable
   \$(build.artifactstagingdirectory). The *.zip* file is published as a folder named *drop*.

Click the build definition's **Summary** link to view a history of builds with the definition:



On the resulting page, click the individual build for more details.

MyFirstProject-ASP.NET Core (.NET Framework)-Cl  Runs Branches Analytics		Edit Run pipeline :
Description	Stages	
#20210420.5 Update Index.cshtml ⊘ Individual CI for 🚱 1 <sup>3</sup> ma£n 🕴 97c8s2b 🖄	0	13 19m ago ⓒ 41s
#20210420.4 Update Index.cshtml ⊘ Individual CI for 🊱 🖹 masin 🕴 d.1077bb 🖄	0	변형 36m ago ① 40s
#20210420.3 Update Index.cshtml Ø Individual CI for @ ₽ main \$ 5802b8e Ø	0	සී 40m ago ල 1m 0s
#20210420.2 Update Index.cshtml ♂ Individual CI for ۞ ₽ main ◊ cb034f7	0	ট3 1h ago ⓒ 41s

A summary of this specific build is displayed. Click the **published** link, and notice the *drop* folder produced by the build is listed:

#20210420.5 Update Index.cshtml on MyFirstProject-ASP.NET Core (.NET Framework)-CI 🕫 Reta	ined by release		Run new :
ummary Releases			
Triggered by 🚳 sughosneo			View change
Repository and version ♀ sughosneo/simple-feed-reader ≱ main ♦ 97c0a2b	Time started and elapsed ᡦ Today at 1:14 PM ☉ 41s	Related © 0 work items 1 oublished: 1 consumed	Tests and coverage
- Artifacts			
blished Consumed			
Name		Size	
> 🖬 drop		906 KB	
			Copy download URL

Use the ellipsis and click on **Downloads artifacts** links to inspect the published artifacts.

#### **Release pipeline**

A release pipeline was created with the name *MyFirstProject-ASP.NET Core-CD*:

Pipeline	Tasks $\vee$	Variables	Retention	Options	History			
Art	ifacts   +	· Add	Stages	+ Add	~	 		
	<b>D</b> rop	Ł		ي بر بر بر بر بر بر بر بر بر بر بر بر بر	roduction job, 2 tasks	8		
C	Schedu not set	le						

The two major components of the release pipeline are the **Artifacts** and the **Stages**. Clicking the box in the **Artifacts** section reveals the following panel:

Artifacto   + Add	Stagos   + Add ~	Artifact	🗓 Delete 😶
		Project * (j)	
£	& Produc	MyFirstProject	
Drop	A 1 job, 2 1	Source (build pipeline) * (i)	
<u></u>		MyFirstProject-ASP.NET Core (.NE	T Framework)-Cl
Schedule not set		Default version * (i)	
		Latest	\ \

The **Source (Build definition)** value represents the build definition to which this release pipeline is linked. The *.zip* file produced by a successful run of the build definition is provided to the *Production* environment for deployment to Azure. Click the *1 phase, 2 tasks* link in the *Production* environment box to view the release pipeline tasks:

Pipelir	ne	Tasks $\vee$	Variables	Retention	Options	ł
Prod Deploy	uctio ment	D <b>n</b> process			•••	
Phase	e1 on ag	gent			+	
	e to Slot					
<b>(</b>	Ma Azur	nage Azur re App Service I	e App Servi Manage	ce - Slo		

The release pipeline consists of two tasks: *Deploy Azure App Service to Slot* and *Manage Azure App Service - Slot Swap*. Clicking the first task reveals the following task configuration:

Pipeli	ne	$Tasks \lor$	Variables	Retention	Options H		
Prod Deploy	uctio	D <b>n</b> process					
Phas Rur	e1 1 on ag	gent			+		
$\bigotimes$	Deploy Azure App Service to Slot						
<b>(</b>	Ma Azur	nage Azur re App Service I	re App Servi Manage	ce - Slo			

The Azure subscription, service type, web app name, resource group, and deployment slot are defined in the deployment task. The **Package or folder** textbox holds the *.zip* file path to be extracted and deployed to the *staging* slot of the *mywebapp<unique\_number>* web app.

Clicking the slot swap task reveals the following task configuration:

Azure App Service Manage 🛈	
Version 0.* 🗸	
Display name *	
Manage Azure App Service - Slot Swap	
Azure subscription * 🛈   Manage 🖪	
Visual Studio Enterprise 🗸 🗸	$\bigcirc$
Action (i)	
Swap Slots	$\sim$
App Service name * (i)	
mywebapp11857 V	Ö
Resource group * (i)	
AzureTutorial $\checkmark$	$\circlearrowright$
Source Slot * (i)	
staging $\checkmark$	$\bigcirc$
✓ Swap with Production ①	
Preserve Vnet (i)	

The subscription, resource group, service type, web app name, and deployment slot details are provided. The **Swap with Production** check box is checked. Consequently, the bits deployed to the *staging* slot are swapped into the production environment.

# **Additional reading**

- <u>Create your first pipeline with Azure Pipelines</u>
- Build and .NET Core project
- Deploy a web app with Azure Pipelines

# Continuous integration and deployment with GitHub Actions

GitHub has long been the home for millions of open-source developers around the globe. Most developers associate source control with GitHub. However, GitHub is an evolving platform that can be used for more than just synchronizing Git repositories.

# **GitHub Actions**

GitHub Actions is a workflow engine that can automate workflows for nearly all events that occur on GitHub. Actions is a great solution for Continuous Integration/Continuous Deployment (CI/CD) pipelines.

In this section of articles, you'll learn how to create an Actions workflow. The workflow will build, test, and deploy a .NET web app to Azure Web Apps.

#### Note

Before you begin, complete the **Publish the app's code to GitHub** and **Disconnect local Git deployment** sections of the <u>Continuous integration and deployment with Azure DevOps</u> section to publish your code to GitHub. Then proceed to the <u>Build</u> article.

In the Build article, you'll create the initial workflow to build and test the .NET app. You'll:

[!div class="checklist"]

- Learn the basic structure of a GitHub Action workflow YAML file.
- Use a template to create a basic build workflow that builds a .NET app and executes unit tests.
- Publish the compiled app so that it's ready for deployment.

In the **Deploy** article, you'll:

[!div class="checklist"]

- Learn about environments in GitHub Actions.
- Create two environments and specify environment protection rules.
- Create environment secrets for managing environment-specific configuration.
- Extend the workflow YAML file to add deployment steps.
- Add a manual dispatch trigger.

# Secure code with CodeQL

In addition to building and deploying code, <u>GitHub Advanced Security</u> offers tools for "shifting left" with security. That is, integrating security early on in the software delivery lifecycle. <u>CodeQL</u> is a code scanning language that runs queries to find potential vulnerabilities or quality issues in your code. CodeQL is run using an Actions workflow.

In the <u>CodeQL</u> article, you'll:

[!div class="checklist"]

- Create a Code Scanning Action.
- Edit the workflow file to include custom scan settings.
- See scanning results.

# **Compare and contrast GitHub Actions and Azure Pipelines**

GitHub Actions and Azure Pipelines have a common lineage and are similar in many respects. However, you should understand the differences before selecting a platform for building, testing, and deploying apps. In the <u>Comparison</u> article, you'll deep dive into these platforms and compare and contrast them. You'll also learn how to select the correct platform for your CI/CD needs.

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# Compare and contrast GitHub Actions and Azure Pipelines

<u>GitHub Actions</u> and <u>Azure Pipelines</u> have a common history. In fact, the Actions agent is a fork of the Pipelines agent. There are many similarities between GitHub Actions and Azure Pipelines and it's worth comparing and contrasting them.

# Pipelines as code

Before you compare GitHub Actions and Azure Pipelines, you should consider the benefits of *pipelines as code*. Pipelines as code:

[!div class="checklist"]

- Benefit from standard source control practices (such as code reviews via pull request and versioning).
- Can be audited for changes just like any other files in the repository.
- Don't require accessing a separate system or UI to edit.
- Can fully codify the build, test, and deploy process for code.

• Can usually be templatized to empower teams to create standard processes across multiple repositories.

#### Note

The term "pipelines" can also be referred to by several different interchangeable words: *pipeline*, *workflow*, and *build* are common terms. In this article, references to *Azure Pipelines* are referring to <u>YAML Pipelines</u>, and not the older UI-based <u>Classic Pipelines</u>.

# Agents and runners

Before you examine pipelines themselves, you should consider how these pipelines *execute*. Both GitHub Actions and Azure Pipelines are really *orchestration engines*. When a pipeline is triggered, the system finds an "agent" and tells the agent to execute the jobs defined in the pipeline file.

Azure Pipelines run on *agents*. The agent is written in .NET, so it will run wherever .NET can run: Windows, macOS, and Linux. Agents can even run in containers. Agents are registered to a <u>pool</u> in Azure Pipelines or to a repository or organization in GitHub. Agents can be *hosted* or *private*.

GitHub Workflows execute on *runners*. The runner code is essentially a fork of the Azure Pipelines code, so it's very similar. It's also cross-platform and you can also use *hosted* or *self-hosted* runners.

#### Hosted agents and runners

Hosted agents (Azure Pipelines) and hosted runners (GitHub) are agents that are spun up and managed by Azure DevOps or GitHub respectively. You don't need to maintain any build infrastructure. When a pipeline triggers that targets a hosted agent, an instance of the specified agent image is created. The job is run by the agent on the instance, and once the job completes, the instance is destroyed. The same applies for hosted runners running GitHub workflows.

#### Note

The list of software installed on Azure Pipelines images is listed in <u>this repository</u>. You can select the platform folder and examine the *README.md* files. You can find information on <u>GitHub hosted</u> runners.

#### Private agents and self-hosted runners

There are times when you can't use hosted images. For example, when you:

- Require SDKs or other software that isn't installed on the images.
- Need to access resources that aren't public (such as an internal SonarQube server or an internal Artifactory instance).
- Need to deploy to private networks.
- Need to install licenses for third-party software required for building your code.
- Need more storage or memory than is provided to the hosted agent images.
- Need more time than the maximum build time limit for hosted agents.

#### Important

It's possible to install tools and SDKs when running pipelines on hosted agents. If the install steps don't take long, this is viable. However, if the tools/software take a long time to install, then you may be better off with a private agent or self-hosted runner, since the install steps will need to execute for every run of the workflow.

#### Azure DevOps agents

Every Azure DevOps account has a hosted pool with a single agent that can run one job at a time. Also included is a set number of free build minutes. You may purchase additional "hosted pipelines" in Azure DevOps. When you purchase an additional hosted pipeline, you're really removing the build minutes limit and adding *concurrency*. One pipeline can run one job at a time. Two pipelines can run two jobs simultaneously, and so on.

#### **Comparison of agents**

Feature	GitHub	Azure Pipelines	Links
Hosted agents for public repos/projects	Free	Up to 10 free Microsoft-hosted parallel jobs that can run for up to 360 minutes (6 hours) each time with no overall time limit per month. You aren't given this free grant by default, you have to <u>submit a request</u>	<u>Azure</u> <u>Pipelines</u> <u>GitHub</u>
Hosted agents for private repos/projects	2,000 minutes free per month, 3,000 minutes for Pro and Team licenses, 50,000 minutes for Enterprise license. Additional minutes may be purchased.	One free parallel job that can run for up to 60 minutes each time, until you've used 1,800 minutes (30 hours) per month. You can pay for additional capacity per parallel job. Paid parallel jobs remove the monthly time limit and allow you to run each job for up to 360 minutes (6 hours).	
Cross-platform	Yes	Yes	
Scale set agents	No	Yes	Azure virtual machine scale set agents

# **Comparison of GitHub Actions and Azure Pipelines**

Azure Pipelines (YAML pipelines) provide a mature set of features. Some of the features include:

- Approvals
- Artifact storage

- Deployment jobs
- Environments
- Gates
- Stages
- Templates
- Triggers
- Variable groups

For a full list of Azure Pipelines features, refer to the Feature availability table.

GitHub Actions are evolving rapidly and provide features such as triggers for almost all GitHub events, artifact storage, environments and environment rules, starter templates, and matrices. Read more about the entire feature set refer <u>GitHub Actions</u>.

## Feature comparison

The following table is current as of January 2023 and is not an exhaustive list of features.

Feature	Description	GitHub Actions	Azure Pipelines
Approvals	Define approval conditions before moving further in the pipeline	Yes	Yes
Artifacts	Upload, store, and download artifacts from jobs	Yes	Yes
Caching	Cache folders or files for subsequent runs	Yes	Yes
Conditions	Specify conditions for steps or jobs	Yes	Yes
Container Jobs	Run jobs inside a container	Yes	Yes
Demands	Specify demands that must be met to match jobs to agents	Yes	Yes
Dependenci es	Specify dependencies between jobs or stages	Yes	Yes
Deployment Groups	A logical set of target machines for deployments	No	Yes
Deployment Jobs	Job that targets a deployment group	No	Yes

Feature	Description	GitHub Actions	Azure Pipelines
Environment s	A collection of resources to target or a logical environment	Yes	Yes
Gates/Check s	Automatic collection and evaluation of signals to control continuation	Yes	Yes
Jobs	Sequence of steps that are executed on an agent	Yes	Yes
Service Containers	Manage the lifecycle of a containerized service instance available during a job	Yes	Yes
Service Connections	Abstract credentials to external systems	No	Yes
Passwordles s connections to cloud providers	Provide technologies and support use cases that reduce and potentially eliminate the use of passwords	Yes	No
Stages	Group jobs in a pipeline	No	Yes
Templates	Define reusable, parameterized building blocks for steps, jobs, or variables	Yes	Yes
Starter Templates	Defines a starter workflow based on the type of code detected in a repository	Yes	No
Triggers	Set of events that cause the pipeline to trigger	Yes	Yes

Feature	Description	GitHub Actions	Azure Pipelines
Variables	Variables that can be passed in, statically or dynamically defined	Yes	Yes
Variable Groups	Store values for use across multiple pipelines	No	Yes

#### Important

GitHub Actions is rapidly evolving. Be sure to check documentation carefully before deciding which platform is right for you.

# Build a .NET web app using GitHub Actions

<u>GitHub Actions</u> allow you to automate workflows in response to events that are triggered in GitHub. A common workflow is Continuous Integration (CI), but Actions can automate other processes. For example, sending welcome emails when people join a repository.

To explore moving code to the cloud, you'll build a GitHub Actions workflow file. The workflow file will be used for the Simple Feed Reader app you've already deployed to Azure App Service.

In this article, you will: > [!div class="checklist"] > > \* Learn the basic structure of a GitHub Action workflow YAML file. > \* Use a template to create a basic build workflow that builds the .NET app and executes unit tests. > \* Publish the compiled app so that it's ready for deployment.

# Workflow structure

Workflows are defined in YAML files, and contain several common nodes:

- a name
- a trigger, defined by an on section
- one or more job sections composed of one or more steps
- optional attributes such as environment variables

Jobs are run on *runners*. You can use *hosted runners*, which are spun up by GitHub during the workflow and then thrown away. Hosted runners are great because you don't have to maintain your own build infrastructure. For workflows that require a specific build environment, or for running workflows on a private network, you can also use *private* runners. To create a private runner, install the runner on any machine that supports .NET.

Each job will specify what runner GitHub should use to execute the steps. You can also specify dependencies between jobs using the needs attribute. Deployment jobs can also specify an environment to target.

The steps node can be as easy as inline commands, or they can be actions. Most CI workflows will have a combination of run steps (for executing scripts) and actions. Individual actions are pulled into the workflow by referencing the GitHub Action repository (and optionally a tag or commit hash for specific versions) and specifying any parameters using the with keyword.

#### Tip

For more information, see GitHub Actions YAML syntax.

From a workflow file, you're able to run any of the available <u>.NET CLI commands</u>. For example, if you're required to build, test, and deploy an ASP.NET Core Blazor WebAssembly app with Ahead-of-Time (AoT) compilation, you'd use the following commands:

- dotnet workload install
- dotnet restore
- dotnet build
- dotnet test
- <u>dotnet publish</u>

#### The .NET SDK is a workflow necessity

All .NET workflows require the .NET SDK, and this can be set up by the actions/setup-dotnet<u>GitHub</u> <u>Action</u>. This action sets up a <u>.NET CLI</u> environment for use in actions. Some <u>GitHub hosted runners</u> have the .NET SDK preinstalled, but that's subject to change. As a best practice, use the actions/setupdotnet action to ensure the proper version is available.

# Create a basic build workflow

A primary principle of effective DevOps is to "build once, and deploy many times". You'll start by creating a workflow to build a basic .NET app. In the next step, you'll publish the output to prepare for deployment.

- 1. Navigate to your GitHub repository and select the **Actions** tab.
- 2. GitHub detects that there's .NET code in the repository and suggests a .NET workflow template. Select **Set up this workflow** to create a new YAML workflow file:



\*\*Figure 1\*\*: Creating a new workflow.

1. Commit the file onto the main branch. Since you've defined a trigger condition for *commits to main*, this commit should trigger the workflow to run.

wrap ‡	Marketplac	Commit changes
	Featured Acti	
	Uplo	O -O- Commit directly to the master branch.
		It Create a new branch for this commit and start a
	By act	pull request. Learn more about pull requests.
	Setu	Constitution of the
	Close	Commit changes 2
	Close	

\*\*Figure 2\*\*: Commit the YAML file.

1. Select the **Actions** tab again. You should see a running workflow. Once the workflow has completed, you should see a successful run.

Search or jump to	Pull requests Issues Codespaces Marketplace Expl	<b>210</b>			
V colindembovsky/simple-feed-rea torited from Acure-Sampler/simple-feed-reader     ⇔ Code 1: Pull requests O Actions	der ⊡ Projects □ Wiki ① Security L± Insights				
Update dotnet.yml .NET #2					
n Summary	Triggered via push 10 minutel ago	Status Success	Total duration 1m 23s		
🧭 build	<b>dotnet.yml</b> en: pub				
	S build Im de				
	Annotations 1 warrsing				
	Ubuntu-latest workflows will use ubuntu-20.04 environments/issues/1816			hub.com/actions/virtual-	

\*\*Figure 3\*\*: Successful build view.

1. Opening the logs, you can see that the .NET build succeeded and the tests ran and passed.

<ol> <li>Summary</li> </ol>	build succeeded 9 moutre ago in the Bi
lots	v 🔕 Bulid
O buik	
	✓ Ø Int.
	<ul> <li>A Markater Statist Look (and a senseting work)</li> <li>Markater Look (and the Markater Look (and the Markater) (and the Analyzing Markater) (and the Markater) (and th</li></ul>

\*\*Figure 4\*\*: Checking the logs.

Note

If any of the tests fail, the workflow will fail.

# Dissect the workflow file

Let's examine the workflow YAML file you have so far:

```
name: .NET
on:
 push:
   branches: [ main ]
  pull_request:
   branches: [ main ]
jobs:
 build:
    runs-on: ubuntu-latest
    steps:
    - uses: actions/checkout@v3
    - name: Setup .NET
     uses: actions/setup-dotnet@v3
     with:
        dotnet-version: 6.0.x
    - name: Restore dependencies
      run: dotnet restore
    - name: Build
      run: dotnet build --no-restore
    - name: Test
      run: dotnet test --no-build --verbosity normal
```

Notice the following things:

- 1. There's a name that names the workflow.
- 2. The on object specifies when this workflow should run. This workflow has two events that trigger it: push to main and pull\_request to main. Each time someone commits to main or creates a pull request (PR) to main, this workflow will execute.
- 3. There's a single job called build. This build should run on a hosted agent. ubuntu\_latest specifies the most recent Ubuntu hosted agent.
- 4. There are five steps:
  - 1. actions/checkout@v3 is an action that checks out the code in the repository onto the runner.
  - 2. actions/setup-dotnet@v3 is an action that sets up the .NET CLI. This step also specifies a name attribute for the logs and the dotnet-version parameter within the with object.
  - 3. Three run steps that execute dotnet restore, dotnet build, and dotnet test. name attributes are also specified for these run steps to make the logs look pretty.

# Publish the output

Now that you've successfully built and tested the code, add steps that publish the output so you can deploy the web app.

1. Navigate to the .github/workflows/dotnet.yml file and select the pencil icon to edit

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<> Code   ใ\ ।	Pull requests 💿 Actions 🔟 Projects 🎞 Wiki 🔘 Security 🗠 Insights 🔞 Settings	
	2 <sup>st</sup> master + simple-feed-reader / .github / workflows / dotnet.yml	Go to file
	colindembovsky Update dotnet yml	Latest commit 183ea1a 4 minutes ago 🕚 History
	At 1 contributor	
	27 lines (23 sloc) 531 Bytes	Raw Blame 🖵 🖉 🖞
	3 name: .NET	

\*\*Figure 5\*\*: Edit the YAML file.

1. Add the following Publish step below the Test step. The step runs the dotnet publish command to publish the web app:

:::{custom-style=CodeBox}```yml

- name: Test run: dotnet test –no-build –verbosity normal # <– this is the current bottom line
- name: Publish run: dotnet publish SimpleFeedReader/SimpleFeedReader.csproj -c
   Release -o website ``` :::
- 2. This publishes the web app to a folder on the hosted agent. Now you'll want to *upload* the site as a build artifact that can be deployed to Azure. To complete this activity, you'll use an existing action.
- 3. On the list of actions in the **Actions Helper** pane on the right, search for artifact. Select on the Upload a Build Artifact (By actions) action.



\*\*Figure 6\*\*: Accessing the snippet helper.

1. Edit the version to v2.2.2 to display a sample snippet. Select the clipboard icon to copy the snippet and paste it into the workflow below the publish step.



\*\*Figure 7\*\*: Copying a snippet.

1. Edit the YAML for this step to look as follows:

:::{custom-style=CodeBox} ```yml

- name: Upload a Build Artifact uses: actions/upload-artifact@v3 with: name: website
   path: SimpleFeedReader/website/\*\* if-no-files-found: error `` :::
- 2. Commit the file.
- 3. Once the workflow completes, you'll see the artifact from the **Home** tab:

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Update dotnet.yml .NET #5	Ř.					
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	() colindembovsky			Success	1m 30s	
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	Annotations 1 warning Whuntu-latest environments/1	workflows will use ssues/1816	Ubuntu-20.04 sc	oon. For more deta	ils, see https://git	
	Artifacts 2					
	😚 website			2.52 MB		

\*\*Figure 8\*\*: Viewing artifacts in the summary page.

## Final workflow file

The final workflow file should look something like this:

```
name: .NET
on:
  push:
   branches: [ main ]
  pull request:
   branches: [ main ]
jobs:
 build:
    runs-on: ubuntu-latest
   steps:

    uses: actions/checkout@v3

    - name: Setup .NET
     uses: actions/setup-dotnet@v3
     with:
       dotnet-version: 6.0.x
    - name: Restore dependencies
     run: dotnet restore
    - name: Build
     run: dotnet build --no-restore
    - name: Test
     run: dotnet test --no-build --verbosity normal
    - name: Publish
     run: dotnet publish SimpleFeedReader/SimpleFeedReader.csproj -c Release -o website
    - name: Upload a Build Artifact
      uses: actions/upload-artifact@v3
      with:
        name: website
        path: SimpleFeedReader/website/**
        if-no-files-found: error
```

# Deploy a .NET web app using GitHub Actions

#### Warning

Please complete the Build tutorial before starting this lab.

In this article, you'll: > [!div class="checklist"] > > \* Learn about Environments in GitHub Actions. > \* Create two environments and specify environment protection rules. > \* Create environment secrets for managing environment-specific configuration. > \* Extend the workflow YAML file to add deployment steps. > \* Add a manual dispatch trigger.

# **Environments**

Now that you've published an artifact that's *potentially deployable*, you'll add *deployment* jobs to the workflow. There's nothing special about a deployment job, other than the fact that it references an

*environment*. Environments are *logical* constructs that allow you to specify environment protection rules, such as approvals, on any group of resources that you're targeting.

In this walkthrough, you'll be deploying to two environments: PRE-PROD and PROD. In a typical development lifecycle, you'll want to deploy the latest code to a *soft* environment (typically DEV) that is expected to be a bit unstable. You'll use PRE-PROD as this *soft* environment. The "higher" environments (like UAT and PROD) are *harder* environments that are expected to be more stable. To enforce this, you can build protection rules into higher environments. You'll configure an approval protection rule on the PROD environment: whenever a deployment job targets an environment with an approval rule, it will pause until approval is granted before executing.

GitHub environments are *logical*. They represent the physical (or virtual) resources that you're deploying to. In this case, the PRE-PROD is just a deployment slot on the Azure Web App. PROD is the production slot. The PRE-PROD deployment job will deploy the published .NET app to the staging slot. The PROD deployment job will swap the slots.

Once you have these steps in place, you'll update the workflow to handle environment-specific configuration using environment secrets.

#### Note

For more information, see GitHub Actions - Environments.

#### **Azure authentication**

To perform actions such as deploying code to an Azure resource, you need the correct permissions. For deployment to Azure Web Apps, you can use a publishing profile. If you want to deploy to a staging slot, then you'll need the publishing profile for the slot too. Instead, you can use a service principal (SPN) and assign permission to this service principal. You can then authenticate using credentials for the SPN before using any commands that the SPN has permissions to perform.

Once you have an SPN, you'll create a <u>repository secret</u> to securely store the credentials. You can then refer to the secret whenever you need to authenticate. The secret is encrypted and once it has been saved, can never be viewed or edited (only deleted or re-created).

#### **Create an SPN**

1. In your terminal or Cloud Shell, run the following command to create a service principal with contributor permissions to the web app you created earlier:

:::{custom-style=CodeBox} azurecli az ad sp create-for-rbac --name "{sp-name}" --sdk-auth -role contributor \ --scopes /subscriptions/{subscription-id}/resourceGroups/{resourcegroup}/providers/Microsoft.Web/sites/{webappname} :::

2. The command should output JSON that has credentials embedded:

```
:::{custom-style=CodeBox} json { "clientId": "<GUID>", "clientSecret": "<GUID>",
"subscriptionId": "<GUID>", "tenantId": "<GUID>", ... } :::
```

3. Make sure to record the clientId, clientSecret, subscription, and tenantId. You can also leave the terminal open for copy/paste later.

#### Create a repository secret

- 1. Now you're going to create an encrypted secret to store the credentials. You'll create this secret at the repository level.
- 2. Navigate to GitHub and select your repository **Settings** tab. Then select **Secrets**. Select **New repository secret**:

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		Actions secrets	New repository secret
	Manage access	Secrets are environment variables that are encrypted. Anyone with collaborator a	access to this repository can use these secrets for Actions.
		Secrets are not passed to workflows that are triggered by a pull request from a fo	
	Branches	Environment secrets	
	Webhooks		
	Natifications	There are no secrets for this repo	sitory's environments.
	Integrations		
		Repository secrets	
	Secrets 👩	There are no secrets for t Encrypted secrets allow you to store sensitive information	this repository.
	Actions		

\*\*Figure 1\*\*: Create a secret.

1. Copy and paste the JSON from the az ad sp create-for-rbac command into the body of the secret. You can create this JSON by hand too if you have the relevant fields for your SPN. The secret should be named AZURE\_CREDENTIALS. Select **Add secret** to save the new secret:

Name	
AZURE_CREDENTIAL	
/alua	
"clientId": "	a na ann ann ann ann ann ann ann ann an
"clientld": " "clientSecret": "	
"clientld": " "clientSecret": "- "tenantld": " "subscriptionld": "	a an ann ann ann an t-ann. Ann ann an ann ann ann ann ann ann ann a
"clientld": " "clientSecret": " " <u>tenantld</u> ": " " <u>subscriptionld</u> ": " }	and a second sec
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\*\*Figure 2\*\*: Add Azure credentials.

1. You'll consume this secret in a workflow in later steps. To access it, use the variable notation \${{}}. In this case, \${{ AZURE\_CREDENTIAL }} will be populated with the JSON you saved.

### Add environments

<u>Environments</u> are used as a *logical boundary*. You can add approvals to environments to ensure quality. You can also track deployments to environments and specify environment-specific values (secrets) for configuration.

For this example, you're going to split the actual Azure environment into two *logical* environments called PRE-PROD and PROD. When you deploy the web app, you'll deploy to the staging slot of the Azure web app, represented by the PRE-PROD environment. When you're ready to deploy to PROD, you'll just perform a slot swap.

In this case, the only difference between the environments is the slot that you're deploying to. In real life, there would typically be different web apps (and separate web app plans), separate resource groups, and even separate subscriptions. Typically, there's an SPN per environment. You may want to override the AZURE\_CREDENTIAL value that you saved as a repository secret by creating it as an *environment secret*.

#### Note

Precedence works from Environment to repository. If a targeted environment has a secret called MY\_SECRET, then that value is used. If not, the repository value of MY\_SECRET (if any) is used.



1. Select **Settings** and then **Environments** in your repository. Select **New Environment**:

\*\*Figure 3\*\*: Create an environment.

1. Enter PRE-PROD and select **Configure environment**:

Environments / A	٨dd
Name	
PRE-PROD	
Configure environment	

\*\*Figure 4\*\*: Name the environment.

1. Since deploying to a staging slot doesn't affect the web app, you can safely deploy to the slot without requiring an approval first. A reviewer could be added if desired. For this example, leave the Environment protection rules empty.

[!NOTE] If you target an environment in a workflow and it does not exist, an "empty" environment is created automatically. The environment would look exactly the same as the PRE-PROD environment - it would exist, but would not have any protection rules enabled.

- 2. Select **Environments** again and again select **New Environment**. Now enter PROD as the name and select **Configure environment**.
- 3. Check the **Required reviewers** rule and add yourself as a reviewer. Don't forget to select **Save protection rules**:

Search or jump to	tuli requests Issues Codespaces Marketplace Explore
Colindembovsky / simple-feed-reader     forked from Azure-Sampler/simple-feed-reader     ⇔ Code    Th Pull requests    ⊙ Actions [	<b>er</b> ⊡ Projects III Wiki ① Security L⊻ Insights <b>@ Settings</b>
Options	Environments / Configure PROD
Manage access Security & analysis	Environment protection rules Environment protection rules can be used to configure manual approvals and timeouts.
Branches Webhooks	Required reviewers     Specify people or teams that may approve workflow runs when they access this environment.     Add us to 5 more inviewers.
Notifications Integrations	Search for people or tearra.
Deploy keys Autolink references	Whit timer Set as amount of time to wait before allowing deployments to proceed.
Actions Environments	Save protection rules
Secrets Moderation settings	

\*\*Figure 5\*\*: Add protection rules.

# **Deploy to staging**

You can now add additional jobs to the workflow to deploy to the environments! You'll start by adding a deployment to the PRE-PROD environment, which in this case is the web app staging slot.

- 1. Navigate to the .github/workflows/dotnet.yml file and select the pencil icon to edit the file.
- 2. You're going to use the web app name a few times in this workflow, and will need the name of the resource group too. You'll define the app and resource group names as variables. With the variables, you can maintain the values in one place in the workflow file.
- 3. Add this snippet below the on block and above the jobs block:

:::{custom-style=CodeBox} ```yml env: app-name: "" rg-name: ""

jobs: # <- this is the existing jobs line ``` :::

[!WARNING] You'll need to replace <name of your web app> with the actual name of your web app, and <name of your resource group> with the actual name of your resource group.

4. Add a new job below the build job as follows:
:::{custom-style=CodeBox} ```yml if-no-files-found: error # <- last line of build job: insert below this line

deploy\_staging: needs: build runs-on: ubuntu-latest

```
environment:
  name: PRE-PROD
  url: ${{ steps.deploywebapp.outputs.webapp-url }}
steps:
- name: Download a Build Artifact
 uses: actions/download-artifact@v3
 with:
    name: website
    path: website
- name: Login via Azure CLI
  uses: azure/login@v1
 with:
   creds: ${{ secrets.AZURE_CREDENTIALS }}
- name: Deploy web app
  id: deploywebapp
  uses: azure/webapps-deploy@v2
 with:
    app-name: ${{ env.app-name }}
    slot-name: staging
    package: website
- name: az cli logout
  run: az logout
```

``` :::

The preceding workflow defines several steps:

- 1. You're creating a new job called deploy\_staging.
- 2. You specify a dependency using needs. This job needs the build job to complete successfully before it starts.
- 3. This job also runs on the latest Ubuntu hosted agent, as specified with the runs-on attribute.
- 4. You specify that this job is targeting the PRE-PROD environment using the environment object. You also specify the url property. This URL will be displayed in the workflow diagram, giving users an easy way to navigate to the environment. The value of this property is set as the output of the step with id deploywebapp, which is defined below.
- 5. You're executing a download-artifact step to download the artifact (compiled web app) from the build job.
- 6. You then login to Azure using the AZURE\_CREDENTIALS secret you saved earlier. Note the \${{ }} notation for dereferencing variables.
- 7. You then perform a webapp-deploy, specifying the app-name, slot-name, and path to the downloaded artifact (package). This action also defines an output parameter that you use to set the url of the environment above.

- 8. Finally, you execute a logout to log out of the Azure context.
- 5. Commit the file.
- 6. When the run completes, you should see two successful jobs. The URL for the PRE-PROD stage has been set and selecting it will navigate you to your web app staging slot:

| $\leftarrow \  \  \rightarrow$ | $\mathbb{C}$ <b><math>igta</math></b> Not secure $\mid$ cd-simplefeedreader-staging azurewebsites.net |
|--------------------------------|-------------------------------------------------------------------------------------------------------|
| 📋 AZ Exams                     | Learning 💭 .NET on Actions                                                                            |
|                                | SimpleFeedReader                                                                                      |
|                                | Simple Feed Reader                                                                                    |
|                                | Enter a feed URL:                                                                                     |
|                                | Retrieve Feed                                                                                         |
|                                | © 2017 - SimpleFeedReader                                                                             |

\*\*Figure 6\*\*: Deployment to PRE-PROD is successful.

1. Notice how the staging slot's direct URL contains -staging:

| $\leftarrow \rightarrow$ | $\mathbb{C}$ <b><math> m igar{1}</math></b> Not secure $\mid$ cd-simplefeedreader-staging azurewebsites.net |  |
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| 🚞 AZ Exams               | Carning 🔘 .NET on Actions                                                                                   |  |
|                          | SimpleFeedReader                                                                                            |  |

#### Simple Feed Reader

| Retrieve Feed |  |  |
|---------------|--|--|
|               |  |  |

\*\*Figure 7\*\*: The staging slot running.

1. You can also now see deployments. Navigate to https://{your repository url}/deployments to view your deployments:

| Search or jump to                                                                     |                    |
|---------------------------------------------------------------------------------------|--------------------|
| ♥ colindembovsky / simple-feed-reader<br>forked from Azure-Samples/simple-feed-reader | ⊙ Watch + 0 ☆ Star |
| 🗘 Code 🏥 Pull requests 💿 Actions 🔟 Projects 🖽 Wiki 💿 Security 🗠 Insights 🔞 Settings   |                    |
|                                                                                       |                    |
| Deployed to PRE-PROD                                                                  |                    |
| 73472ea was deployed by (the colindembovsky 20 hours ago Active                       |                    |

\*\*Figure 8\*\*: View deployments.

#### **Deploy to production**

Now that you've deployed successfully to PRE-PROD, you'll want to deploy to PROD. Deployment to PROD will be slightly different since you don't need to copy the website again - you just need to swap the staging slot with the production slot. You'll do this using an Azure CLI (az) command.

- 1. Navigate to the .github/workflows/dotnet.yml file and select the pencil icon to edit the file.
- 2. Add a new job below the deploy\_staging job as follows:

:::{custom-style=CodeBox} ```yml run: az logout # <- last line of previous job: insert below this line

deploy\_prod: needs: deploy\_staging runs-on: ubuntu-latest

```
environment:
  name: PROD
  url: ${{ steps.slot_swap.outputs.url }}
steps:
- name: Login via Azure CLI
  uses: azure/login@v1
  with:
    creds: ${{ secrets.AZURE_CREDENTIALS }}
- name: Swap staging slot into production
  id: slot_swap
  run: |
    az webapp deployment slot swap -g ${{ env.rg-name }} -n ${{ env.app-name }} -s staging
    url=$(az webapp show -g ${{ env.rg-name }} -n ${{ env.app-name }} --query
"defaultHostName" -o tsv)
    echo "::set-output name=url::http://$url"
- name: az cli logout
  run: az logout
...
   :::
```

The deployment to the PROD environment workflow specifies several steps:

- 1. Once again, you specify a new job deploy\_prod that needs deploy\_staging to complete before starting.
- 2. You're targeting the PROD environment this time. Also, the url value is different from before.

- 3. For the steps, you don't need to download the artifact since you're just going to perform a slot swap. You start by executing a login to the Azure context.
- 4. The Swap staging slot into production step is a multi-line run command (note the use of the pipe symbol |). You also specify an id for this step so that you can refer to it (you refer to it in the url property of the environment). The first line executes the slot swap using the variables you defined above in the workflow. The second line uses an az webapp show command to extract the URL of the target web app. This final line uses ::set-output in an echo to create an output variable for this task, setting the value to the web app URL.

[!NOTE] The URL *must* start with http:// or https:// or it won't render.

- 3. Commit the file.
- 4. Let the workflow run for a couple minutes until it has deployed to PRE-PROD. At this point, the workflow will pause and wait for the required approval since you're targeting the PROD environment, which requires an approval as defined earlier:

| Search or jump to                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Pull requests issues Codespaces Marketplace Expl | ore                                        |                                          | ₲ +• 働•            |
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\*\*Figure 9\*\*: Waiting for an approval.

1. Select **Review deployments**, select the **PROD** checkbox, optionally add a comment, and then select **Approve and deploy** to start the PROD job.

| Review pending deployments             |        |                      | ×   |  |  |            |  |
|----------------------------------------|--------|----------------------|-----|--|--|------------|--|
| requested by colindembovsky in .NET #9 |        |                      |     |  |  |            |  |
| 2                                      |        |                      |     |  |  |            |  |
| PROD                                   |        |                      | (1) |  |  |            |  |
| Review needed from colindembovsky      |        |                      |     |  |  |            |  |
| Leave a comment                        |        |                      |     |  |  |            |  |
| 3                                      |        |                      |     |  |  |            |  |
|                                        |        |                      |     |  |  | 1          |  |
|                                        |        |                      |     |  |  | w deployme |  |
|                                        |        | . 4                  |     |  |  |            |  |
|                                        | Reject | S Approve and deploy |     |  |  |            |  |
|                                        |        |                      |     |  |  |            |  |

\*\*Figure 10\*\*: Approve the PROD deployment.

1. The deployment should only take a few seconds. Once it has completed, the URL for the PROD environment will update.

| he deployments have been approved.                                                 |                                             |                                              |        |                                                |  |
|------------------------------------------------------------------------------------|---------------------------------------------|----------------------------------------------|--------|------------------------------------------------|--|
| * colindembovsky / simple-feed-re-<br>torked from Azure-Samples/simple-feed-reader | ader                                        |                                              |        |                                                |  |
| ⇔ Code 11 Pull requests ⊙ Actions                                                  |                                             |                                              |        |                                                |  |
| Update dotnet.yml .NET #10                                                         |                                             |                                              |        |                                                |  |
| 🛱 Summary                                                                          |                                             |                                              |        |                                                |  |
|                                                                                    | () colindembovsky pushed <-> d02/766 master | Success                                      | 5m 47s |                                                |  |
| <ul> <li>build</li> <li>deploy_staging</li> <li>deploy_prod</li> </ul>             | dotnet yml<br>ori push                      |                                              |        |                                                |  |
|                                                                                    |                                             | deploy_staging<br>http://cd-simplefeedreader |        | O O doploy_prod     http://cd-simplefedreadera |  |

\*\*Figure 11\*\*: PROD deployment completed.

1. Selecting the PROD URL will navigate you to the PROD site.

| $\leftarrow \rightarrow$ | $\mathbb{C}$ <b>A</b> Not secure $\mid$ cd-simplefeedreader.azurewebsites.net |  |  |  |
|--------------------------|-------------------------------------------------------------------------------|--|--|--|
| 🛅 AZ Exams               | 🦰 Learning 🌎 .NET on Actions                                                  |  |  |  |
| SimpleFeedReader         |                                                                               |  |  |  |

#### Simple Feed Reader

| Retrieve Feed |  |  |
|---------------|--|--|
|               |  |  |

\*\*Figure 12\*\*: The PROD site.

#### Add a manual queue option

You now have an end-to-end build and deploy workflow, including approvals. One more change you can make is to add a manual trigger to the workflow so that the workflow can be triggered from within the **Actions** tab of the repository.

- 1. Navigate to the .github/workflows/dotnet.yml file and select the pencil icon to edit the file.
- 2. Add a new trigger between on and push on lines 3 and 4:

:::{custom-style=CodeBox} yml on: workflow\_dispatch: # <-- this is the new line push: :::

- 3. The workflow\_dispatch trigger displays a Run workflow button in the **Actions** tab of the repository—*but only if the trigger is defined in the default branch*. However, once this trigger is defined in the workflow, you can select the branch for the run.
- 4. Commit the file.

5. To see the **Run workflow** button, select the **Actions** tab. Select the .NET workflow in the list of workflows. At the top of the list of runs, you'll see the **Run workflow** button. If you select it, you can choose the branch to run the workflow against and queue it:



\*\*Figure 13\*\*: Manual dispatch.

#### Handle environment configuration

Your workflow is deploying the same binary to each environment. This concept is important to ensure that the binaries you test in one environment are the same that you deploy to the next. However, environments typically have different settings like database connection strings. You want to ensure that the DEV app is using DEV settings and the PROD app is using PROD settings.

For this simple app, there's no database connection string. However, there's an example configuration setting that you can modify for each environment. If you open the *simple-feed-reader/SimpleFeedReader/appsettings.json* file, you'll see that the configuration includes a setting for the Header text on the Index page:

```
"UI": {
    "Index": {
        "Header": "Simple News Reader"
    }
},
```

To show how environment configuration can be handled, you're going to add a secret to each environment and then substitute that value into the settings as you deploy.

#### Add environment secrets

- 1. On your repository, select **Settings** > **Environments** > **PRE-PROD**.
- 2. Select **Add secret** and add a secret called index\_header with the value PRE PROD News Reader. Select **Add secret**.

| Add secret                                                                         |            |
|------------------------------------------------------------------------------------|------------|
| Name                                                                               |            |
| index_header 😕                                                                     |            |
| Value                                                                              |            |
| PRE PROD News Reader 🥴                                                             |            |
|                                                                                    |            |
| <u>a</u>                                                                           | Add secret |
| Set an amount of time to wait before allowing deployments to proceed.              |            |
|                                                                                    |            |
|                                                                                    |            |
| Secrets are encrypted environment variables. They are accessible only by GitHub Ac |            |
| ① Add Secret                                                                       |            |
|                                                                                    |            |

\*\*Figure 14\*\*: Add an environment secret.

- 1. Repeat these steps to add a secret called index\_header with the value PROD News Reader for the PROD environment.
- 2. If you select **Settings** > **Secrets** in the repository, you'll see the changes. They should look something like this:

| Actions secrets                                                                                                                                                                                                                                                 | New repository secret |                    |  |  |  |  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|--------------------|--|--|--|--|
| Secrets are environment variables that are <b>encrypted</b> . Anyone with <b>collaborator</b> access to this repository can use these secrets for Actions.<br>Secrets are not passed to workflows that are triggered by a pull request from a fork. Learn more. |                       |                    |  |  |  |  |
| Environment secrets                                                                                                                                                                                                                                             |                       |                    |  |  |  |  |
| A INDEX_HEADER                                                                                                                                                                                                                                                  | Updated now           | Manage environment |  |  |  |  |
| A INDEX_HEADER<br>PRE-PROD                                                                                                                                                                                                                                      | Updated 2 minutes ago | Manage environment |  |  |  |  |
| Repository secrets                                                                                                                                                                                                                                              |                       |                    |  |  |  |  |
| A AZURE_CREDENTIALS                                                                                                                                                                                                                                             | Updated 18 hours ago  | Update Remove      |  |  |  |  |

\*\*Figure 15\*\*: View secrets.

#### Update the workflow to handle configuration

- 1. Navigate to the .github/workflows/dotnet.yml file and select the pencil icon to edit the file.
- 2. Add the following step before the az cli logout step in the deploy\_staging job:

:::{custom-style=CodeBox} ```yml - name: Update config uses: Azure/appservice-settings@v1 with: app-name: \${{ env.app-name }} slot-name: staging app-settings-json: | [ { "name": "UI:Index:Header", "value": "\${{ secrets.INDEX\_HEADER }}","slotSetting": true } ]

- name: az cli logout # <-- this exists already

``` :::

3. Add almost the same code to the deploy\_prod job above its az cli logout step. The only difference is that you don't specify a slot-name, since you're targeting the production slot:

:::{custom-style=CodeBox} ```yml - name: Update config uses: Azure/appservice-settings@v1 with: app-name: \${{ env.app-name }} app-settings-json: | [ { "name": "Ul:Index:Header", "value": "\${{ secrets.INDEX\_HEADER }}","slotSetting": true } ]

- name: az cli logout # <-- this exists already</pre>

``` ...

- 4. Commit the file.
- 5. Let the workflow run and approve the deployment to PROD once the approval is reached.
- 6. You should see the following headers on the index page for both sites:

| ← → C ▲ Not secure cd-simplefeedreader-staging.azureweb ☆ ☆ 奋 ﴾ … | ← → C ▲ Not secure cd-simplefeedreader.azurewebsites.net ☆ |
|-------------------------------------------------------------------|------------------------------------------------------------|
| SimpleFeedReader                                                  | SimpleFeedReader                                           |
| PRE PROD News Reader                                              | PROD News Reader                                           |
| Enter a feed URL:                                                 | Enter a feed URL:                                          |
| Retrieve Feed                                                     | Retrieve Feed                                              |
| © 2017 - SimpleFeedReader                                         | © 2017 - SimpleFeedReader                                  |

#### Final workflow file

The final workflow file should look like this:

```
name: .NET
on:
  workflow_dispatch:
    inputs:
      reason:
        description: 'The reason for running the workflow'
        required: true
        default: 'Manual build from GitHub UI'
  push:
    branches: [ main ]
  pull_request:
    branches: [ main ]
env:
  app-name: "cd-simplefeedreader"
  rg-name: "cd-dotnetactions"
jobs:
  build:
```

<sup>\*\*</sup>Figure 16\*\*: Settings changed in the environments.

```
runs-on: ubuntu-latest
 steps:
  - uses: actions/checkout@v3
  - name: 'Print manual run reason'
   if: ${{ github.event_name == 'workflow_dispatch' }}
   run:
      echo 'Reason: ${{ github.event.inputs.reason }}'
  - name: Setup .NET
   uses: actions/setup-dotnet@v3
   with:
      dotnet-version: 6.0.x
  - name: Restore dependencies
   run: dotnet restore
  - name: Build
   run: dotnet build --no-restore
  - name: Test
   run: dotnet test --no-build --verbosity normal
  - name: Publish
   run: dotnet publish SimpleFeedReader/SimpleFeedReader.csproj - c Release - o website
  - name: Upload a Build Artifact
   uses: actions/upload-artifact@v3
   with:
     name: website
     path: SimpleFeedReader/website/**
     if-no-files-found: error
deploy_staging:
 needs: build
  runs-on: ubuntu-latest
 environment:
    name: STAGING
    url: ${{ steps.deploywebapp.outputs.webapp-url }}
 steps:
  - name: Download a Build Artifact
   uses: actions/download-artifact@v3
   with:
     name: website
     path: website
  - name: Login via Azure CLI
   uses: azure/login@v1
   with:
      creds: ${{ secrets.AZURE CREDENTIALS }}
  - name: Deploy web app
    id: deploywebapp
   uses: azure/webapps-deploy@v2
    with:
      app-name: ${{ env.app-name }}
      slot-name: staging
     package: website
  - name: Update config
    uses: Azure/appservice-settings@v1
    with:
    app-name: ${{ env.app-name }}
    slot-name: staging
    app-settings-json:
```

```
[
             {
                 "name": "UI:Index:Header",
                 "value": "${{ secrets.INDEX_HEADER }}",
                 "slotSetting": true
             }
         ]
    - name: az cli logout
      run: az logout
 deploy prod:
   needs: deploy_staging
   runs-on: ubuntu-latest
   environment:
     name: PROD
      url: ${{ steps.slot_swap.outputs.url }}
   steps:
    - name: Login via Azure CLI
     uses: azure/login@v1
     with:
        creds: ${{ secrets.AZURE CREDENTIALS }}
    - name: Swap staging slot into production
      id: slot_swap
      run:
        az webapp deployment slot swap -g ${{ env.rg-name }} -n ${{ env.app-name }} -s
staging
        url=$(az webapp show -g ${{ env.rg-name }} -n ${{ env.app-name }} --query
"defaultHostName" -o tsv)
        echo "::set-output name=url::http://$url"
    - name: Update config
     uses: Azure/appservice-settings@v1
     with:
      app-name: ${{ env.app-name }}
      app-settings-json:
         [
             {
                 "name": "UI:Index:Header",
                 "value": "${{ secrets.INDEX_HEADER }}",
                 "slotSetting": true
             }
         ]
    - name: az cli logout
      run: az logout
```

## Secure .NET Code with CodeQL and GitHub Actions

<u>CodeQL</u> is a static code analysis engine that can automate security and quality checks. With CodeQL, you can perform *variant analysis*, which uses known vulnerabilities as seeds to find similar issues. CodeQL is part of <u>GitHub Advanced Security</u> that includes:

[!div class="checklist"]

- Code scanning—find potential security vulnerabilities in your code.
- Secret scanning—detect secrets and tokens that are committed.
- Dependency scanning—detect vulnerabilities in packages that you consume.

CodeQL supports some of the most popular programming languages and compilers:

- C/C++
- Java
- C#
- Python
- Go
- JavaScript
- TypeScript

CodeQL is a powerful language and security professionals can create custom queries using CodeQL. However, teams can benefit immensely from the large open-source collection of queries that the security community has created without having to write any custom CodeQL.

In this article, you'll set up a GitHub workflow that will scan code in your repository using CodeQL. You will:

[!div class="checklist"]

- Create a code scanning action.
- Edit the workflow file to include custom scan settings.
- See scanning results.

#### Note

To see security alerts for your repository, you must be a repository owner.

#### Create the code scanning workflow

You can use a starter workflow for code scanning by navigating to the **Security** tab of your repository.

1. Navigate to your GitHub repository and select the **Security** > **Code Scanning Alerts**. The top recommended workflow should be CodeQL Analysis. Select **Set up this workflow**.

| Search or jump to                                                                                                                                        | lore                  |                                                        |  |
|----------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|--------------------------------------------------------|--|
| Y colindembovsky/simple-feed-reader      torked from Azur-Sampler/simple-feed-reader      Order 11 Pull requests ○ Actions □ Projects □ Writi ① Security |                       |                                                        |  |
|                                                                                                                                                          | Overview              | Get started with code scanning                         |  |
|                                                                                                                                                          | Security policy       | Automatically detect common vulnerabilities and coding |  |
|                                                                                                                                                          | Security advisories 0 | CodeOL Analysis                                        |  |
|                                                                                                                                                          | Dependabot alerts     | by Giblub @                                            |  |
|                                                                                                                                                          | Code scanning alerts  | TypeScript, Python, and Go developers.                 |  |
|                                                                                                                                                          |                       | Set up this workflow                                   |  |

\*\*Figure 1:\*\* Create a new code scanning workflow.

- 1. A new workflow file is created in your .*github/workflows* folder.
- 2. Select **Start Commit** on the upper right to save the default workflow. You can commit to the main branch.



\*\*Figure 2:\*\* Commit the file.

1. Select the **Actions** tab. In the left-hand tree, you'll see a **CodeQL** node. Select this node to filter for CodeQL workflow runs.

| Search or jump to                                                                                                         | Pull requests Issues Marketplace Explore                | <b>¢</b> +• ∰•   |
|---------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------|------------------|
| Colindembovsky / simple-feed<br>forked from Azure-Samples/Simple-feed-reader     ⇔ Code      11 Pull requests      ○ Acti | -reader ② Watch + 0 ☆ S                                 | itar 0 🚏 Fork 92 |
| Workflows New workflow All workflows                                                                                      | CodeQL<br>codeql-analysisyml<br>Q. Filter workflow runs |                  |
| τ <sub>α</sub> .riti<br>Ϋ <sub>α</sub> CodeQL                                                                             | 1 workflow run Event - Status -                         | Branch + Actor + |
|                                                                                                                           | CodeQL #1: Commit 3765#2 pushed by colindembovsky       | ⊘ In progress    |

\*\*Figure 3:\*\* View the CodeQL workflow runs.

Take a look at the workflow file while it runs. If you remove the comments from the file, you'll see the following YAML:

```
name: "CodeQL"
on:
   push:
      branches: [ main ]
   pull_request:
      branches: [ main ]
   schedule:
      - cron: '40 14 * * 6'
jobs:
   analyze:
      name: Analyze
   runs-on: ubuntu-latest
   strategy:
      fail-fast: false
```

```
matrix:
language: [ 'csharp' ]
steps:
- name: Checkout repository
uses: actions/checkout@v3
- name: Initialize CodeQL
uses: github/codeql-action/init@v1
with:
languages: ${{ matrix.language }}
- name: Autobuild
uses: github/codeql-action/autobuild@v1
- name: Perform CodeQL Analysis
uses: github/codeql-action/analyze@v1
```

Notice the following things:

- 1. The workflow name is CodeQL.
- 2. This workflow triggers on push and pull\_request events to the main branch. There's also a cron trigger. The cron trigger lets you define a schedule for triggering this workflow and is randomly generated for you. In this case, this workflow will run at 14:40 UTC every Saturday.

[!TIP] If you edit the workflow file and hover over the cron expression, a tooltip will show you the English text for the cron expression.

- 3. There's a single job called analyze that runs on the ubuntu-latest hosted agent.
- 4. This workflow defines a strategy with a matrix on the array of language. In this case, there's only csharp. If the repository contained other languages, you could add them to this array. This causes the job to "fan out" and create an instance per value of the matrix.
- 5. There are four steps, starting with checkout.
- 6. The second step initializes the CodeQL scanner for the language this job is going to scan. CodeQL intercepts calls to the compiler to build a database of the code while the code is being built.
- 7. The Autobuild step will attempt to automatically build the source code using common conventions. If this step fails, you can replace it with your own custom build steps.
- 8. After building, the CodeQL analysis is performed, where suites of queries are run against the code database.
- 9. The run should complete successfully. However, there appear to be no issues.

| Overview             | Code scanning                    |                     |          |  |                  |  |
|----------------------|----------------------------------|---------------------|----------|--|------------------|--|
| Security policy      | Filters - Q. tool:CodeQL is:open |                     |          |  |                  |  |
| Security advisories  |                                  |                     |          |  |                  |  |
| Dependabot alerts    | Uppen X 0 Llosed                 |                     | Branch + |  | lag <del>+</del> |  |
| Code scanning alerts |                                  |                     |          |  |                  |  |
| CodeQL               |                                  | A                   |          |  |                  |  |
|                      |                                  | $( \circ )$         |          |  |                  |  |
|                      |                                  | $\sim$              |          |  |                  |  |
|                      | No code so                       | anning alerts found | Ι.       |  |                  |  |
|                      |                                  |                     |          |  |                  |  |
|                      |                                  |                     |          |  |                  |  |

\*\*Figure 4:\*\* No results to the initial scan.

#### **Customize CodeQL settings**

The CodeQL scan isn't reporting any security issues. That's expected with this basic sample. CodeQL can also scan for *quality* issues. The current workflow is using the default security-extended suite. You can add quality scanning in by adding a configuration file to customize the scanning suites. In this step, you'll configure CodeQL to use the security-and-quality suites.

[!INFORMATION] For other CodeQL configuration options, see <u>Configuring CodeQL code scanning in</u> <u>your Cl system</u>.

1. Navigate to the *.github* folder in the **Code** tab and select **Add File**:

| Search or jump to 7 Pull requests Iss                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | sues Marketplace Explore | ⋬ +- @-                               |
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| Code II Pull requests ⊙ Actions <sup>™</sup> Projects I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                          |                                       |
| 말 master + simple-feed-reader / .github /                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                          | Go to file Add file → ····            |
| This branch is 20 commits ahead of Azure-Samples:master.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                          | Create new file<br>Upload files mpare |
| colindembovsky Create codeql-analysis.yml                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                          | × 3765ff2 1 hour ago 🕤 History        |
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| workflows                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                          |                                       |
| De la contra de la |                          |                                       |

\*\*Figure 5:\*\* Create a new file.

1. Enter *codeql/codeql-config.yml* as the name. This creates the file in a folder. Paste in the following code:

:::{custom-style=CodeBox} ```yml name: "Security and Quality"

queries:

- uses: security-and-quality ``` :::

| <b>()</b> s             | earch or jump to                            |                                         | Pull requests   | Issues M | arketplace Explo | ore        |  |
|-------------------------|---------------------------------------------|-----------------------------------------|-----------------|----------|------------------|------------|--|
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| simpl                   | Le-feed-reader / .git                       | hub / codeql /<br>Preview<br>d Quality" | codeql-config.y | ml       | Cancel           |            |  |
| 3                       | queries:<br>- uses: security                | -and-quality                            |                 |          |                  |            |  |

\*\*Figure 6:\*\* Create the CodeQL configuration file.

- 1. Select **Commit to main** at bottom of the editor to commit the file.
- 2. Edit the CodeQL workflow to use the new configuration file. Navigate to *...github/workflows/codeql-analysis.yml* and select the pencil icon. Add a new property to the with section as shown below:

:::{custom-style=CodeBox} yml - name: Initialize CodeQL uses: github/codeql-action/init@v1
with: languages: \${{ matrix.language }} config-file: ./.github/codeql/codeql-config.yml # <-add this line :::</pre>

1. Select **Start Commit** and commit to the main branch.

#### **Review the security alerts**

#### Important

You must be a repository owner to view security alerts.

This sample repository is small. As such, it doesn't contain any major security or quality issues. However, "real world" repositories will likely have some issues.

When the last CodeQL workflow run completes, you should see two issues in the **Security** tab:

| Search or jump to                                 | o 👔                  | Pull requests Issues Marketplace Explore                                                                   | 4 +-                                             |
|---------------------------------------------------|----------------------|------------------------------------------------------------------------------------------------------------|--------------------------------------------------|
| V colindembovsky<br>forked from Azure-Samples/sim | / simple-feed-reader | ader                                                                                                       | ⓒ Watch → 0 🏠 Star 0 🦞 Fork 92                   |
| <> Code 🏦 Pull re                                 | quests 🕑 Actions     | I Projects II Wiki O Security 2 🗠 Insights 🕸 Settings                                                      |                                                  |
| Overview                                          |                      | Code scanning                                                                                              |                                                  |
| Security policy                                   |                      | Filters + Q. tool:CodeQL is:open                                                                           |                                                  |
| Security advisories                               |                      |                                                                                                            |                                                  |
| Dependabot alerts                                 |                      | Closed                                                                                                     | Branch + Severity + Rule + Tag + Sort +          |
| Code scanning aler                                | ts 2                 | Missed 'readonly' opportunity<br>(Generated) SimpleFeedReader/obj/Debug/netcoreapp2.1/Razor/Pages/Index.cd | ■aster<br>html.g.cs#L31 • Detected 4 minutes ago |
| CodeQL                                            |                      | Issed 'readonly' opportunity<br>(Generated) Simplef eedReader/obj/Debug/netcoreapp2.1/Razor/Pages/_Layout  | .cshtmlg.cs#L54 + Detected 4 minutes ago         |
|                                                   |                      | Q ProTip! You can run CodeQL locally                                                                       |                                                  |

Figure 7: View security alerts.

- 1. Select the first alert to open it.
- 2. In this case, the alert is for a generated file that isn't committed to the repository. For that reason, the preview is unavailable.
- 3. Notice the tags that are applied. These tags can be used for filtering issues.
- 4. Select **Show more** under the rule information to show help and recommendations.



\*\*Figure 8:\*\* Open an alert.

1. Selecting **Dismiss** will open options for dismissing this issue:



\*\*Figure 9:\*\* Dismiss an alert.

# Monitor and debug

Having deployed the app and built a DevOps pipeline, it's important to understand how to monitor and troubleshoot the app.

In this section, you'll complete the following tasks:

[!div class="checklist"]

- Find basic monitoring and troubleshooting data in the Azure portal
- Learn how Azure Monitor provides a deeper look at metrics across all Azure services
- Connect the web app with Application Insights for app profiling
- Turn on logging and learn where to download logs
- Stream logs in real time
- Learn where to set up alerts
- Learn about remote debugging Azure App Service web apps.

## Basic monitoring and troubleshooting

App Service web apps are easily monitored in real time. The Azure portal renders metrics in easy-tounderstand charts and graphs.

- 1. Open the <u>Azure portal</u>, and then navigate to the *mywebapp<unique\_number>* App Service.
- 2. The **Overview** tab displays useful "at-a-glance" information, including graphs displaying recent metrics.

| App Service                                                      |                                                                                                                                                    | den an Alexandra                                                                                                                                                                                                               |                                                                                                                                                                                   |
|------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Search (Ctrl+/)                                                  | x L∠i Browse ■ Stop * Swap 🕐 Restart 🔟 Delete                                                                                                      |                                                                                                                                                                                                                                |                                                                                                                                                                                   |
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| X Diagnose and solve problems                                    | df11f062-9277-40f1-a559-888e4c82c4db                                                                                                               | ftp://waws-prod-dm1-089:                                                                                                                                                                                                       | ftp.azurewebsites.windows.net                                                                                                                                                     |
| Quickstart  Deployment credentials                               | Diagnose and solve problems<br>Our set-service diagnostic and evolute/outing experience<br>heps you identify and restore issues with your net spp. | Application Insights     Application Insights     Application insights produces and tag-sever quality     users actually do with it                                                                                            | App Service Advisor<br>Arg Service Advisor swights the inservice any<br>arg service advisor set and the inservice any<br>are cored by freehrest, priority and impact to your app. |
| iii. Deployment slots                                            |                                                                                                                                                    |                                                                                                                                                                                                                                |                                                                                                                                                                                   |
| Deployment options     Continuous Delivery (Preview)             | Http 5xx 📌                                                                                                                                         | Data In 💉                                                                                                                                                                                                                      | Data Out 🖈                                                                                                                                                                        |
| ATTINGS                                                          |                                                                                                                                                    | 845                                                                                                                                                                                                                            | 540                                                                                                                                                                               |
| Application settings                                             |                                                                                                                                                    |                                                                                                                                                                                                                                | 258                                                                                                                                                                               |
| ? Authentication / Authorization                                 |                                                                                                                                                    | 25.0                                                                                                                                                                                                                           |                                                                                                                                                                                   |
| Application Insights                                             | 5:15 PM 5:30 PM 5:45 PM 6 PM                                                                                                                       | 5:15 PM 5:30 PM 5:45 PM 6 PM                                                                                                                                                                                                   | 5:15 PM 5:30 PM 5:45 PM 6 PM                                                                                                                                                      |
| Managed service identity (Pr                                     | HTTP SERVER ERRORS @                                                                                                                               | 17.6 kB                                                                                                                                                                                                                        | 12.94 кв                                                                                                                                                                          |
| Backups                                                          |                                                                                                                                                    | 1110 10                                                                                                                                                                                                                        | 1210 1 10                                                                                                                                                                         |
| Custom domains                                                   |                                                                                                                                                    |                                                                                                                                                                                                                                |                                                                                                                                                                                   |
| 3 SSL settings                                                   | Requests 💉                                                                                                                                         | Average Response Time 💉                                                                                                                                                                                                        |                                                                                                                                                                                   |
| Networking                                                       | 6                                                                                                                                                  | Du                                                                                                                                                                                                                             |                                                                                                                                                                                   |
| Scale up (App Service plan)                                      | <u>- 5</u>                                                                                                                                         | 60                                                                                                                                                                                                                             |                                                                                                                                                                                   |
| Scale out (App Service plan)                                     |                                                                                                                                                    |                                                                                                                                                                                                                                |                                                                                                                                                                                   |
| WebJobs                                                          |                                                                                                                                                    | - 2x                                                                                                                                                                                                                           |                                                                                                                                                                                   |
| Push                                                             |                                                                                                                                                    | 01                                                                                                                                                                                                                             |                                                                                                                                                                                   |
| MySQL In App                                                     | REQUESTS 0<br>8                                                                                                                                    | AVERAGE RESPONS 0<br>243.52 ms                                                                                                                                                                                                 |                                                                                                                                                                                   |
| U Properties                                                     |                                                                                                                                                    |                                                                                                                                                                                                                                |                                                                                                                                                                                   |

- \* \*\*Http 5xx\*\*: Count of server-side errors, usually exceptions in ASP.NET Core code.
- \* \*\*Data In\*\*: Data ingress coming into your web app.
- \* \*\*Data Out\*\*: Data egress from your web app to clients.
- \* \*\*Requests\*\*: Count of HTTP requests.
- \* \*\*Average Response Time\*\*: Average time for the web app to respond to HTTP requests.

Several self-service tools for troubleshooting and optimization are also found on this page.

| App Service                                             |                                                                                                                                                       |                                                                                                                                               |                                                                                                                                           |
|---------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|
| Search (Ctrl+/)                                         | « 🗹 Browse 🔳 Stop 🍫 Swap 🕐 Restart 🛅 Delete                                                                                                           |                                                                                                                                               |                                                                                                                                           |
| 📀 Overview                                              | Resource group (change)<br>AzureTutorial<br>Status                                                                                                    | URL<br>https://mywebapp218<br>App Service plar/prici                                                                                          | 16.azurewebsites.net<br>ng tier                                                                                                           |
| Activity log                                            | Running                                                                                                                                               | mywebapp21816 (Star<br>Git/Deoloyment usern                                                                                                   | ndard: 1 Small)<br>ame                                                                                                                    |
| Access control (IAM)                                    | Central US<br>Subscription (change)                                                                                                                   | camsoper<br>Git clone url                                                                                                                     |                                                                                                                                           |
| 🛷 Tags                                                  | vs-beta<br>Subscription ID                                                                                                                            | https://camsoper@my<br>FTP.hostname                                                                                                           | webapp21816.scm.azurewebsites.net:443/mywebapp21816.git                                                                                   |
| ✗ Diagnose and solve problems                           | df11f062-9277-40f1-a559-888e4c82c4db                                                                                                                  | ftp://waws-prod-dm1-                                                                                                                          | 089.ftp.azurewebsites.windows.net                                                                                                         |
| DEPLOYMENT                                              |                                                                                                                                                       |                                                                                                                                               |                                                                                                                                           |
| 📣 Quickstart                                            | Diagnose and solve problems<br>Our self-service diagnostic and troubleshooting experience<br>helps you identify and resolve issues with your web app. | Application Insights<br>Application Insights helps you detect and diagnose quality<br>issues in your apps, and helps you understand what your | App Service Advisor<br>App Service Advisor provides Insights for Improving app<br>experience on the App Service platform. Recommendations |
| Deployment credentials                                  |                                                                                                                                                       | users actually do with it.                                                                                                                    | are sorted by freshness, priority and impact to your app.                                                                                 |
| iii. Deployment slots                                   |                                                                                                                                                       |                                                                                                                                               |                                                                                                                                           |
| IB Deployment options                                   | Http 5xx 🖈                                                                                                                                            | Data In 💉                                                                                                                                     | Data Out 🖈                                                                                                                                |
| 6% Continuous Delivery (Preview)                        | 100                                                                                                                                                   | 1048                                                                                                                                          | 648                                                                                                                                       |
| SETTINGS                                                | 80                                                                                                                                                    | 84:8                                                                                                                                          | 588                                                                                                                                       |
| - Application settings                                  | 60                                                                                                                                                    | 6kB                                                                                                                                           | 240                                                                                                                                       |
| Automational Automation                                 | 20                                                                                                                                                    | 2168                                                                                                                                          | 248                                                                                                                                       |
|                                                         | 0                                                                                                                                                     | OKB N                                                                                                                                         |                                                                                                                                           |
| Application insights     Managed service identity (Pr., | E-15 PM E-20 PM E-45 PM 6 PM<br>HTTP SERVER ERRORS 0                                                                                                  | 5:15 PM 5:20 PM 5:45 PM 6 PM<br>DATAIN O                                                                                                      | 5:15 PM 5:20 PM 5:25 PM 6 PM<br>DATA OUT 10                                                                                               |
| a Backups                                               | 0                                                                                                                                                     | 21.19 кв                                                                                                                                      | 17.57 kB                                                                                                                                  |
| Custom domains                                          |                                                                                                                                                       |                                                                                                                                               |                                                                                                                                           |
| C SSL settings                                          | Requests 🖈                                                                                                                                            | Average Response Time 🖈                                                                                                                       |                                                                                                                                           |
| Networking                                              | 6                                                                                                                                                     | 84                                                                                                                                            |                                                                                                                                           |
| Scale up (App Service plan)                             | <u> </u>                                                                                                                                              | 0                                                                                                                                             |                                                                                                                                           |
| Scale out (App Service plan)                            |                                                                                                                                                       | 41                                                                                                                                            |                                                                                                                                           |
| 😘 WebJobs                                               |                                                                                                                                                       | 25                                                                                                                                            |                                                                                                                                           |
| 👯 Push                                                  | 5:15 PM 5:20 PM 5:45 PM 6 PM                                                                                                                          | 5:15 PM 5:20 PM 5:25 PM 6 PM                                                                                                                  |                                                                                                                                           |
| S. MySQL In App                                         | REQUESTS 0<br>10                                                                                                                                      | AVERAGE RESPONS 0<br>244.29 ms                                                                                                                |                                                                                                                                           |
| Properties                                              |                                                                                                                                                       |                                                                                                                                               |                                                                                                                                           |
| Locks                                                   |                                                                                                                                                       |                                                                                                                                               |                                                                                                                                           |

\* \*\*Diagnose and solve problems\*\* is a self-service troubleshooter.

\* \*\*Application Insights\*\* is for profiling performance and app behavior, and is discussed later in this section.

\* \*\*App Service Advisor\*\* makes recommendations to tune your app experience.

### Advanced monitoring

<u>Azure Monitor</u> is the centralized service for monitoring all metrics and setting alerts across Azure services. Within Azure Monitor, administrators can granularly track performance and identify trends. Each Azure service offers its own <u>set of metrics</u> to Azure Monitor.

## Profile with Application Insights

<u>Application Insights</u> is an Azure service for analyzing the performance and stability of web apps and how users use them. The data from Application Insights is broader and deeper than that of Azure Monitor. The data can provide developers and administrators with key information for improving apps. Application Insights can be added to an Azure App Service resource without code changes.

- 1. Open the <u>Azure portal</u>, and then navigate to the *mywebapp<unique\_number>* App Service.
- 2. From the **Overview** tab, click the **Application Insights** tile.



1. Select the **Create new resource** radio button. Use the default resource name, and select the location for the Application Insights resource. The location doesn't need to match that of your web app.

| Application Insights Application Insights helps you detect and diagnose guality issues in your web apps and web services, and helps yo |
|----------------------------------------------------------------------------------------------------------------------------------------|
| a tually do with it.<br>Getting started with Application Insights monitoring                                                           |
| Link your application to Application Insights                                                                                          |
| Select existing resource                                                                                                               |
| Search                                                                                                                                 |
| 💡 my-blog my-blog South Central US                                                                                                     |
| ● Create new resource  * New resource name  * Location  mywebapp21816  ✓ East US  Instrument your application                          |
| * Runtime/Framework ASP.NET Core                                                                                                       |
| Code level diagnostics<br>Identify code that slowed down your web app and debug runtime exceptions with local variables<br>On Off      |
| ✓ Advanced Settings                                                                                                                    |
| ок                                                                                                                                     |

- 1. For **Runtime/Framework**, select **ASP.NET Core**. Accept the default settings.
- 2. Select **OK**. If prompted to confirm, select **Continue**.
- 3. After the resource has been created, click the name of Application Insights resource to navigate directly to the Application Insights page.



As the app is used, data accumulates. Select **Refresh** to reload the blade with new data.

| T<br>T | Mywebapp21816<br>Application Insights - Last 24 hours (30 minute g | granularity) - ASP.NET web application         |                                     | ★                    |
|--------|--------------------------------------------------------------------|------------------------------------------------|-------------------------------------|----------------------|
|        |                                                                    | ♀ Search Metrics Explorer                      | Analytics 🕑 Time range              | 🕐 Refresh 🛛 😶 More   |
|        | Overview                                                           | Please try new Overview befor                  | e it becomes the default experience | . →                  |
|        | Activity log                                                       |                                                |                                     |                      |
|        | Access control (IAM)                                               | de Line Steam                                  | 🛱 Caunt Datasian                    |                      |
|        | 🛷 Tags                                                             | 0 V Click to                                   | 1 0                                 | >                    |
|        | X Diagnose and solve problems                                      | Alerts configure                               | Users Detections (7d)               | Availability App map |
|        | INVESTIGATE                                                        | Health                                         |                                     |                      |
|        | - Application map                                                  | Overview timeline<br>MYWEBAPP21816             |                                     |                      |
|        | 😨 Smart Detection                                                  | 2s                                             |                                     |                      |
|        | ➔ Live Metrics Stream                                              | 1s<br>0.5s                                     |                                     | SERVER RESPONSE TI   |
|        | Metrics Explorer                                                   | 0s<br>100ms                                    |                                     | 1.53 5               |
|        | Metrics (preview)                                                  | 80ms<br>60ms                                   |                                     | _                    |
|        | Search                                                             |                                                |                                     | PAGE VIEW LOAD TIME  |
|        | 🌻 Availability                                                     | 20                                             |                                     | SERVER REQUESTS      |
|        | u≝ Failures                                                        | 10                                             |                                     |                      |
|        | Performance                                                        | 0                                              |                                     | 11                   |
|        | Servers                                                            | May 31                                         | 6 AM 12 PM 6 PM                     |                      |
|        | Browser                                                            |                                                |                                     |                      |
|        | Workbooks (preview)                                                | Total of Server Requests by I<br>MYWEBAPP21816 | Request Performance                 |                      |
| ι      | USAGE (PREVIEW)                                                    | REQUEST PERFORMANCE                            | TOTAL                               | % TOTAL              |
|        | 🎍 Users                                                            | <250ms                                         |                                     | 17 43.6%             |
|        | sessions                                                           | 250ms-500ms                                    |                                     | 8 20.5%              |
|        | 📑 Events                                                           | 1sec-3sec                                      |                                     | 6 15.4%              |
|        | ₹ Funnels                                                          | 500ms-1sec                                     |                                     | 4 10.3%              |
|        | User Flows                                                         | 7sec-15sec                                     |                                     | 2 5.1%               |
|        | 🛂 Retention                                                        | 3sec-7sec                                      |                                     | 1 2.6%               |
|        | <ol> <li>Impact</li> </ol>                                         |                                                | -                                   |                      |
|        | 🗳 Cohorts 🗸 🗸                                                      |                                                |                                     |                      |
|        |                                                                    |                                                |                                     |                      |

Application Insights provides useful server-side information with no additional configuration. To get the most value from Application Insights, <u>instrument your app with the Application Insights SDK</u>. When properly configured, the service provides end-to-end monitoring across the web server and

browser, including client-side performance. For more information, see the <u>Application Insights</u> <u>documentation</u>.

# Logging

Web server and app logs are disabled by default in Azure App Service. Enable the logs with the following steps:

- 1. Open the <u>Azure portal</u>, and navigate to the *mywebapp*<unique\_number> App Service.
- 2. In the menu to the left, scroll down to the **Monitoring** section. Select **Diagnostics logs**.



- 1. Turn on **Application Logging (Filesystem)**. If prompted, click the box to install the extensions to enable app logging in the web app.
- 2. Set Web server logging to File System.
- 3. Enter the **Retention Period** in days. For example, 30.
- 4. Click Save.

ASP.NET Core and web server (App Service) logs are generated for the web app. They can be downloaded using the FTP/FTPS information displayed. The password is the same as the deployment credentials created earlier in this guide. The logs can be <u>streamed directly to your local machine with</u> <u>PowerShell or Azure CLI</u>. Logs can also be <u>viewed in Application Insights</u>.

## Log streaming

App and web server logs can be streamed in real time through the portal.

- 1. Open the <u>Azure portal</u>, and navigate to the *mywebapp<unique\_number>* App Service.
- 2. In the menu to the left, scroll down to the **Monitoring** section and select **Log stream**.



Logs can also be streamed via Azure CLI or Azure PowerShell, including through the Cloud Shell.

## Alerts

Azure Monitor also provides <u>real time alerts</u> based on metrics, administrative events, and other criteria.

#### Note

Currently alerting on web app metrics is only available in the Alerts (classic) service.

The <u>Alerts (classic) service</u> can be found in Azure Monitor or under the **Monitoring** section of the App Service settings.

| MONITORING |                  |  |  |  |
|------------|------------------|--|--|--|
| ~          | Alerts (Classic) |  |  |  |
| 4          | Diagnostics logs |  |  |  |
| м          | Log stream       |  |  |  |
| -          | Process explorer |  |  |  |
|            |                  |  |  |  |

# Live debugging

Azure App Service can be <u>debugged remotely with Visual Studio</u> when logs don't provide enough information. However, remote debugging requires the app to be compiled with debug symbols. Debugging shouldn't be done in production, except as a last resort.

# Conclusion

In this section, you completed the following tasks:

[!div class="checklist"]

- Find basic monitoring and troubleshooting data in the Azure portal
- Learn how Azure Monitor provides a deeper look at metrics across all Azure services
- Connect the web app with Application Insights for app profiling
- Turn on logging and learn where to download logs
- Stream logs in real time
- Learn where to set up alerts
- Learn about remote debugging Azure App Service web apps.

# Additional reading

- <u>Troubleshooting ASP.NET Core on Azure App Service and IIS</u>
- <u>Common errors reference for Azure App Service and IIS with ASP.NET Core</u>
- Monitor Azure web app performance with Application Insights
- Enable diagnostics logging for web apps in Azure App Service
- <u>Troubleshoot a web app in Azure App Service using Visual Studio</u>
- <u>Create classic metric alerts in Azure Monitor for Azure services Azure portal</u>

# Next steps

In this guide, you created a DevOps pipeline for an ASP.NET Core sample app. Congratulations! We hope you enjoyed learning to publish ASP.NET Core web apps to Azure App Service and automate the continuous integration of changes.

Beyond web hosting and DevOps, Azure has a wide array of Platform-as-a-Service (PaaS) services useful to ASP.NET Core developers. This section gives a brief overview of some of the most commonly used services.

## Storage and databases

<u>Redis Cache</u> is high-throughput, low-latency data caching available as a service. It can be used for caching page output, reducing database requests, and providing ASP.NET Core session state across multiple instances of an app.

<u>Azure Storage</u> is Azure's massively scalable cloud storage. Developers can take advantage of <u>Queue</u> <u>Storage</u> for reliable message queuing, and <u>Table Storage</u> is a NoSQL key-value store designed for rapid development using massive, semi-structured data sets.

<u>Azure SQL Database</u> provides familiar relational database functionality as a service using the Microsoft SQL Server Engine.

<u>Cosmos DB</u> globally distributed, multi-model NoSQL database service. Multiple APIs are available, including SQL API (formerly called DocumentDB), Cassandra, and MongoDB.

# Identity

<u>Azure Active Directory</u> and <u>Azure Active Directory B2C</u> are both identity services. Azure Active Directory is designed for enterprise scenarios and enables Azure AD B2B (business-to-business) collaboration, while Azure Active Directory B2C is intended business-to-customer scenarios, including social network sign-in.

# Mobile

<u>Notification Hubs</u> is a multi-platform, scalable push-notification engine to quickly send millions of messages to apps running on various types of devices.

# Web infrastructure

<u>Azure Container Service</u> manages your hosted Kubernetes environment, making it quick and easy to deploy and manage containerized apps without container orchestration expertise.

<u>Azure Search</u> is used to create an enterprise search solution over private, heterogenous content.

<u>Service Fabric</u> is a distributed systems platform that makes it easy to package, deploy, and manage scalable and reliable microservices and containers.