Practical Guide

Azure DevOps

Complete CI/CD Pipeline

By: Mukesh Kumar

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The methods described in this eBook are the author's personal thoughts. They are not intended to be a definitive set of instructions for this project. You may discover there are other methods and materials to accomplish the same end result.

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About The Author

Mukesh Kumar is a **Software Developer** and **Microsoft MVP** who has a Master's degree in Computer Science. He is also **C# Corner MVP, Blogger, Writer** and has more than seven years of extensive experience designing and developing enterprise-scale applications on Microsoft Technologies like C#, Asp.Net, Web API, Asp.NET Core, Microsoft Azure, Angular 4+, JavaScript, Node.JS, Python etc.

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1. About DevOps

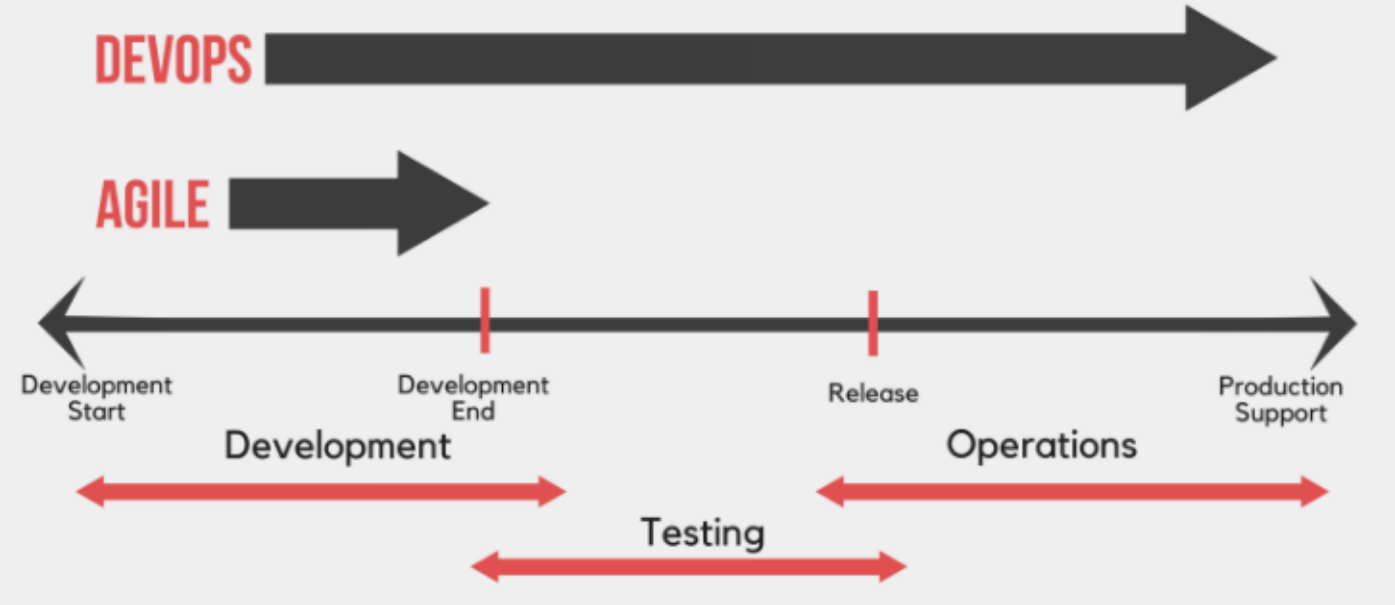
1.1 Definition

DevOps is a combination of Development and Operations. It means Dev + Ops = DevOps. It is a culture which automates the system and improves and accelerates delivery to the client in a repeated manner. It's basically a collaboration between the Development team and the Operations team for serving a better quality application. It is a culture for continuous integration and continuous delivery where we make the automated build system as well as automated deployment system. In other words, DevOps is practice collaboration between Development and Operations from the planning of a project to deployment on production. It involves the complete SDLC life cycle as well as monitoring.

Understanding DevOps, you should consider the following points as well.

- ✓ DevOps means only combining the two teams of Development and Operations.
- ✓ It is not a separate team.
- ✓ It is not a product or tool.
- ✓ DevOps people do not hire from outside, they are internal team members who are working either in the development phase or in the operations phase.

It is a group of people, processes and tools. It basically brings the two or more different teams like development and operations together with a well-defined process, using some great tools for automatic software delivery to the client. It is a set of practices which are used by the DevOps teams to speed up the quality delivery. There are different kinds of tools or set of tools which are used in **Continuous Integration (CI) and Continuous Delivery (CD)** where it performs restoring the code, building the processes, executing the test cases, and deployment on the stage environment, etc.



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1.2 Why DevOps

To understand why DevOps is required, let's first understand, what happens without DevOps.

As an IT consulting firm, while initiating a new project, we have two different kinds of teams. First is the Development team, which is involved completely in developing and testing, including writing code and unit test cases. The other team is the Operations team which is involved in operating and monitoring the product.

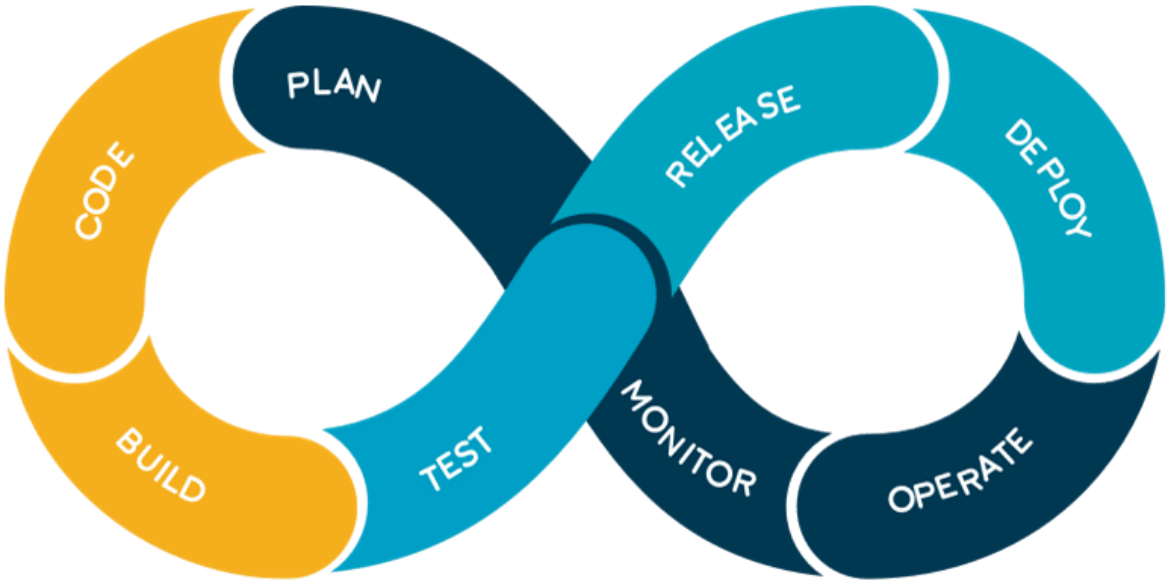
- ✓ Without DevOps, both teams **(Development and Operations)** work completely in an isolated manner.
- ✓ If DevOps is not there then the team spends most of the time in building the code and deploying on multiple environments.
- ✓ Each team waits for others to be done. This means, if development is going on then the testing team waits for the deployment of the code (Artifact) on the QA environment and in the same manner the operations team waits for the deployment on the Production environment. So, due to this, a large amount of time gets wasted.
- ✓ As a human being, we make mistakes. Every time, building the code and deploying on specific environments in a manual fashion can increase the issues and resolving it will take a lot of time. Rather than doing it manually, we can make it automated using DevOps.

So, the above points show that we face lots of human issues and system issues if we are not following DevOps. Now, let's see how we can make it more systematic using DevOps and how DevOps helps us to achieve the same tasks in less time without any errors.

- ✓ DevOps increases the higher success rate of new releases without any error.
- ✓ It helps us to simplify the whole development and deployment process.
- ✓ Automates the manual process like build process, release process, etc.
- ✓ Automates executing the test cases.
- ✓ Configures the continuous delivery and continuous deployment in the release cycle.
- ✓ Live monitoring.
- ✓ It also helps in team collaboration.
- ✓ Reduces the failures and rollbacks
- ✓ Provides continuous improvement

1.3 DevOps Lifecycle

DevOps is a culture where Development and Operations teams get involved. The development phase has its own lifecycle and the Operations phase has its own as well. If we combine both lifecycles, we get the lifecycle of DevOps. If an organization is not following or considering some of the points from the DevOps lifecycle then we can say, they are not following DevOps culture. From planning to deployment, we have several stages which are very important and we cannot skip any of them. So, let's understand the DevOps lifecycle.



PLAN:

It is the first stage of any new project. Here, we plan for a new project from requirement gathering from the customer and planning to deliver the final project to the customer.

- ✓ What the requirements are.
- ✓ What types of product we have to create.
- ✓ What the timelines are for different sprints and the final product.
- ✓ What technologies we will use.
- ✓ What tools we will use.
- ✓ How many team members will be available for this project.
- ✓ What process we are going to follow, like agile.

CODE:

In this stage, we do the coding for creating the product with actual functionality as discussed with the customer. We use different types of methodologies for achieving the goal, like Agile methodology. Here we group the tasks in the sprint and their estimation as well. Sprints are basically for 2-3 weeks. Unit Test cases are also to be a part of the coding.

BUILD:

In this stage, we build the code. Code building happens two times; first when a developer is writing the code, then he/she has to build the code every time in their own local system to see the functionality. The second time, when a team member checks in the code in source control repository, then it automates the build for the code and makes the artifact for deployment.

TEST:

Testing is the heart of any development process. We write the Unit Test cases along with code. In DevOps, test cases auto execute and validate the build process.

RELEASE:

In this stage, it collects the build artifact which can deploy further.

DEPLOY:

Here, we start the deployment on the respective stages which are configured in the Release Pipeline. Actually after testing and validating the build artifact, it auto starts the deployment on the respective environment using a continuous delivery process. But before deploying it to the production environment, it asks for approval which can be done manually.

We can also automate the whole deployment process using continuous deployment. This is basically used when we have small changes which can be deployed on production as well without any approvals.

OPERATE & MONITOR: After successful deployment on the production environment, we have to operate the whole system and monitor the application. This monitoring is not only the performance but also the functionality.

1.4 Prerequisites

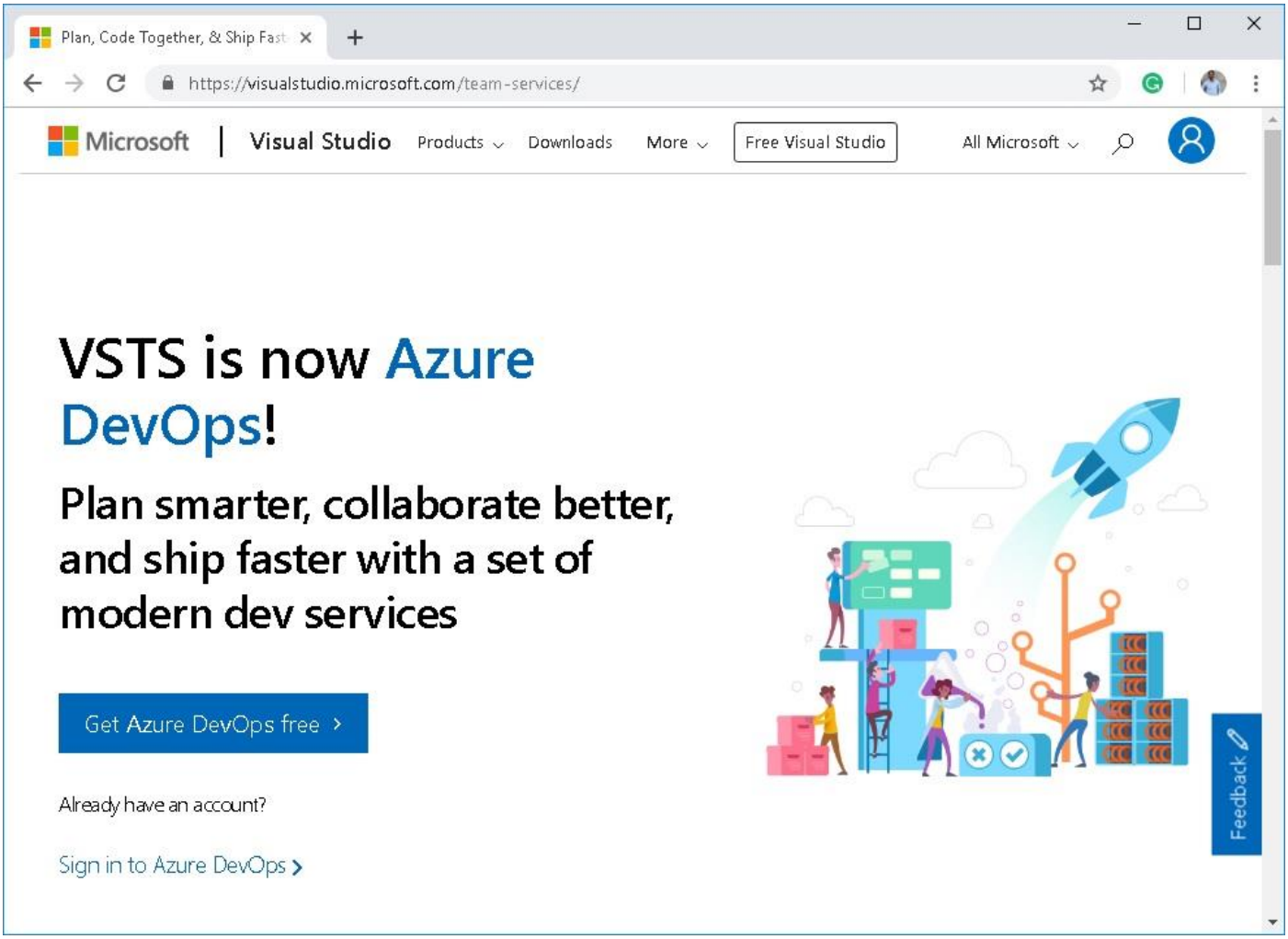
In order to do this practical demonstration, we will require a few tool and some accounts.

Visual Studio 2017 or Higher Version: It is a world class IDE which supports more than 40 programming languages. We will create the sample application along with a test project using Visual Studio 2017. So, before starting the demonstration, we will require Visual Studio 2017. If you would like to download Visual Studio 2017, we can download it from HERE.

Alternatively,

1. We can also use the Visual Studio Code, which is totally open source and can be download from HERE.
2. We can also create the Virtual Machine on the cloud (Cloud Account is required) and install Visual Studio 2017.

Azure DevOps: We need an Azure DevOps account. If we have an account with Azure DevOps that's fine; otherwise we can sign up from HERE. Earlier it was known as VSTS (Visual Studio Team Service). We can also get the free trial Azure DevOps account. Just click on the button 'Get Azure DevOps Free' as follows.



Microsoft Azure Account: We also require Microsoft Azure account to access Cloud Services like VM, App Service, and Database. If we don't have any subscription for Microsoft Azure then we can go with a Free Trial. https://portal.azure.com is the portal for accessing all Microsoft Azure Services.

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2. CI/CD Pipeline

Now a days, the delivery process in software development is rapid and fast. With the help of several tools, we try to customize our delivery process. If delivery process will be smooth then we can deliver the high quality of product to customer within timeline. Actually, customer wants to get the small change or small functionality to be added in minimum time. To enable to faster delivery process, we take the help of some of the mechanism like agile and various tools and people and it is called DevOps.

Let see what the old process in development are and what happens if some issues are there.

1. Get the requirements from Business.
2. Make a plan for converting the requirements into the actual functionality.
3. Developers do the code and check in it to a repository like TFS, GitHub etc.
4. After all code checks in to the repository, a developer executes the build process.
5. Run the test cases against the code.
6. If everything is fine, code gets deployed on the DEV server and then on QA.
7. If QA confirms the OK then deployment goes started on PROD.

Above is the general development workflows which are used mostly in small organizations. But is this process correct? Let understand the problem with the above development and delivery process.

1. Every time a developer check in the code into repository, but he/she doesn't know about Build. Is build created successfully or not?
2. Developers should wait for other developers to do the check in the code and building the code before deploying to DEV/QA server.
3. If a developer has completed his/her work and has checked in the code, they have to wait for others developers to check in the code as well.
4. If something wrong with anyone code then builds cycle will stop and wait again till the issue is resolved.
5. As a human being, we do a lot of mistakes. We can also do a mistake while doing the manual deployment.
6. Chances to get more issues from development to deployment.

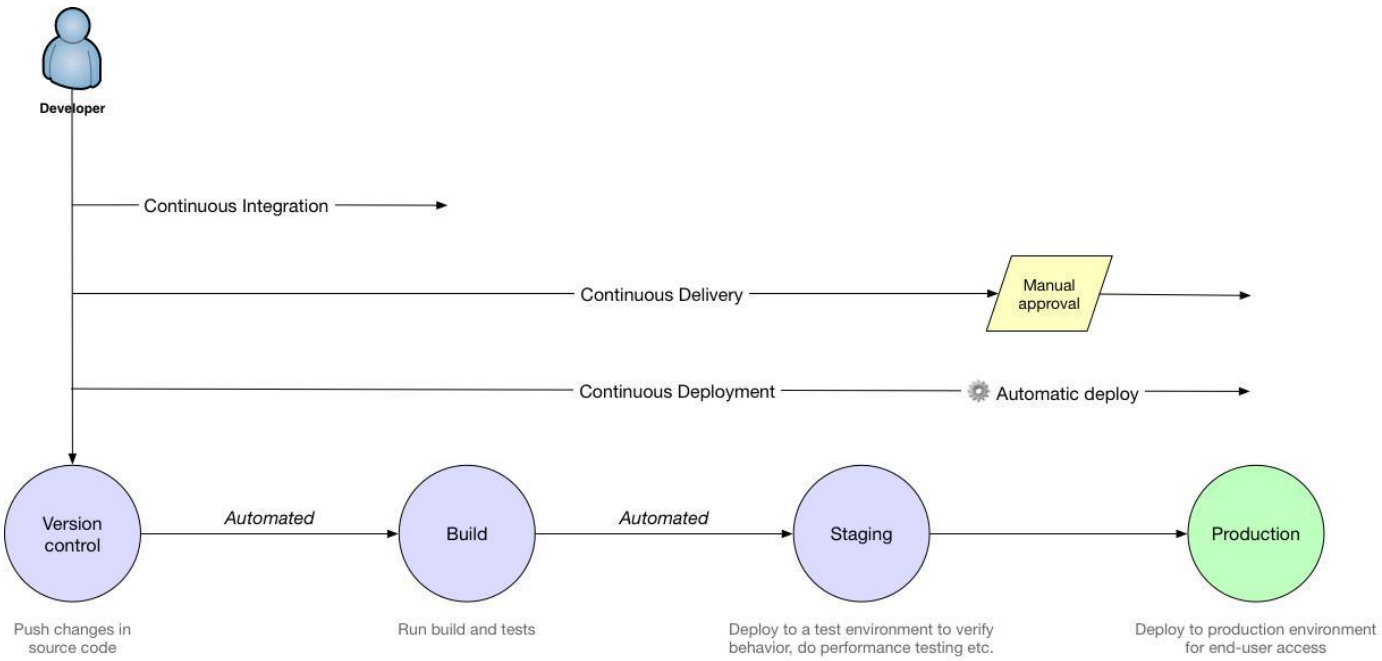
As we can see with above points, there are several issues while using the old deployment process. Which also need more time as doing manual deployment, more resource for completing manual deployment and obviously more money. We can resolve all the above issues if we implement the **Azure DevOps**. **In Azure DevOps**, we have **Continuous Integration (CI)** and **Continuous Delivery (CD)**. These help us to make the whole process as automated. So, let understand what these are.

Continuous Integration (CI): It is an automated build process which starts automatically when a developer checks in the code into the respective branch. Once the code check in process is done, the Continuous Integration process starts. It fetches the latest code from the respective branch and restore the required packages and start building automatically. After build process, it auto starts executing the Unit Test Cases and at the end, build artifact is ready. This build artifact further will use for deployment in Release process.

Continuous Delivery (CD): It is the next process after Continuous Integration. Once build artifact is ready for deployment then release process gets started. As per the Azure DevOps Release Pipeline configuration, it starts deploying the build artifact on the different stage server (Environments) automatically. But in the Continuous

Delivery, the deployment on the production goes manual. Manual does not mean here that we will deploy the build artifact manually, but here we have to approve before deploying on the PROD.

Continuous Deployment: It is the combination of **CI + CD and deployment on the production without any approval**. It means, in the Continuous Deployment, everything goes automatically.



As per the above image, we can see that once a developer checks in the code into the Version Control, Azure DevOps Pipeline starts. From getting the code from Version Control, restoring it, restoring packages from NuGet, Maven etc., building the code, executing the unit tests cases are part of the **Continuous Integration (CI)**.

Including Continuous Integration, if build artifact gets auto-deployed on any staging server like DEV or QA and deploys on the Production after manual approval is called **Continuous Delivery (CD)**. If manual approval is converted into automatic deployment then it's called **Continuous Deployment**. So, basically Continuous Deployment is the same as Continuous Delivery but without any manual approval. All goes in auto approval mode.

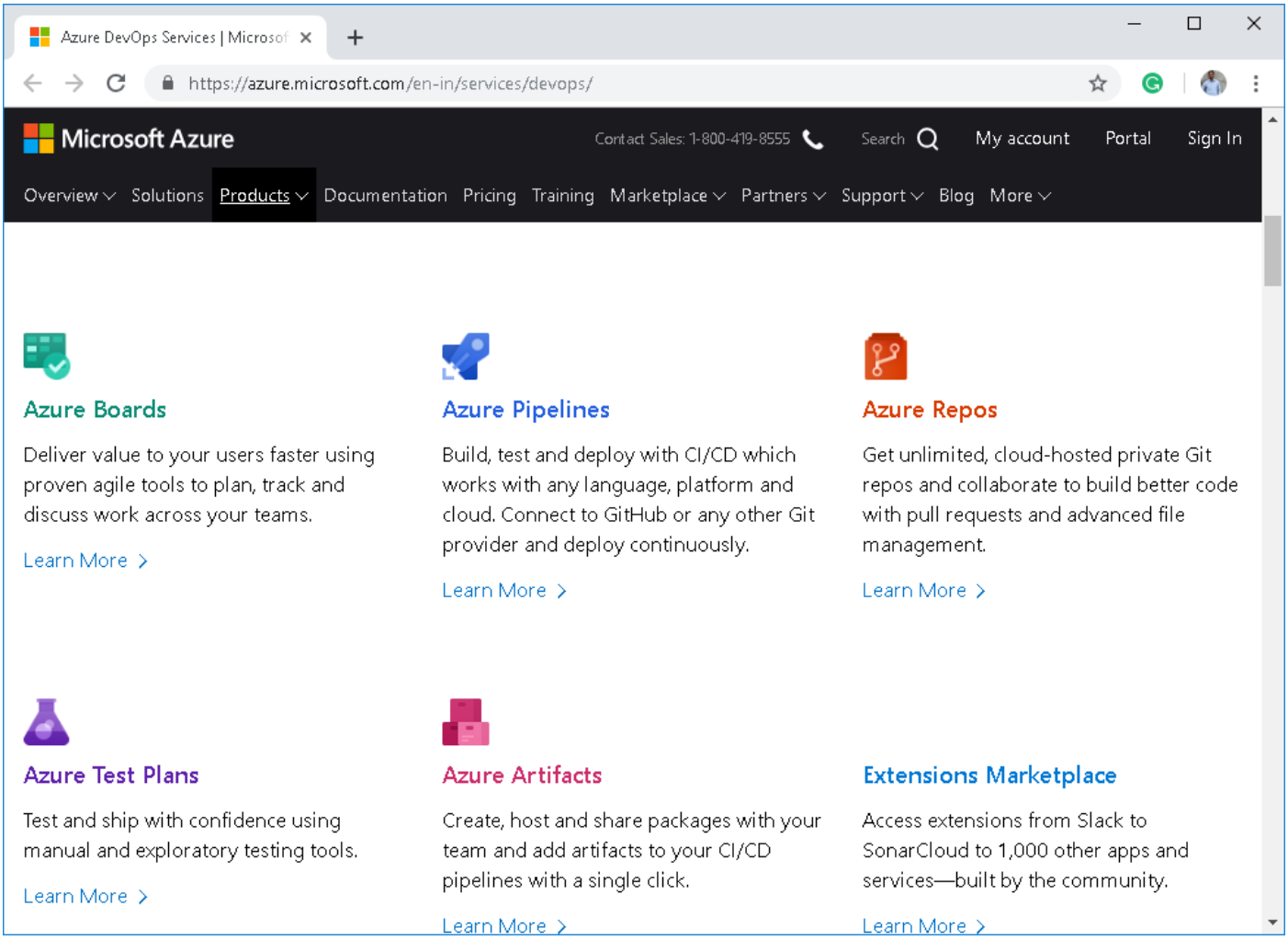
3. Why Azure DevOps

DevOps is a group of people, processes and tools which enable and automate the continuous delivery. Azure DevOps formally known as Visual Studio Team Service (VSTS) provides the repository management, project management, Build/Release Pipeline etc. Azure DevOps is free for a small project which has up to five users. But we can also use the paid version of it.

Azure DevOps provides unlimited cloud-hosted Git repos for a small or big project. Here developer can pull the code from Repos or push the code into Repos. It is basically a complete file management system.

While building the source code, it requires lots of third-party packages. Using Azure Artifacts, it enables the **NPM**, **MAVEN** or **NuGet** packages will available for private or public source code.

The most important feature of Azure DevOps is Azure pipeline. It enables the automated build and release pipeline. Azure Pipeline helps us to achieve Continuous Integration and Continuous Delivery for the project. Know more update about Azure DevOps HERE.



Microsoft Azure DevOps is most popular and widely use throughout the world because **it is free for Open Source Project and Small Teams project.** We can use lots of Azure DevOps features with free version like Azure Pipeline, Azure Boards, Azure Repos, and Azure Artifacts etc. It means, we don't need to go for paid version of Azure DevOps, if and only if we want to use those features which are in free versions.

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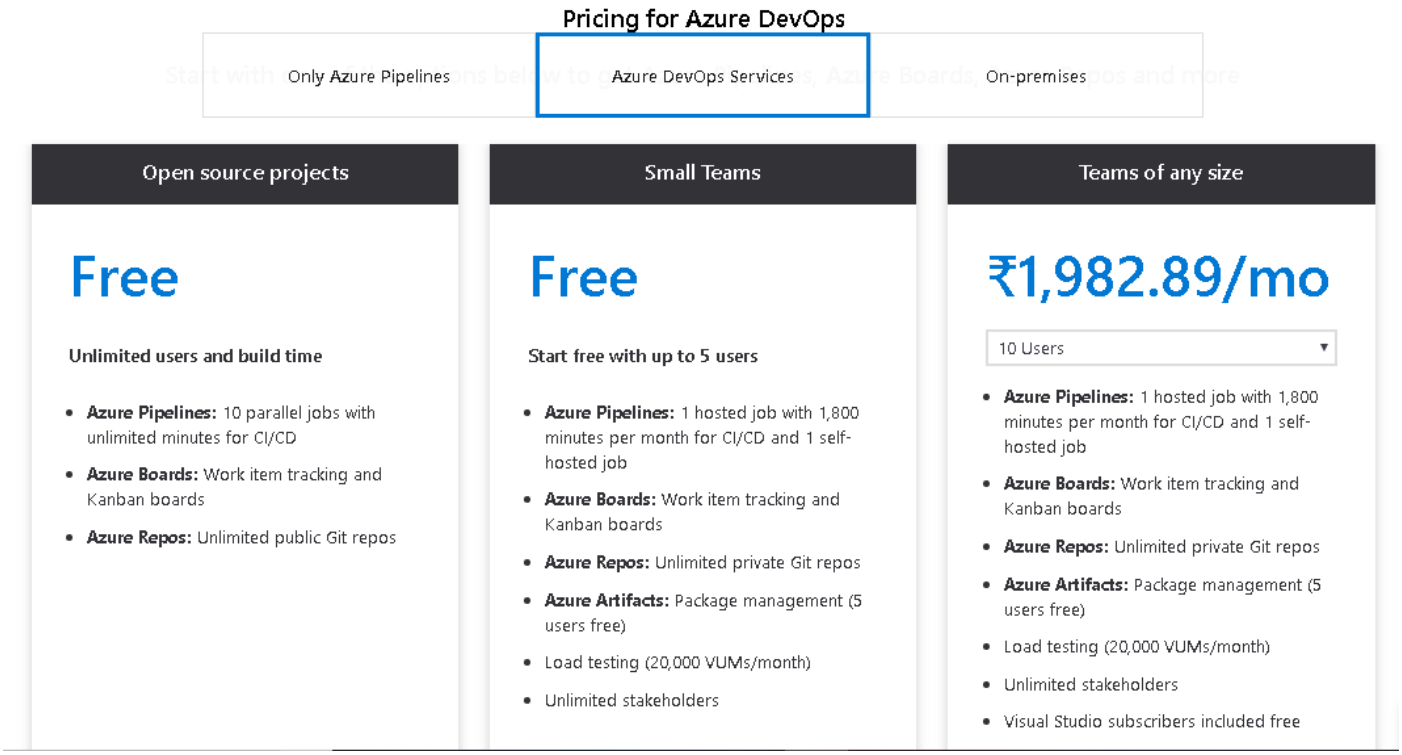

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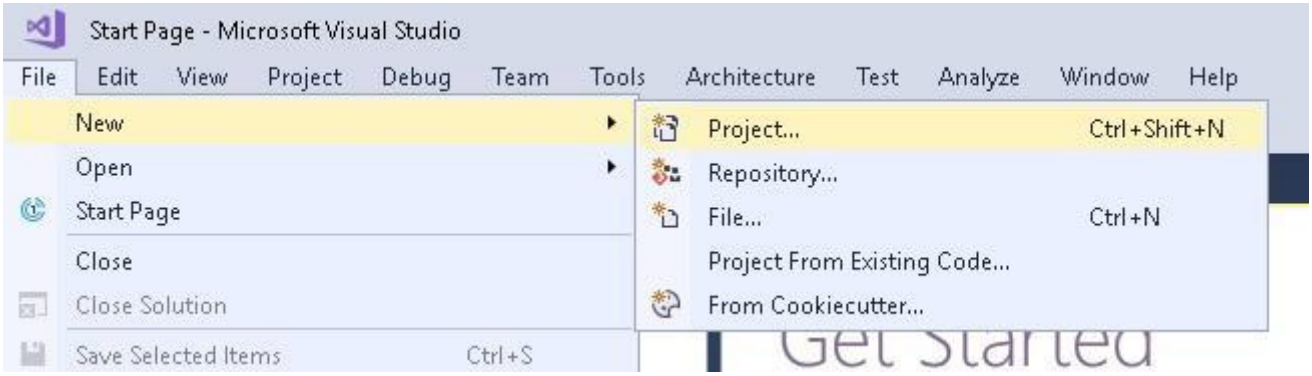
4. DevOps Project Setup

In this session, we will create a project in Visual Studio 2017 or in higher version which will be used for this demonstration. Apart from the main project, it will also include a testing project, where all required Unit Test Cases will write. For this demonstration, we are using Visual Studio 2017 but anyone can use higher version of Visual Studio for creating the Asp.NET Core. So, let start creating the Asp.Net Core project along with xUnit testing project for DevOps Demo.

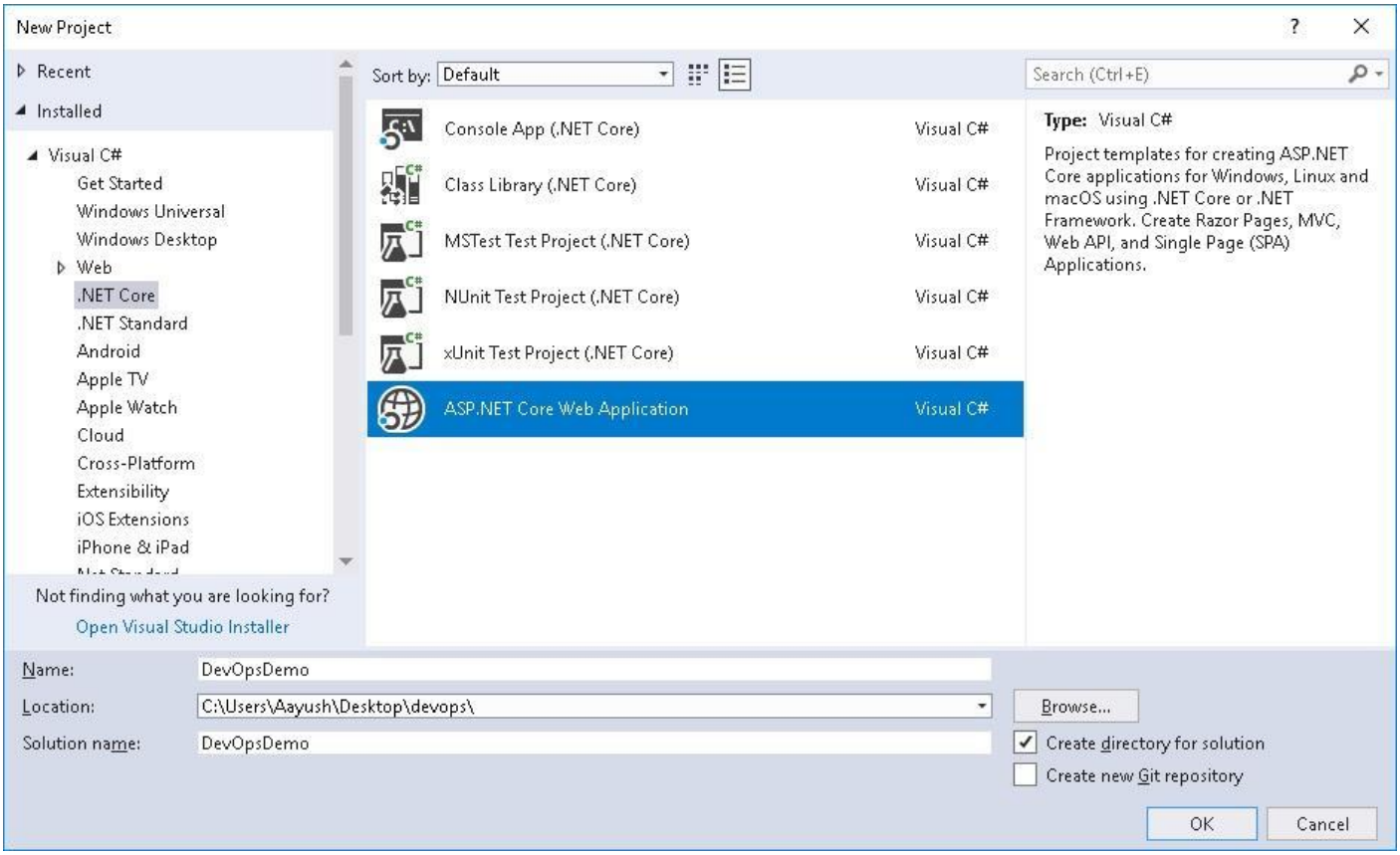
4.1 Create Asp.Net Core Project

Let create an **Asp.Net Core Project** in Visual Studio. Open **Visual Studio 2017 or higher version** and go to the **File** menu and choose **New** and then **Project**.



A "**New Project**" dialog window will open as follows. As we are going to create **.Net Core application**. So, move to the first panel and from the **Installed**, choose **Visual C# > Web > .Net Core**. Here we will find different kinds of **.Net Core application** template. We will select **ASP.NET Core Web Application**.

After selection the **.Net Core application** template, provide the **suitable name for the project** as well as a solution name like **DevOpsDemo**. This project is being created for DevOps demonstration, so let keep the simple name as DevOpsDemo. Don't forget the provide the project **location** and **click to OK**.



Next dialog window will ask to choose the **Project template**, here, we are working on **ASP.NET Core 2.1**. We have different kinds of project templates are available like **API, Web Application, Model View Controller** etc. Here we will select **Web Application (Model-View-Controller)** which enable the functionality of MVC. Apart from this, we require two more things, first check on checkbox for configuring the HTTPS and change authentication and choose **No Authentication. Now click to OK**.

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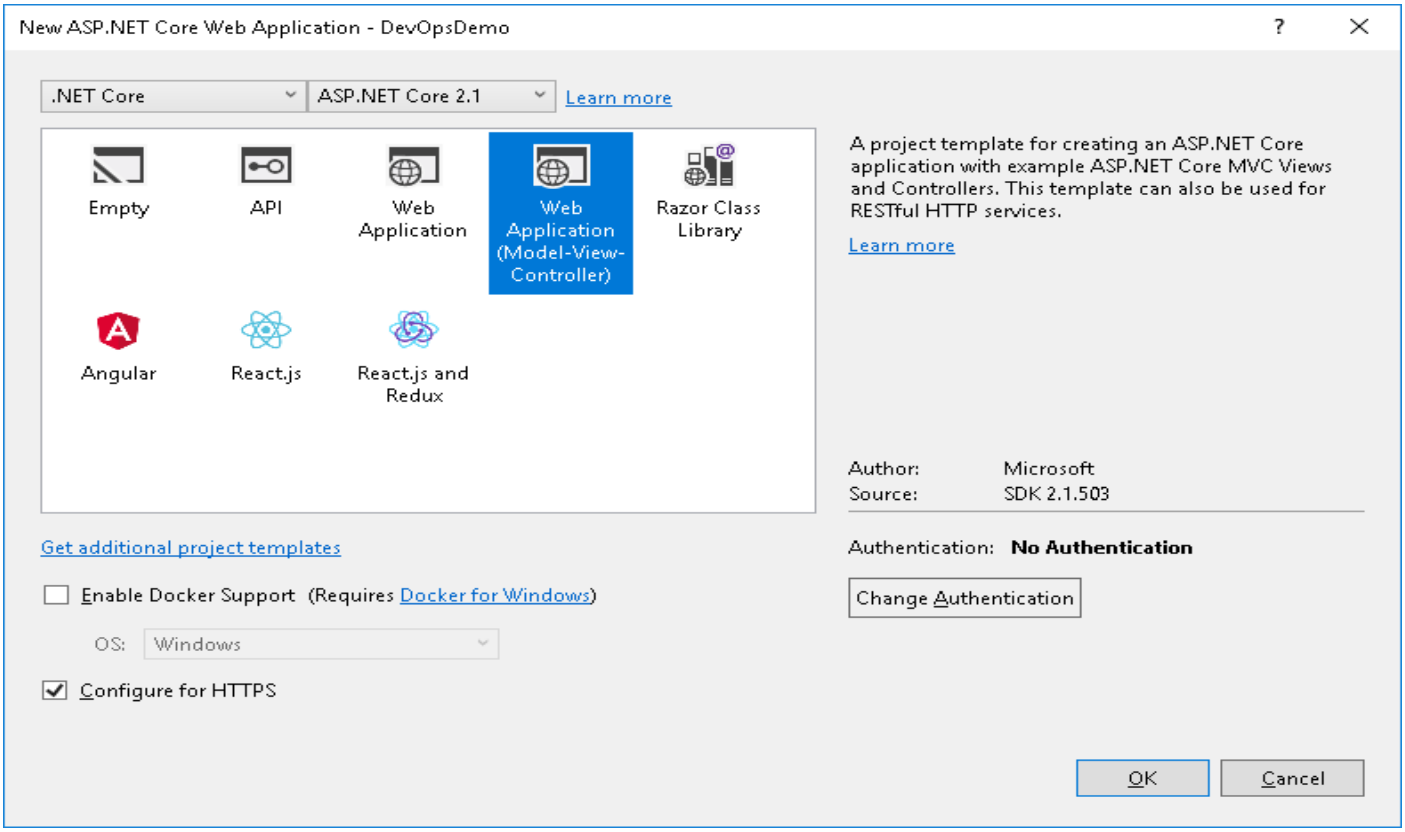

It will take a few moments to create and configure the project and final project will be ready. Once project will be ready, we can see the basic MVC structure application in ASP.NET Core Web Application.

Let add some Model-View-Controller functionality. So, let create a **Model** class for **'Post'**. **Right click** on the Model folder from the project and choose **Add** and then choose **Class**.

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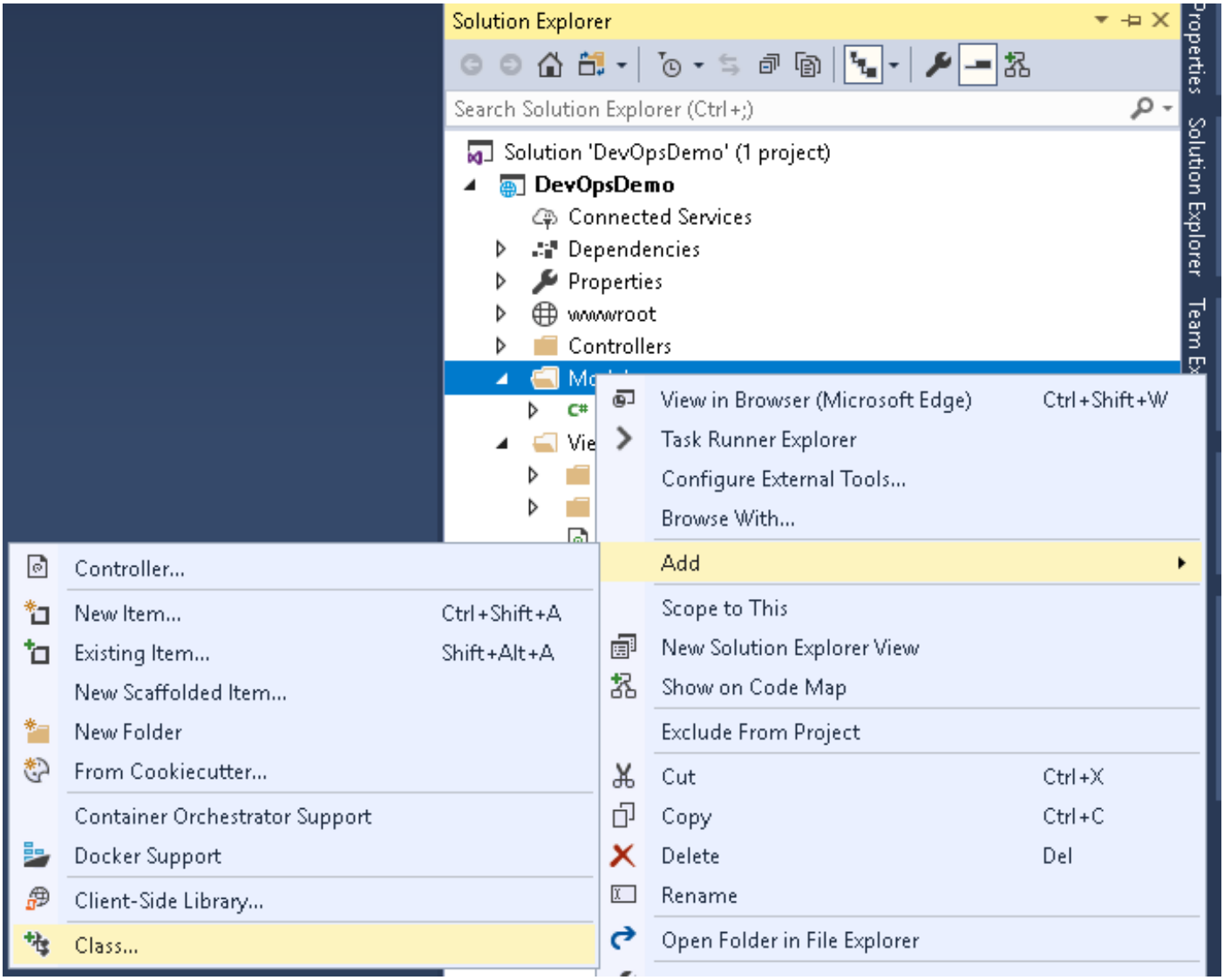

It will open **Add New Item** dialog window, from here we can choose different kinds of Model data file like class, interface etc. So, just choose Class and provide the name for the class as **'PostViewModel.cs'** and click to **Add**.

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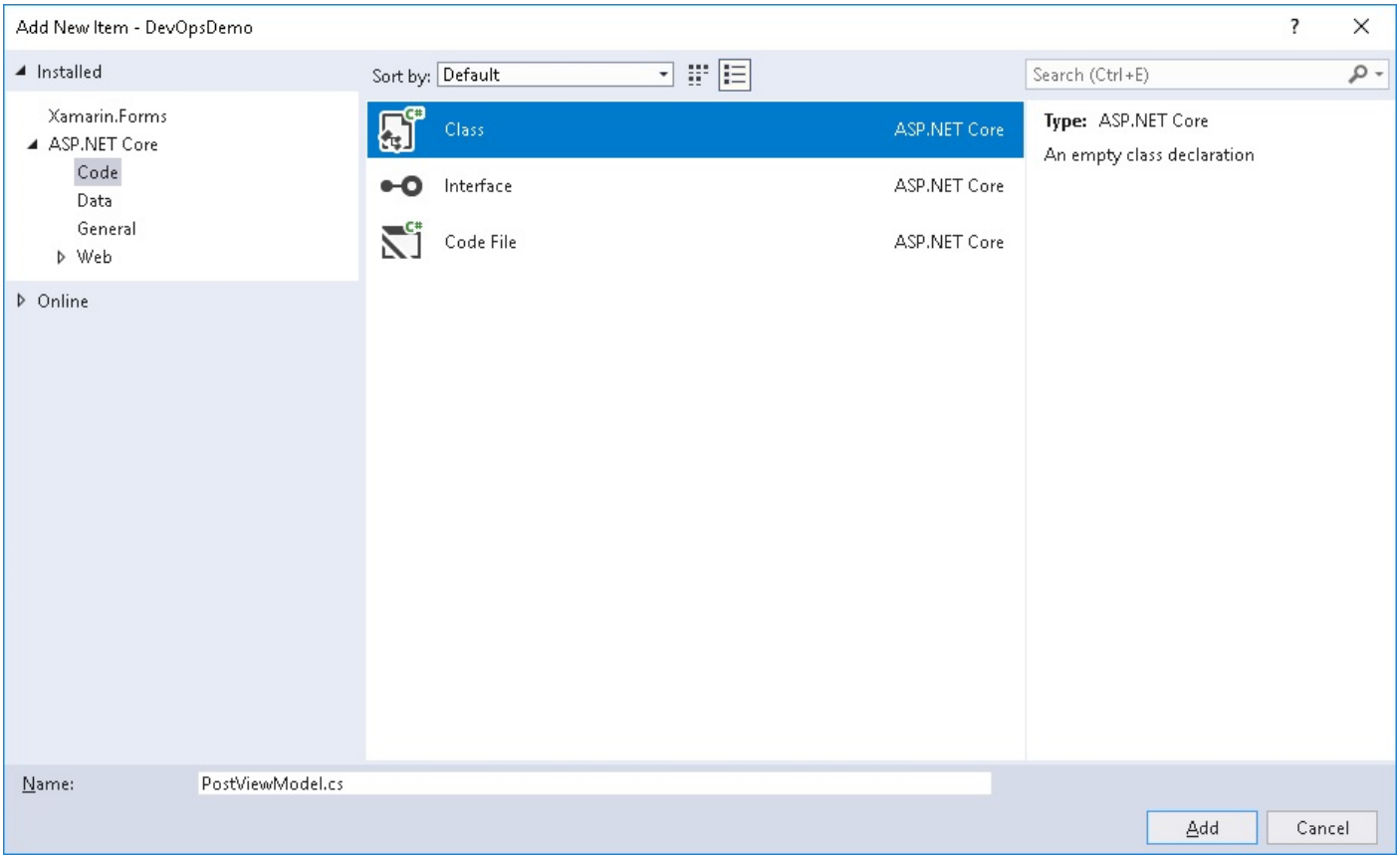

Open the **PostViewModel** and update the class's code as follows. Here we are adding four properties like **PostId, Title, Description and Author** for PostViewModel class**.**

```
namespace DevOpsDemo.Models
{
    public partial class PostViewModel
    {
        public int PostId { get; set; }
        public string Title { get; set; }
        public string Description { get; set; }
        public string Author { get; set; }
    }
}
```

Next step to create repository information. So, let create one more folder for repository classes and interfaces as Repository. Once **Repository** folder is created then right click on folder and select **Add > New Item**. It will open **Add New Item** dialog window from where we can select the file type. So, first select an **Interface** and provide the name for interface as **IPostRepository.cs** and click to **Add**.

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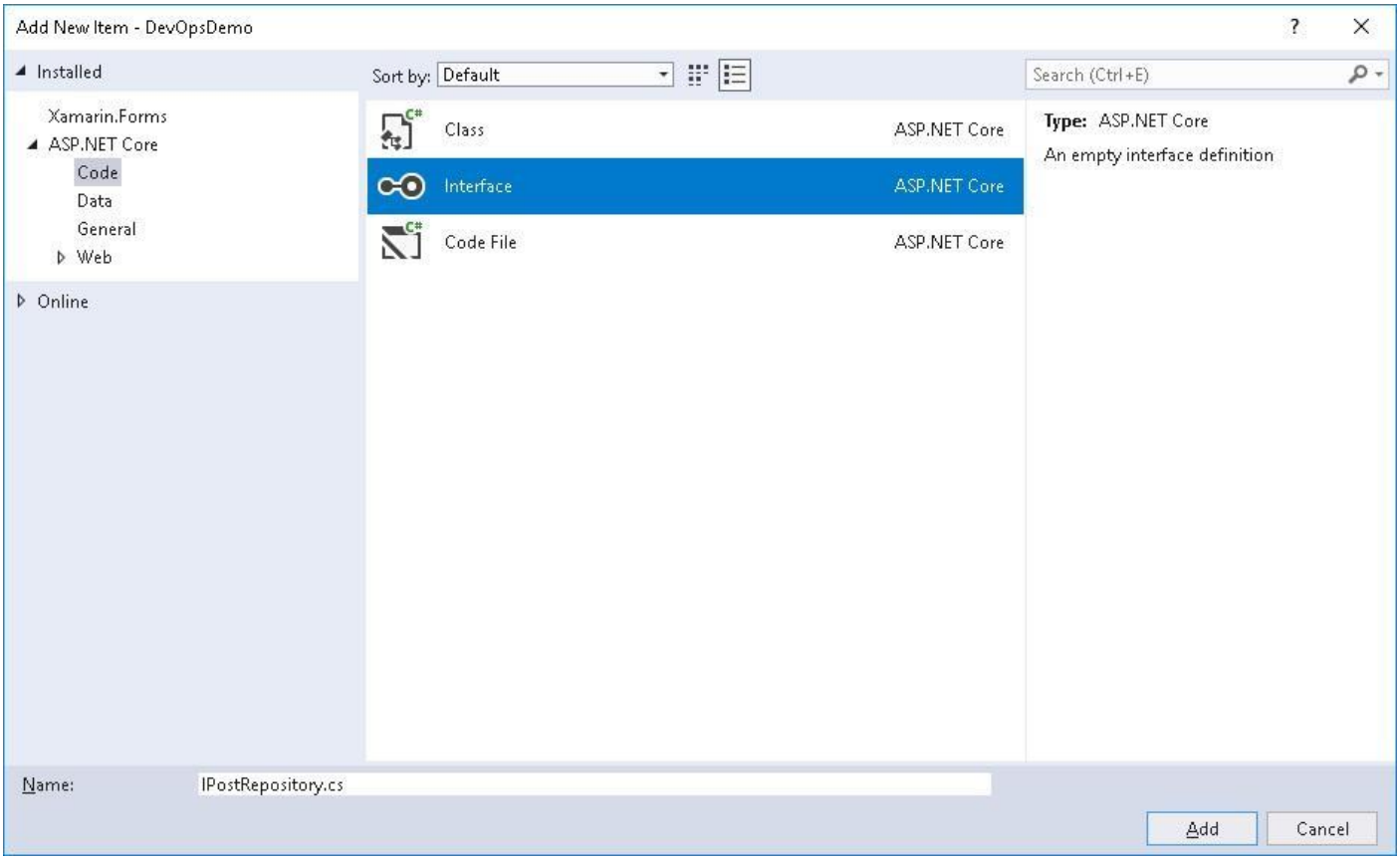


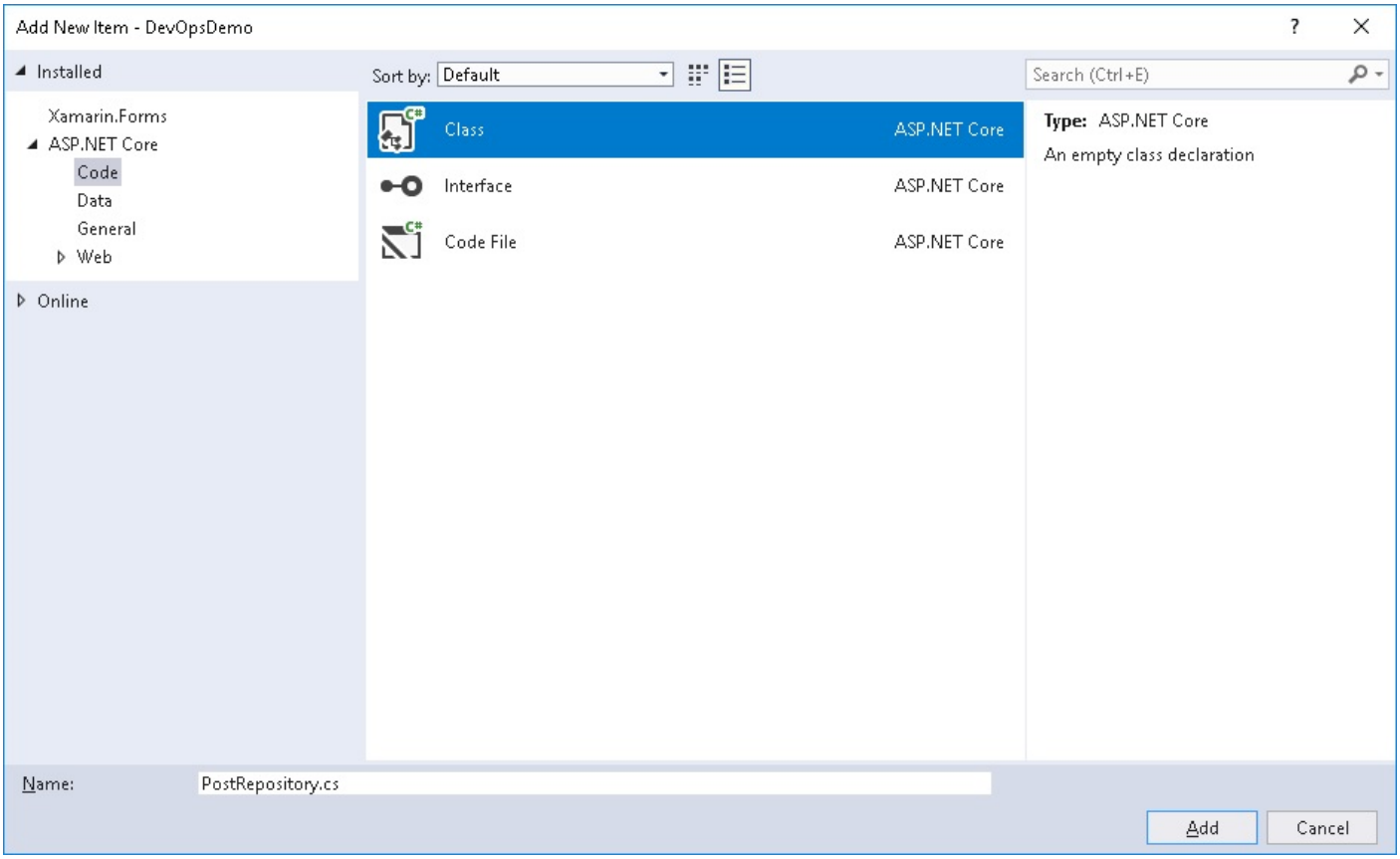
Update the code for **IPostRepository** interface as follows. Here we are adding one method which will return the list of Post.

IPostRepository.cs

```
using DevOpsDemo.Models;
using System.Collections.Generic;

namespace DevOpsDemo.Repository
{
    public interface IPostRepository
    {
        List<PostViewModel> GetPosts();
    }
}
```

Same process needs to follow to add one new class as **PostRepository.cs** in Repository folder as follows.



Here is the **PostRepository** class which implements the **IPostRepository**. We are creating some dummy data for Posts. We are keeping it simple and not implementing the database driven functionality for getting the real time data. It is because this demonstration is only for understanding How DevOps works and How we can implement Continuous Integration and Continuous Delivery.

PostRepository.cs

```
using DevOpsDemo.Models;
using System.Collections.Generic;

namespace DevOpsDemo.Repository
{
    public class PostRepository : IPostRepository
    {
        public List<PostViewModel> GetPosts()
        {
            var posts = new List<PostViewModel> {
                new PostViewModel(){ PostId =101, Title = "DevOps Demo Title
1", Description ="DevOps Demo Description 1", Author="Mukesh Kumar"},
                new PostViewModel(){ PostId =102, Title = "DevOps Demo Title
2", Description ="DevOps Demo Description 2", Author="Banky Chamber"},
                new PostViewModel(){ PostId =103, Title = "DevOps Demo Title
3", Description ="DevOps Demo Description 3", Author="Rahul Rathor"},
            };
```

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```
            return posts;
        }
    }
}
```

Now, it's time to show the data on View which are returning from repository. So, let open the **HomeController** and implement the **constructor dependency injection** for getting the instance of the **PostRepository** class and create a **ActionResult** as **Index**. Here, in the Index method, we will fetch the data using **PostRepository** instance and return the data into the View.

HomeController.cs

```
using DevOpsDemo.Models;
using DevOpsDemo.Repository;
using Microsoft.AspNetCore.Mvc;
using System.Diagnostics;

namespace DevOpsDemo.Controllers
{
    public class HomeController : Controller
    {
        IPostRepository postRepository;
        public HomeController(IPostRepository _postRepository)
        {
            postRepository = _postRepository;
        }

        public IActionResult Index()
        {
            var model = postRepository.GetPosts();

            return View(model);
        }

        public IActionResult About()
        {
            ViewData["Message"] = "Your application description page.";

            return View();
        }

        public IActionResult Contact()
        {
            ViewData["Message"] = "Your contact page.";

            return View();
        }
```

```
        public IActionResult Privacy()
        {
            return View();
        }

        [ResponseCache(Duration = 0, Location = ResponseCacheLocation.None,
NoStore = true)]
        public IActionResult Error()
        {
            return View(new ErrorViewModel { RequestId = Activity.Current?.Id
?? HttpContext.TraceIdentifier });
        }
    }
}
```

We will populate the data on View in tabular format. So, once data will be there, we will iterate on it and display the data as follows.

Index.cshtml

```
@model IList<DevOpsDemo.Models.PostViewModel>

@{
    ViewData["Title"] = "Home Page";
}

<div class="row">
    <h2>Post List</h2>

    <table class="table">
        <thead>
            <tr>
                <th>Post Id</th>
                <th>Title</th>
                <th>Description</th>
                <th>Author</th>
            </tr>
        </thead>
        <tbody>
            @foreach (var item in Model)
            {
                <tr>
                    <td>@Html.DisplayFor(modelItem => item.PostId)</td>
                    <td>@Html.DisplayFor(modelItem => item.Title)</td>
                    <td>@Html.DisplayFor(modelItem => item.Description)</td>
                    <td>@Html.DisplayFor(modelItem => item.Author)</td>
                </tr>
            }
        </tbody>
```

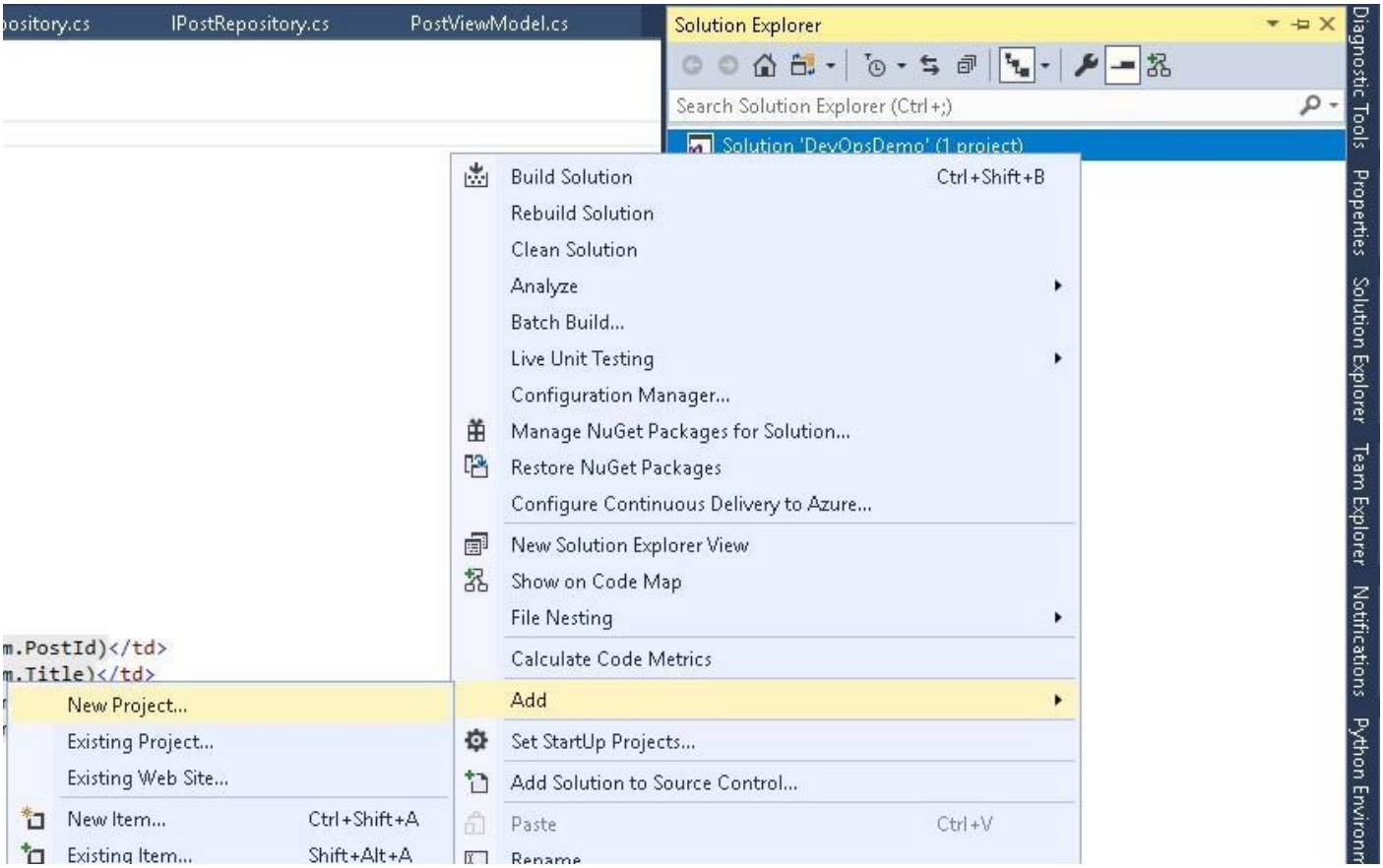
```
    </table>
</div>
```

4.2 xUnit Test Project

Testing is an important aspects of any product. Without testing, we can not think that product is ready to deliver. We do the testing in many ways but in development phase, while writing the code for specific functionality, we write the test cases against the functionality and check everything is working fine as expected or not.

Unit Test Cases helps us to find the bugs or issues in the code in the earlier stage while building the code. At the time of building the code and creating the artifact, it also executes the test cases and if test cases are being failed, it means, something is wrong and functionality is not as expected.

Here, we will create a separate testing project for ASP.NET Core Web Application. So, let right click on the **DevOpsDemo** solution and select **Add > New Project** as showing in the following image.



It will open the New Project dialog window, here we have to follow the same process as we have done above for creating the new ASP.NET Core Web Application project. Only we have to change the application template, for a testing project, we will choose the **xUnit Test Project (.Net Core).** After selecting the project template, provide the name of the testing project as **DevOpsDemo.Test** and click to **OK**.

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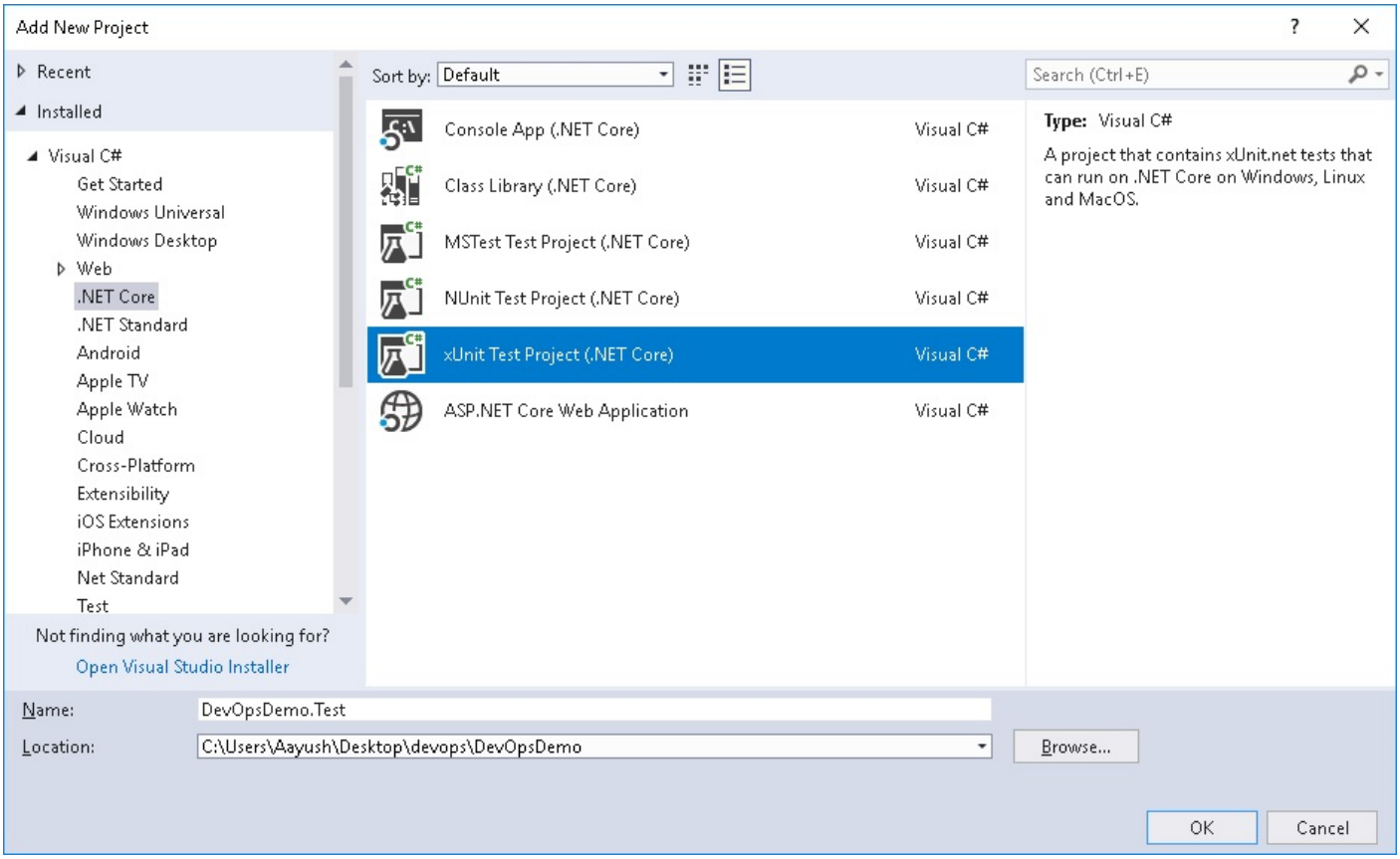
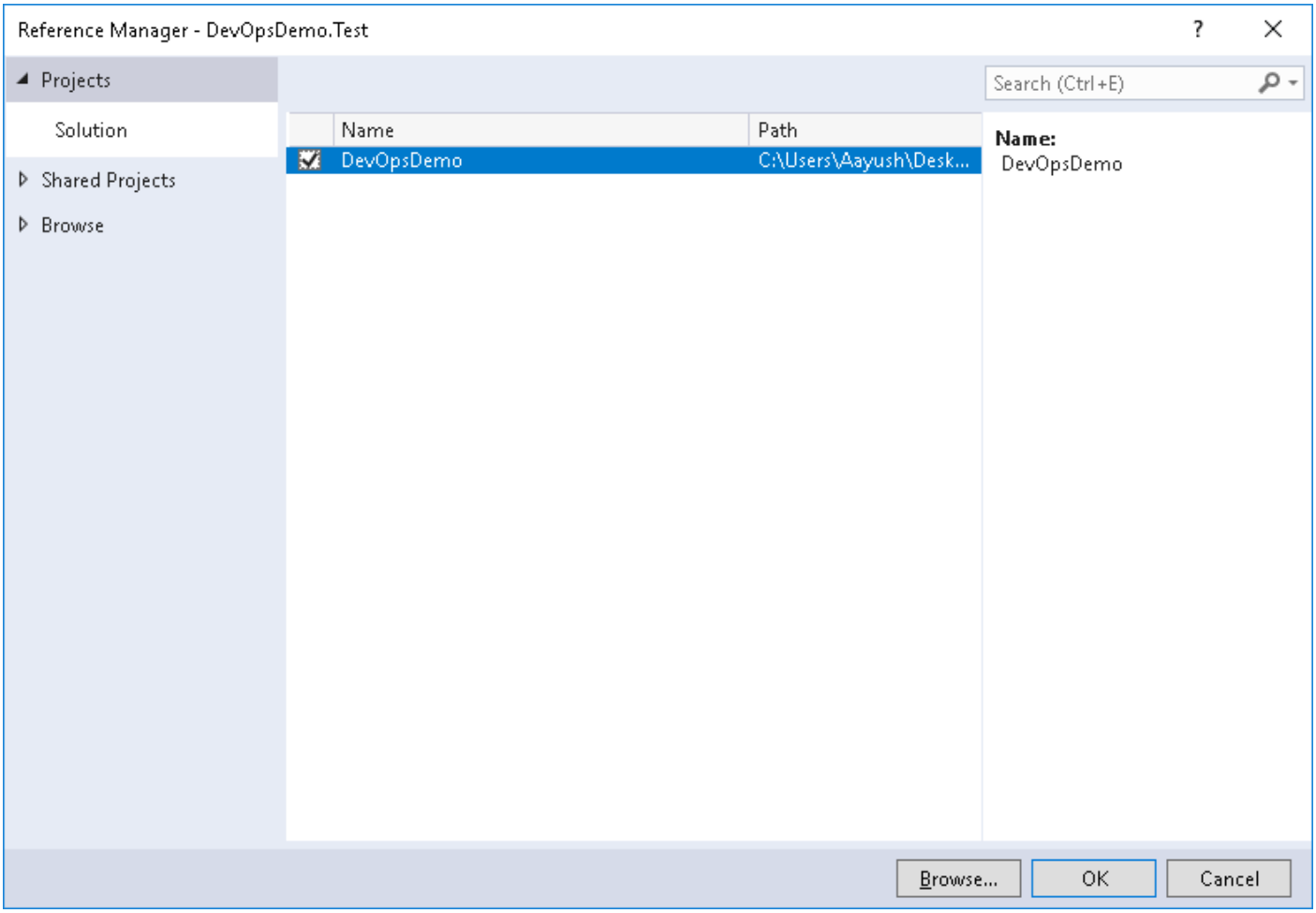


Within a few seconds, the xUnit testing project will be ready. It will contain one unit test class as **UnitTest1.cs**. Before moving next, just rename **UnitTest1** to **PostTestController**.

As we will test the main project functionality. So, it is time to add the main project reference in the test project so that we can access the repository and controller for writing the test cases. So, **Right click on the Dependencies in testing project and select Add Reference.** It will open the Reference Manager for **DevOpsDemo.Test** project. From the Projects section in left panel, select the **DevOpsDemo** (mark checked) and click to **OK**.

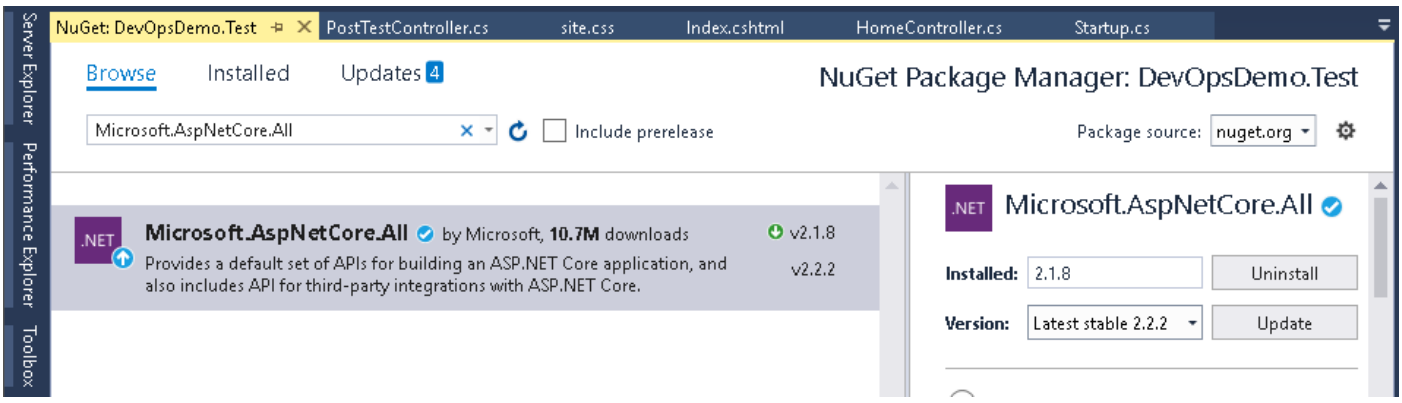
(By: Mukesh Kumar)



Install Microsoft.AspNetCore.All from NuGet (version 2.1.8)

As this is the xUnit testing project and by default we can not get all the Asp.Net Core functionality. So, let first add the packages which will provide complete set of APIs for building the Asp.NET Core application. Let **Right click on Dependencies** and select **Manage NuGet Packages**. It will open the **NuGet Package Manager** from where new packages can be searched for installation or see the installed packages or see if any update is available for any package.

So, go to the **Browse** section and search for **Microsoft.AspNetCore.All** in the search section and install it. For this demonstration, we are using version **2.1.8 for Microsoft.AspNetCore.All**.



(By: Mukesh Kumar)

Open the **PostTestController** and write the few unit test cases for **HomeController** as follows.

PostTestController.cs

```
using DevOpsDemo.Controllers;
using DevOpsDemo.Models;
using DevOpsDemo.Repository;
using Microsoft.AspNetCore.Mvc;
using System;
using System.Collections.Generic;
using Xunit;

namespace DevOpsDemo.Test
{
    public class PostTestController
    {
        private PostRepository repository;

        public PostTestController()
        {
            repository = new PostRepository();

        }

        [Fact]
        public void Test_Index_View_Result()
        {
            //Arrange
            var controller = new HomeController(this.repository);

            //Act
            var result = controller.Index();

            //Assert
            Assert.IsType<ViewResult>(result);
        }
        [Fact]
        public void Test_Index_Return_Result()
        {
            //Arrange
            var controller = new HomeController(this.repository);

            //Act
            var result = controller.Index();

            //Assert
            Assert.NotNull(result);
        }
```

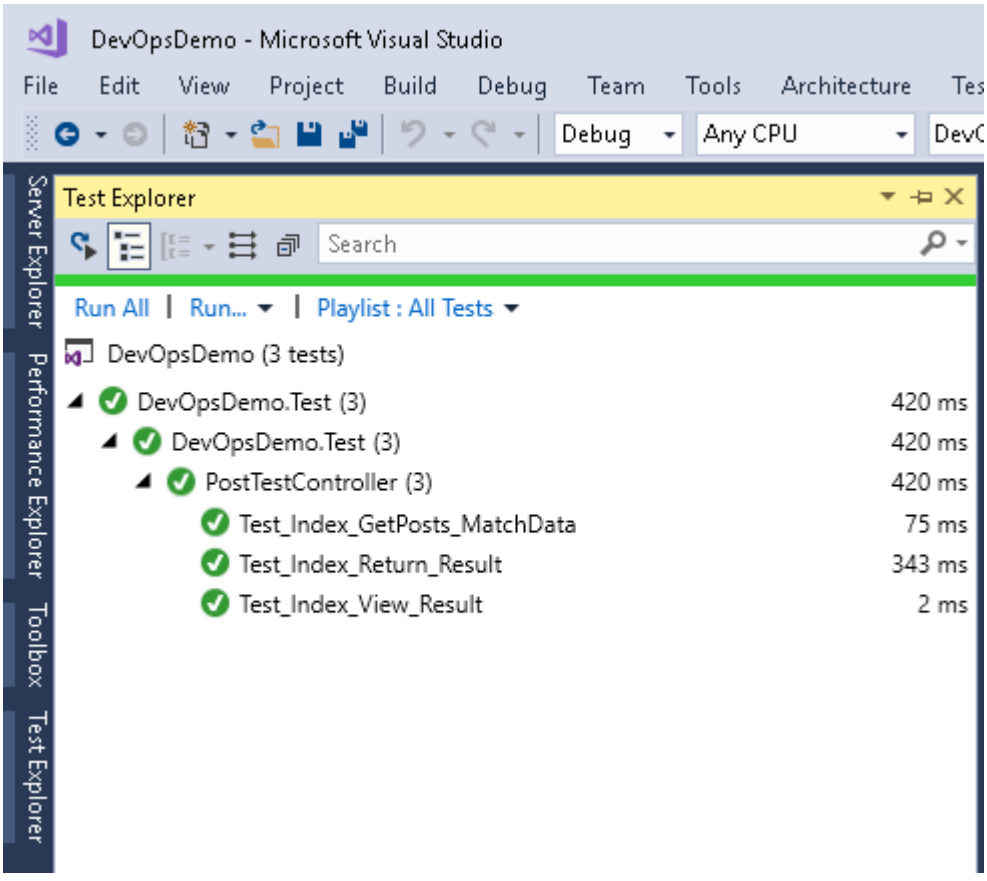
```
        [Fact]
        public void Test_Index_GetPosts_MatchData()
        {
            //Arrange
            var controller = new HomeController(this.repository);

            //Act
            var result = controller.Index();

            //Assert
            var viewResult = Assert.IsType<ViewResult>(result);
            var                                  model                                  =
Assert.IsAssignableFrom<List<PostViewModel>>(viewResult.ViewData.Model);

            Assert.Equal(3, model.Count);
            Assert.Equal(101, model[0].PostId);
            Assert.Equal("DevOps Demo Title 1", model[0].Title);
        }
    }
}
```

Let open the **Test Explorer** and click to **Run All** as shown in following image to start executing the unit test cases, which start building the solution and start executing the unit test cases. Once all unit test cases run then you can see the status as green. As per the following image, we can see that all test cases are passed.



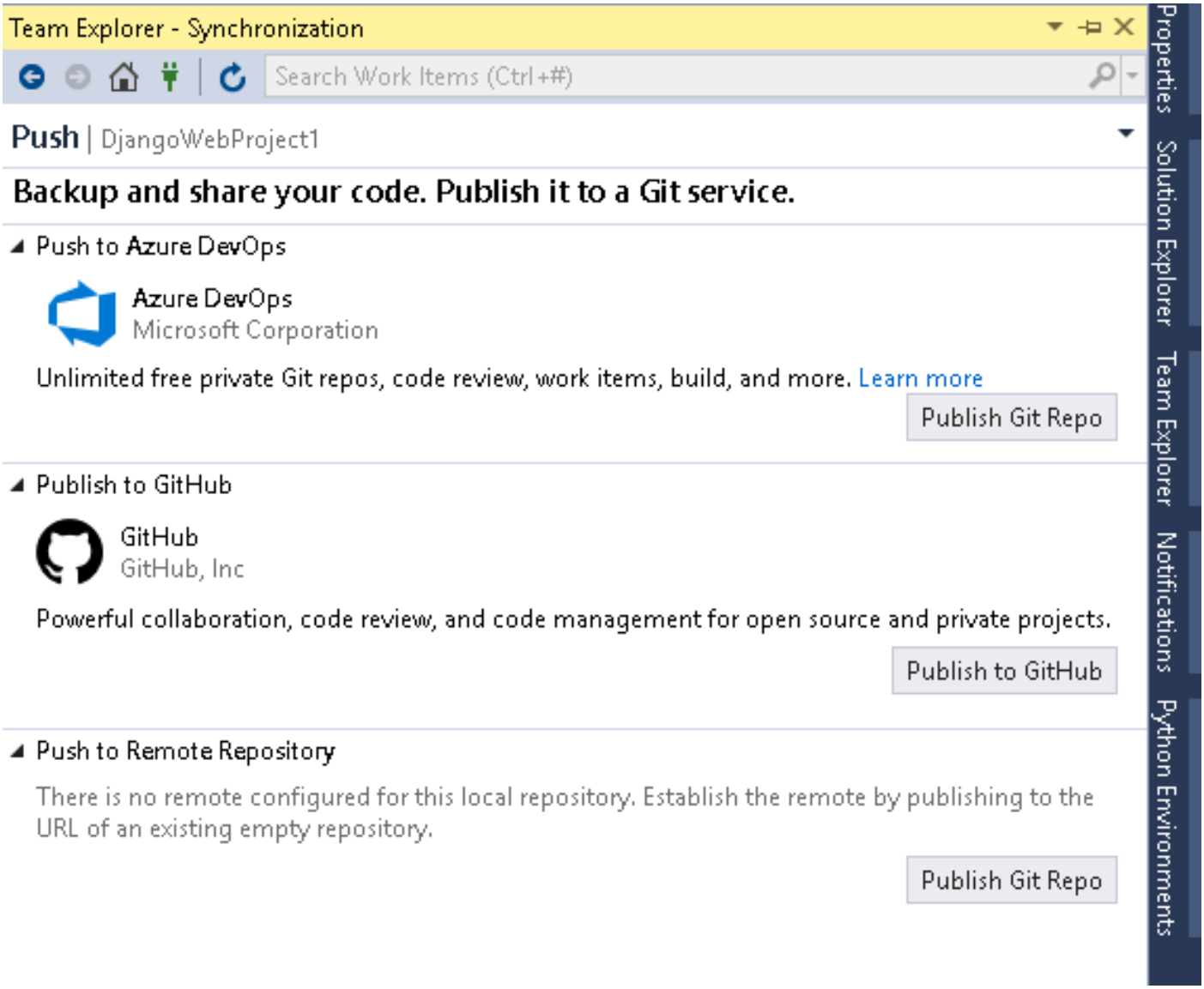
(By: Mukesh Kumar)

4.3 Add Project to GitHub

Now it's time to add this above project to any repository like TFS, GitHub, Bitbucket etc. so that we can access it while setting up Azure DevOps pipeline. Let choose the **GitHub** so that it will be accessible publically. So, right click on the Solution **(DevOpsDemo)** and select **Add Solution to Source Control**. It will add your file in a local repository

Now, go to Team Explorer, here we can find **'Sync'** option, just click on it. It will open the window from where we can publish code to a particular repository like **GitHub** as follow.

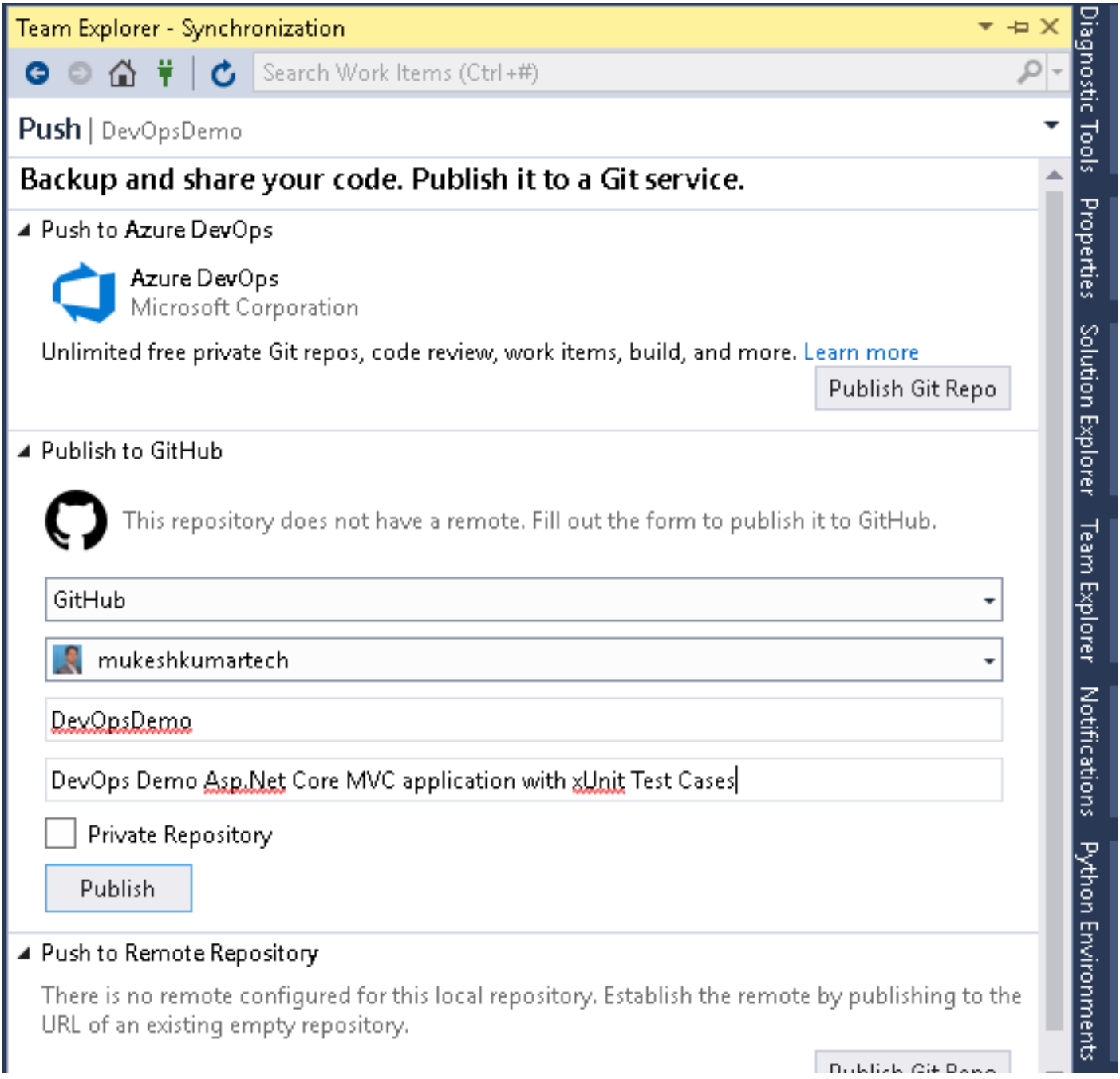
Here, we will choose the **Publish to GitHub**, so that we can publish this code to **GitHub** public repository.



Once we click on the **Publish to GitHub**, it will ask for **Authentication with your GitHub account**. Let provide the credentials to log in with **GitHub** Account. After logging in with **GitHub**, we will get the following screen. Here, we can provide the **name** and **description** of the repository which will create in **GitHub** for adding this project. We can make it private to check the checkbox for Private Repository. For this demonstration, we will keep it public, so let click on the Publish button.

(By: Mukesh Kumar)

It will take few minutes to create the new repository in **GitHub** with provided name and publish the whole code into this repository.

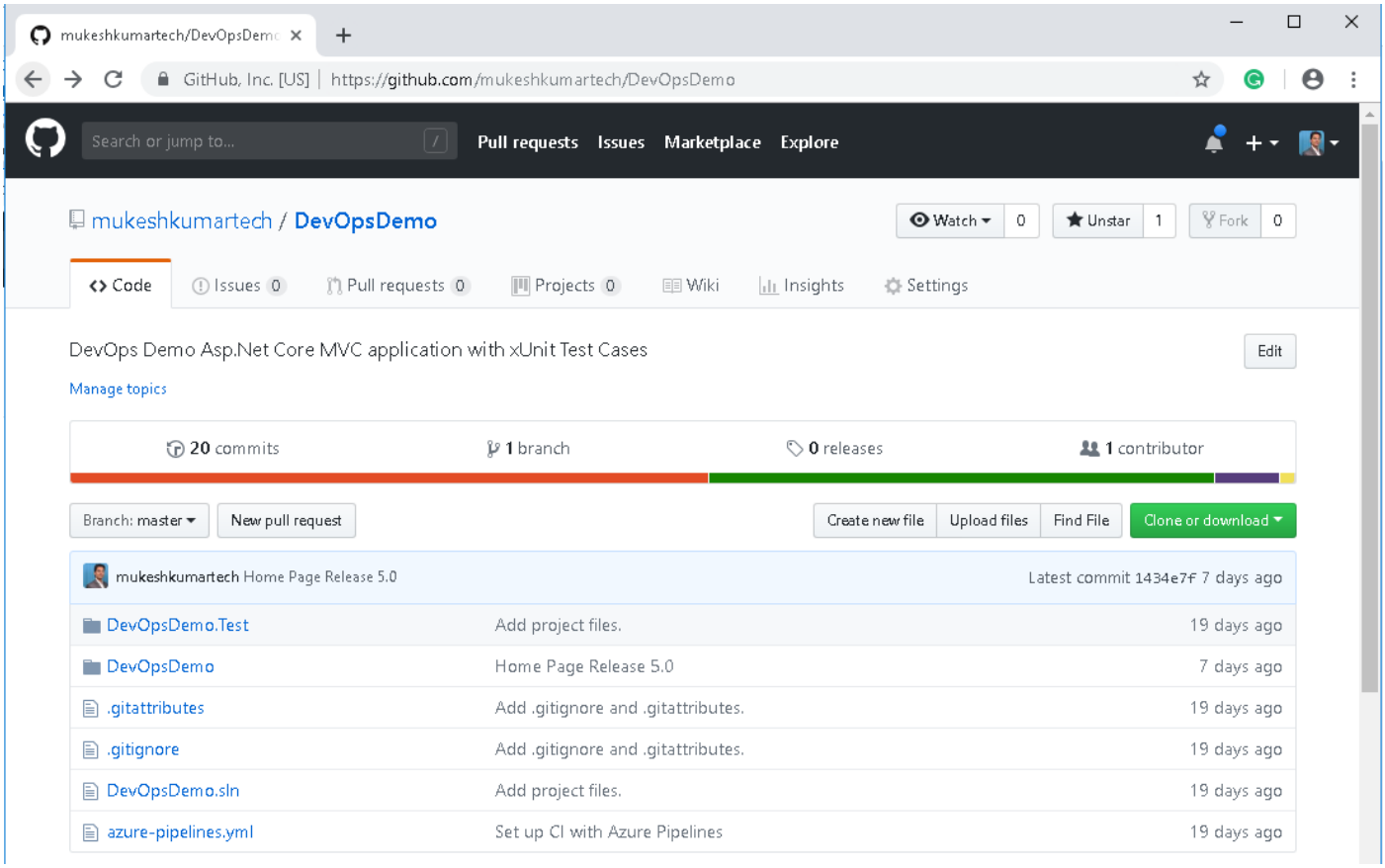


Now, go to following GitHub URL where we can find the published code for this whole demonstration.

---

https://github.com/mukeshkumartech/DevOpsDemo

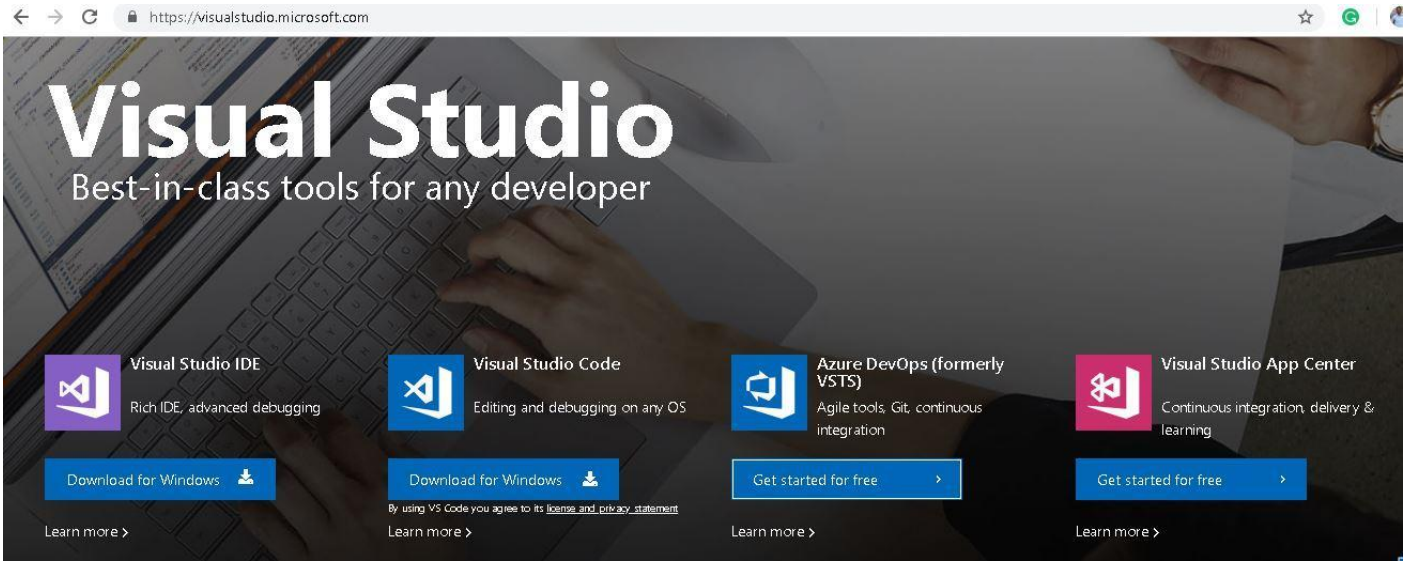
(By: Mukesh Kumar)



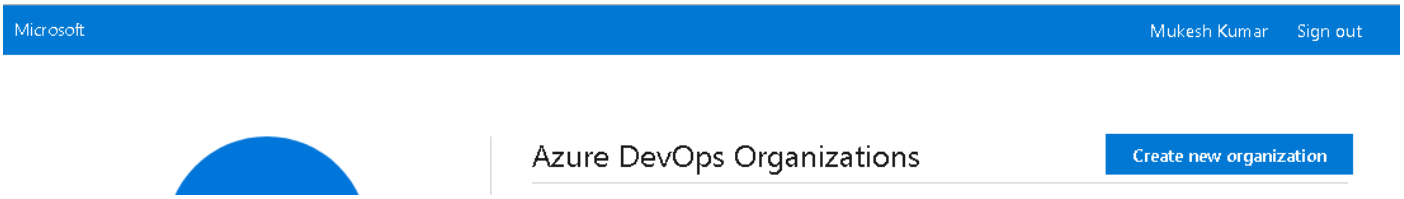
(By: Mukesh Kumar)

5. Create Organization and Project

Let move to **https://visualstudio.microsoft.com** and create new account or **sign in** with existing credentials.

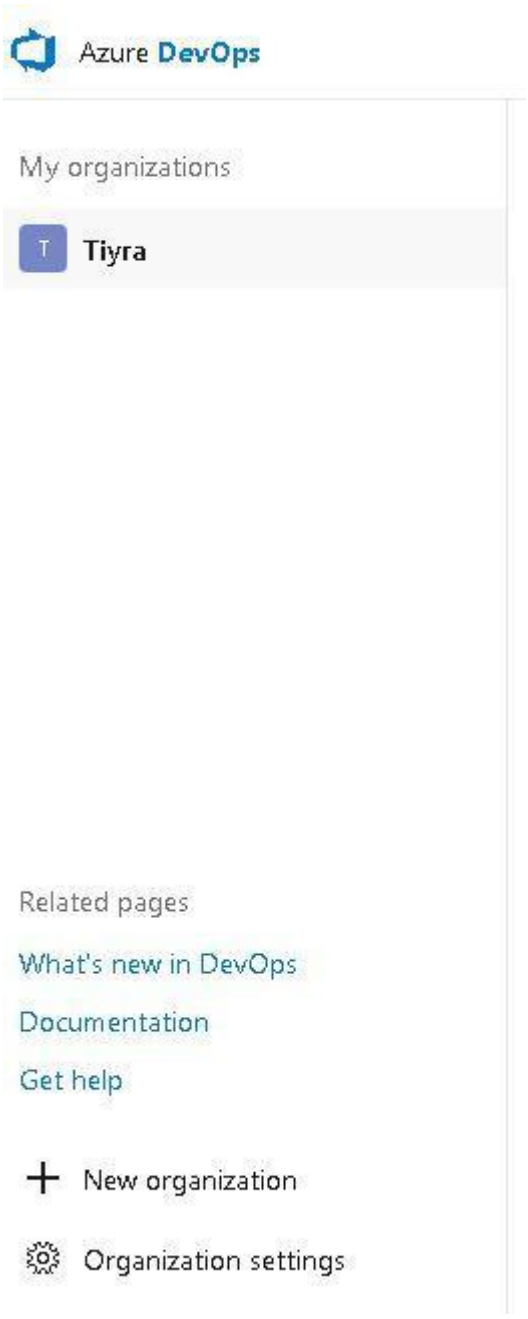


Once we will be logged in successfully, then we have a new screen as follows. From here we can create a new organization on clicking **'Create new organization'** button.



We have another option to create the organization, if we have already an organization and we would like to add a new one then we can create to using **Create Organization** option as follows.

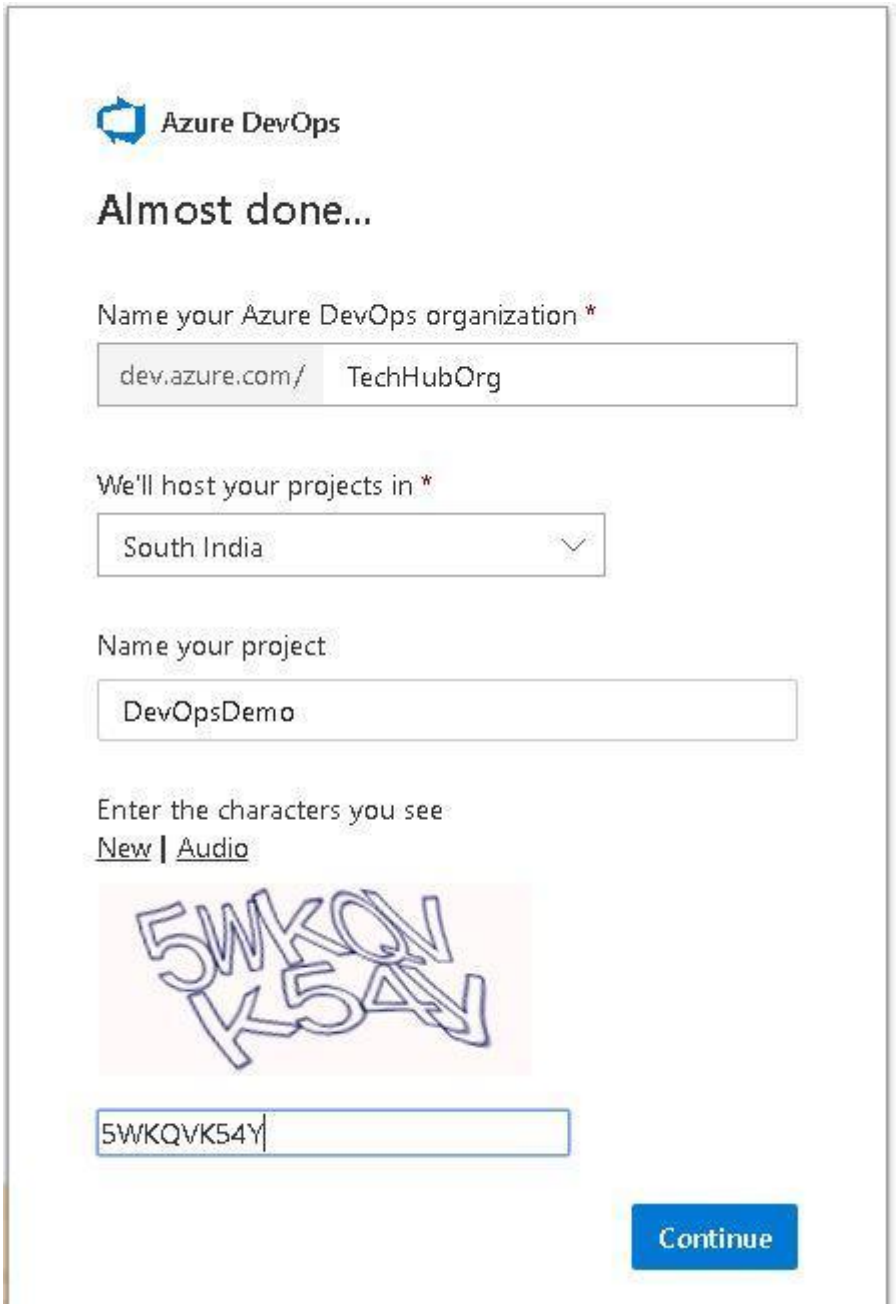
(By: Mukesh Kumar)



It will take few seconds to configuring Azure DevOps new organization.

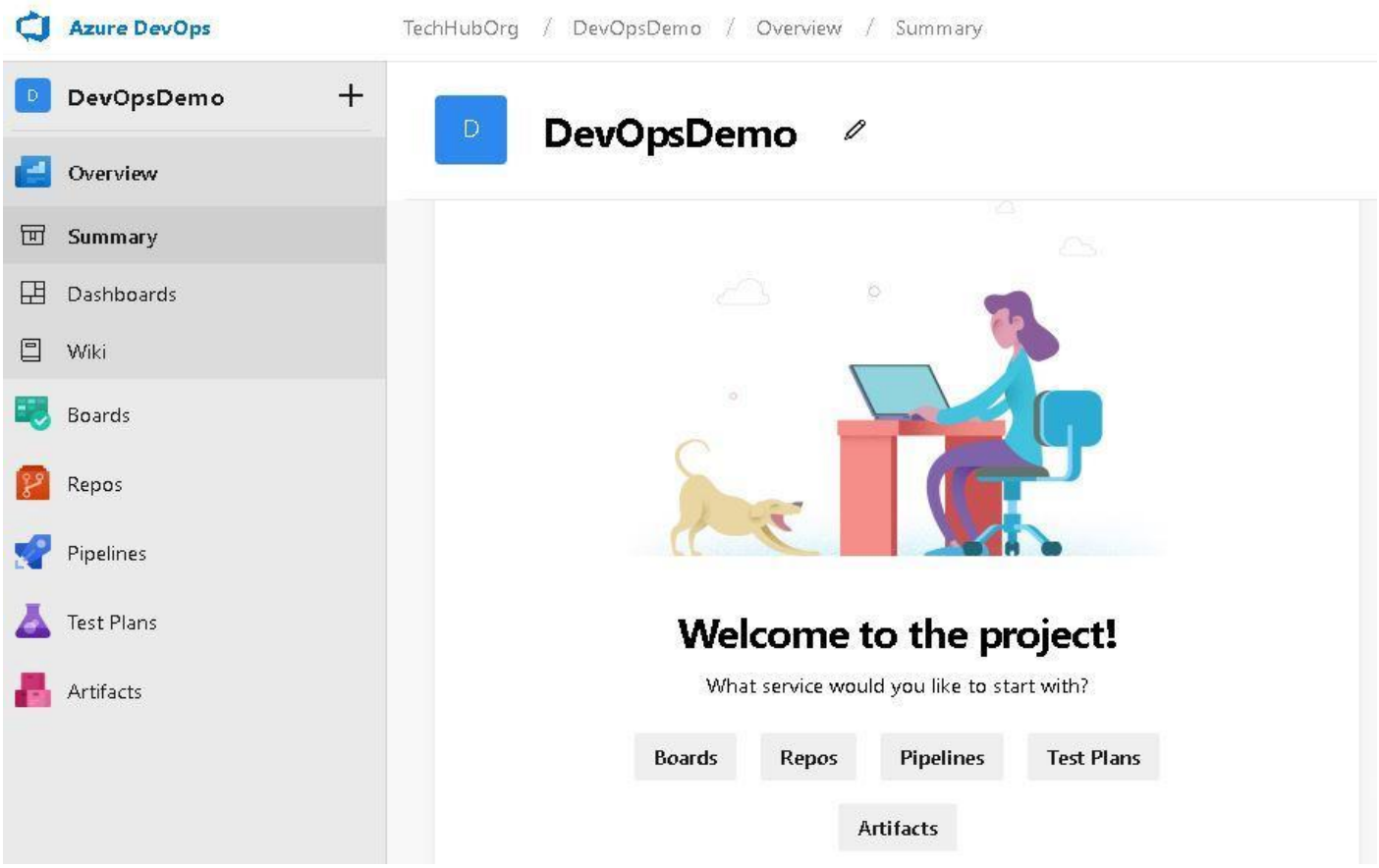
(By: Mukesh Kumar)

Next screen will ask about the name of the **Azure DevOps organization**, here we are giving the name as '**TechHubOrg'**, we have to also provide the hosting location as '**South India'** for our organization. At the time of creating the new organization, we can also provide the name of the project. This project will auto create inside this new organization. Now, fill the security question and click to **Continue** button.



Next screen will open the project which has created recently at the time of creating the organization. Here, we have created **DevOpsDemo** project inside the **TechHubOrg** organization. Following is the welcome screen for the DevOpsDemo project. From here, we can manage all the things like Boards, Repos, Pipeline and Test Plans etc. which will be project specific.

(By: Mukesh Kumar)

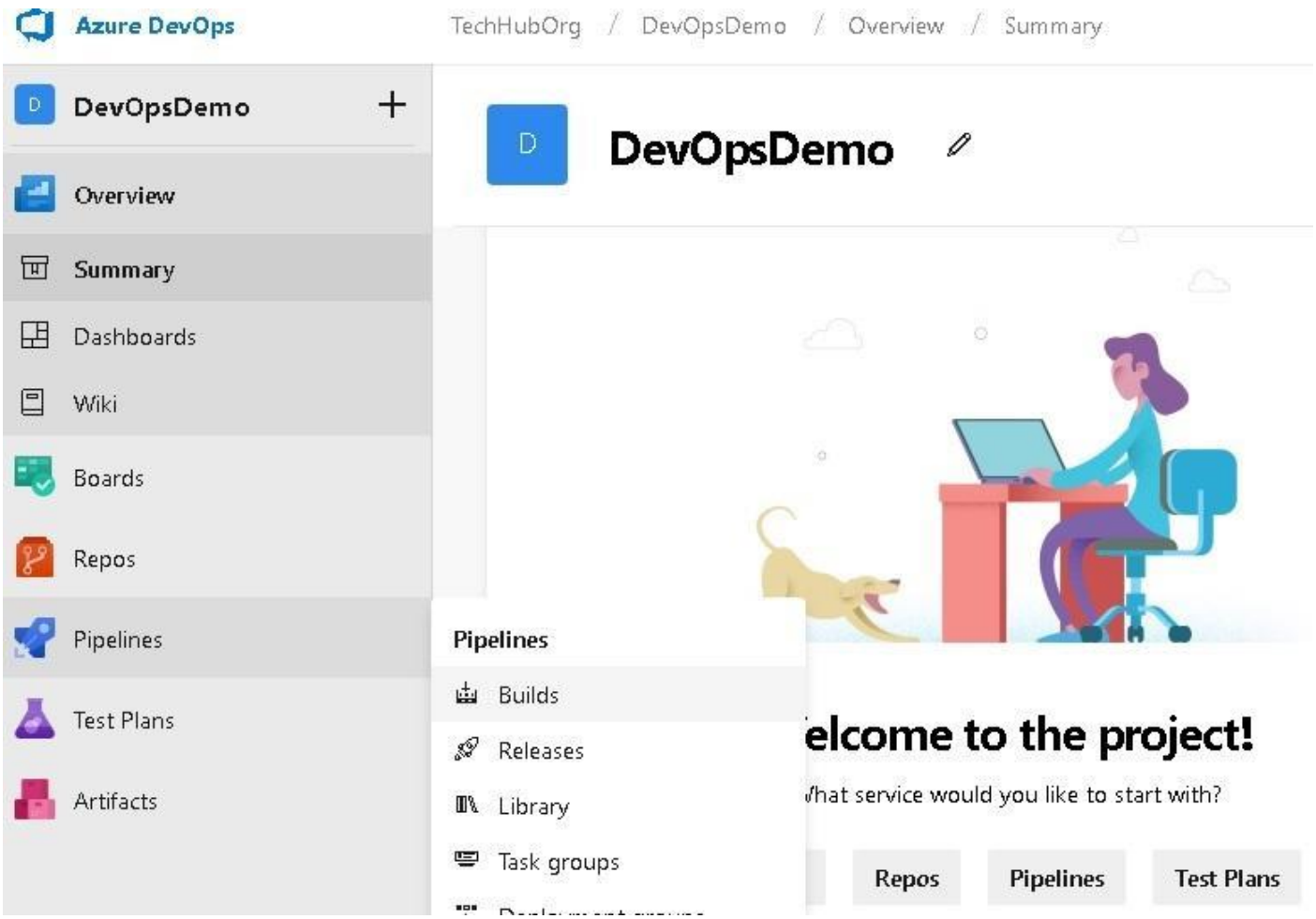


(By: Mukesh Kumar)

6. Continuous Integration

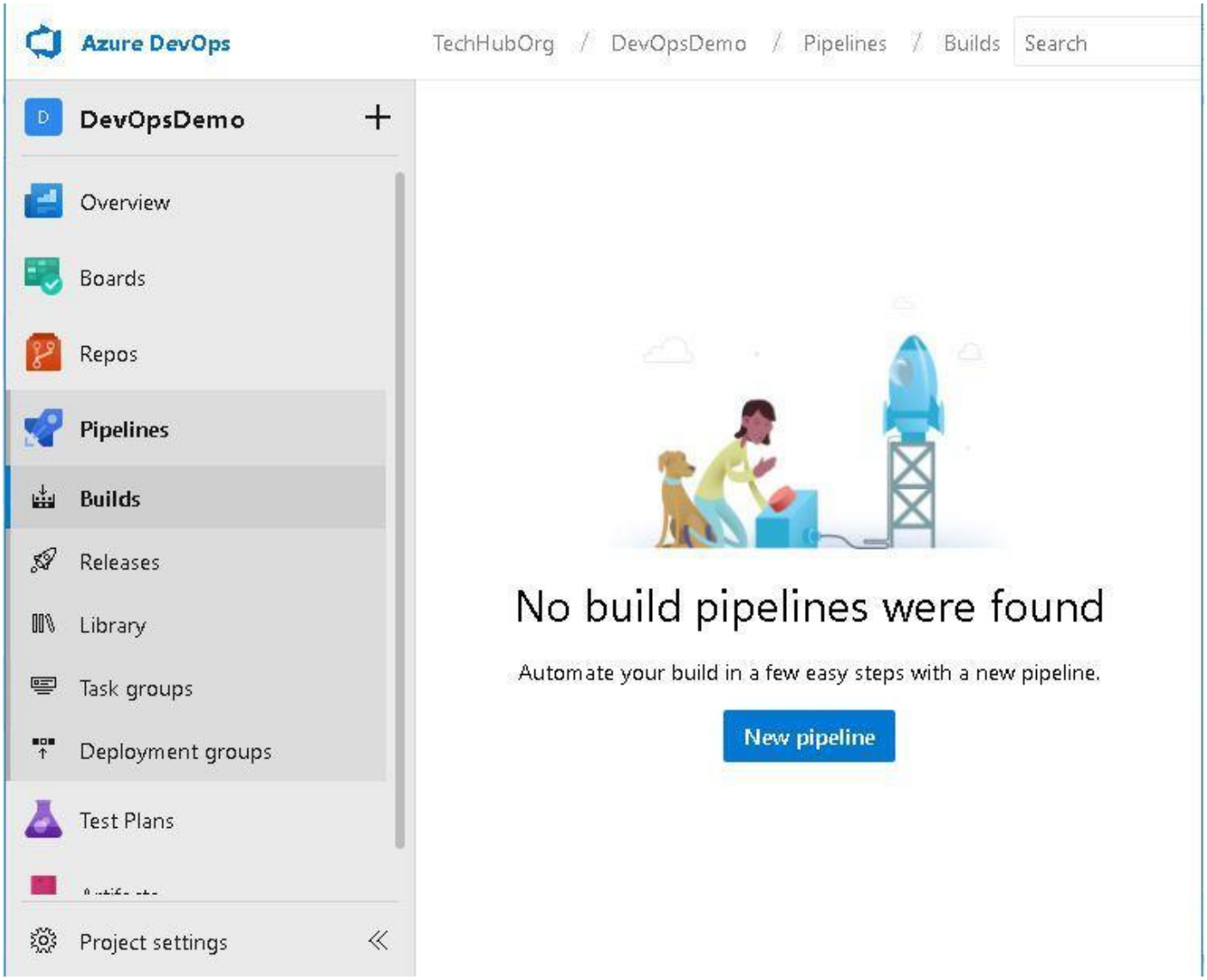
Let create the Azure Build pipeline. Build pipeline is basically responsible for building the code and testing the corresponding Unit Test Cases once the developer checks in the code into the repository. If everything will fine, then it will create the Artifact which can be used for deployment.

For creating the build pipeline in **Azure DevOps**, click on **Pipeline** and select **Build** as shown in the following images.



Next screen says that we don't have any build pipeline setup yet and it has one button as new pipeline for creating new one. So, let click on **New Pipeline**. It will only create the build pipeline.

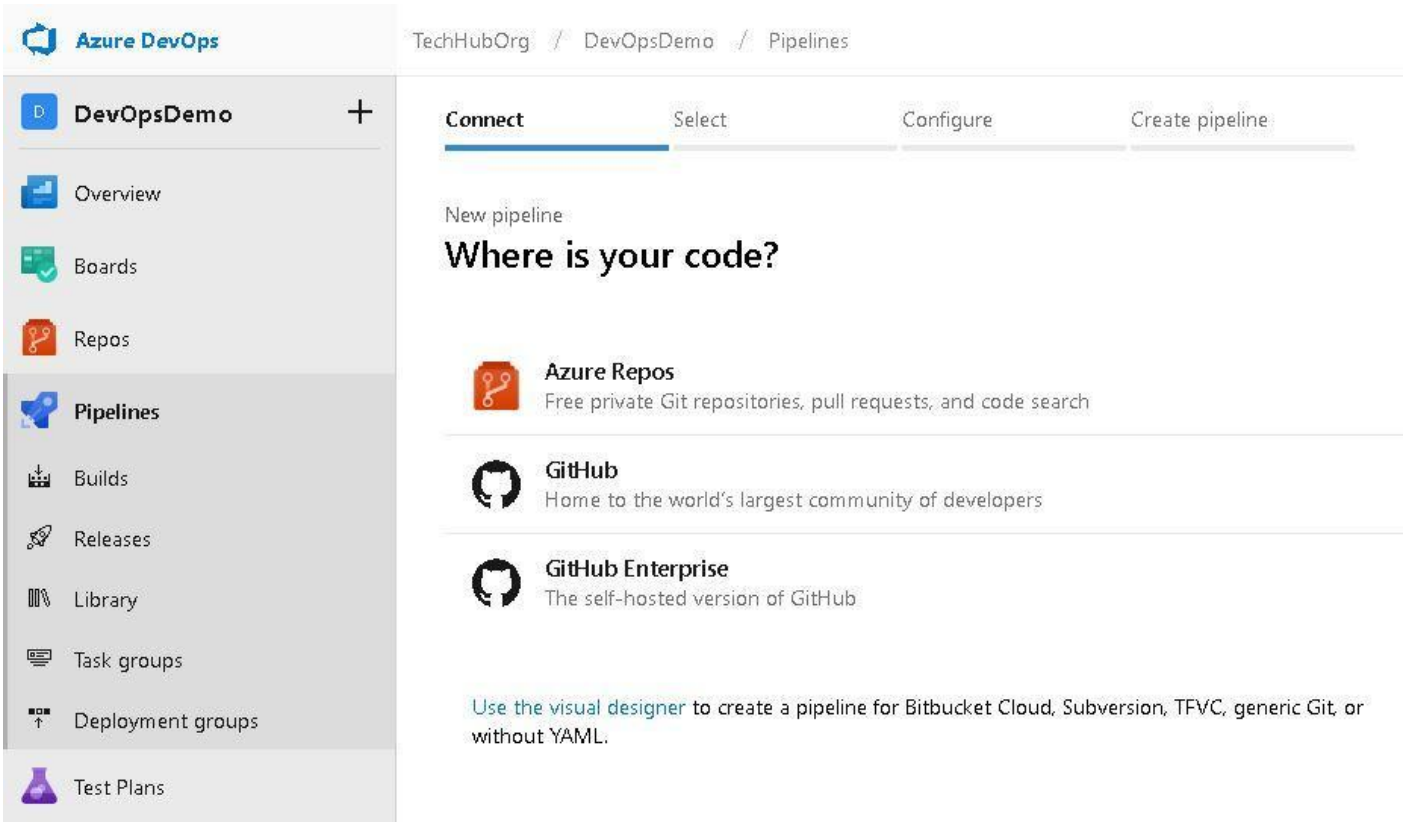
(By: Mukesh Kumar)



After clicking on **New Pipeline**, it will start the wizard for setting up the build pipeline. It will basically ask for where code repository file and do some configuration.

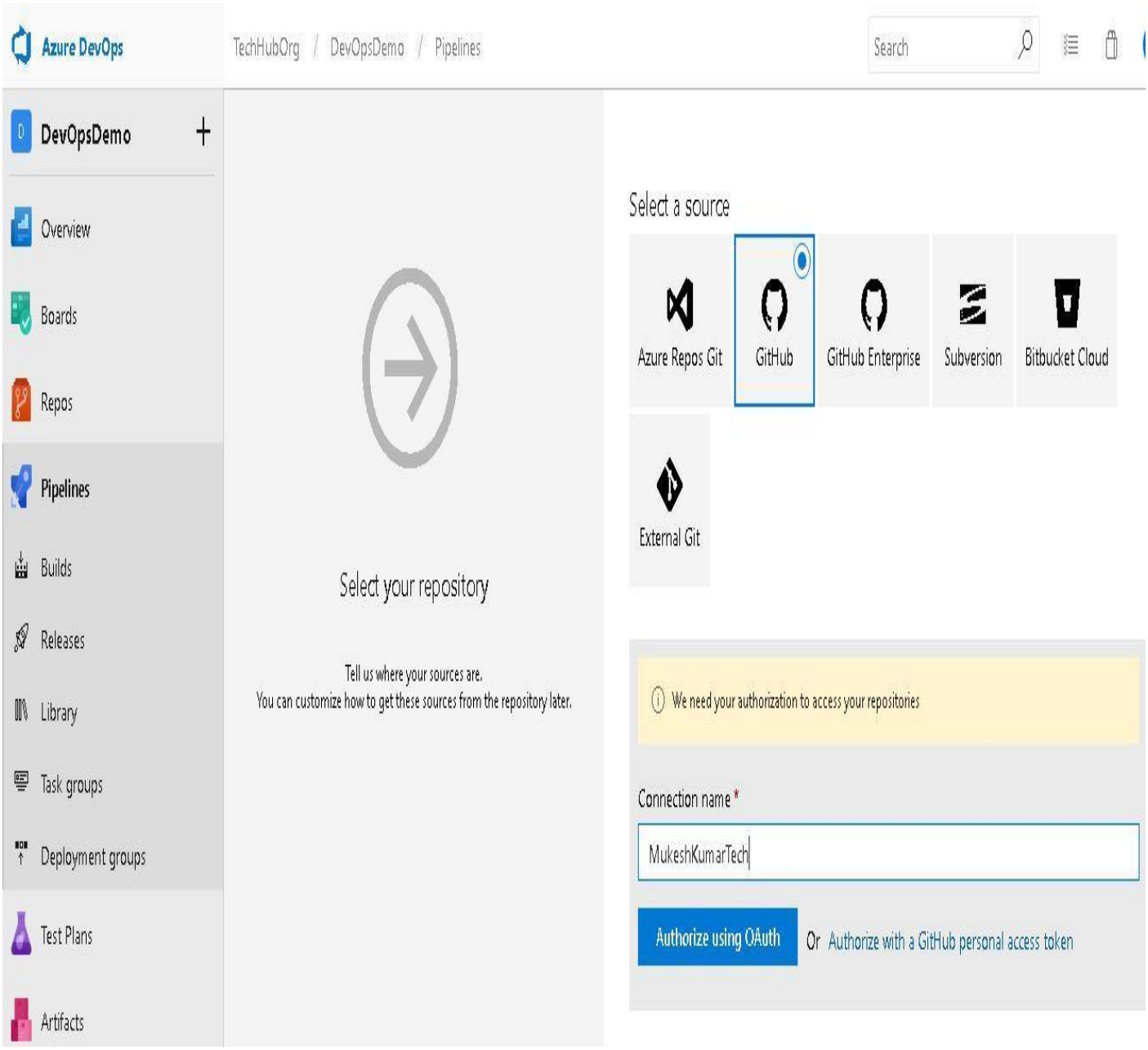
Here, we will not go with Wizard process, we will use the **Visual Designer** for creating and configuring the Azure DevOps Build pipeline. So, let click on the link **'Use the Visual Designer'** as shown in below image.

(By: Mukesh Kumar)



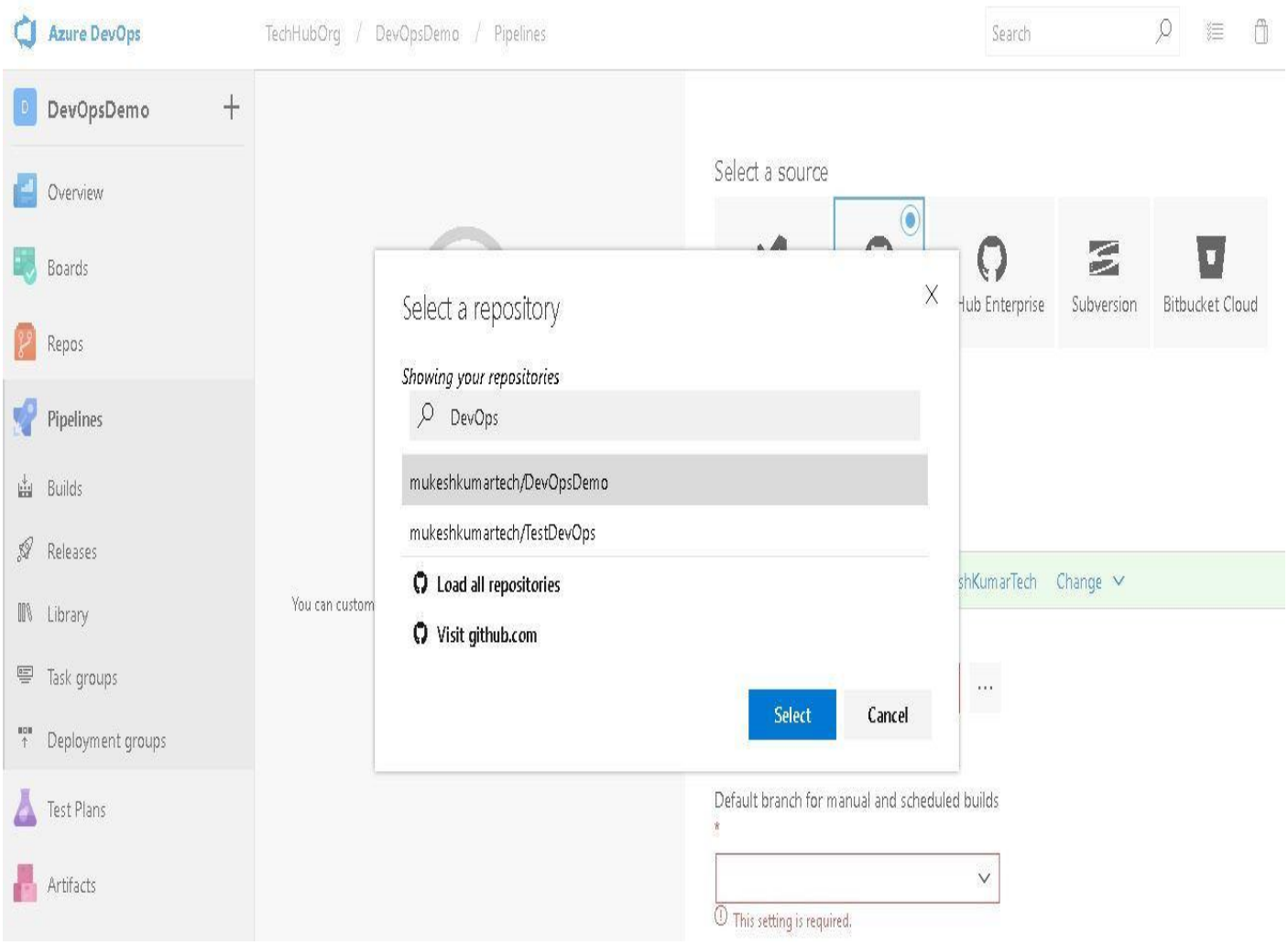
As we select the Visual Designer, it will ask to choose the repository. All available repositories are part of the Azure DevOps like Azure Repo Git, GitHub, Bitbucket etc. We have already pushed our project code which we have already created above in **GitHub**. So, select the **GitHub** and provide the connection name, which will use further. Now, click to **Authorize using OAuth**. It will open a dialog window for login to **GitHub**. Here we have to provide the GitHub credentials for Authorization with **GitHub**.

(By: Mukesh Kumar)



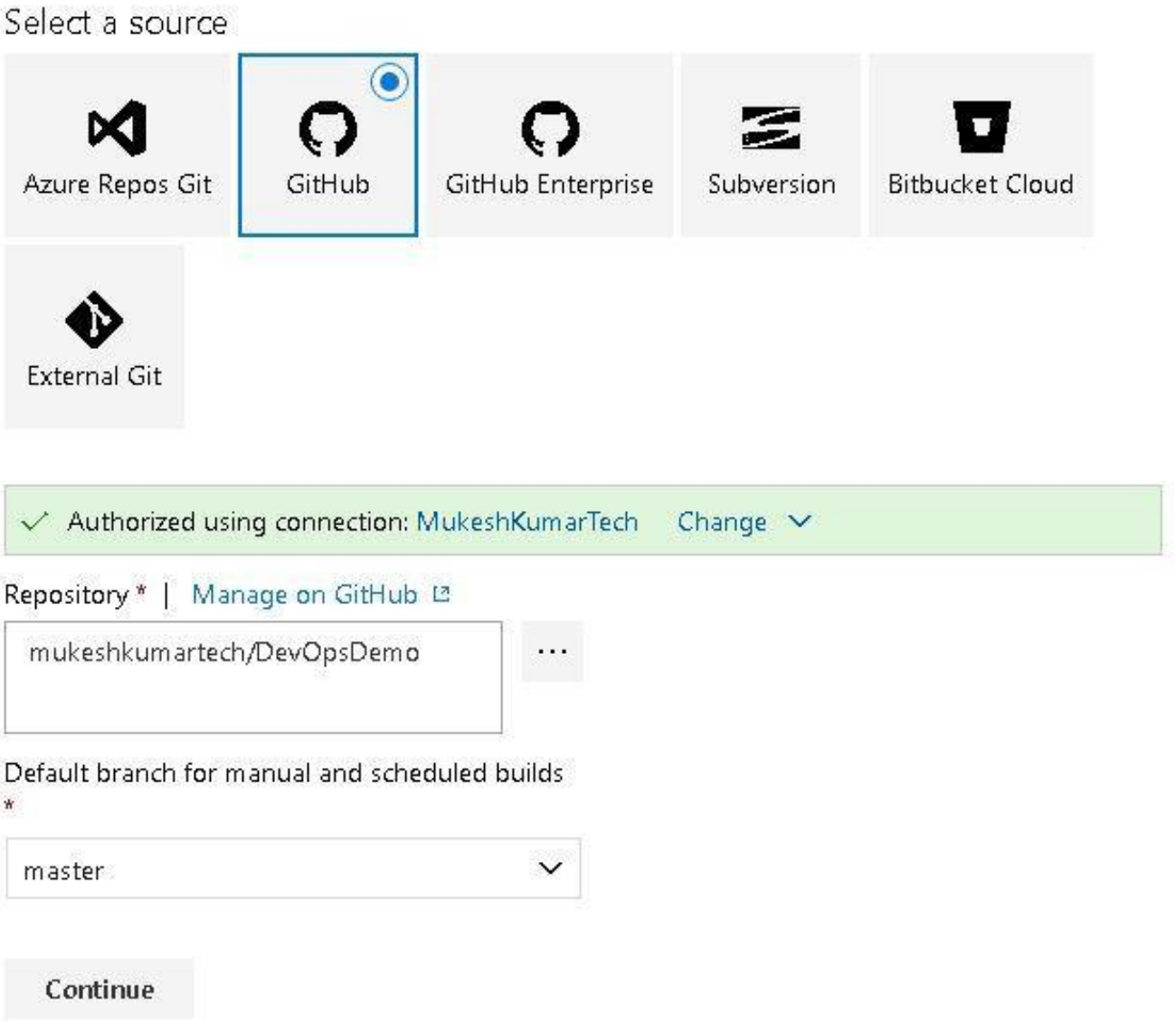
Once we will authorize with GitHub account then we can see all **GitHub** repository. Here we have to select **DevOpsDemo** because we have created and added our project code into DevOpsDemo repository.

(By: Mukesh Kumar)

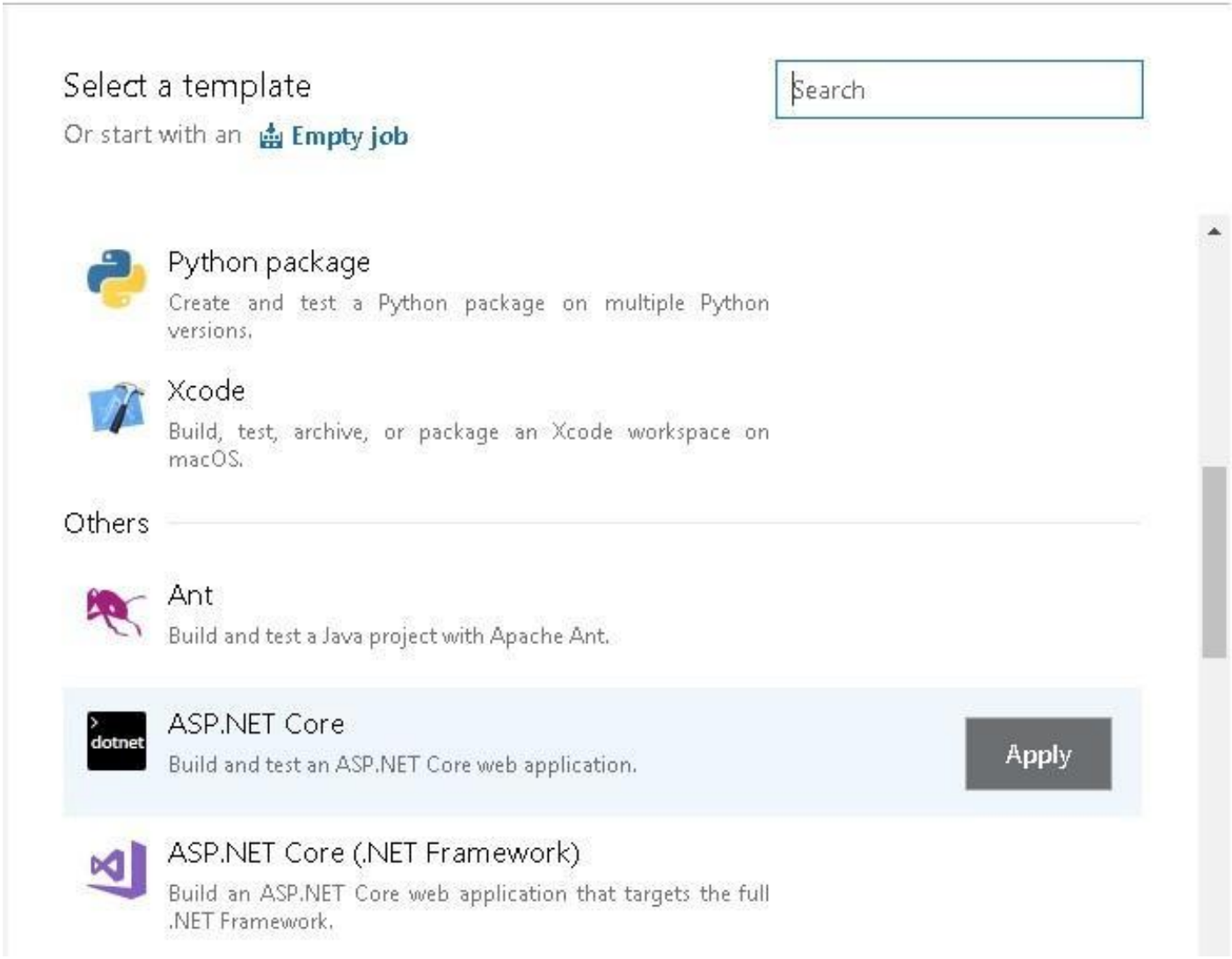


Let select the repository and then the branch, by default it will be **master [Other branch can also be selected]** and click to **Continue**.

(By: Mukesh Kumar)



Next screen will ask about selecting the project template, as we have created the **Asp.Net Core application**. So, here we will choose the **Asp.Net Core** and click to **Apply**.



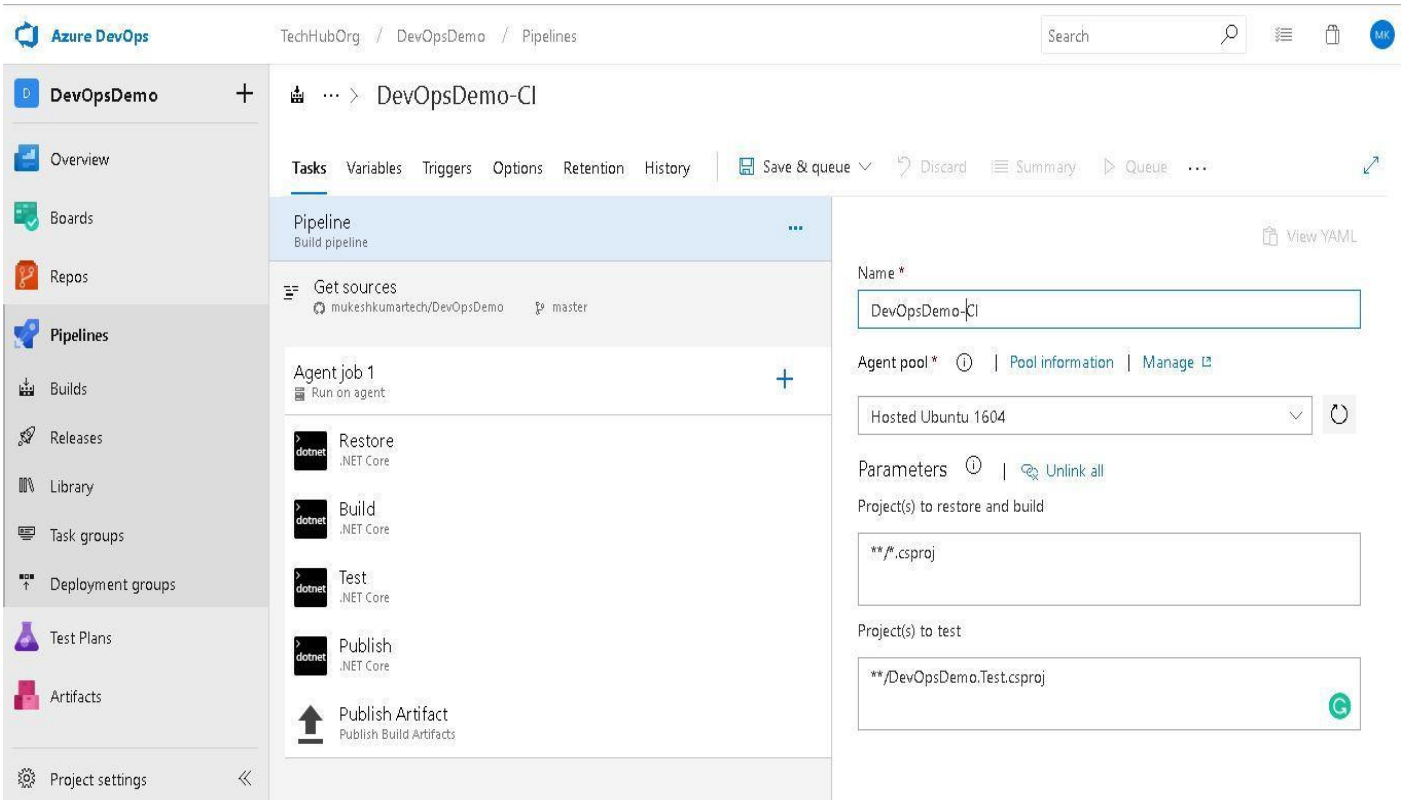
Next screen will all about **Azure DevOps Build pipeline configuration** like name of the build pipeline, restoring the code from repository, building the code, testing the unit test cases etc.

By default, **Tasks** tab will be selected. Here we can provide the **name of build pipeline** as we have given it as **'DevOpsDemo-CI'**.

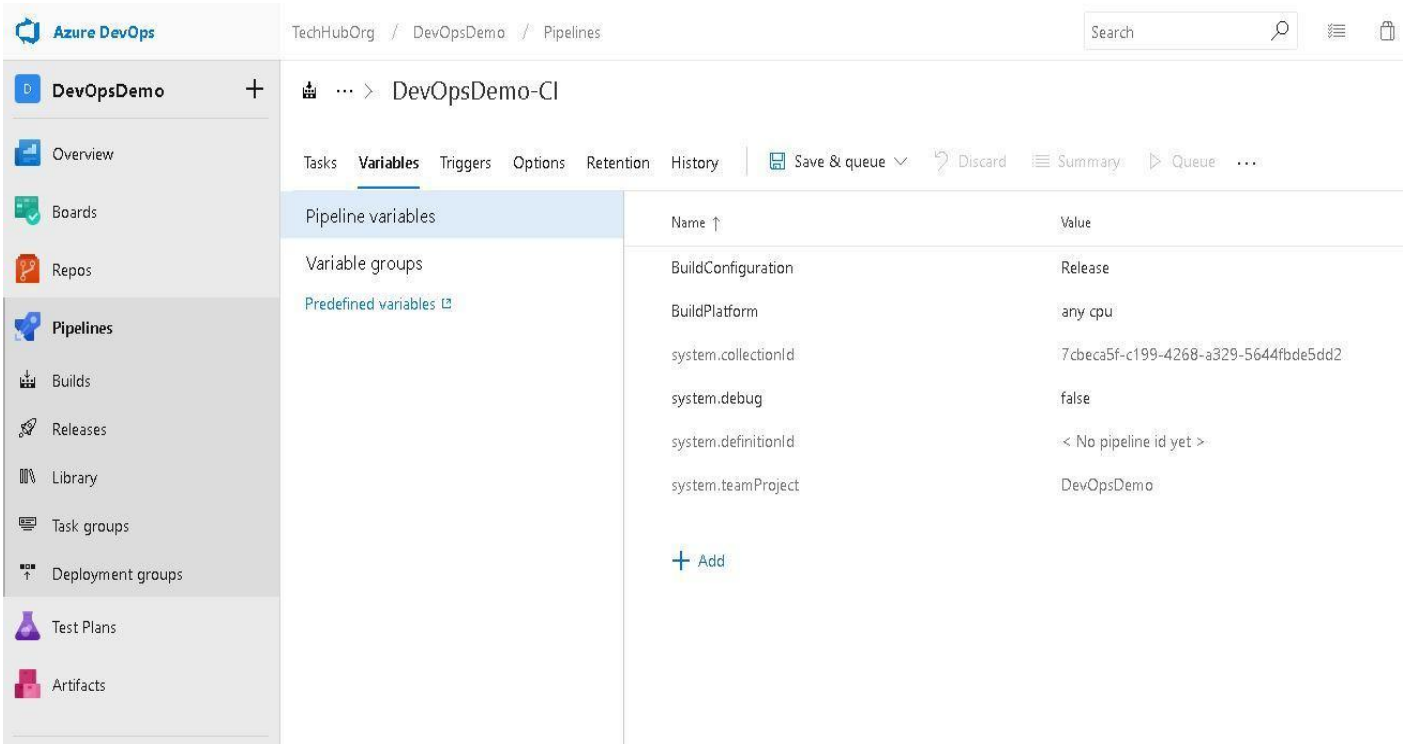
We have two options for project, first as 'Projects to restore and build'. For our case, we don't need to do anything. Let keep the default one. Second, 'Project to test', here, our testing project name was **DevOpsDemo.Test**. So, we will mention it inside **'Project to Test'**.

By default, we have available jobs like **Restore, Build, Test and Publish**. If anything else requires and we would like to perform in between in build process, we can add new job using **+ sign**.

(By: Mukesh Kumar)



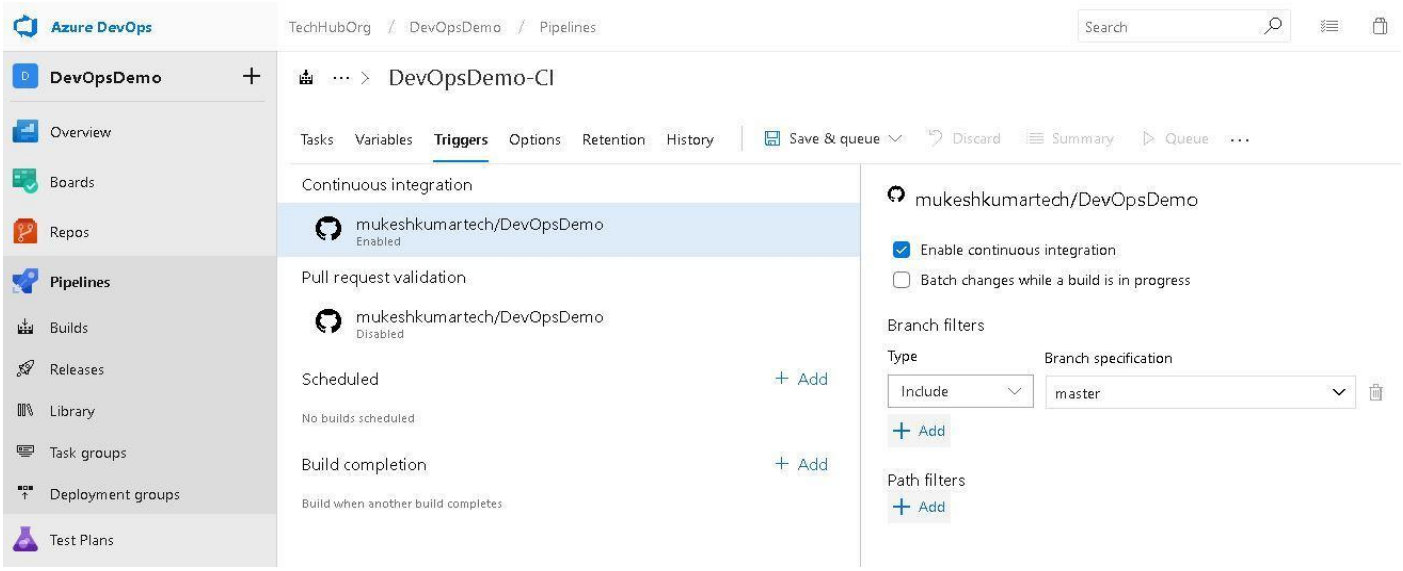
Let move to **Variables** tab, here we can configure the build setting like **Build Configuration, Build Platform**.



Move to next tab **'Triggers'**. It is very important tab from where we can enable the **Continuous Integration**. So, just check the checkbox for **Enable Continuous Integration**. It means, as we will check in our code into repository, it will auto start the building code and creating the build artifact which will be deployed in release cycle.

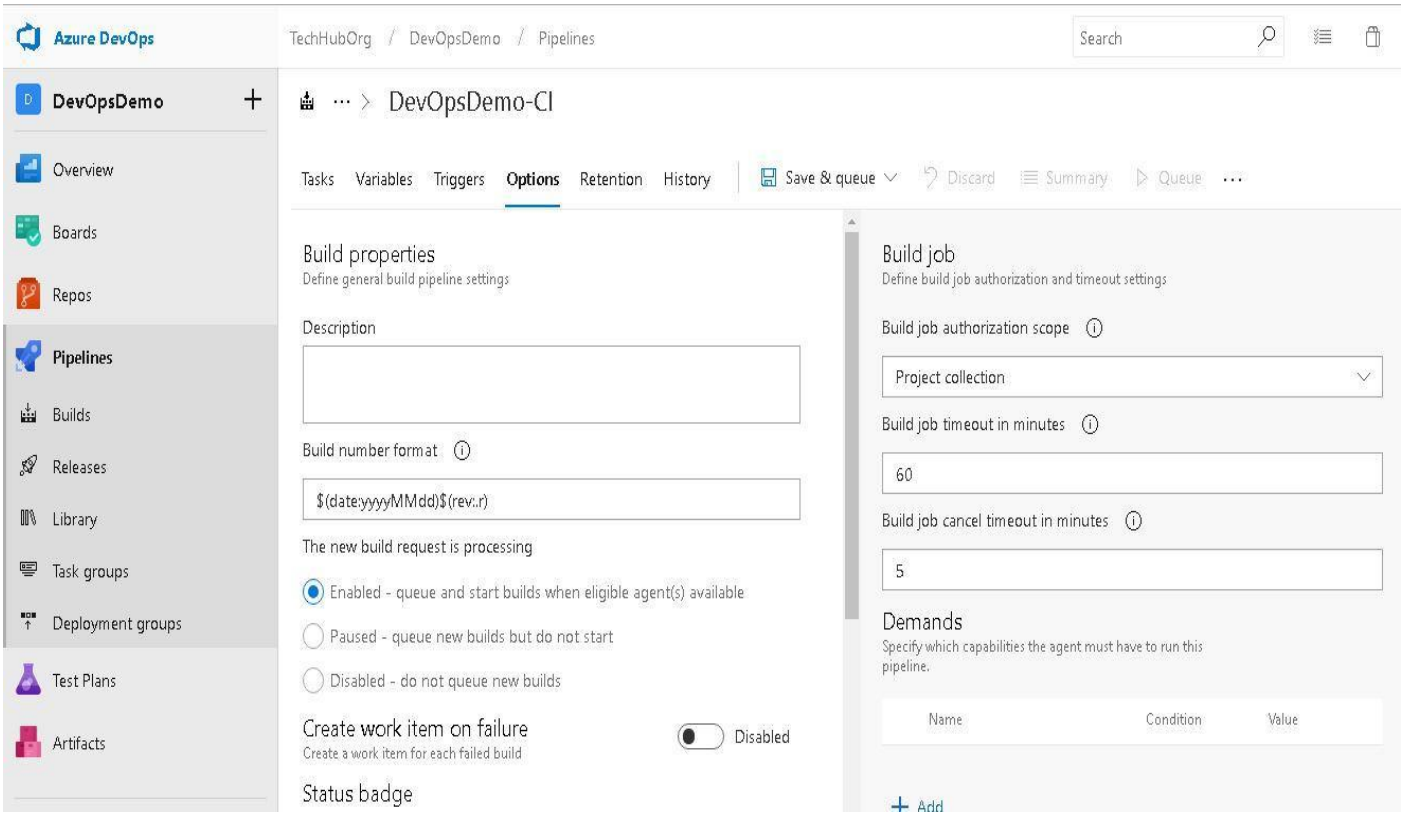
(By: Mukesh Kumar)

If we have multiple branch and we would like to filter any specific branch then we can define it into **Brach Filters** section.



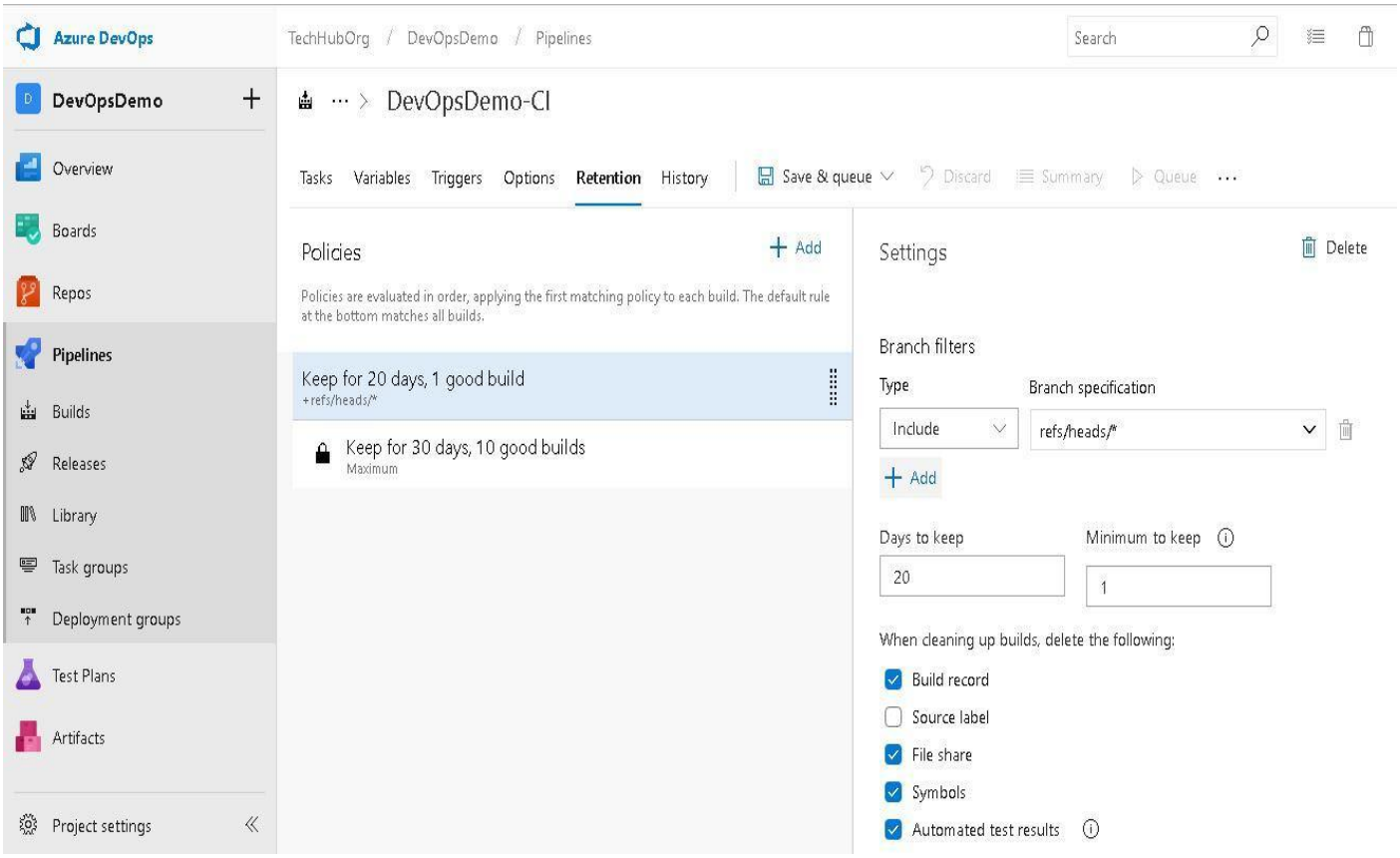
Let move to **Options** tab, here we get the options to define the build version number using **'Build number format'** section. This one is by default format, but we can modify it as per our requirement.

Create work item on failure is also a great feature which is used to create new work item once build becomes fail. In a Build Job section, we can define the build job timeout in minutes.



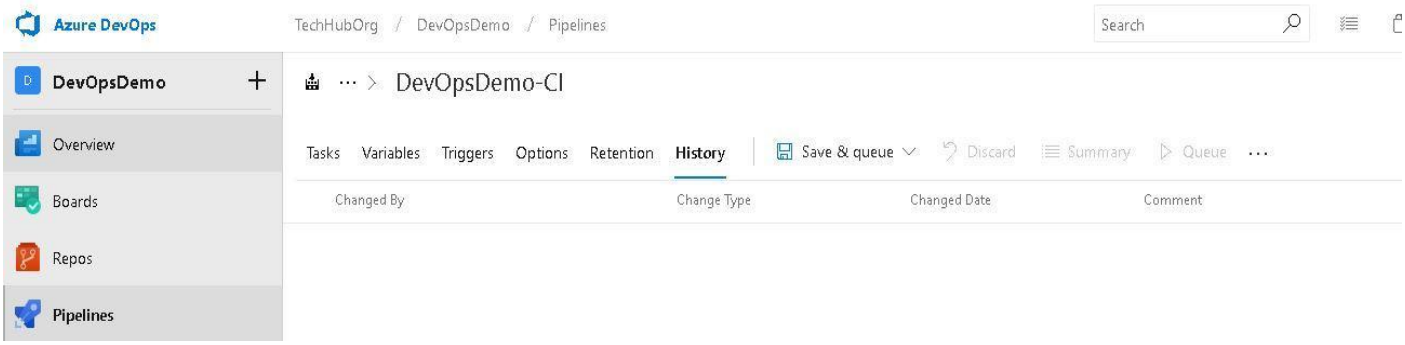
(By: Mukesh Kumar)

Now, time to move on **Retention** tab. Here we can define that for how many days, we would like to keep the build information. How many good builds we would like to keep for those days. Everything can be set up here. Apart from these, we can also define, what information should be deleted and what are not at the clearing the build information.



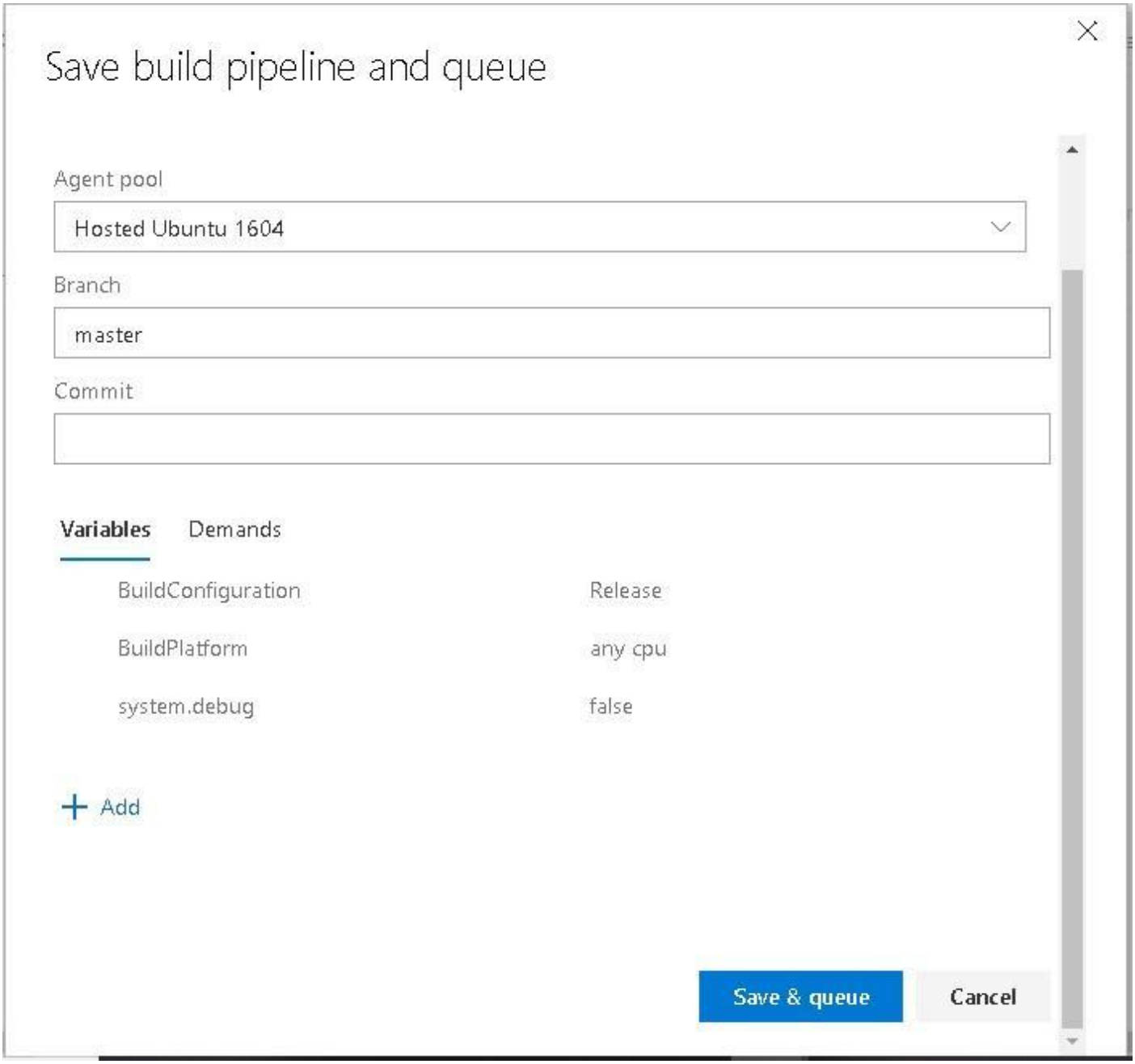
Let move to **History** tab, here we are doing setup the **Azure DevOps build cycle**, so we don't have any history information. But in future, when any build cycle performs then we can see all the history here.

We have done configuring the Azure DevOps Build Pipeline, now let click to Save and Queue.



Once we will click to **Save and Queue** then it will ask for confirmation. So, just click to **Save and Queue** button once more as follows.

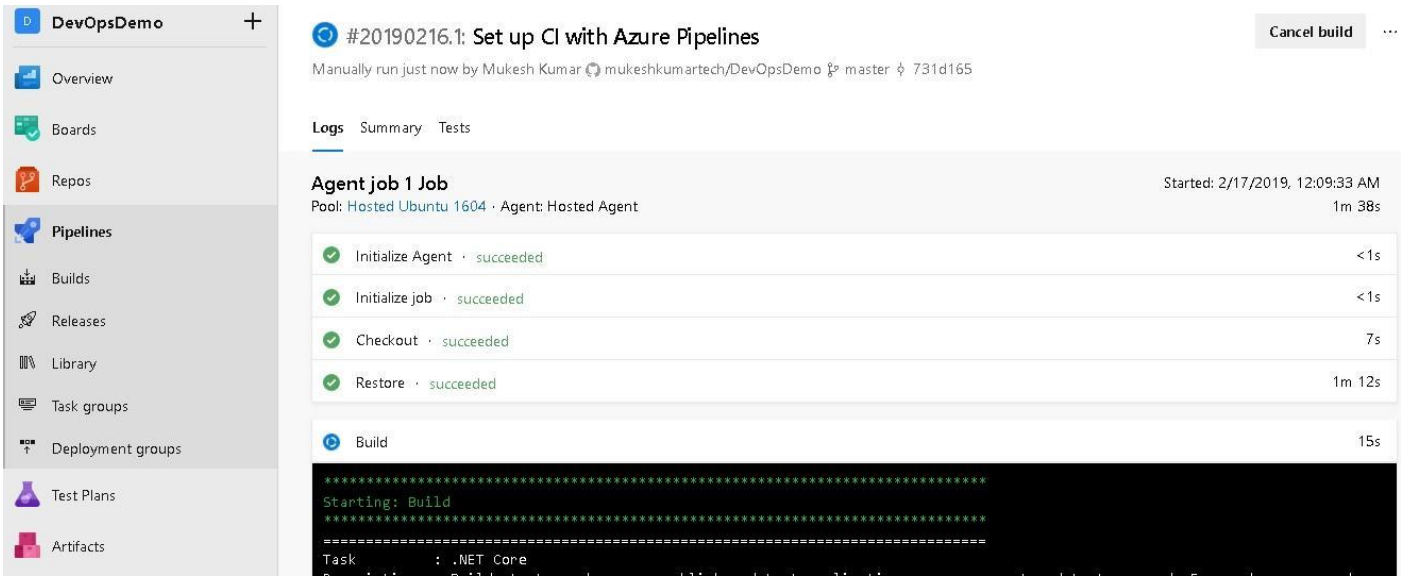
(By: Mukesh Kumar)



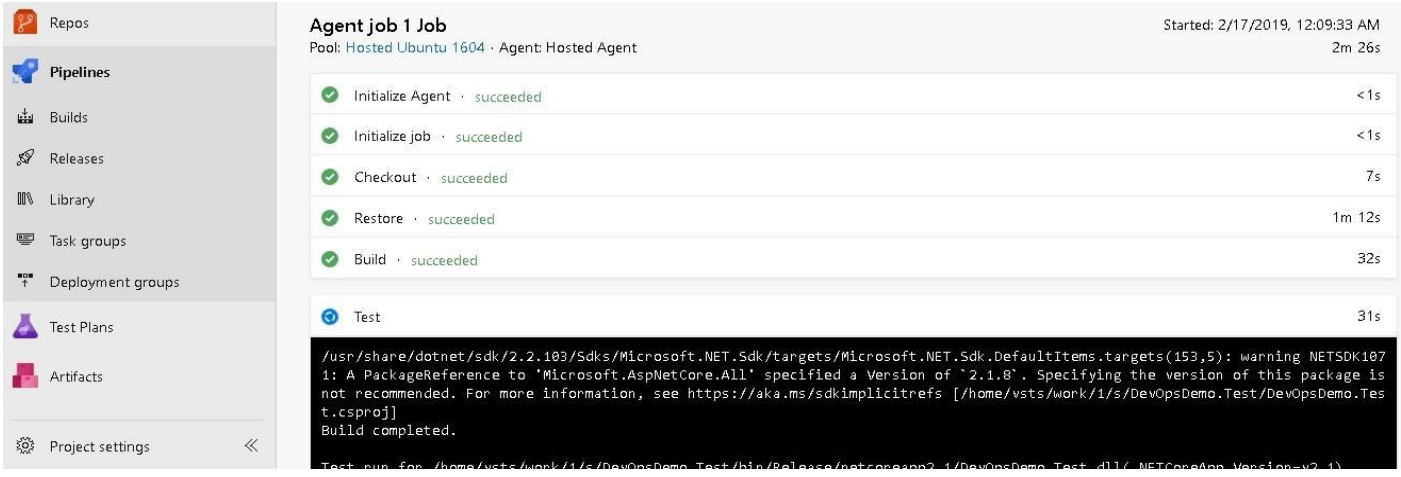
After clicking on Save and Queue button. First it will save the configuration for build pipeline and start queuing a build. As per the following image, we can see a message **'Build #20190216.1 has been queued'**.

(By: Mukesh Kumar)

Let click on the **build # number** and we can see the log for jobs which are performing. As per the following images, build has already processed the Initialize Job, Checkout Job, Restoring the code Job and now has been moved on Build. It is performing the Build.

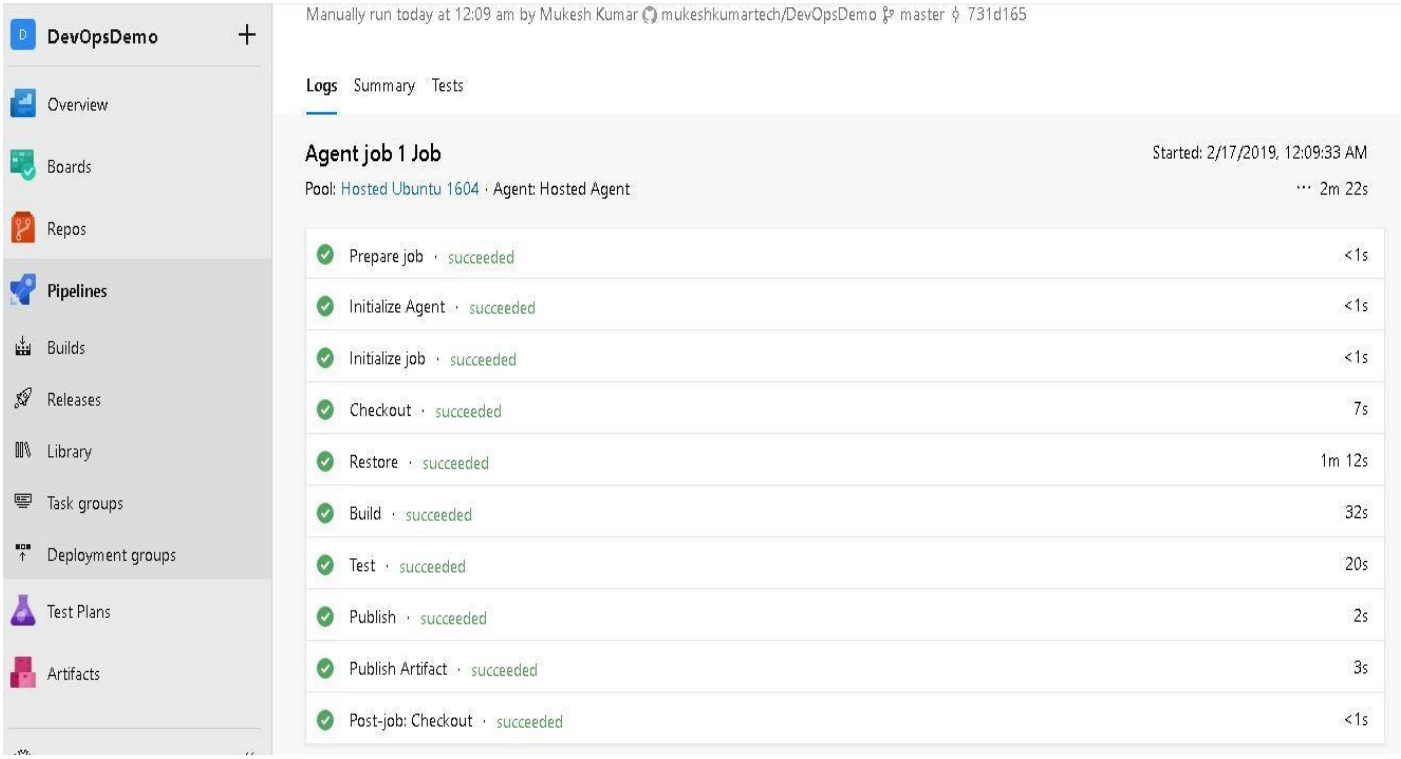


After build completes, it will move to Test the Unit Test Cases, which we have already defined at the time of creating the Build Pipeline.

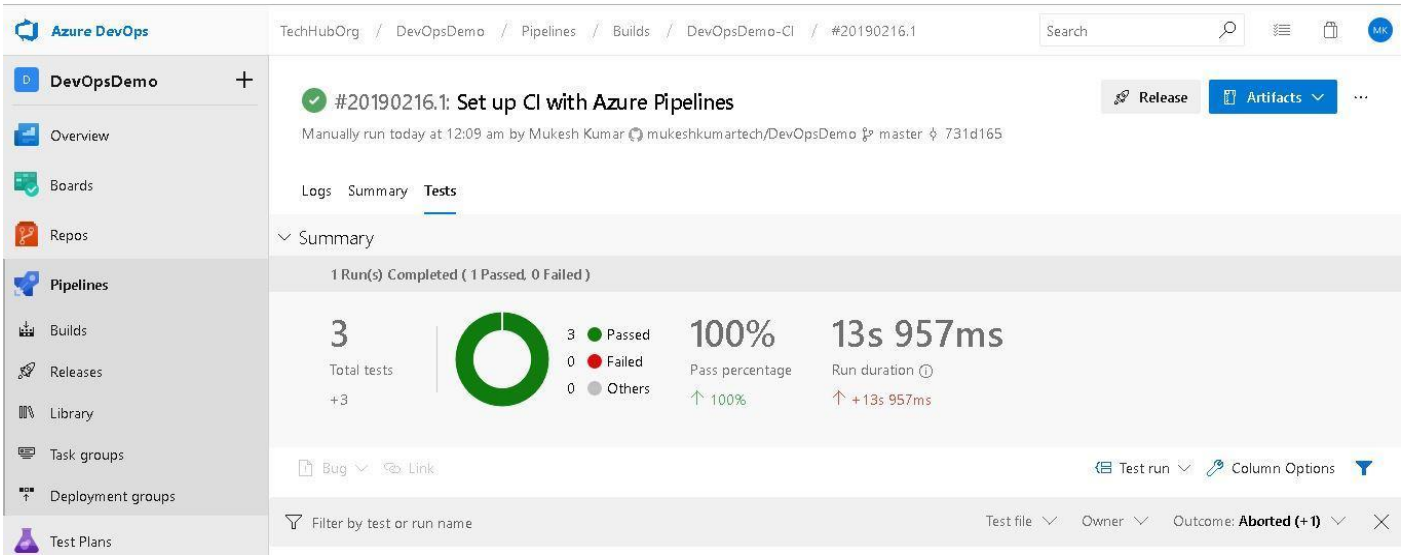


(By: Mukesh Kumar)

After few minutes, we can see that all jobs complete successfully as follows with **succeeded message.** If something will wrong with our code then it will fail with proper information.

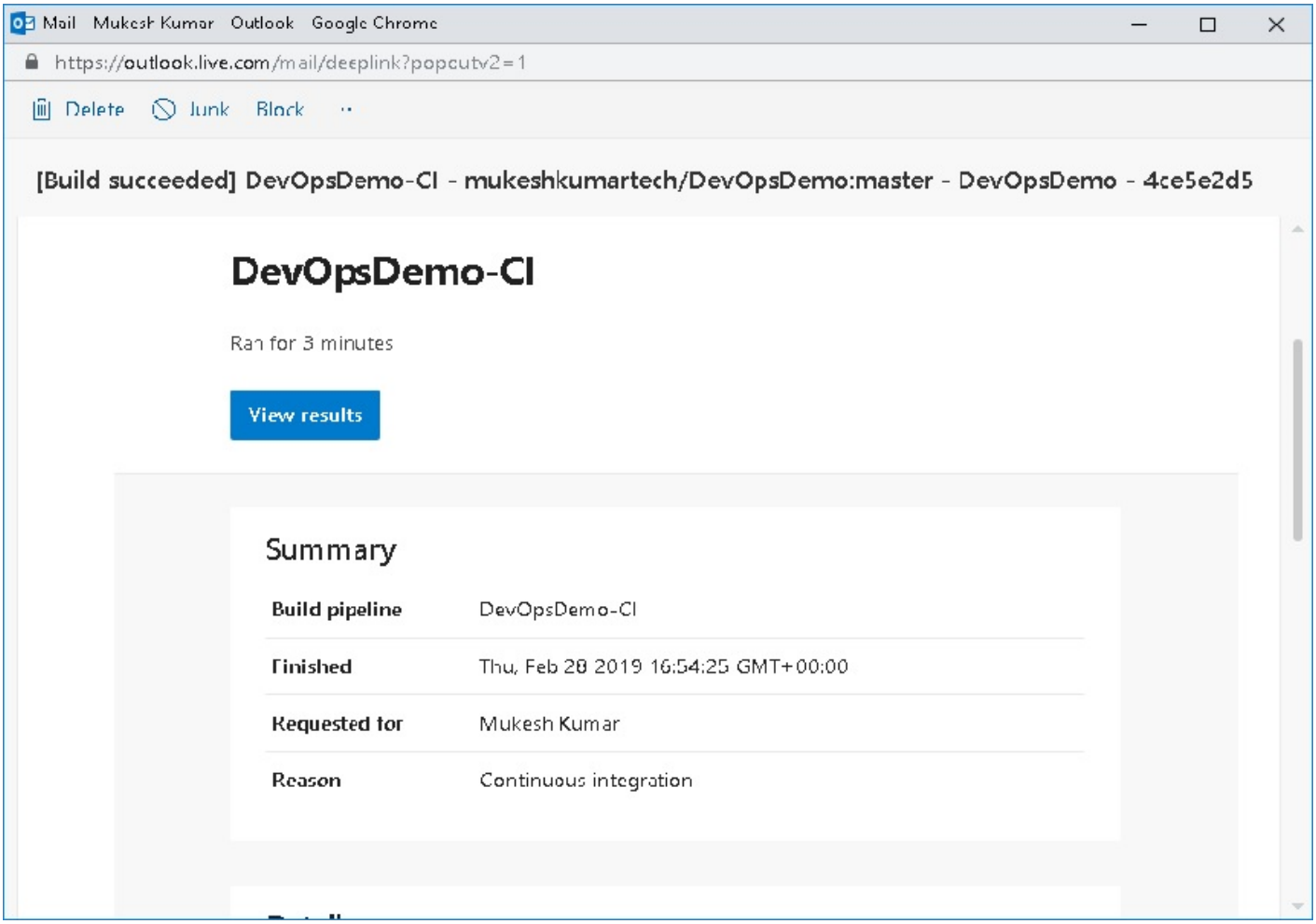


Here, we have to confirm that **our Unit Test Cases** has executed and passed successfully or not. So, let move to Tests tab, here we can the summary of executed Unit Test Cases. We had created 3 Unit Test Cases and all have been passed.



We will also inform about any build process completes in the Azure DevOps Build pipeline through Email as follows.

(By: Mukesh Kumar)



So, as we have performed several things as follows.

- ✓ Created the Azure DevOps Build Pipeline.
- ✓ Configured the Build Pipeline and Enable the Continues Integration.
- ✓ Save the Build and Queue the Default Build.
- ✓ Azure DevOps Build executed successfully.
- ✓ Unit Test Cases passed successfully.

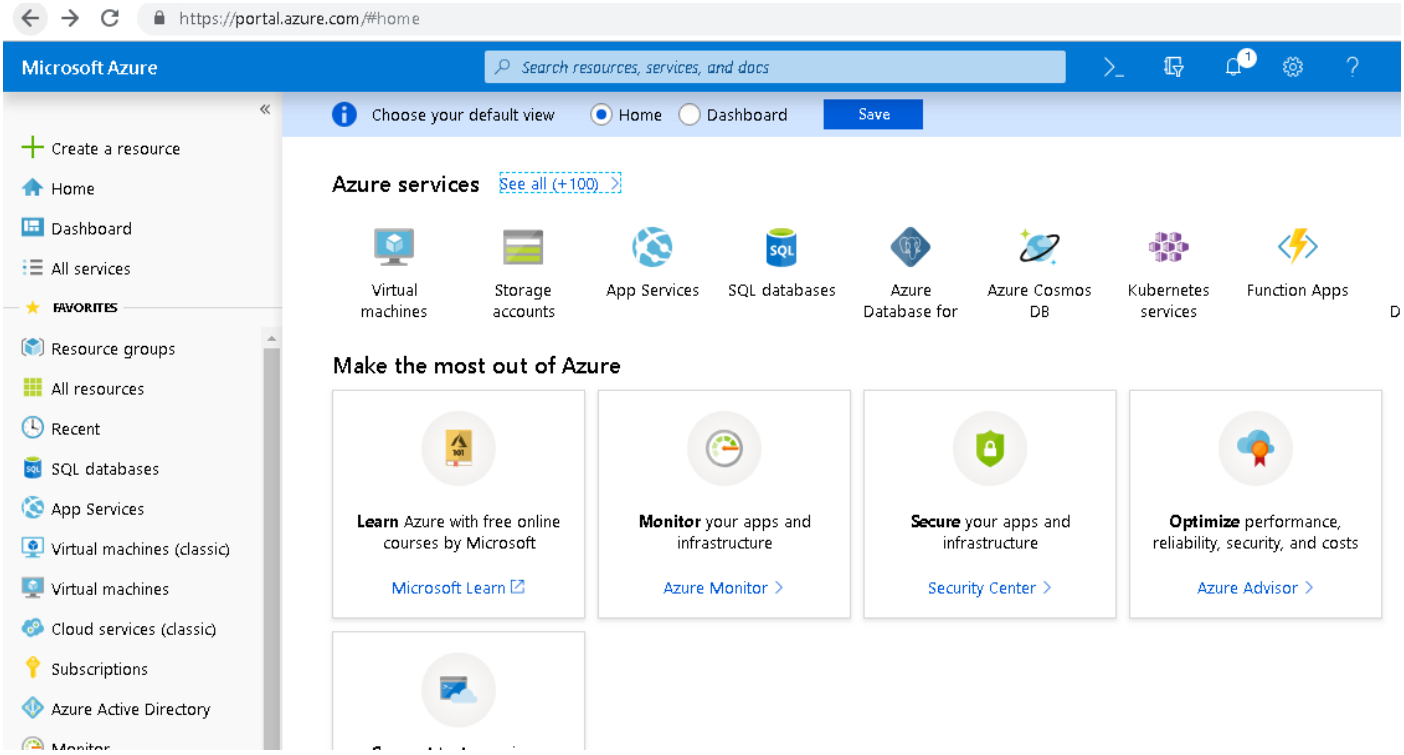
(By: Mukesh Kumar)

7. Create Azure App Services

As we have done with creating the Build Artifact in Azure DevOps Build Pipeline which can be deployed. So, we have to see how we can deploy it to web app. But before moving to Release lifecycle. First we will create the 3 Web Apps **(DEV, QA and PROD)** where we can deploy our artifact in different stages.

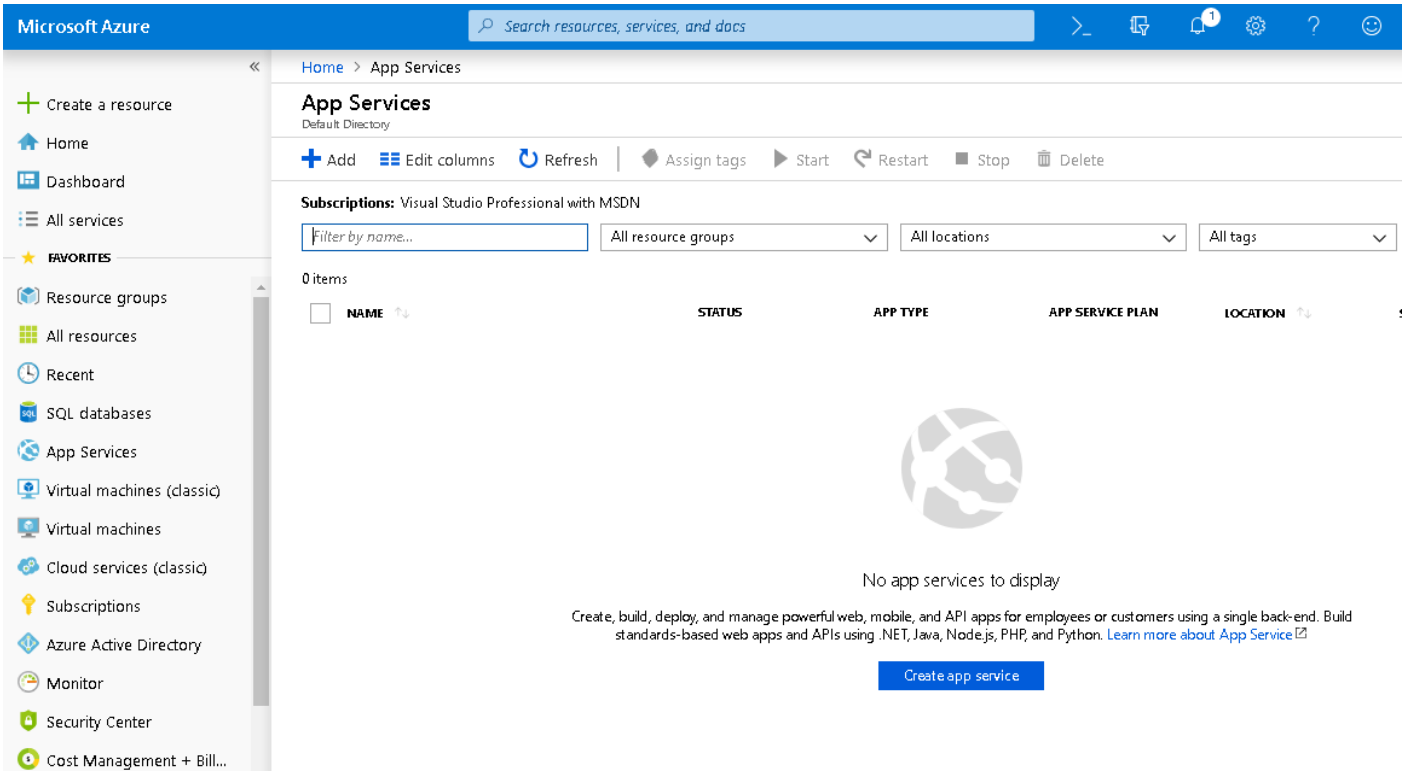
Before moving to next, as we have defined above that we will require the Azure Subscription. So, open https://portal.azure.com and log in with your credentials. Once we will login, we can see the default Dashboard for Azure Portal as follows. Here we have different options available to create the VM, Web App, Storage etc.

Azure App Service is a fast and simple way to create web apps using Java, Node, PHP or ASP.NET, as well as supporting custom language runtimes using Docker. A continuous integration and continuous deployment (CI/CD) pipeline that pushes each of your changes automatically to Azure app services allows you to deliver value to your customers faster.



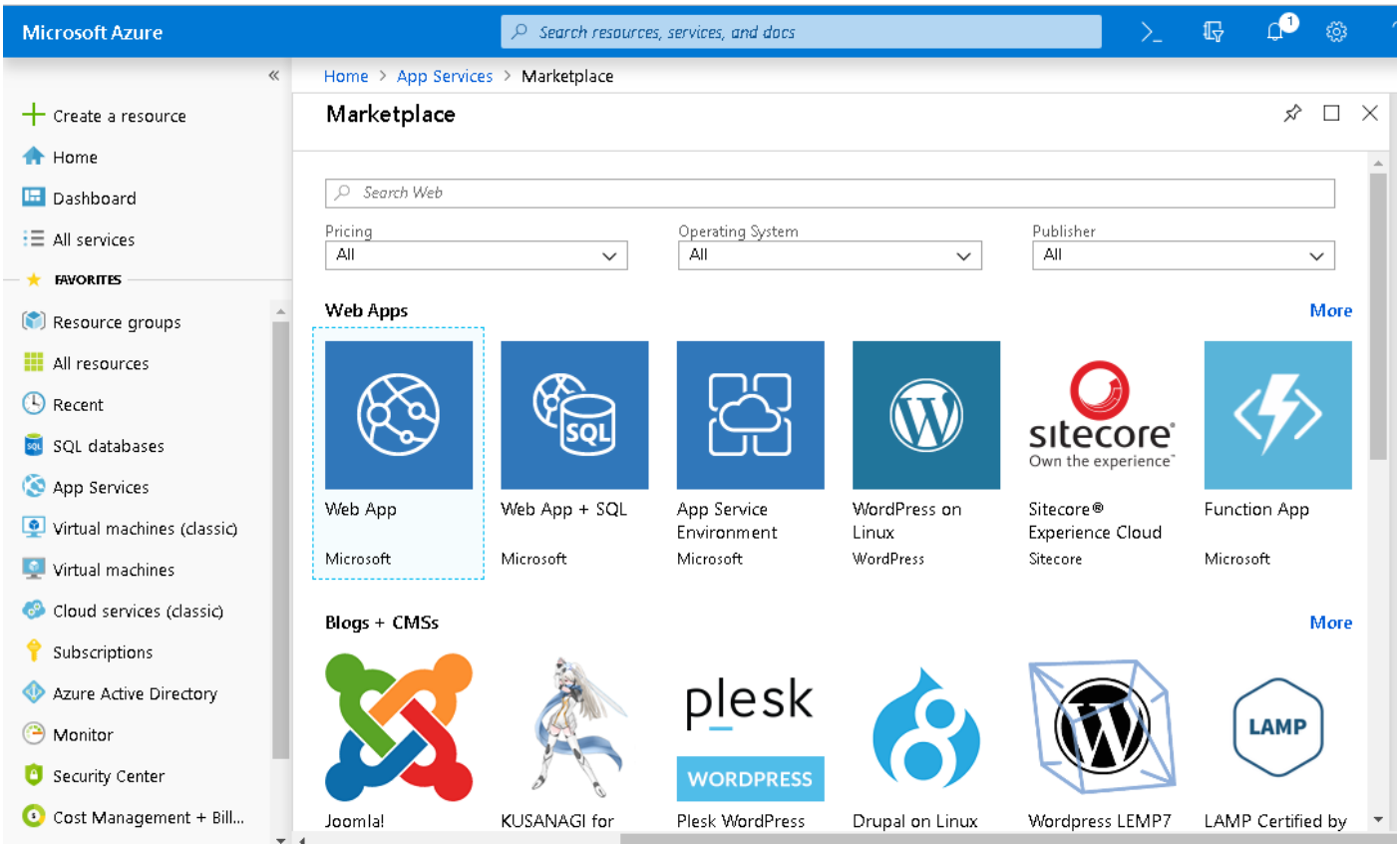
We are here to create 3 Web App. So for doing that let click on **'App Services'** from the left panel just after SQL Database [See the above image]. It will open the App Services page from where we can create new App Services. We don't have any App Services in our bucket. So, let create new App Service to click on button **'Create App Service'**.

(By: Mukesh Kumar)



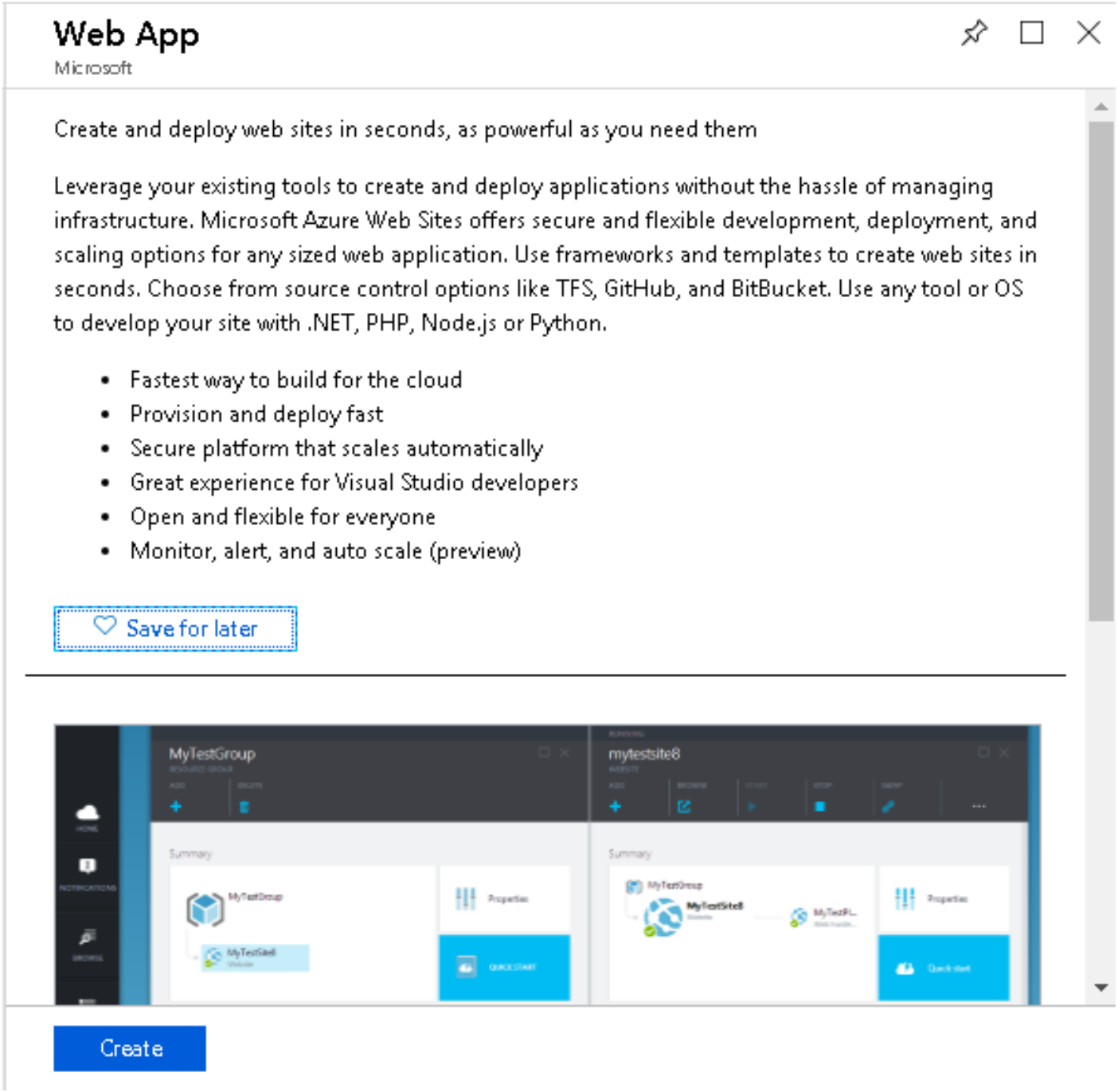
Next screen will provide us different kinds of templates avaialble for creating the App Services. Here we will create simple Web App. So, click on **Web App**.

(By: Mukesh Kumar)



From the **Web App** section, we have to click on **Create**.

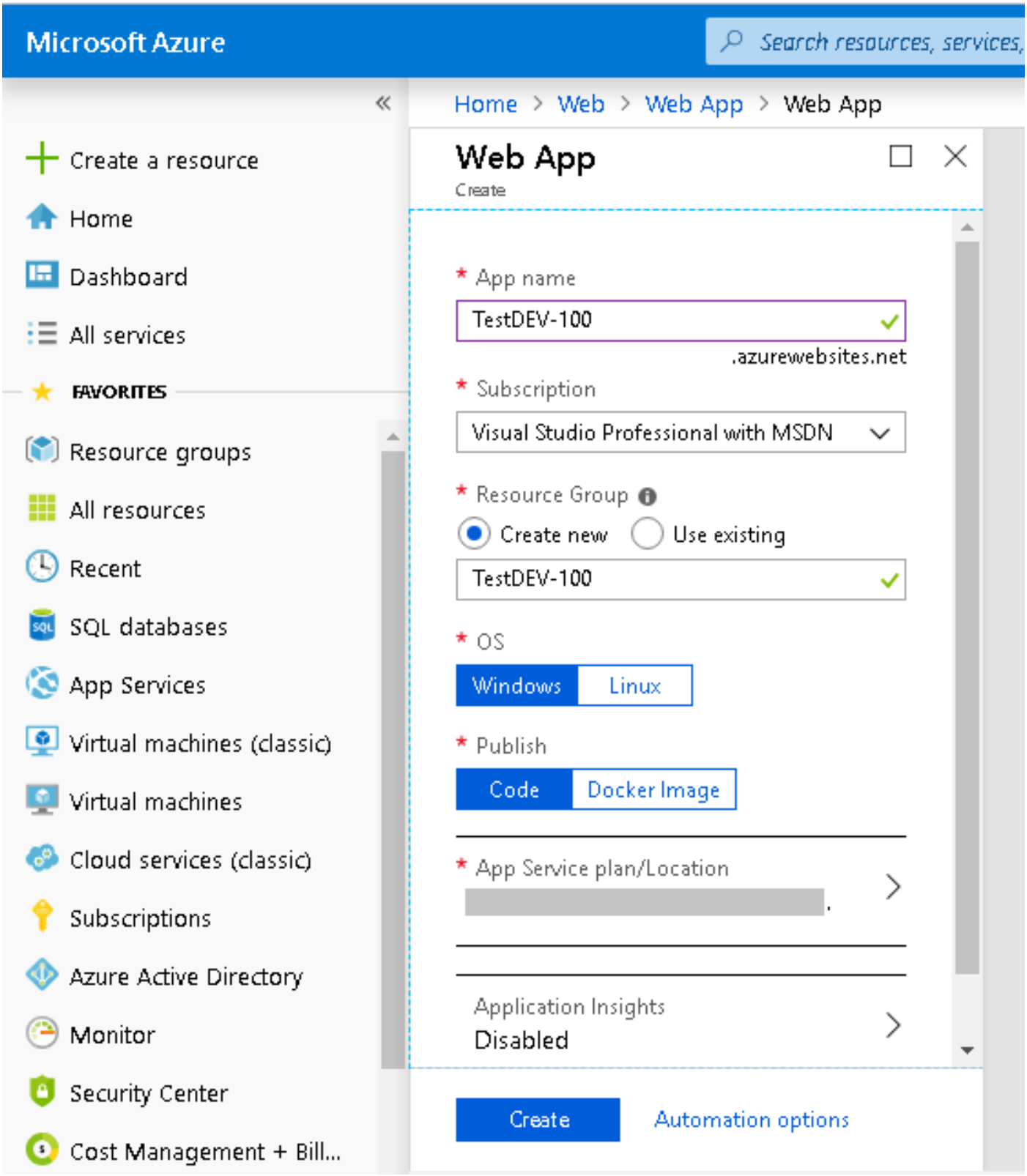
(By: Mukesh Kumar)



Next screen will ask a few information before creating the Web App. So, let provide the name of a web app as **'TestDEV-100'**. Name should be common through out Azure Portal. Next, we have to provide the **Azure Subscription**. Next, we have to provide the **Resource Group**, we can reuse if we have already created but for this demonstration we are creating the new.

Next option is **App Service Plan and Location**. It is used to track the what we have used and how much we have to pay as per used resource. Rest of the options just keep the default and click to Create button.

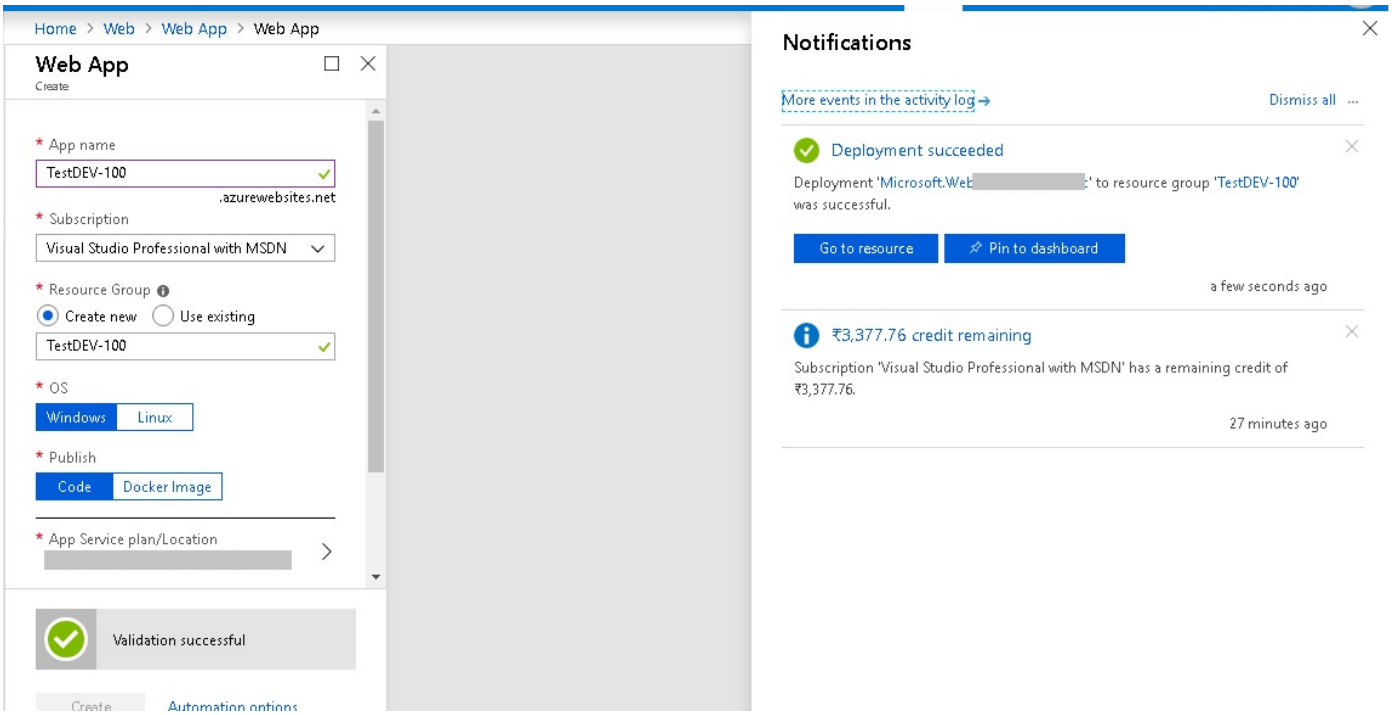
(By: Mukesh Kumar)



It will start the validating the information which we have provided. Once validation will succeed. It will start creating the Web App Service. It might take time to create the Web App Service as per our network speed. We can see the progress of creating the Web App Service in the Notification bar.

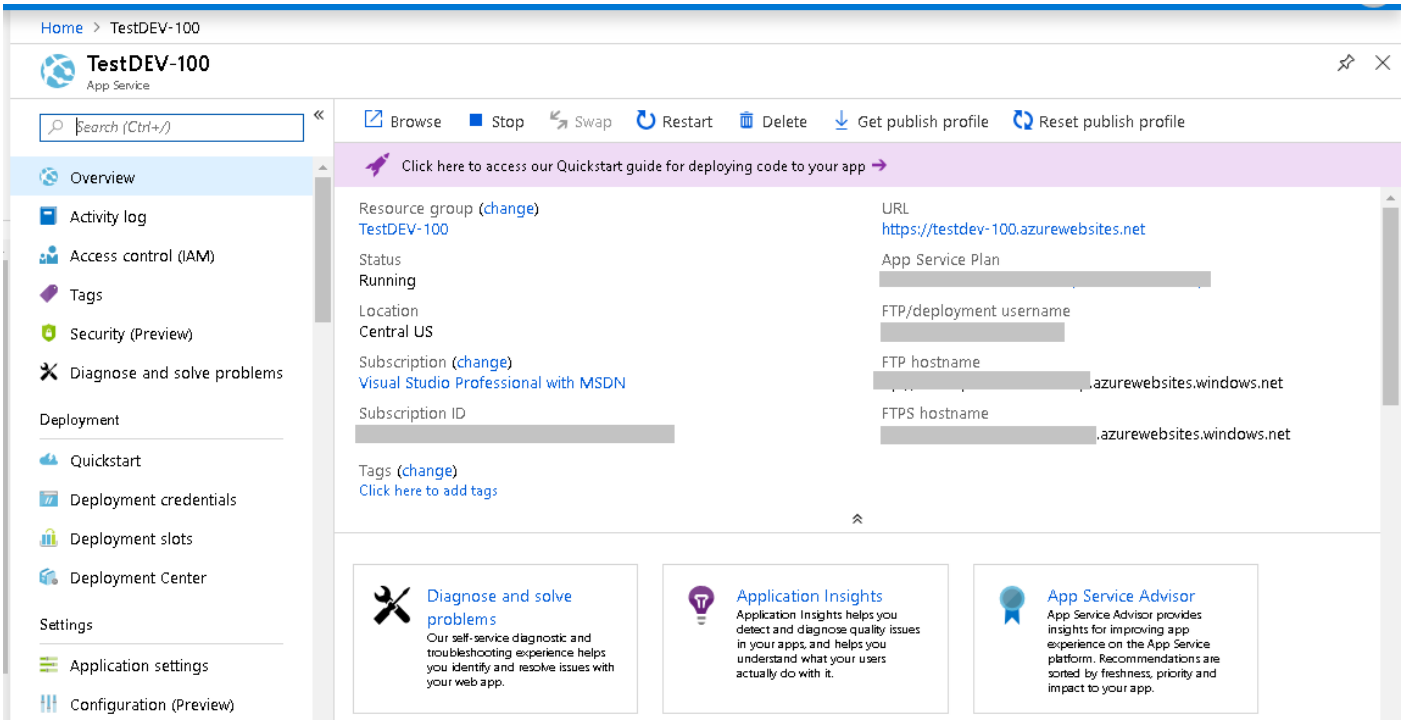
Just click on the **Notification icon** and it will open the windows something like below. Here we will get notify that our resource **(Web App)** has created and we have an option to **Go to Resource**.

(By: Mukesh Kumar)



Let click on **Go to Resource**. It will open the page where we can get all the information for newly created web app **(TestDEV-100).** Here we can see location of the resouce where it is created, URL of web app for accessing it and many further options for deployment like **user name and password**.

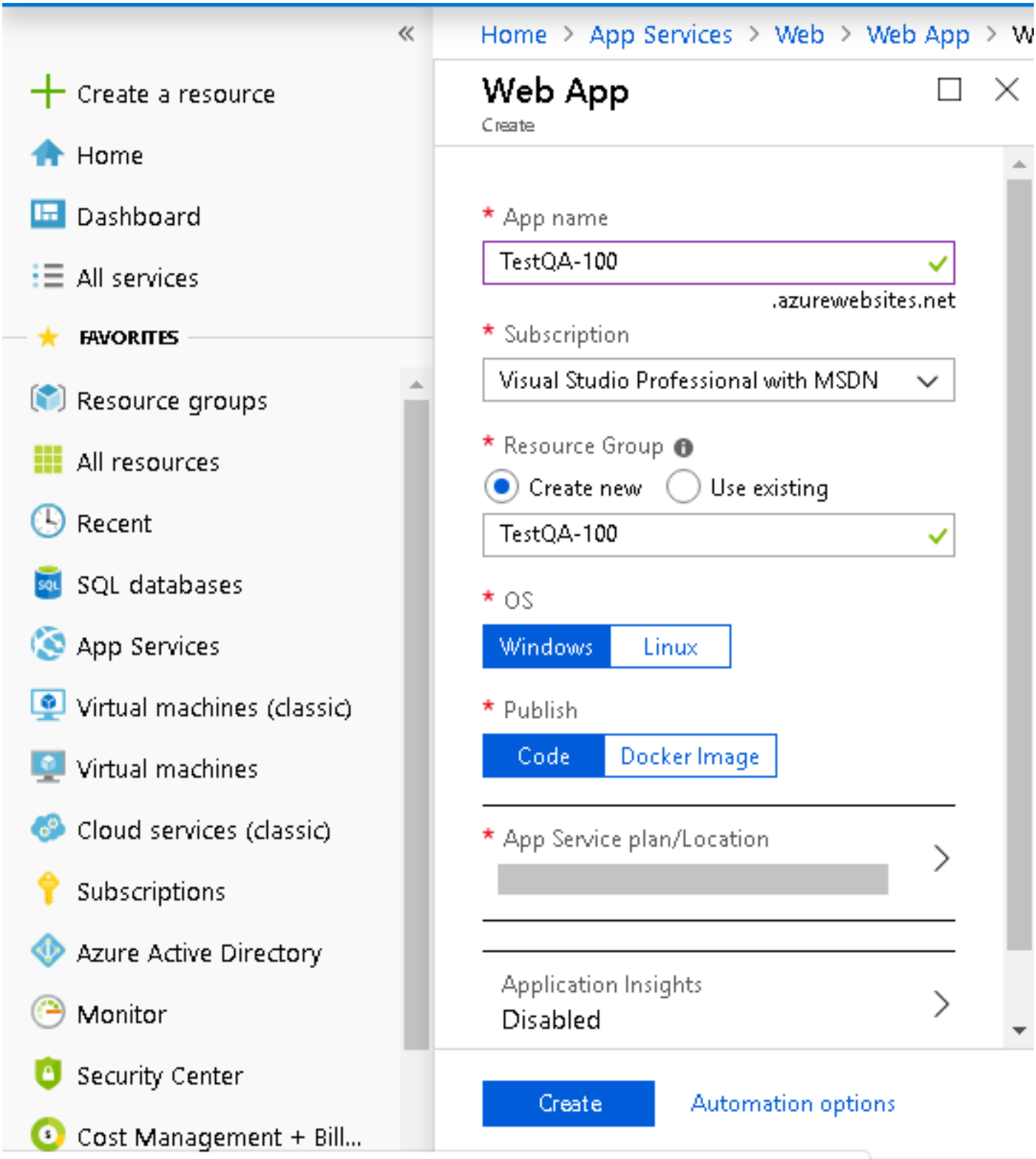
At the top, we have couple of more option for this Web App, like we can **stop** the Web App if it is running. We can **restart** it , we can **delete** it. If we would like to get he **publish profile** which could be used for publishing the artifact on this web app.



(By: Mukesh Kumar)

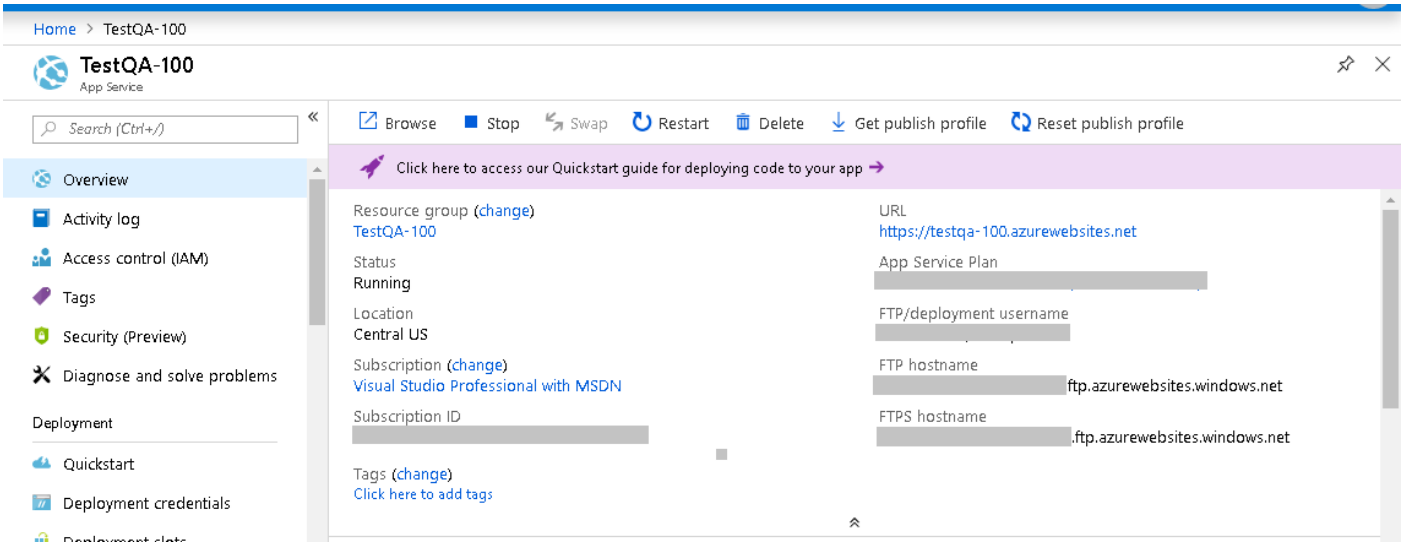
Let move **App Services** and follows the same process as we have followed for createing the **TestDEV-100** web app and create two more Web App like **TestQA-100 and TestPROD-100**.

For the QA environment, we will create the **TestQA-100** Web app.



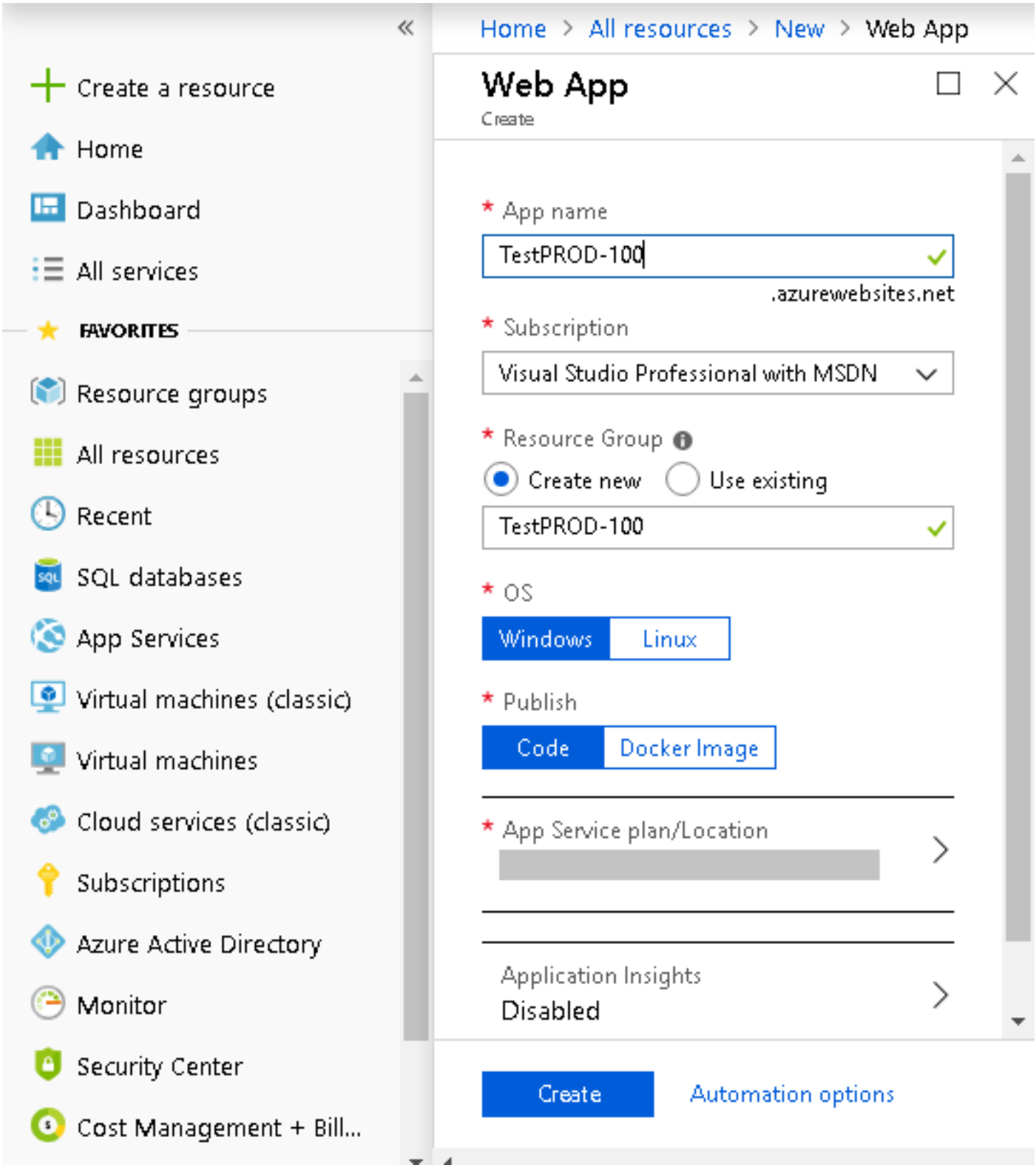
Once **TestQA-100** will create successfully, we will get the information something like as follows.

(By: Mukesh Kumar)



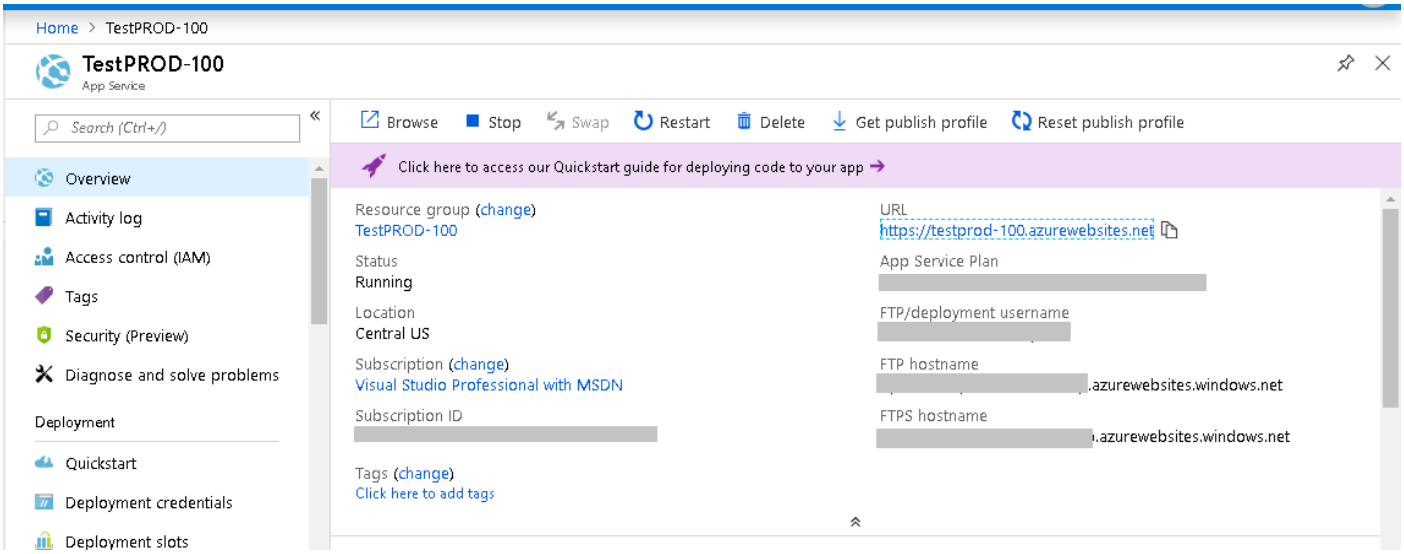
For the **PRDO** environment, we will create the **TestPROD-100** Web app.

(By: Mukesh Kumar)

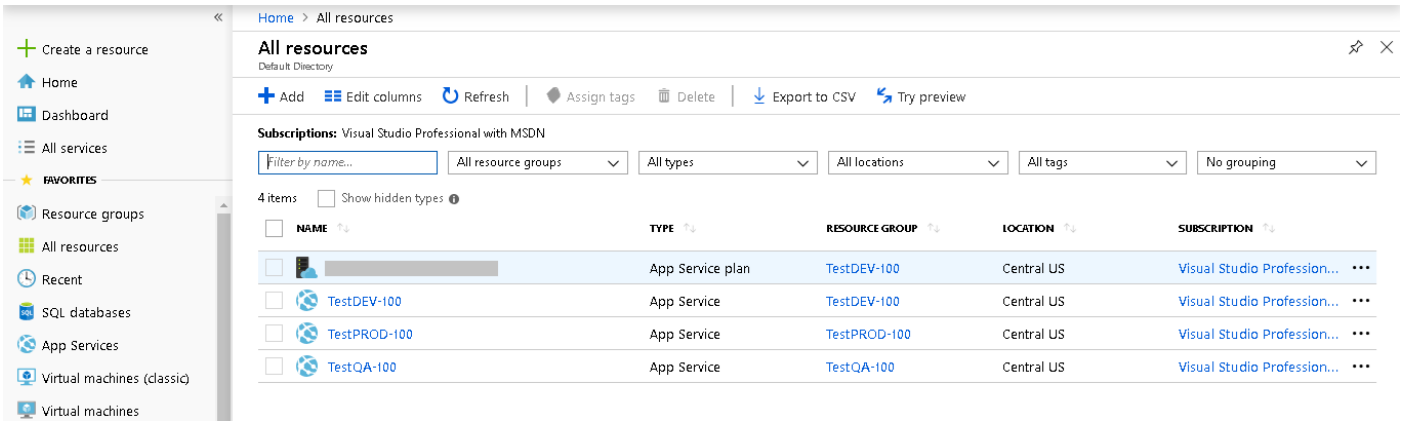


Once **TestPROD-100** web app will be created successfully. We will get all information about this resource as follows.

(By: Mukesh Kumar)



Now, let move to **Resouce page**, here we can find all newly create App Services. We have 3 Web App for **DEV, QA and PROD environment** respectively. Apart from we have one **App Service Plan**, under which all App Service will run.



Till yet, we have created the **Azure DevOps Build Pipeline** successfully and able to create the build artifact. Apart from this, we have created 3 Web App for different environments like DEV, QA and PROD. These app services will be used in Azure DevOps Release Pipeline for deployments.

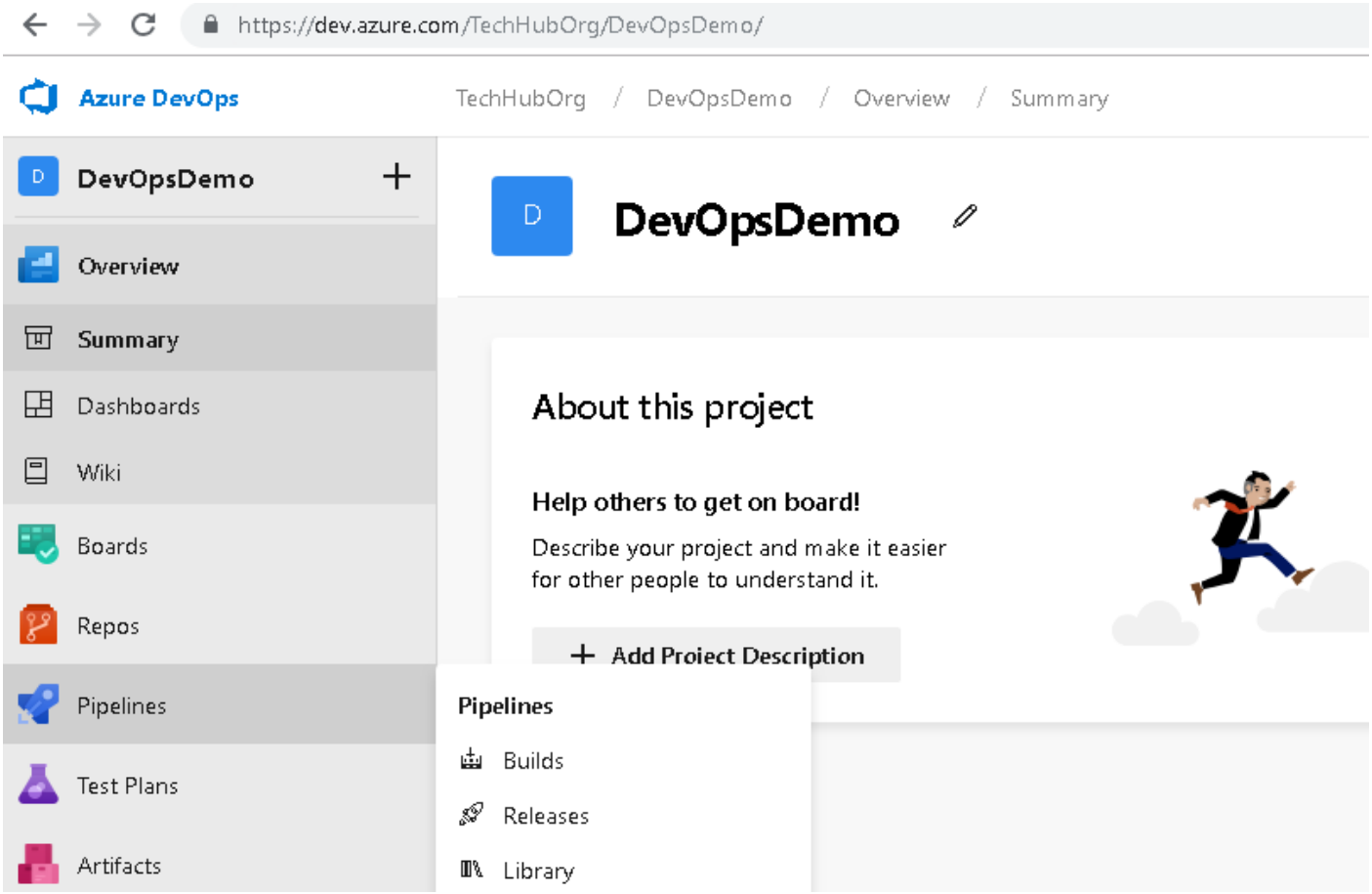
(By: Mukesh Kumar)

8. Continuous Delivery

Let move to **DevOpsDemo** project in Azure DevOps using following URL.

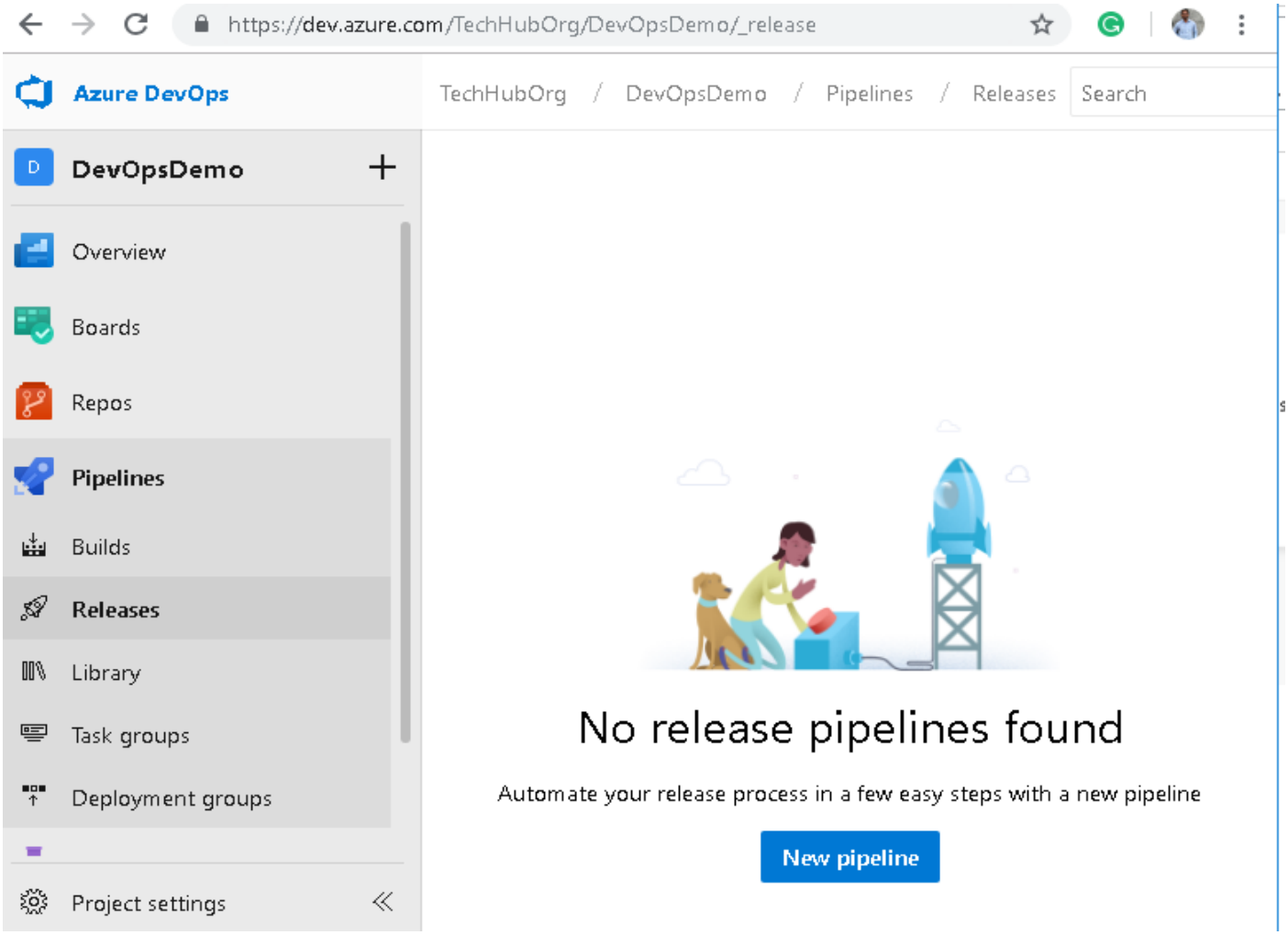
https://dev.azure.com/TechHubOrg/DevOpsDemo.

Click to **Pipeline** and choose **Releases** for creating new **Azure DevOps Release Pipeline**.



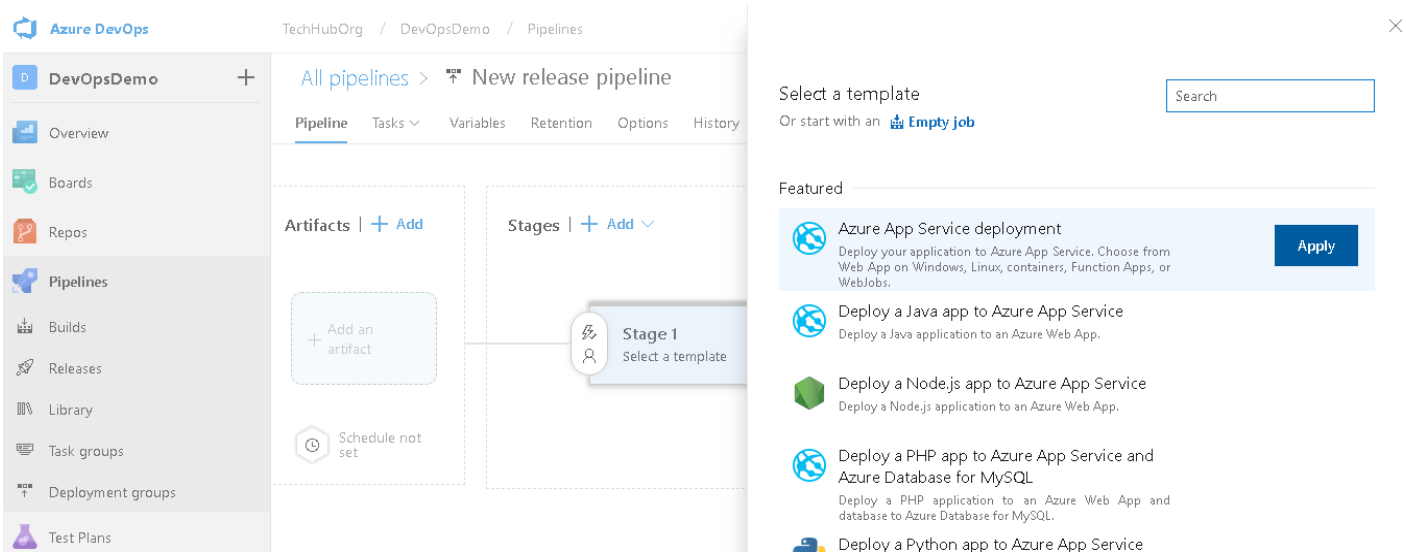
Next screen will show all the release pipeline if we have any. But we don't have created any for now. So, let create new to click on **New Pipeline**.

8.1 Create Dev Stage



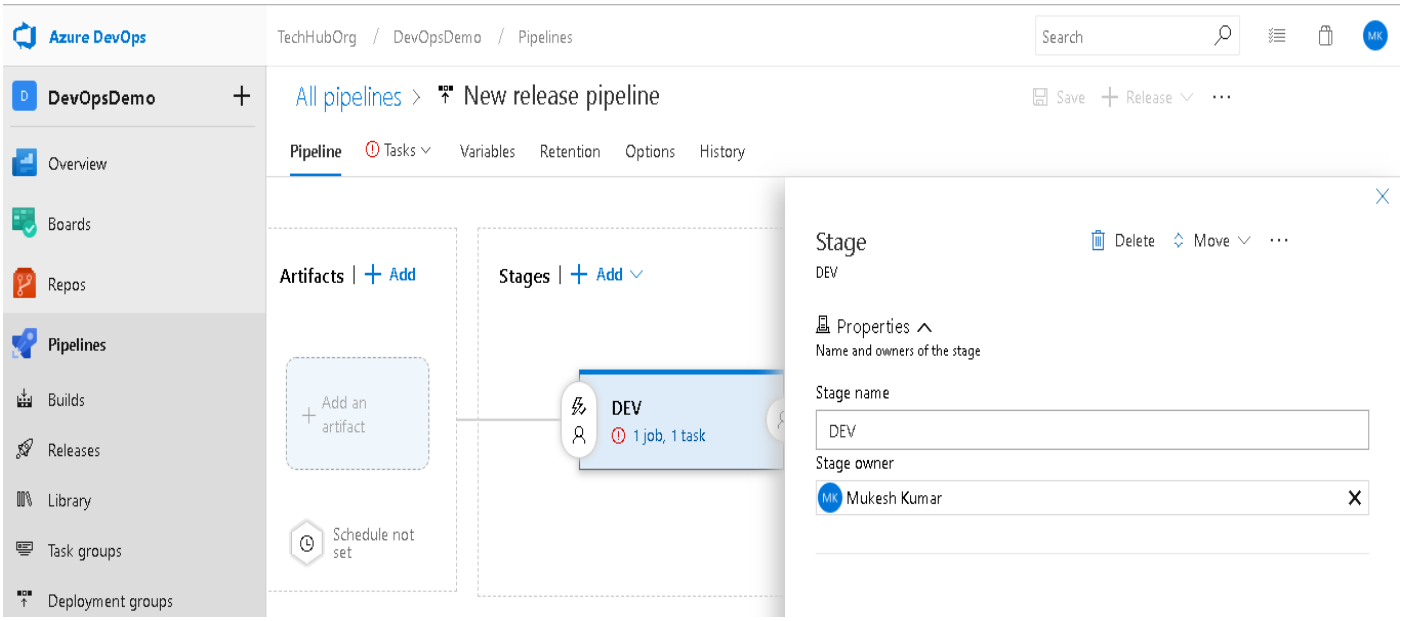
Next screen will ask to configure the **Release Pipeline** like what service we will use, which Artifact will use for deployment, what template will use for deployment etc. So, let select a template **as Azure App Service Deployment** and click to **Apply**. As we have already created 3 App Services above for deployment for different environments like DEV, QA and PRDO. We will choose TestDEV-100 for this DEV stage.

By default the name of the Release Pipeline is **'New Release Pipeline'**. We will change it later.

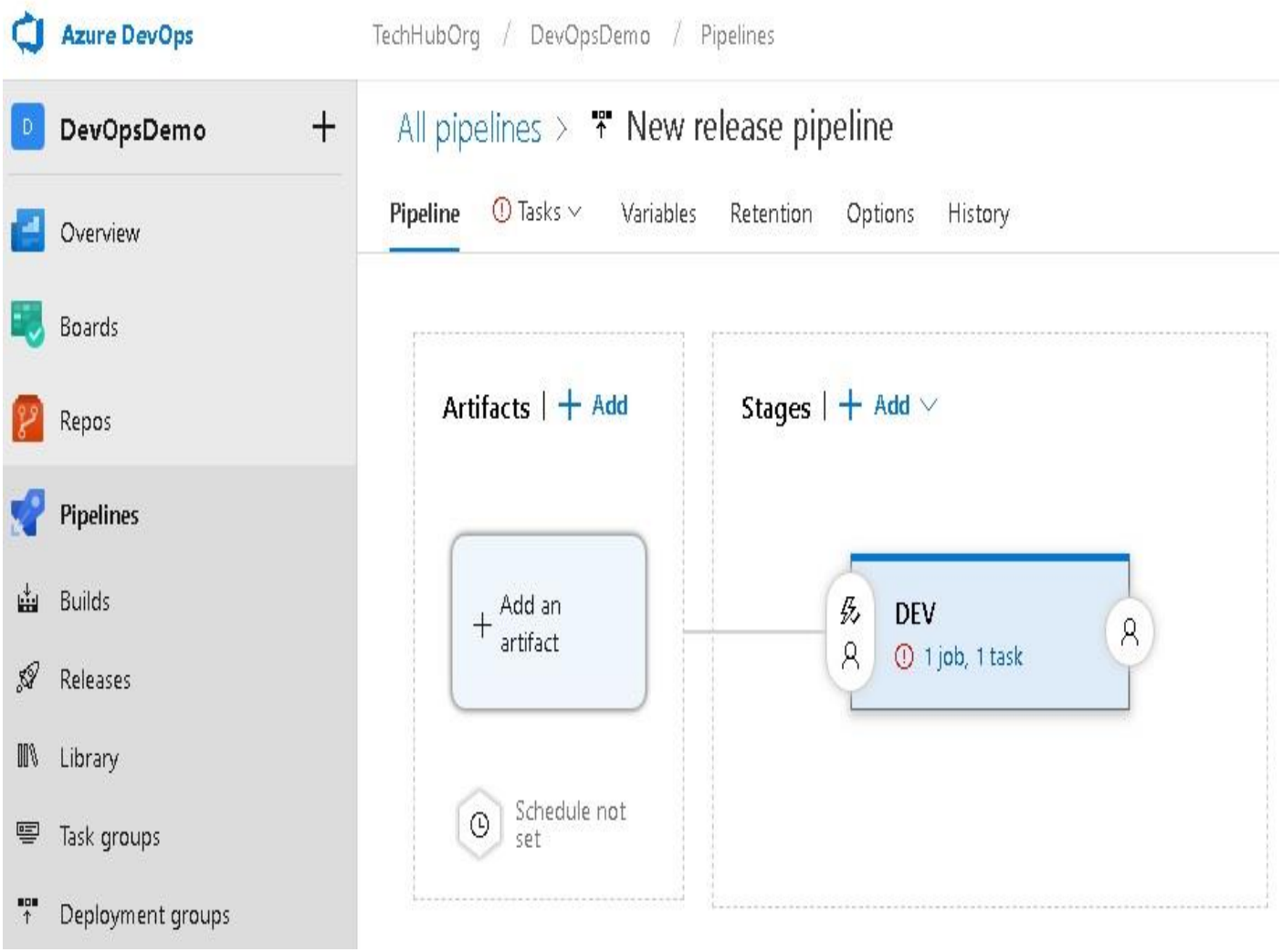


(By: Mukesh Kumar)

After selecting the template as **Azure App Service Deployment**, it will ask to provide the **name** for this stage. This is our first stage, so let provide the Stage Name as '**DEV'** and click to close **(X)** button in right top corner **(Only for closing this dialog, don't close the page itself.).**

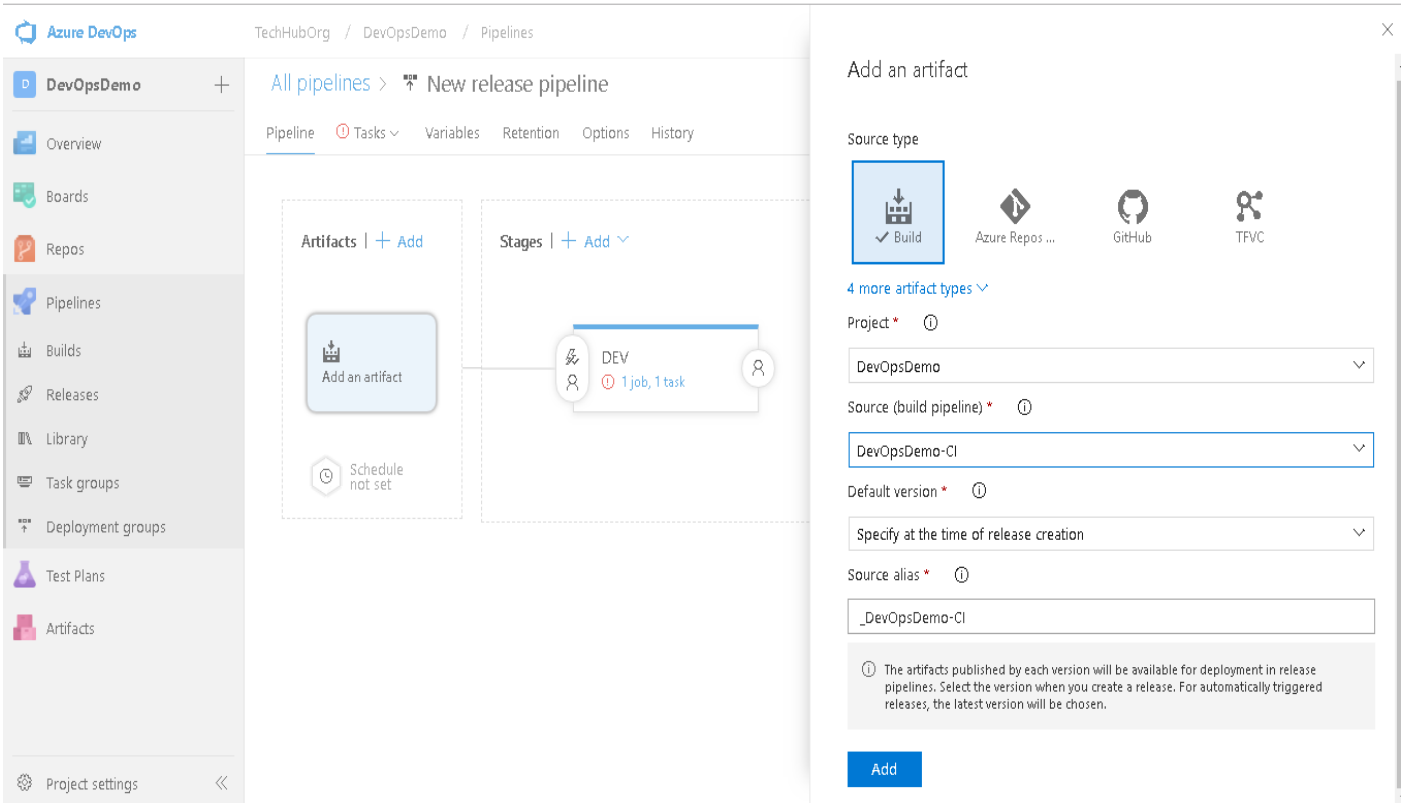


Once we close the stage dialog then we will get the screen something like below. Here, we have two section for now. First one is the **Artifact** section. Here we will **add the Artifact** which is created in **Azure DevOps Build Pipeline**. Another section is **Stage** section. We could have multiple stage like DEV, QA, PRDO etc or many more as per the requirement.

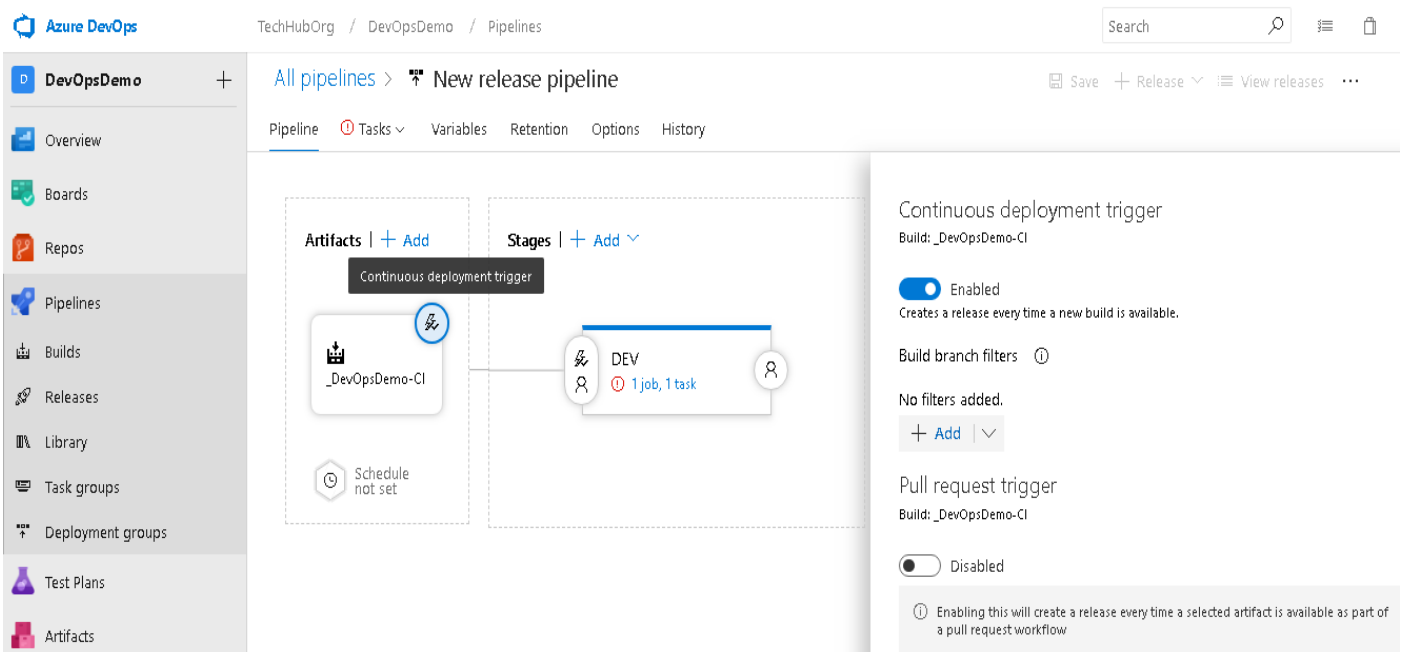


Let click on the **Add an Artifact**. It will open a popup a dialog window in right side as follows. Here we will configure the Artifact. So, first select **the Source Type as Build**, because we will take the Artifact for deployment from the Build Pipeline. Next select the **name of the project as DevOpsDemo**. Next we have to select the **Source (Build Pipeline).** As we have Build Pipeline **'DevOpsDemo-CI'**, so select it. Rest of the options keep the default and click to **Add**.

(By: Mukesh Kumar)



Once we click to **Add**, it will add the **'_DevOpsDemo-CI'** artifact. Now, we have available the **Artifact** which can be deployed to any environment. So, let enable the **Continuous Deployment**. Click on the **Continuous Deployment Trigger** as we can see in below image. It will open the Continuous Deployment Trigger dialog window in the right. Let **Enabled the Continuous Deployment Trigger** which will create a new release every time a new build is available. Let keep all other options are default.

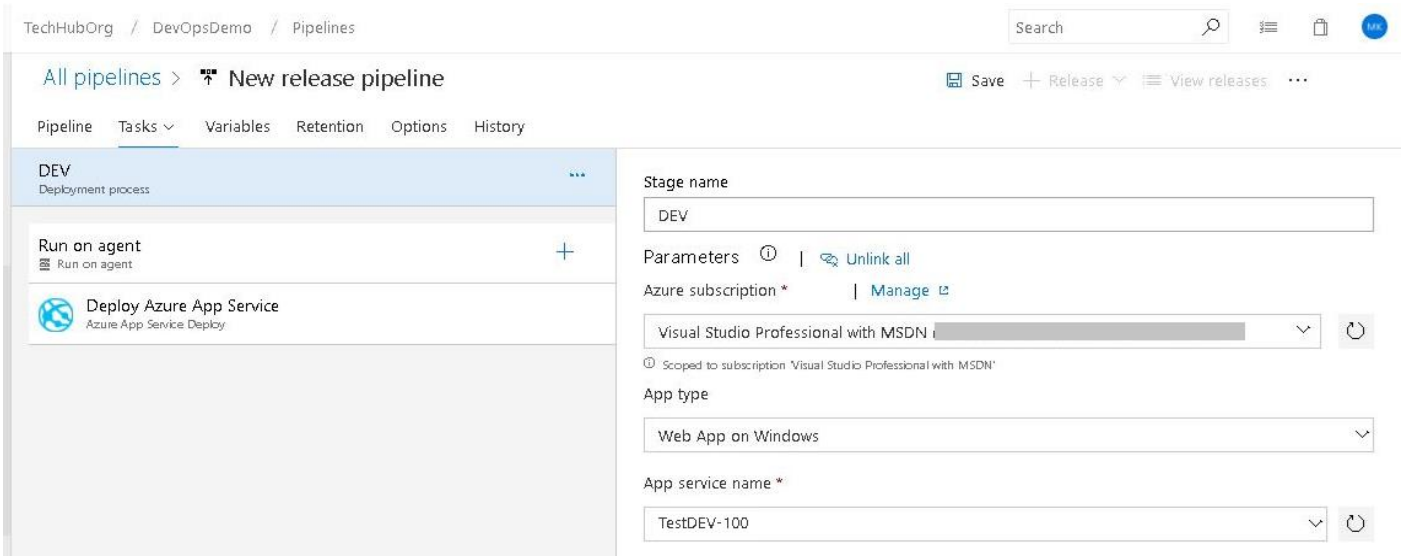


(By: Mukesh Kumar)

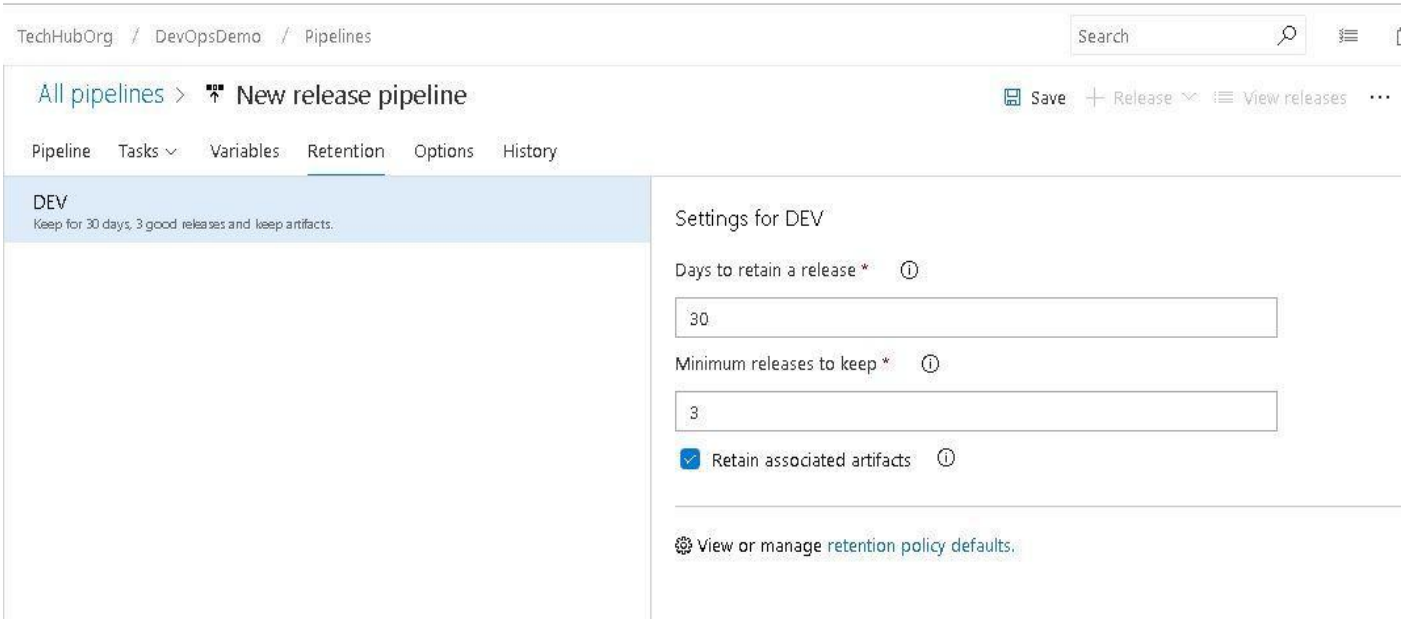
Let close the **Continuous Deployment Trigger** dialog window. So we have done with setup of Continuous Deployment Trigger, if new build will be there then it will deploy to respective environment.

Now let move to Stages section and click to **'1 Job, 1 Task'** in **DEV** stage for configuring the **DEV** environment so that if new build will be there it auto deploys on DEV environment.

Each stage in Release pipeline has its own configuration. We have to move on **Tasks** tab, here we can provide or modify information like **stage name, Azure Subscription** etc. The most important configuration is **App Service name**. We will define the **TestDEV-100 web app in App Service Name** so that after building the application, it can deploy on DEV server first.

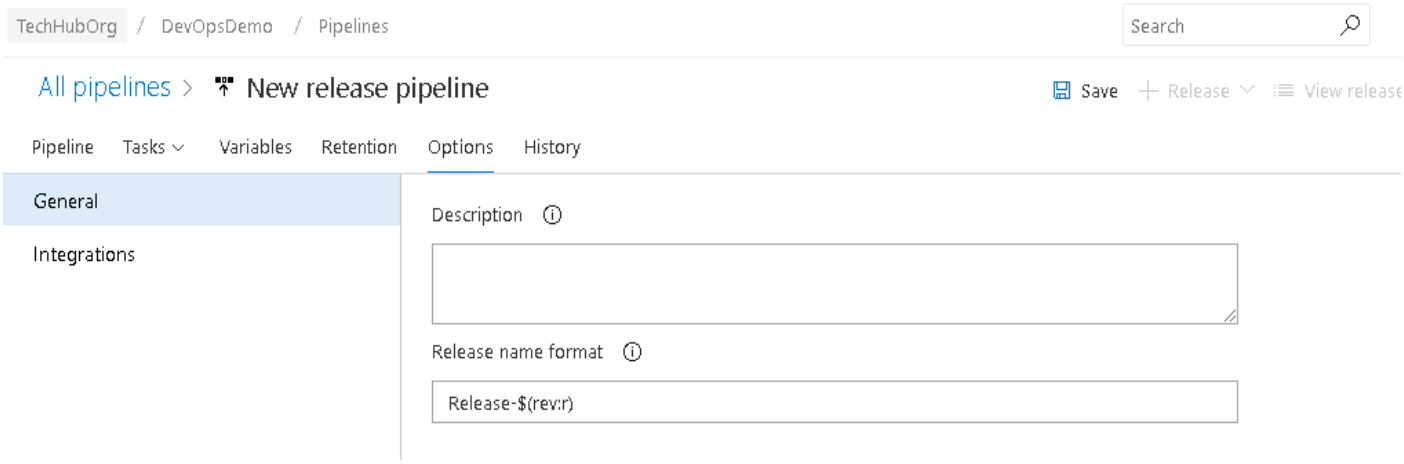


We don't have to do in **Variables** tab section, let it be default value and move to **Retention** tab. Here we can do the setting for **DEV** environment like how many days we would like to retain the release information and how many releases information, we want to keep.



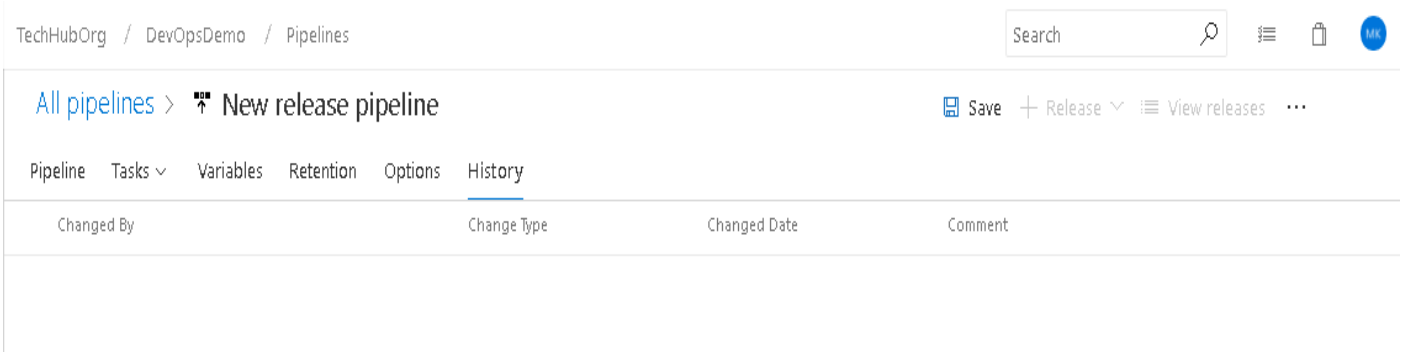
(By: Mukesh Kumar)

Now let move to **Options** tab, here we can provide the information about this Release like **description of the Release** and what will be **format of Release Name.** By default, it will create default format for release name but it can be modify.



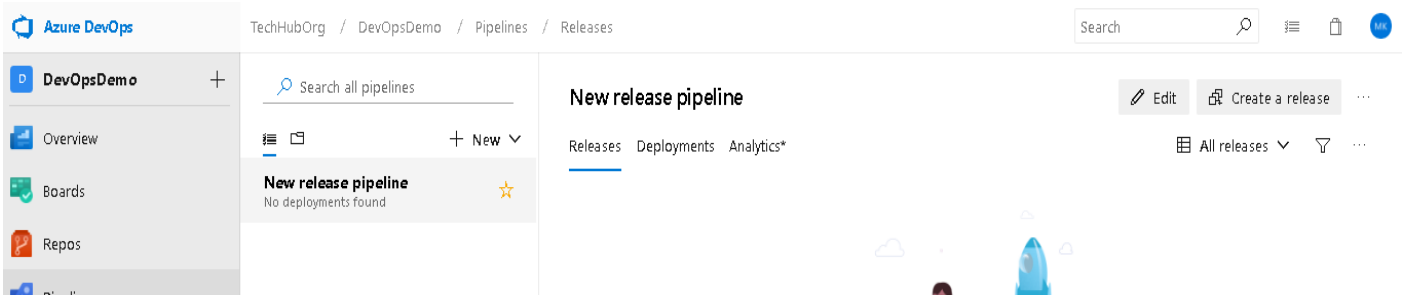
Next tab is **History** tab. Here for now, we will not find anything. It will be empty because we haven't run any release cycle for now.

After configuring all tabs as per the requirements, its time to **save** the information. So, click on **Save**.



After creating and saving the release pipeline, we can see our configured Azure DevOps Release pipeline as follows.

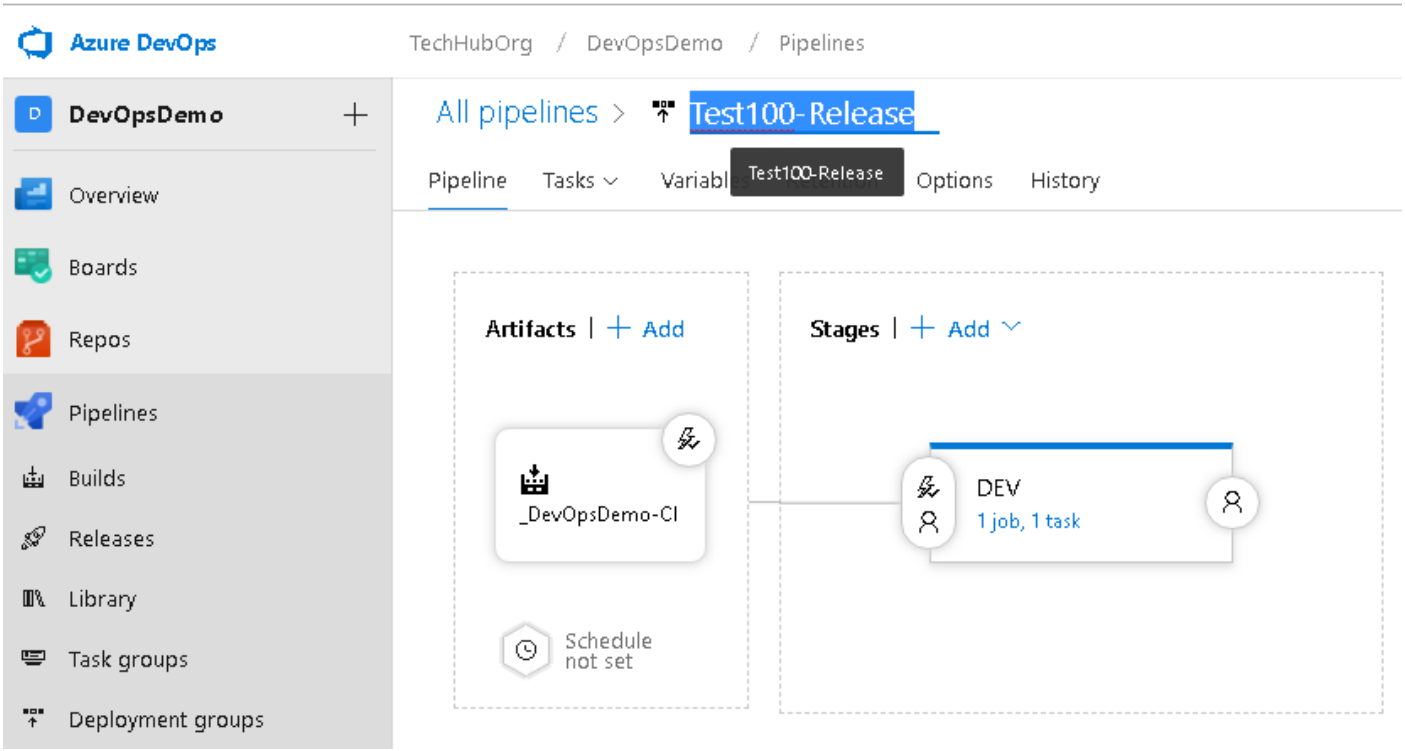
We can see Release pipeline anytime from **Pipeline>Releases**. Here we can see all the available Release pipeline. If we would like to **Edit** and then we can **edit** also.



Let click on the **Edit** button **(As showing in above image)** for **editing the Release Pipeline**. Once we click to edit the release pipeline, it will open the same page from where we can define the artifact and other stages information.

(By: Mukesh Kumar)

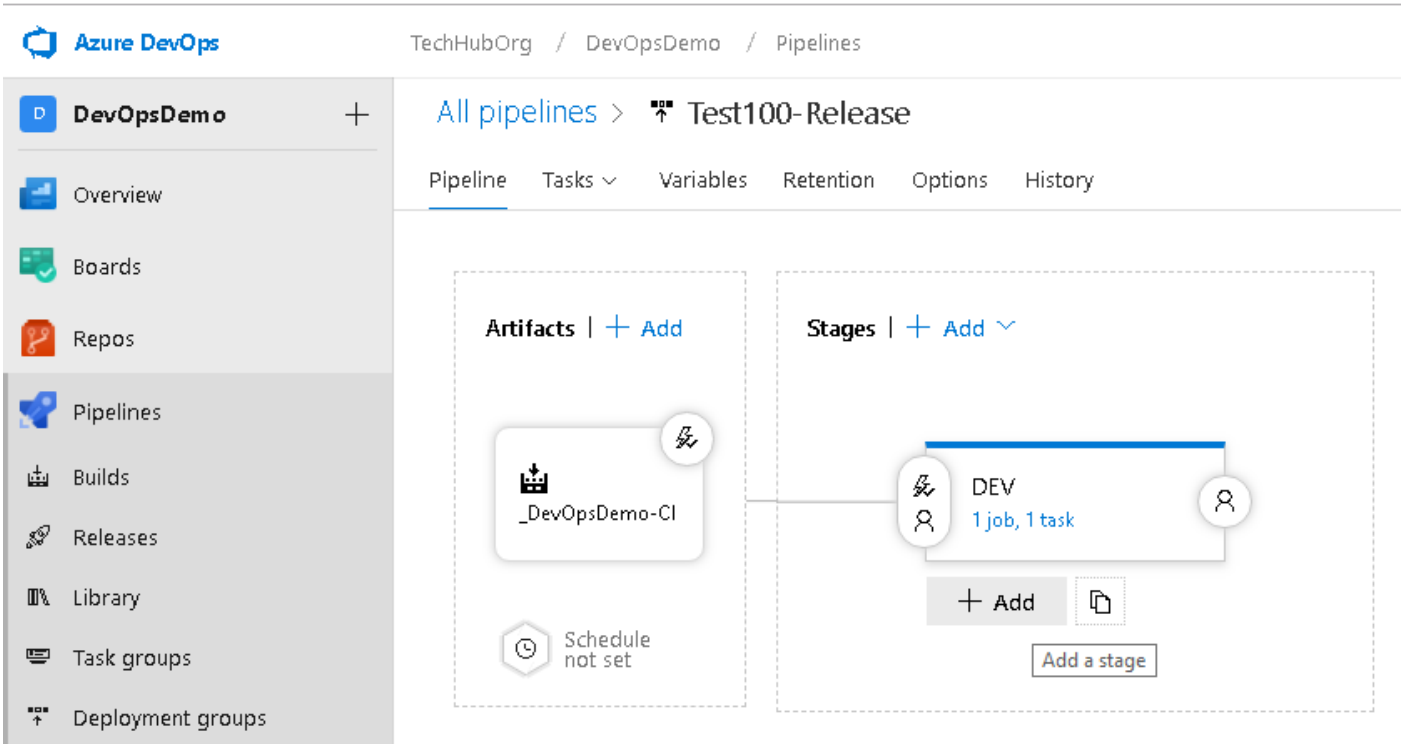
So, let first modify the name of the Release Pipeline. Click on the **'New release pipeline'** text just after All pipelines and rename it with **'Test100-Release'**. So, we have changed the name of the **Azure DevOps Release Pipeline** name.



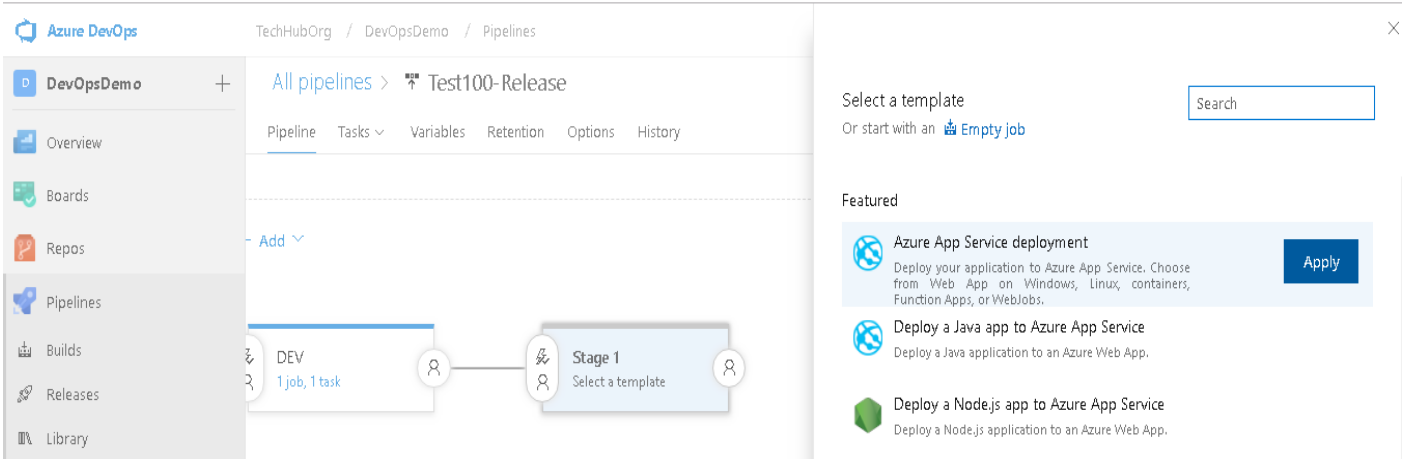
8.2 Create QA Stage

We have already setup the **DEV** environment. If new build will be available it wil deploy to **Dev (TestDEV-100 Web App)** environment. But let add one more stage for **QA (TestQA-100).**

For **adding new stage**, we can directly click to **(+ Add)** icon just after Stages or mouse hover just below to DEV stage, here we will get the icon (+ Add). Just click on it.

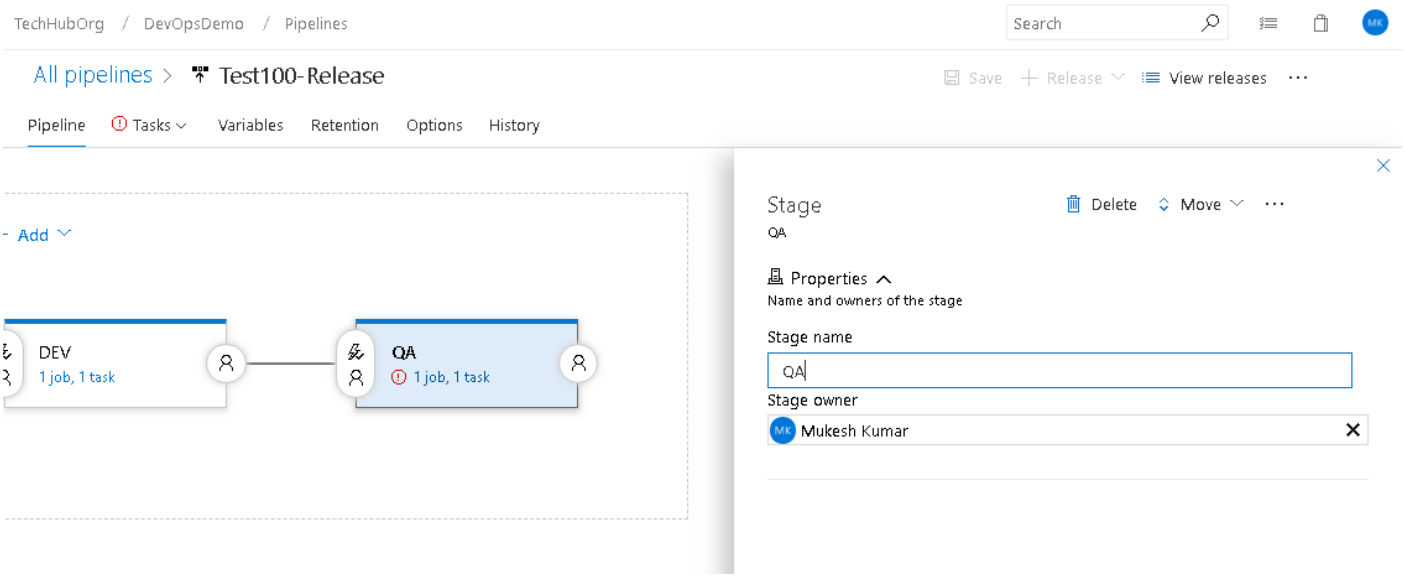


So, it has added one more stage in **Azure DevOps Release Pipeline.** Now, it is asking for selecting the template. We have to follow the same process which we have already followed for **DEV (TestDEV-100)** environment setup. So, let select the template as **'Azure App Service Deployment' and click to Apply button.**

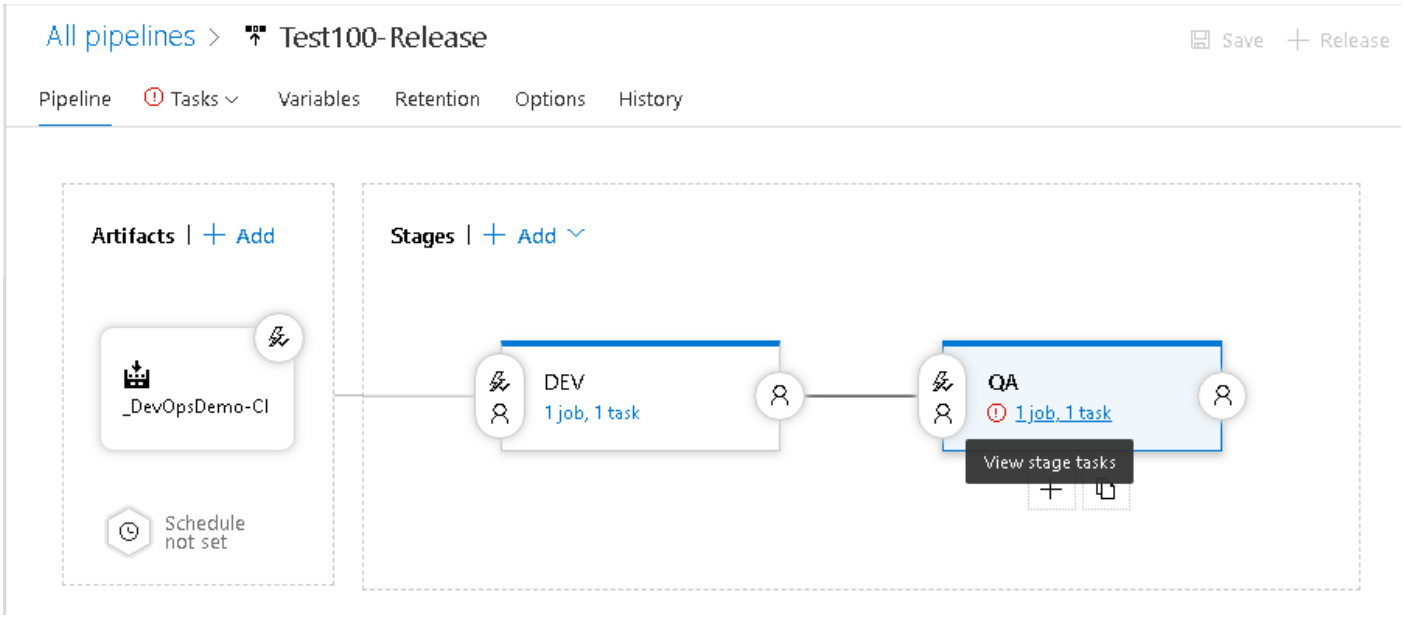


Close the **'Select Template'** dialog window and we will see that one more stage (**Stage 1 – in above image)** has added just after DEV stage. Now, click on the **Stage 1** and change the stage name to **QA** as showing in following image.

(By: Mukesh Kumar)



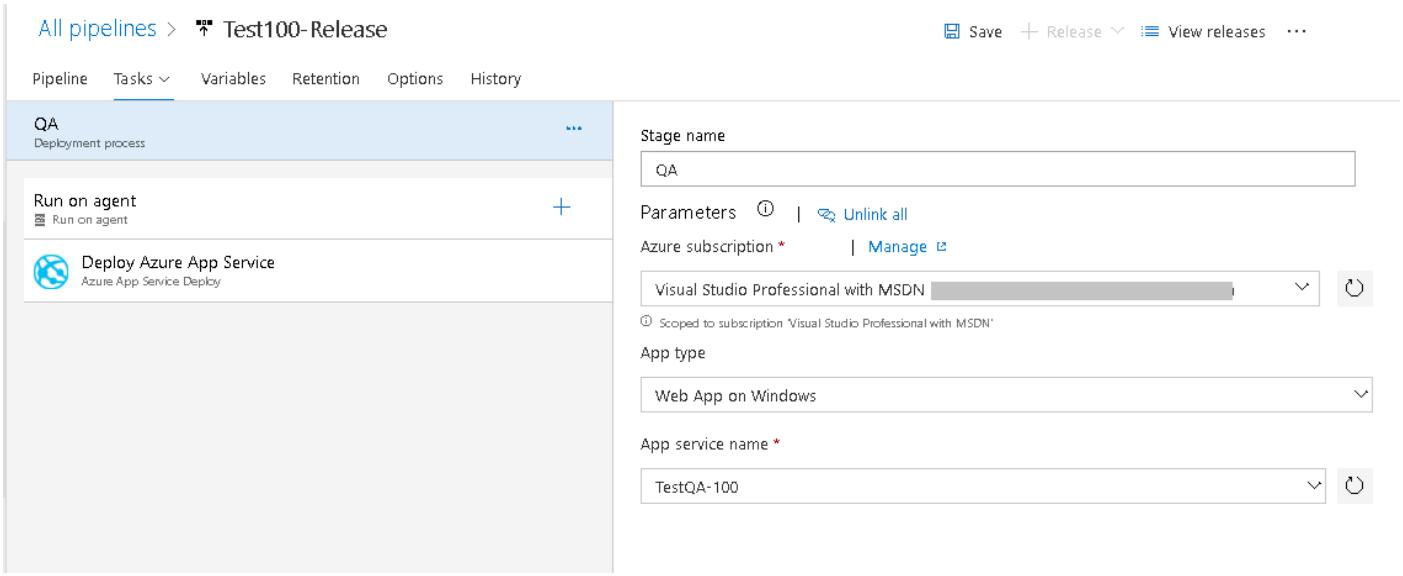
Now close the the Stage name dialog using close **(X)** icon in the right top corner. Its time to configure the **QA (TestQA-100)** environment. So, click on the **'1 Job, 1 Task' in QA stage.**



Here, we have to configure the **QA stage**. First tab is Tasks tab. Here we will do the configuration as we have already done for DEV stage. So, let provide the Azure Subscription and most important the App Service Name as **'TestQA-100'**.

For the rest of the tabs like **Variables**, **Retention**, **Options** and **History**, we are not going to do anything. We will keep the default setting for these tabs. But we can modify it as per our requirements. Now click to **Save**.

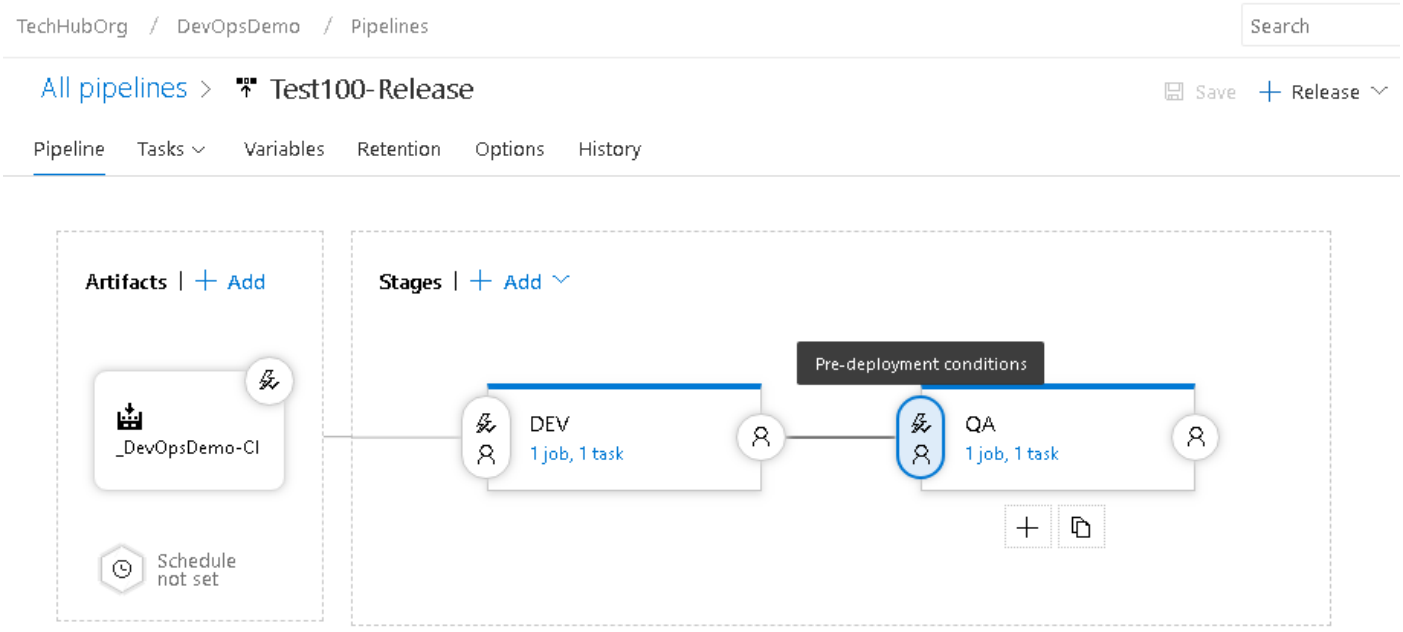
(By: Mukesh Kumar)



This time, we have two stages **DEV and QA**. What we have configured till yet that if new build be available then it automatically will deploy on DEV stage. But what about QA. How we will deploy on QA.

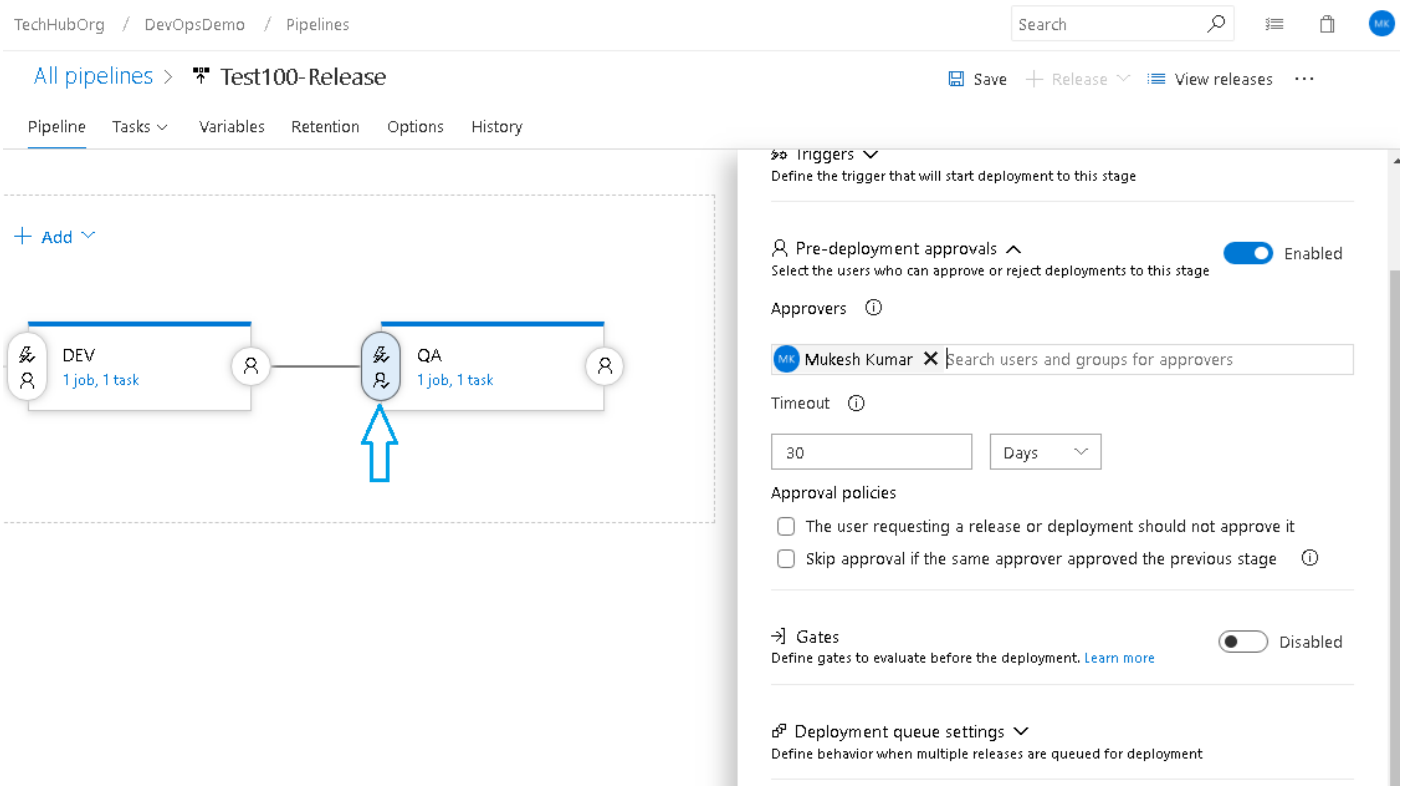
Actually for build deployment, it will deploy automatically to all stages one by one once after build is available. But here we would like to some confirmation before deploying on the QA stage.

So, let configure the **'Pre-Deployment Conditions'**. Click on the **'Pre-Deployment Conditions'** from the **QA stage** as showing in below image.



Enable the Pre-Deployment Approvals and provide the **name of the approver** in Approvers section. For this demonstration, we are providing the current user name **'Mukesh Kumar'**. So, now after DEV deployment, the Artifact will not auto deploy to QA. It will first wait for the approval by Mukesh Kumar.

(By: Mukesh Kumar)



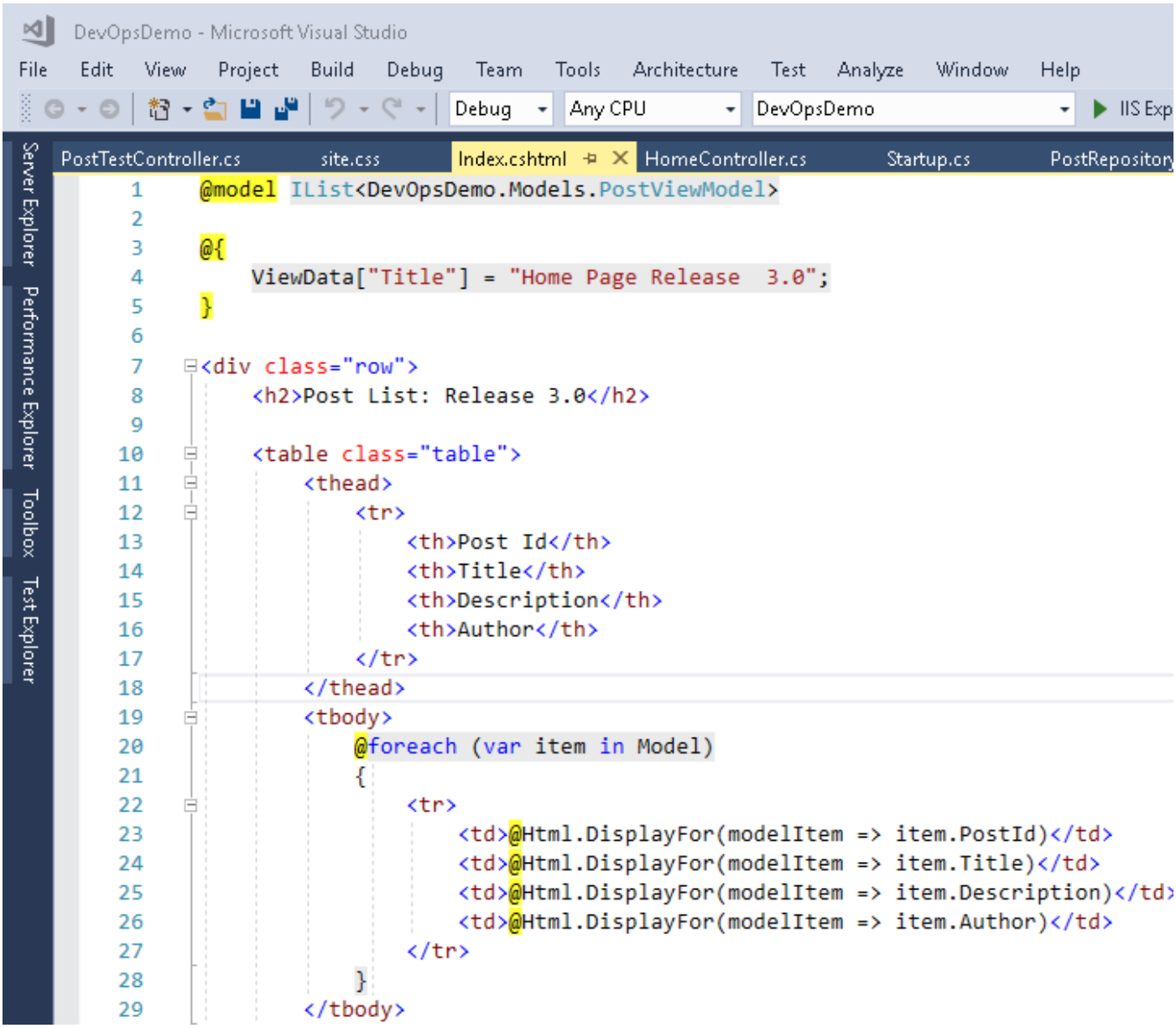
We have done with **QA environment setup**. Let click to **SAVE** for saving the **Azure DevOps Release Pipeline with new stage as QA.**

So, what we have achieved so far. We have configured the Azure DevOps Build Pipeline as well as Release pipeline. In Release pipeline, we have created two stages for two different environments like DEV and QA. So, if new build (Artifact) will be available then it first will deploy to DEV (TestDEV-100) environment and will ask for Approval before deploying it to QA (TestQA-100).

Now, its time to see the real time deployment. How build deploy on the different stages. So, let open the Visual Studio 2017 or higher version. And opent the project '**DevOpsDemo'**, which we have created in previous section.

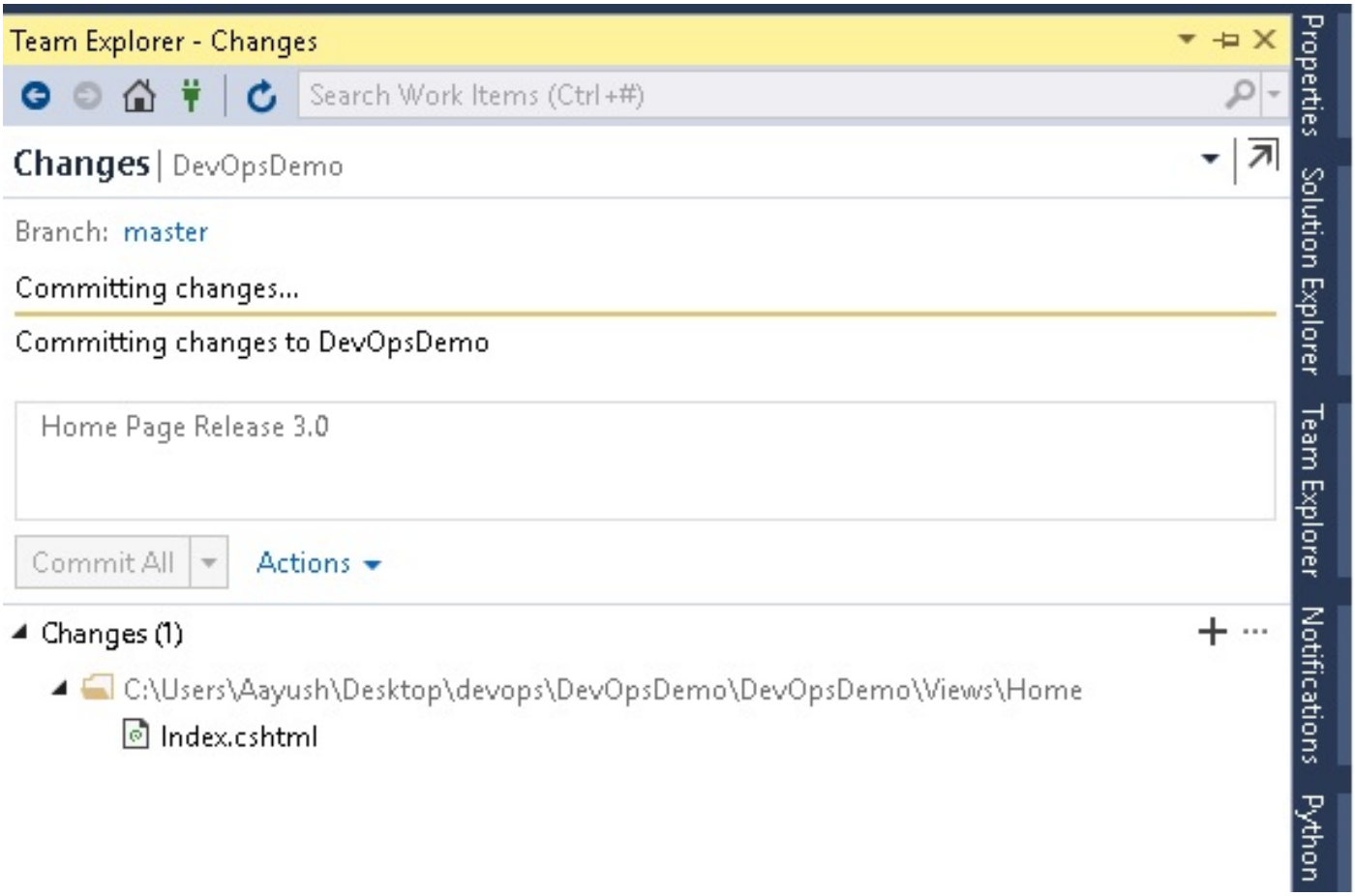
Open the **Index.cshtml** file in main project and replace the text for title from **'Home Page'** to **'Home Page Release 3.0'**. And similarlly change the text **'Post List'** with **'Post List Release 3.0'**. Here we will only change the version number and see the output after auto deployment.

(By: Mukesh Kumar)

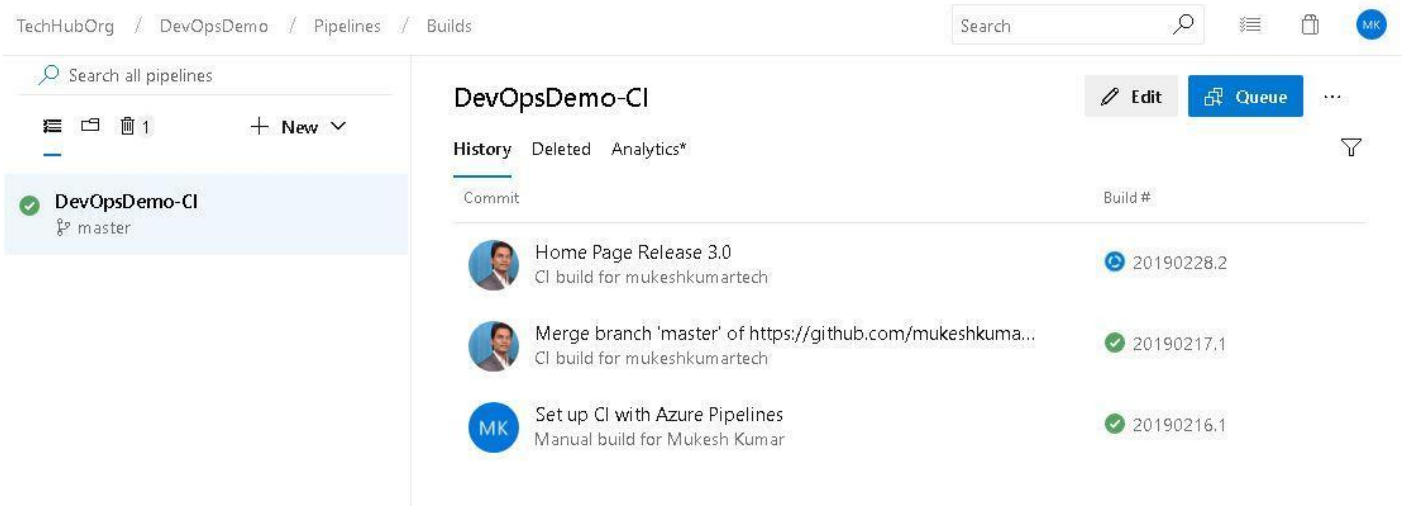


Its time to check in the code in **GitHub** repository. So, Go to **Team Explorer > Changes > prvoide the comment as 'Home Page Release 3.0'** and click to **'commit all and sync'.**

(By: Mukesh Kumar)

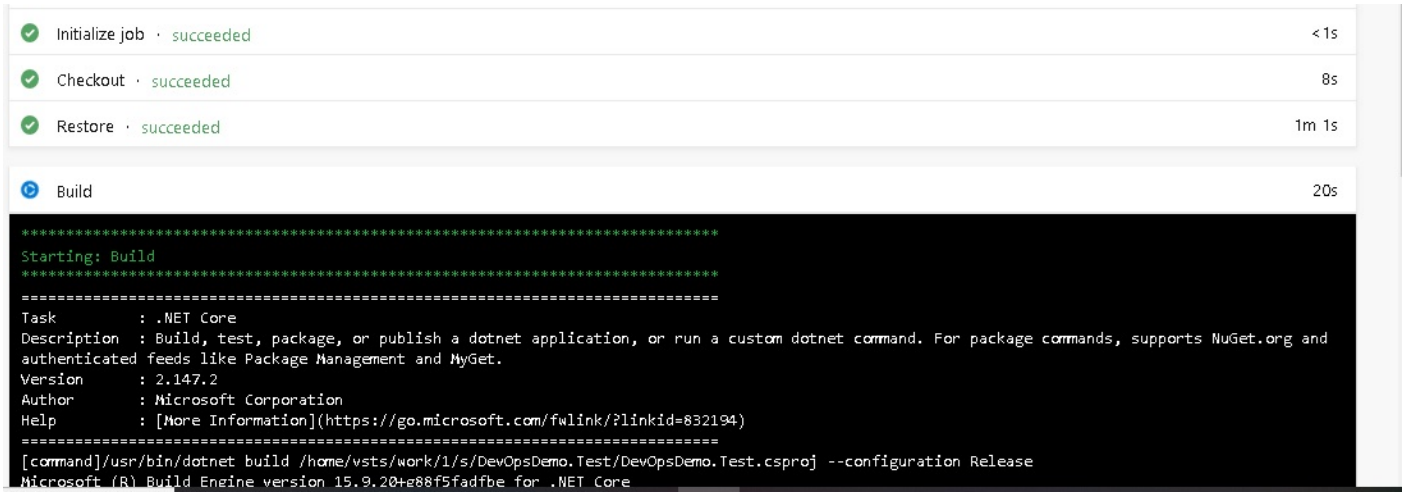


When we open the **Build Pipeline**, in the **history** tab, we can see that a new **Continuous Integration build is started** with same comment which we have provided at the time of check in the code as **'Home Page Release 3.0'**.

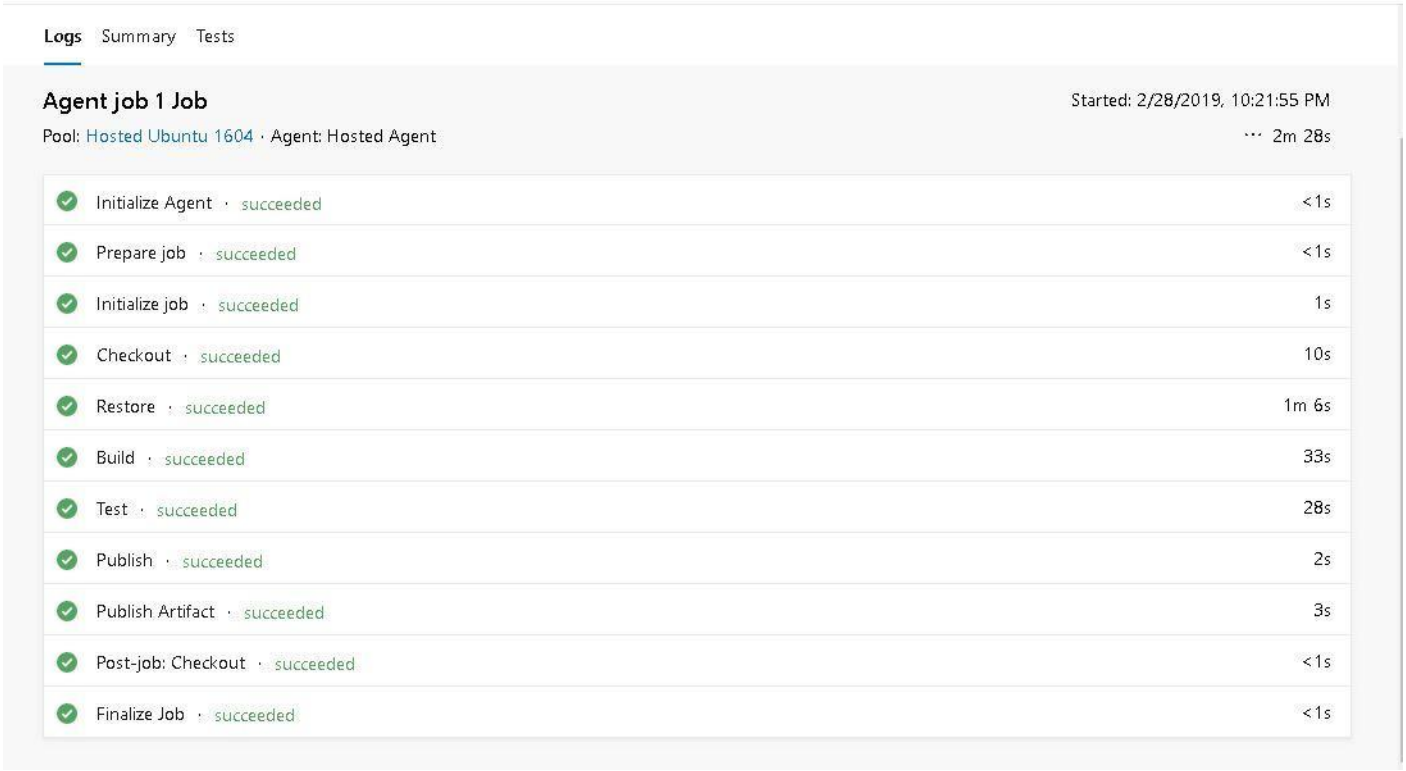


Click on new started build and we will see that all the Jobs are executing one by one as follow.

(By: Mukesh Kumar)



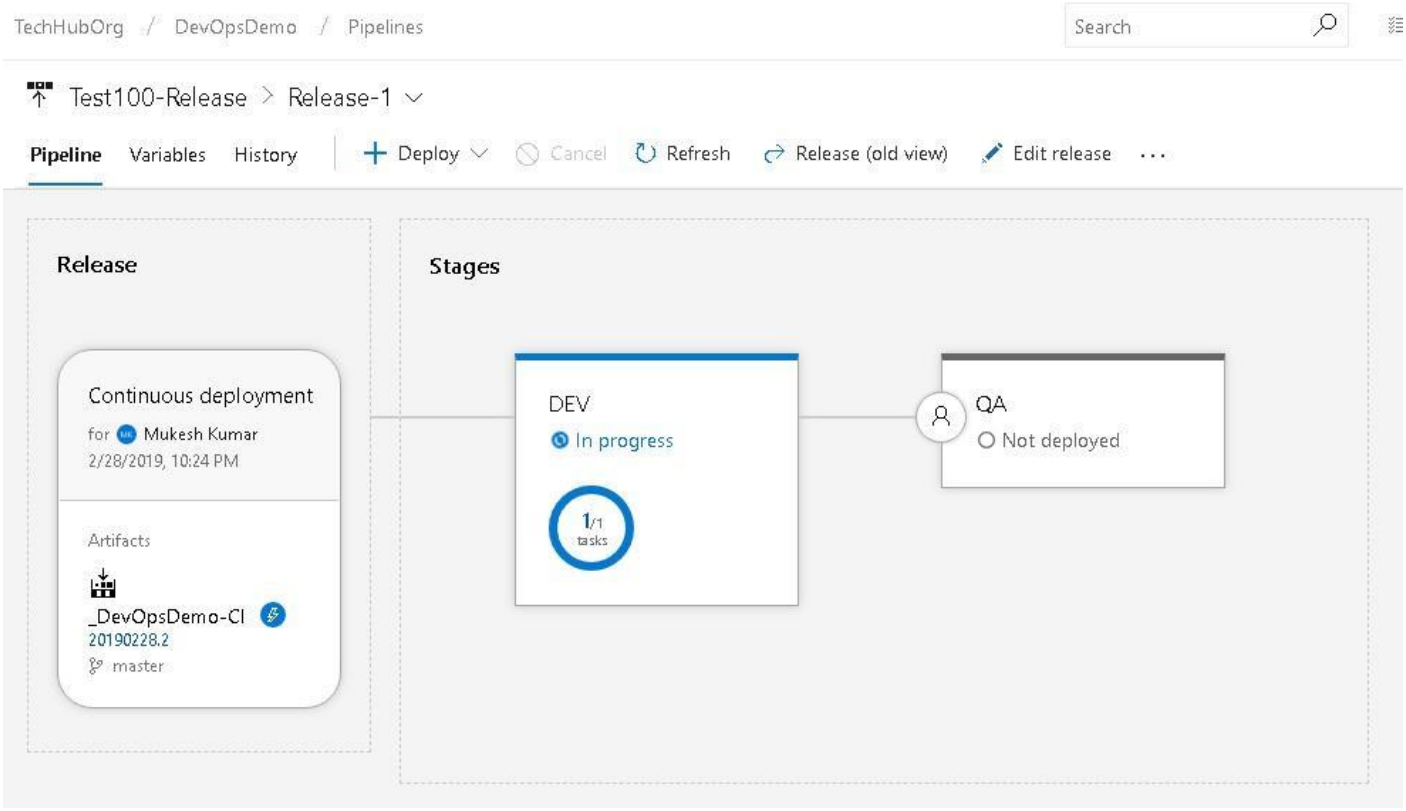
Once all jobs execute successfully then we can see the a **'succeeded'** message in **green color for each Job**.



Let move **to Azure DevOps Release Pipeline** and open **Test100-Release**. Here we can see that one release is initiated as **'Release-1'** and **DEV** is processing this.

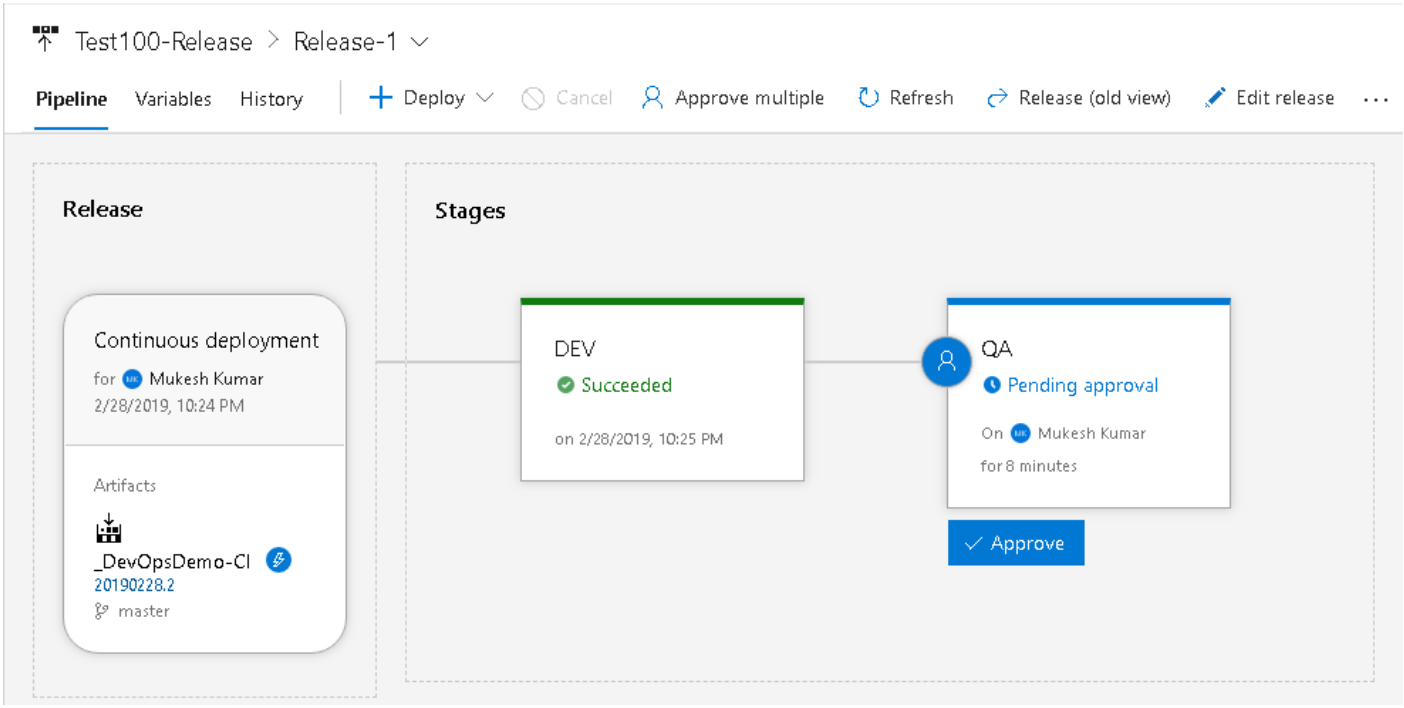
(By: Mukesh Kumar)

Now, click on the **Release-1** for detailed information. As per the following image, we can see that we have artifact **(build)** is available and this is performing the **Continuous Deployment on DEV (TestDEV-100)** environment. Yet it is in progress.



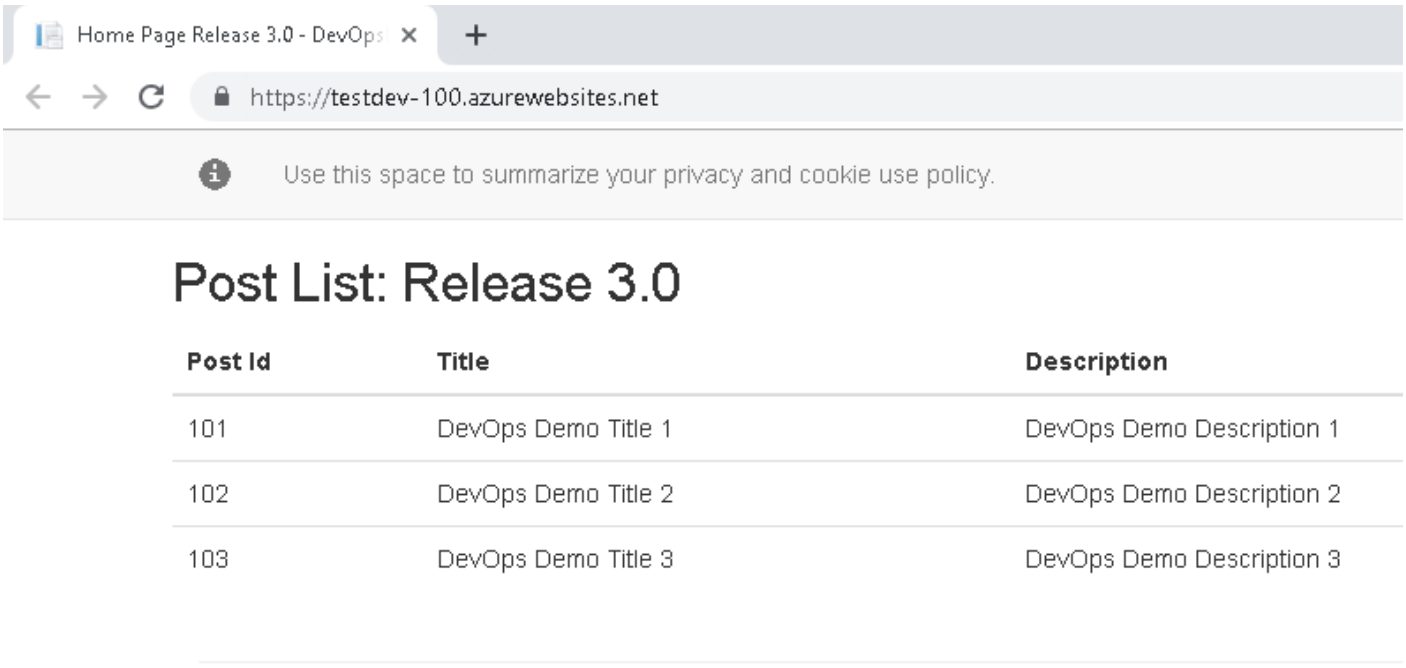
After few minutes, we will see that **Continouse Deployment** has done on **DEV**. But for **QA**, it is **pending for approval**. Once a current user (**Mukesh Kumar**), as we have defined earlier, will approve then Continous Deployment will start on QA.

(By: Mukesh Kumar)



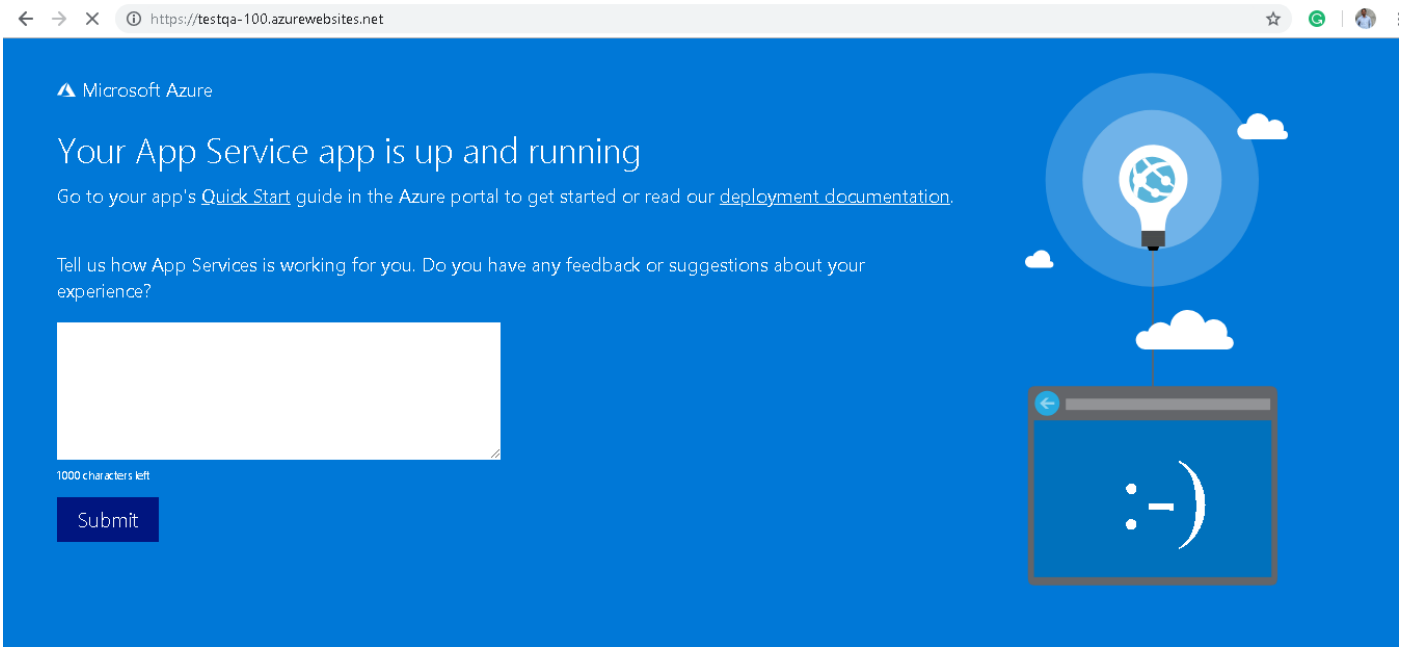
So, let check first what has been deployed on **DEV** environment. So, open the **TestDEV-100 App service**. Here we can find the URL for accessing the TestDEV-100 app service and it is https://testdev-100.azurewebsites.net. Let open this in **browser** and here we go.

Great, as we can see with below image. It has been successfully deployed the **Release 3.0 on DEV (TestDEV-100)** environment. We can see both title and post list text are shoiwng **Release 3.0**.

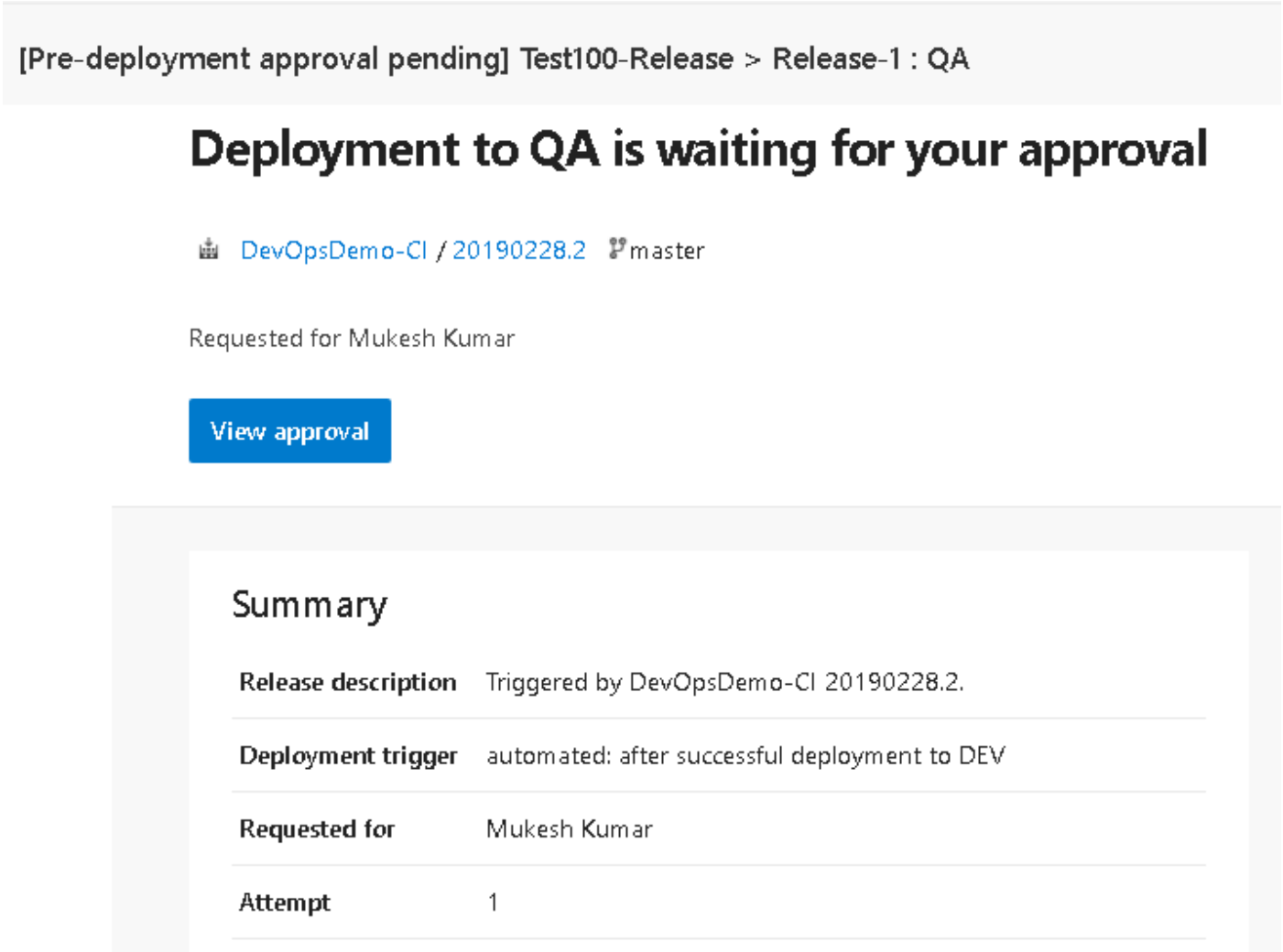


Now, let move to **QA** environment and open **TestQA-100** app service using URL https://testqa-100.azurewebsites.net. And we will see that nothing has deployed yet on QA environment. And its showing the default page for Azure App Service.

(By: Mukesh Kumar)

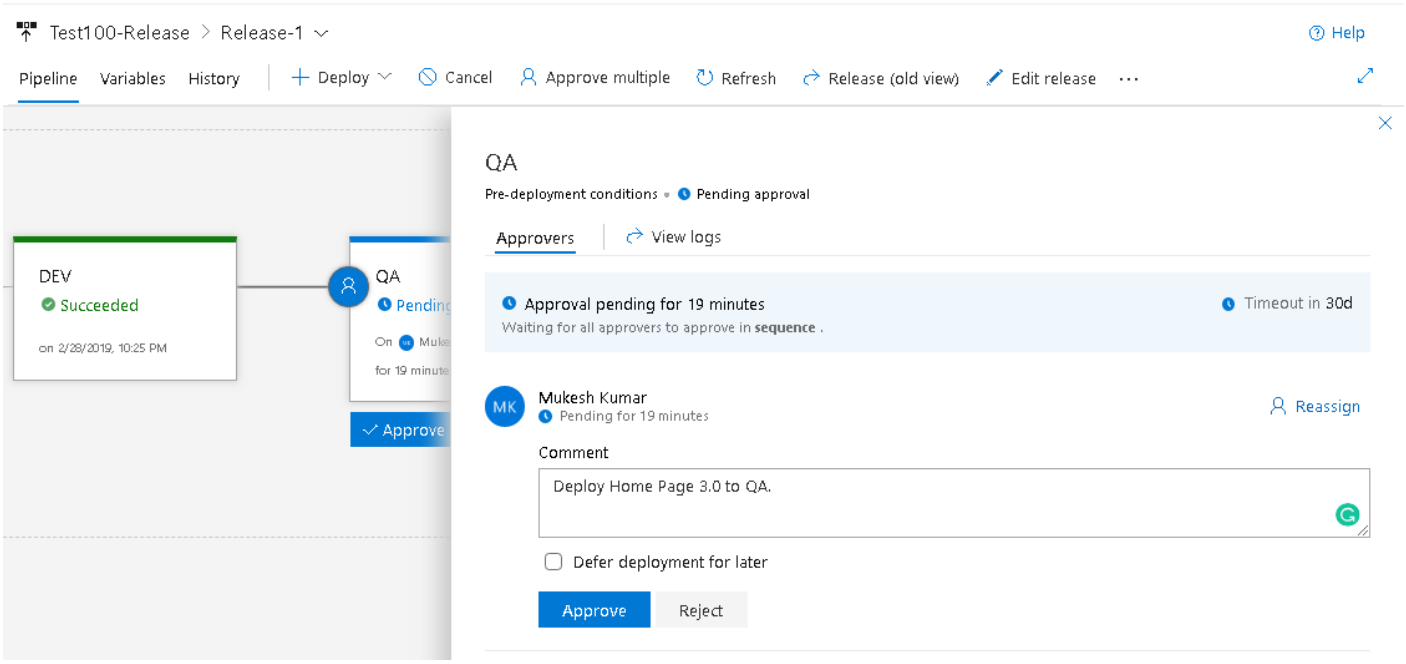


We will also be informated via email that approval is pending for QA deployment.

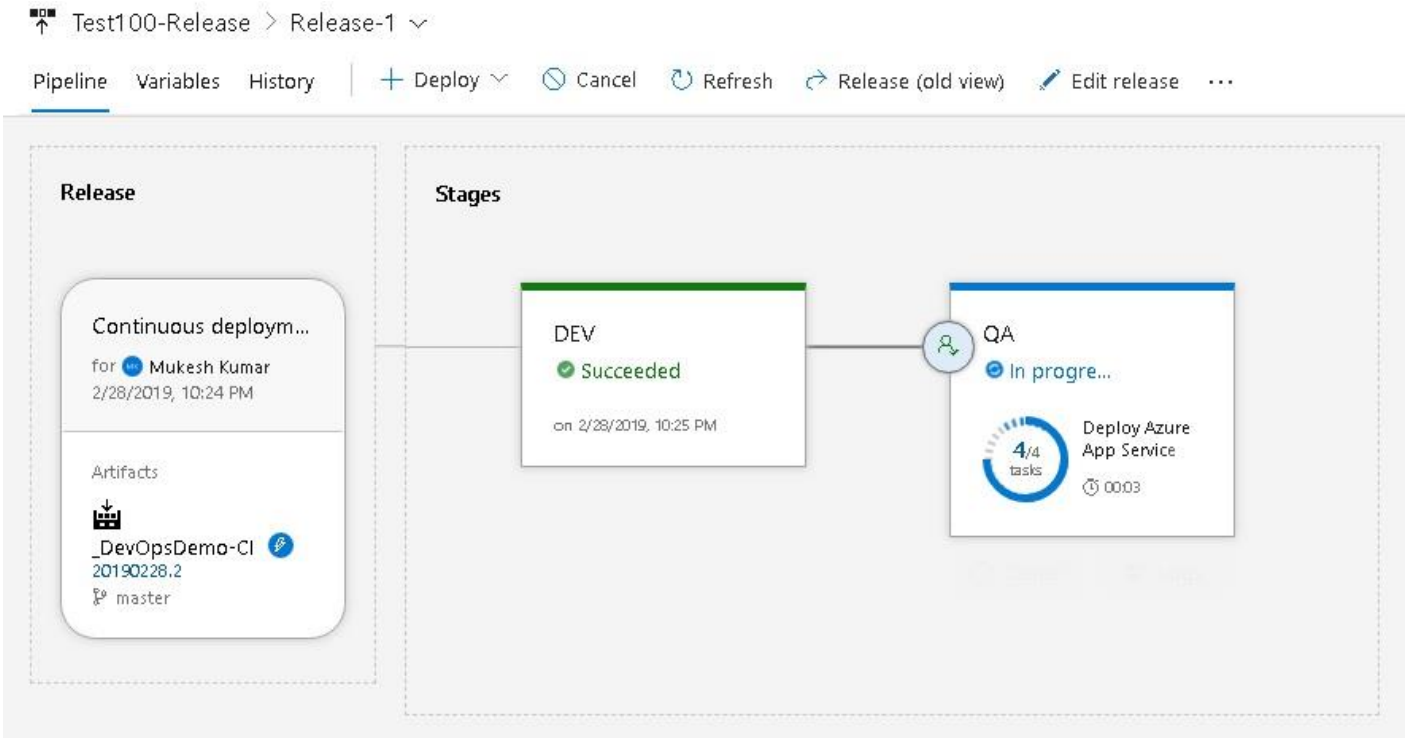


(By: Mukesh Kumar)

Now, let current user **(Mukesh Kumar)** to approve the pending approval for QA environment. When we click on **Apprvoe button** from **QA** stage, it will open the dialog where we can put some comment before approving it. So, let put the comment as **'Deploy Home Page 3.0 to QA'** and click to **Approve** button.

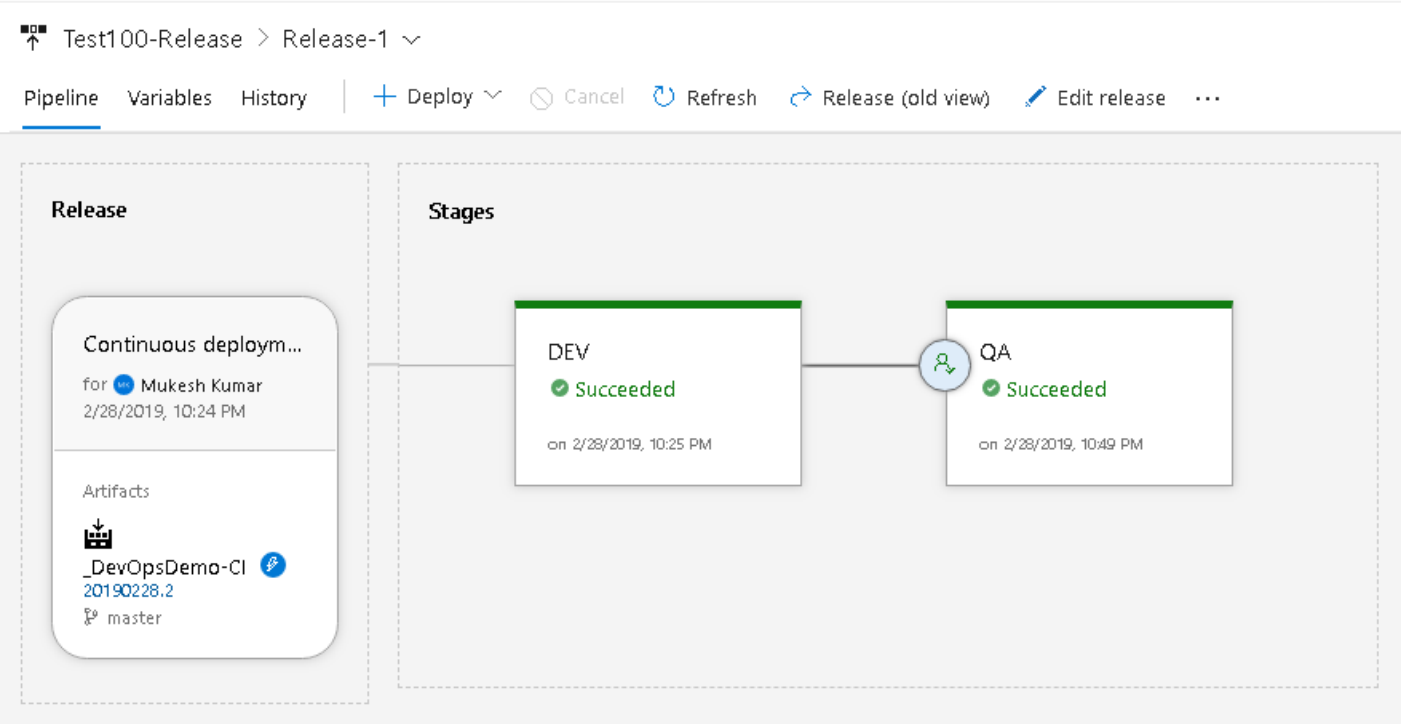


As pending approval will approve, **Continous Deployment** has initiated and will start deploying the Artifact (Build) on **QA (TestQA-100)** environment.

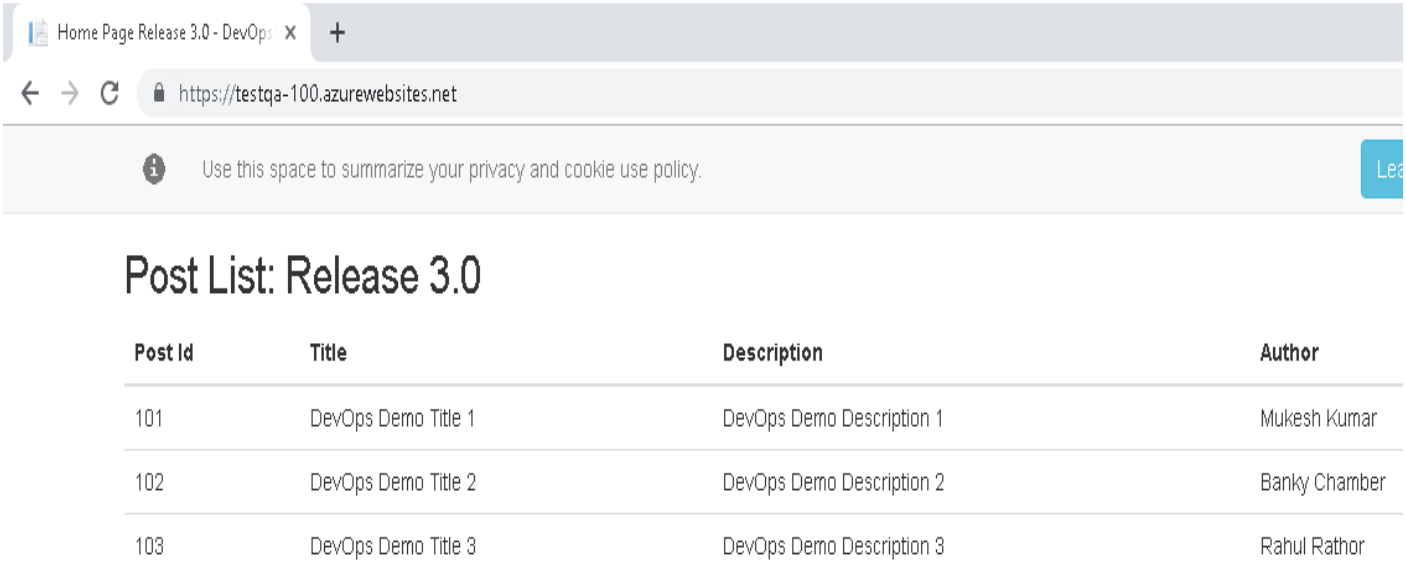


After few minutes, the deployment will done on QA and we can see **succeeded** message on **QA stage.**

(By: Mukesh Kumar)



Now, once more let open the **QA (TestQA-100 App Service)** URL as https://testqa-100.azurewebsites.net. And here we go, we have **successfully deployed to QA of release 3.0.**

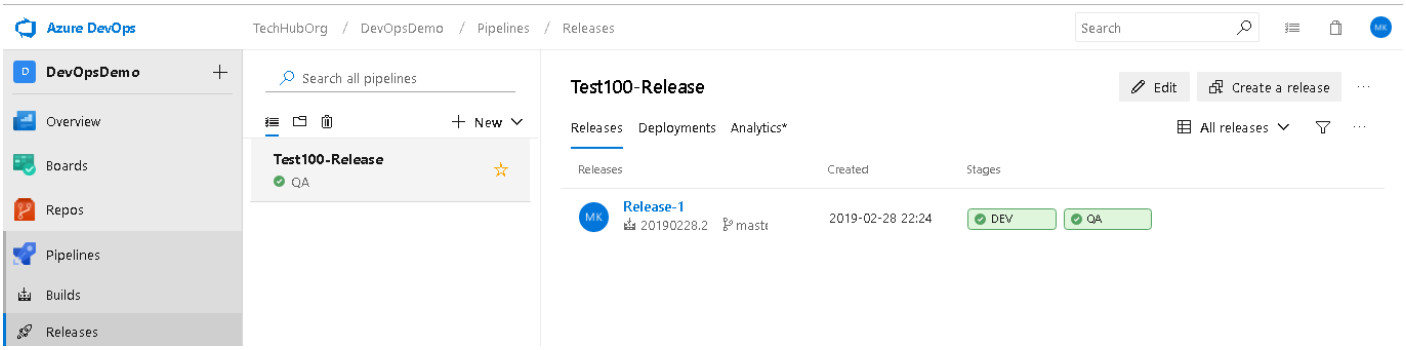


So far, so good. We have seen, committing the code into the GitHub repository, building the code in Build pipeline, executing the unit test cases in Build pipeline, deployment on the DEV and QA environment.

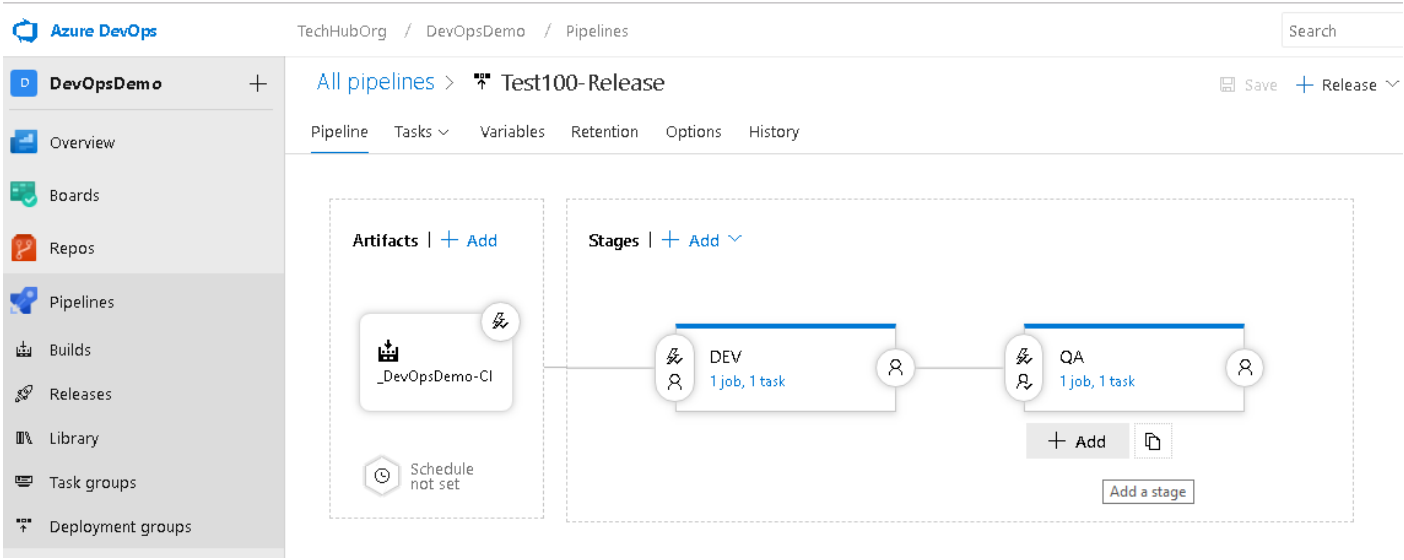
(By: Mukesh Kumar)

8.3 Create Prod Stage

Now, its time to add one more stage as **PROD**. So, open the **Pipeline > Release > Test100-Release**. From here just click on **Edit** button for editing the **Azure DevOps Release Pipeline**.

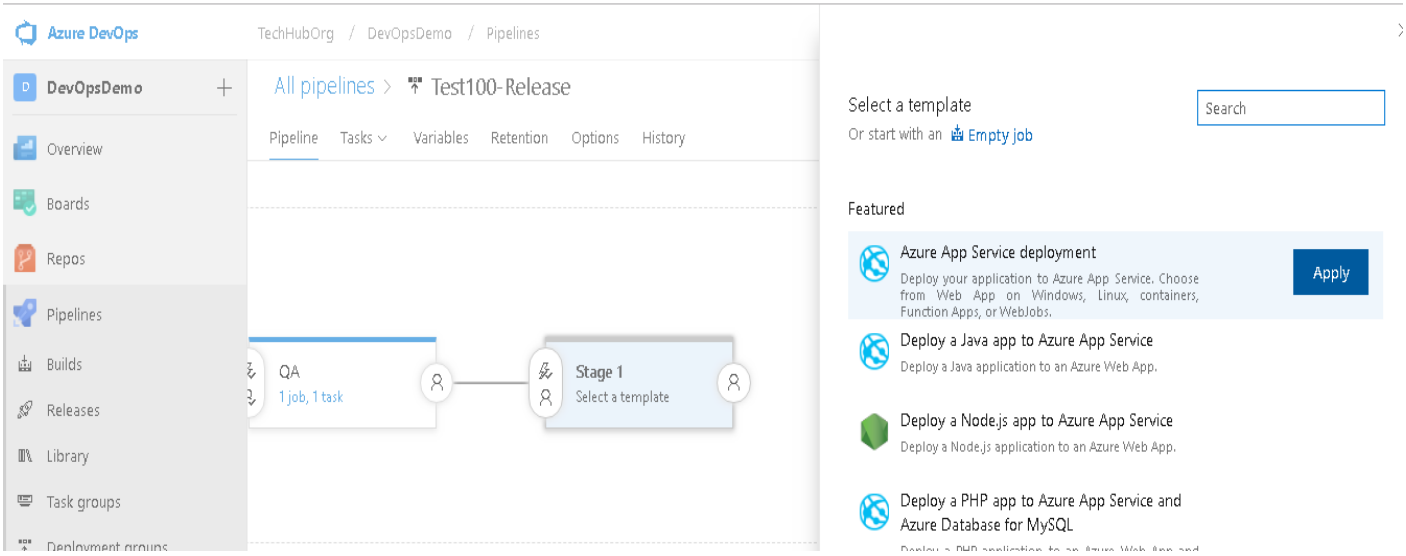


Follow the same steps which we have already followed while adding the **QA stage**. So, just mouse hover just below to QA stage and click to **(+ Add)** icon for adding the new stage.

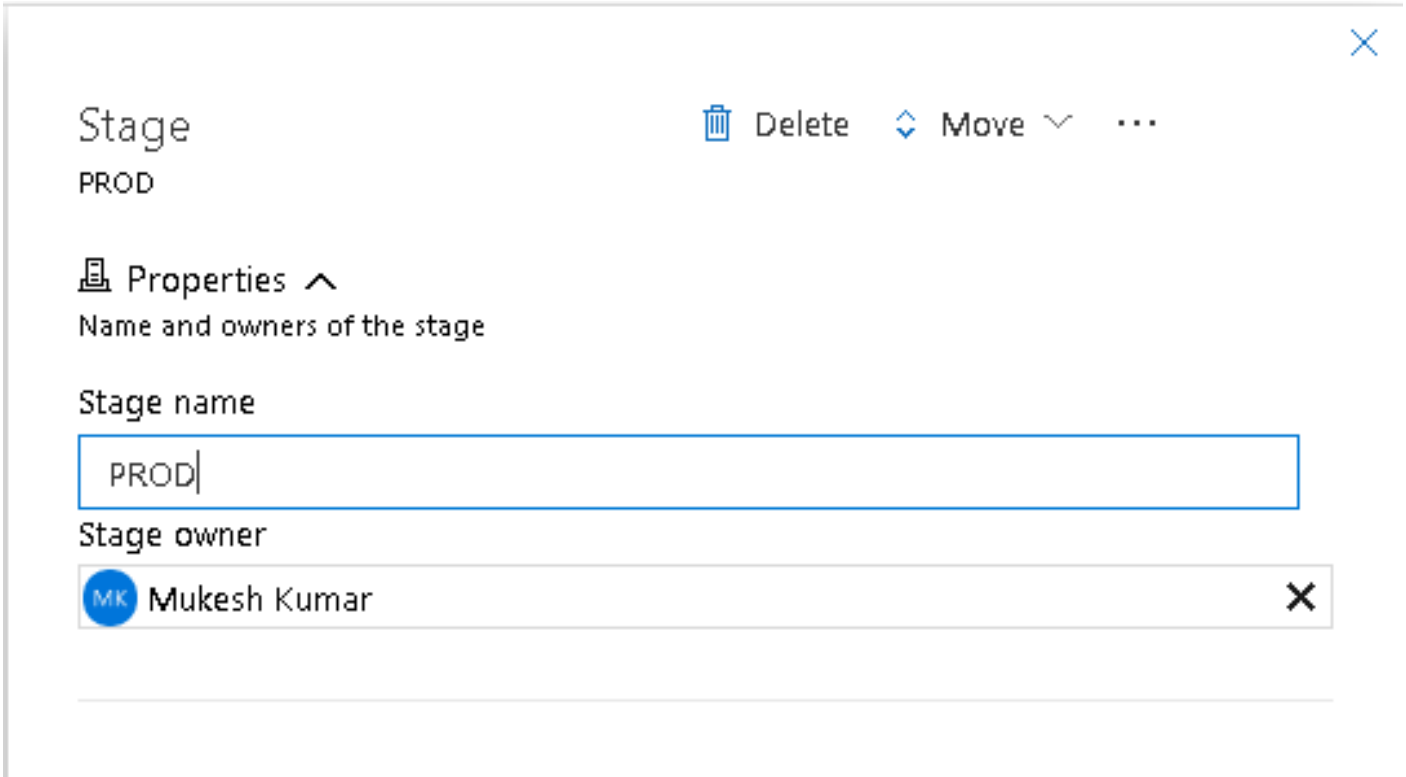


As generally, it will ask to select the template. So, select the template as **'Azure App Service Deployment'** and click to **Apply**. After applying the template just close this dialog window.

(By: Mukesh Kumar)

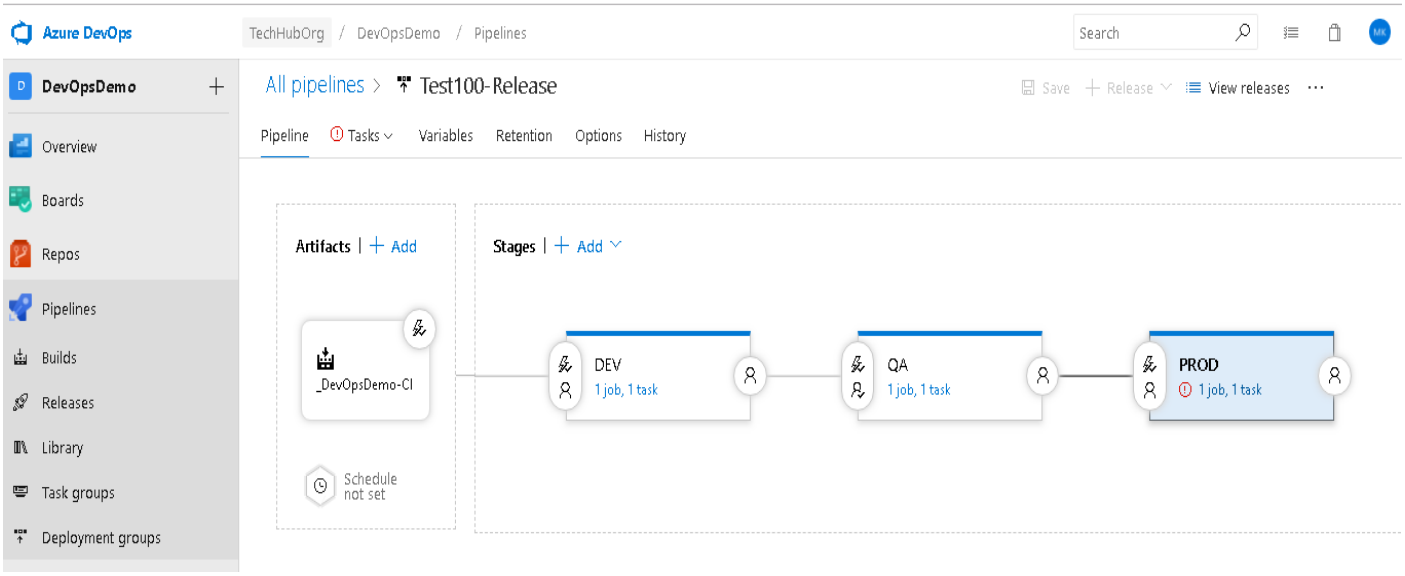


Now, we can see that just after the **QA** stage, one more stage has added as **'Stage 1'**. Just click on it and it will open the stage name dialog popup. From here we can change the name of the stage. So, just add the name as '**PROD'**. And close the Stage dialog popup using close icon **(X)** at the right top corner.

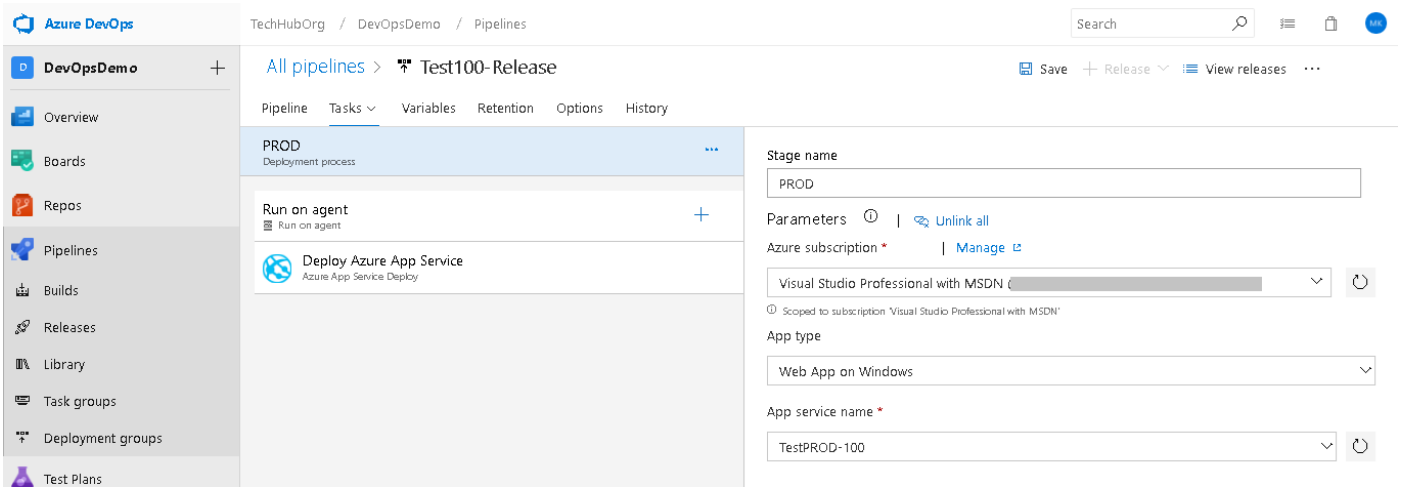


Here with following image, we can clearly see that we have now 3 different environment for **DEV, QA and PROD** respectively. But configuration is pending for **PROD (TestPROD-100)** environment. So, let complete it first. Click on the **(1 Job, 1 Task)**.

(By: Mukesh Kumar)



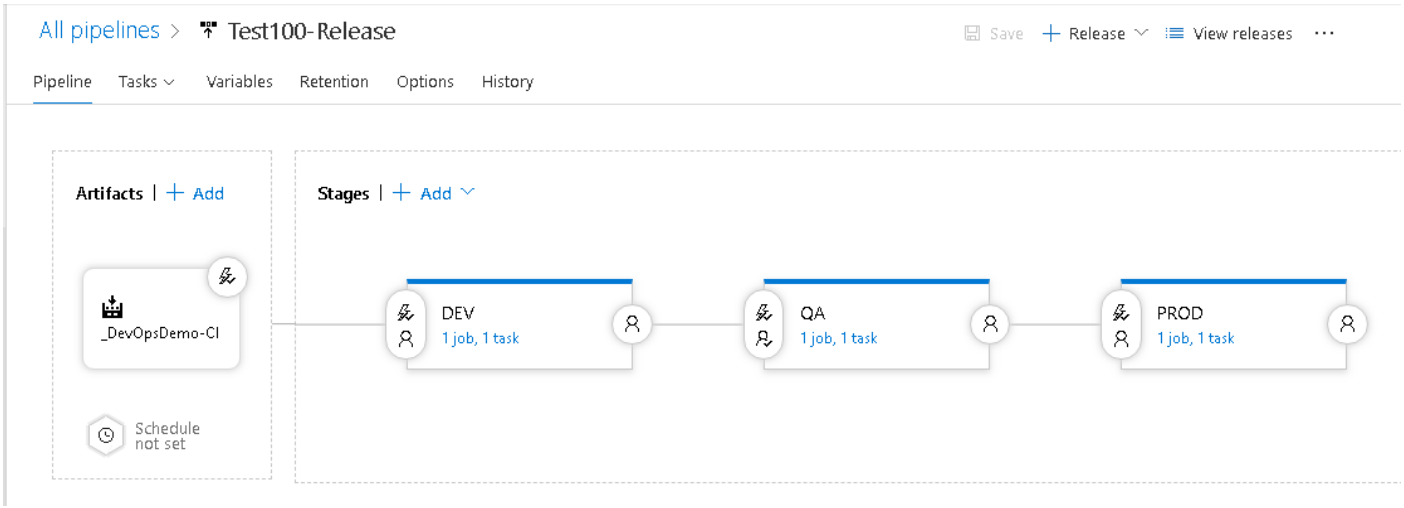
Go to **Tasks** tab, Provide the **Azure Subscription**, App type as we have done previously. But be carefully while selecting the App Service Name. This time, we will choose the **TestPRDO-100** as an App Service Name.



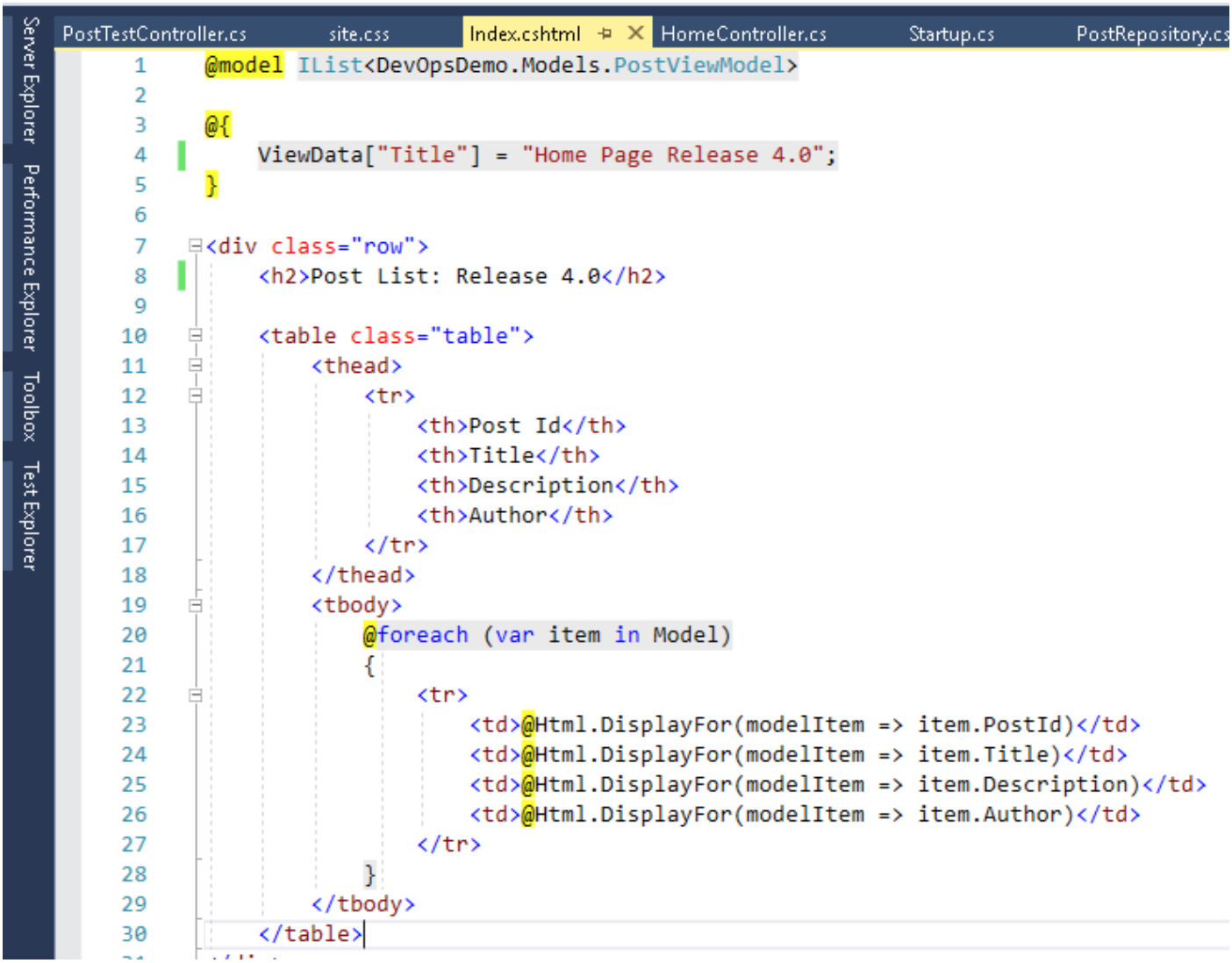
Nothing we have to do for **variable, retention, options and history**. Keep all tabs with default values and click to **SAVE**.

So, we have ready all 3 environments as follows. We are configuring any approval for **PROD** deployment. After QA deployment, PROD will start deploying.

(By: Mukesh Kumar)

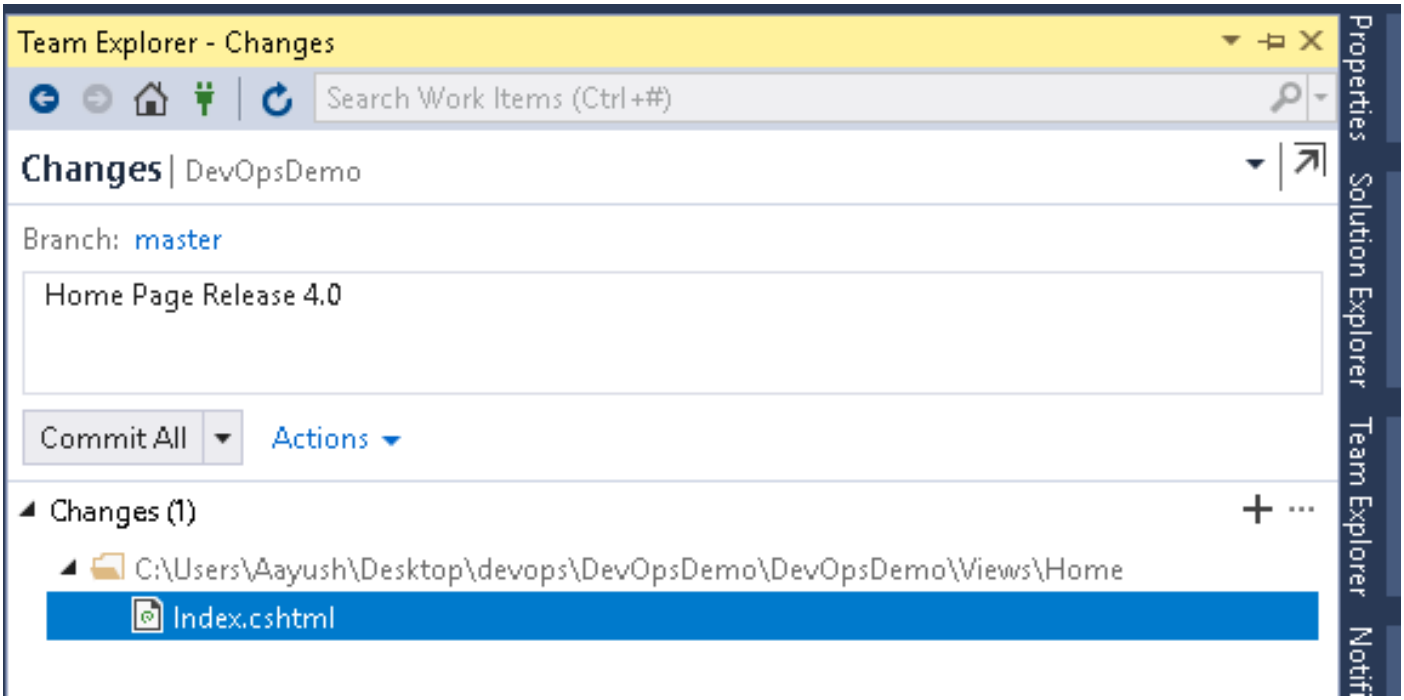


Let move to **Visual Studio 2017 or higher version** and make again changes in **Index.cshtml** file. This time we will only change the version number from **'3.0' to '4.0'**. Rest of the code will be same.

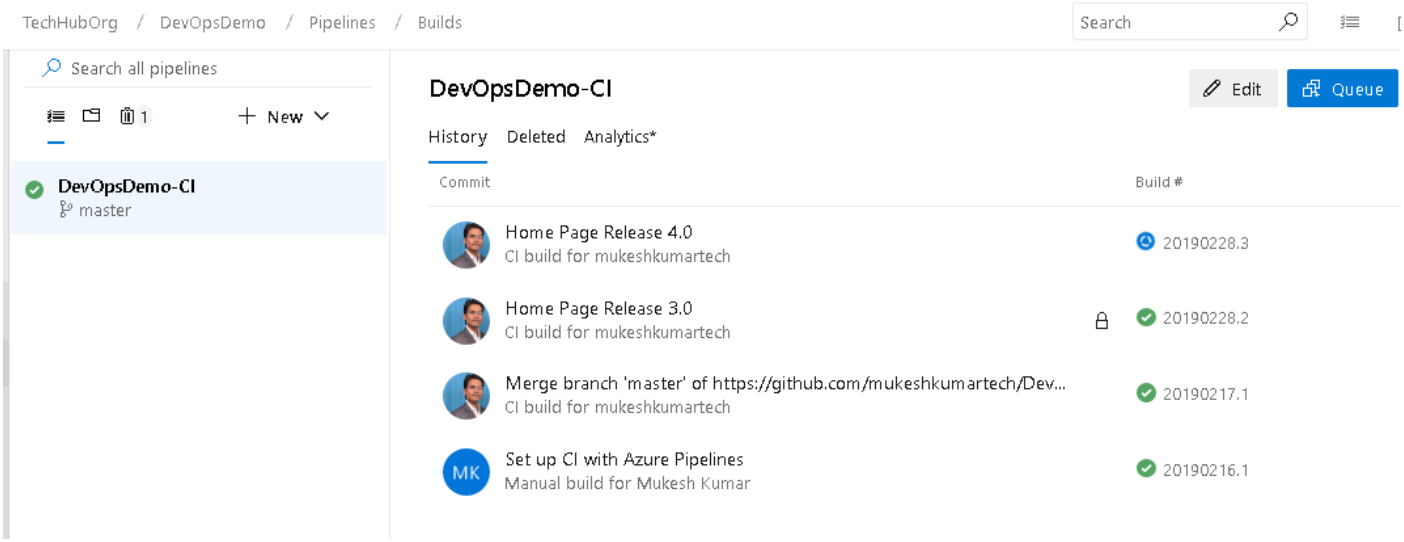


(By: Mukesh Kumar)

After making the changes in **Index.cshtm** as above, let check in the code. First provide the valuable comment so that it can be tracked and **Commit All and Sync**.

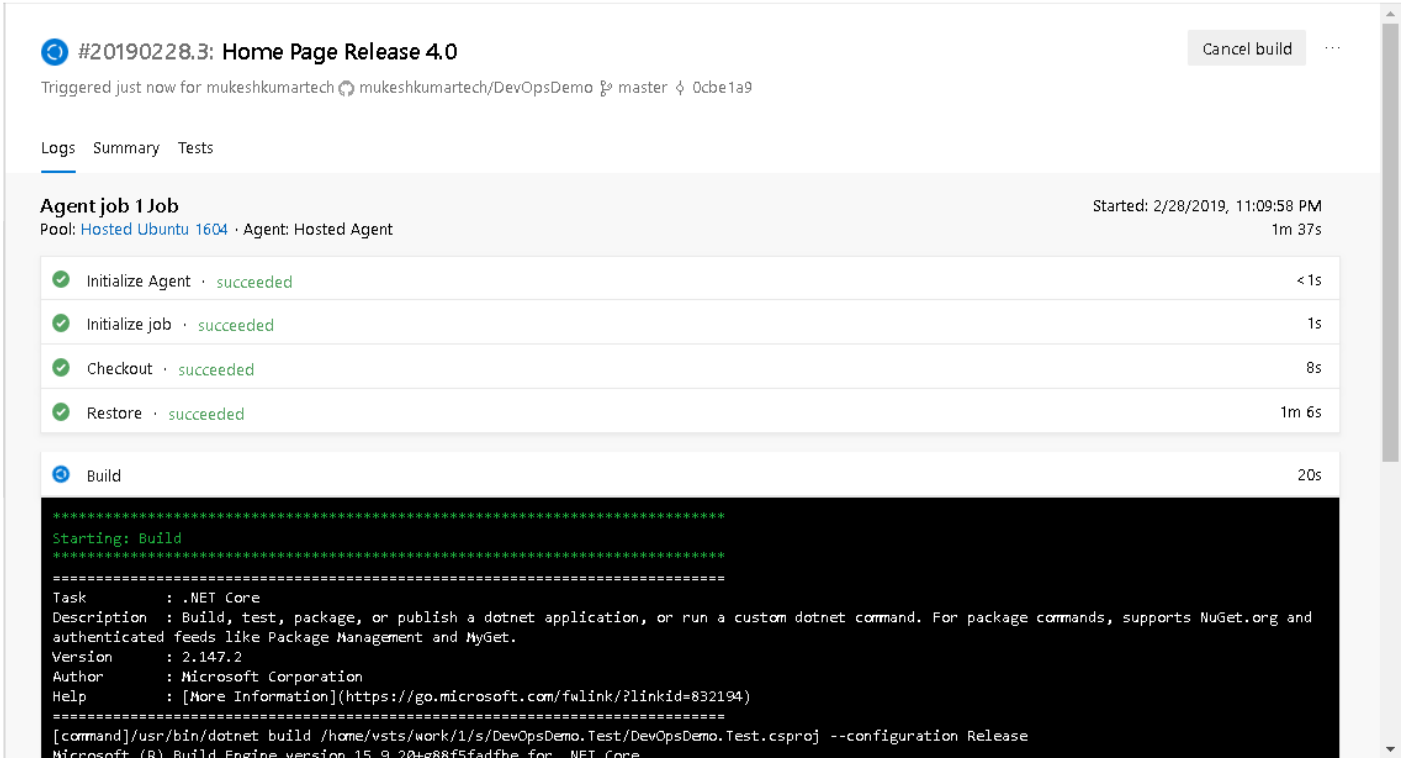


After successfully checked in the code. Let move to build pipeline **(TechHubOrg > DevOpsDemo > Pipeline > Builds)**. Here we can see that new build as initiats as **'Home Page Release 4.0'**.

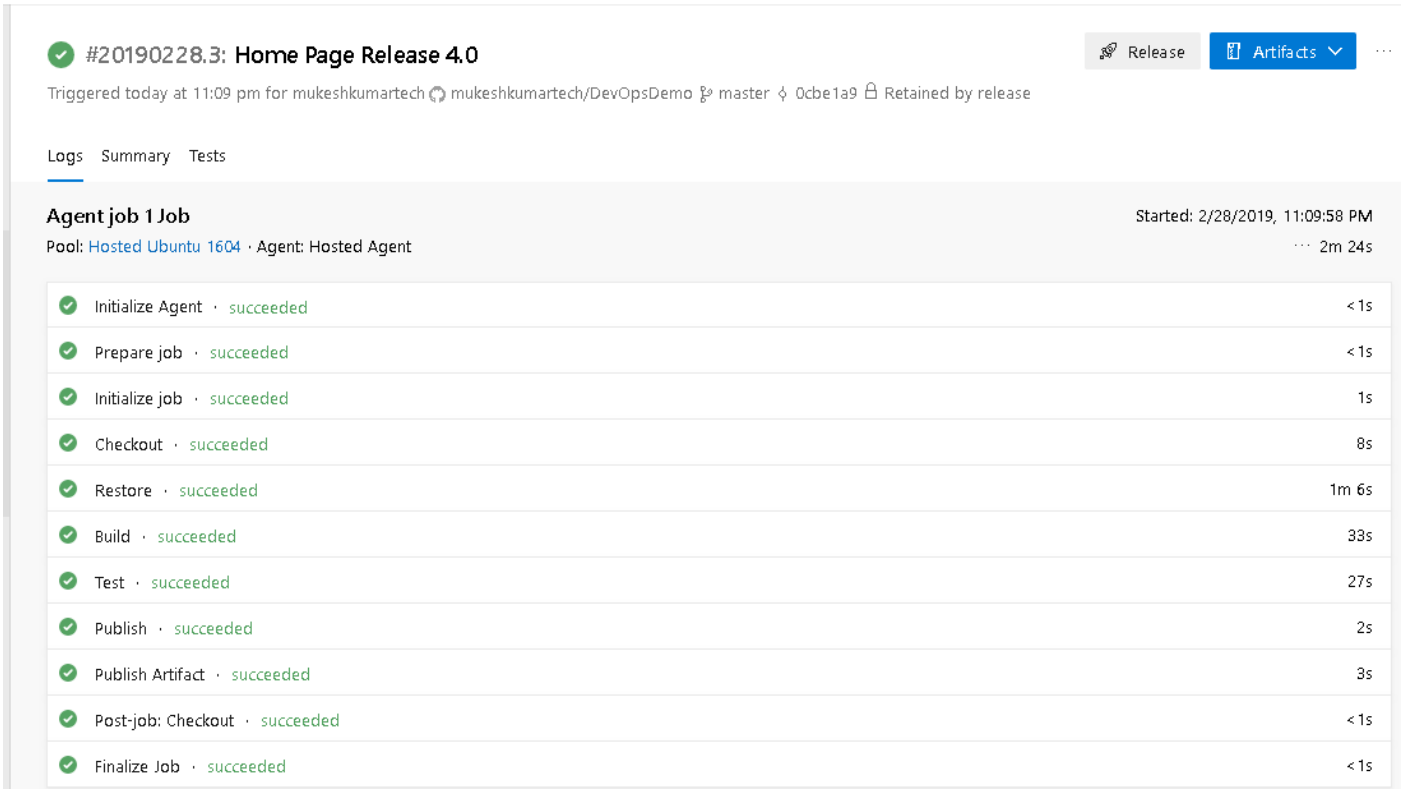


Let opent the new build **'Home Page Release 4.0'** as follows. Here it will perform all jobs before completing the Build.

(By: Mukesh Kumar)

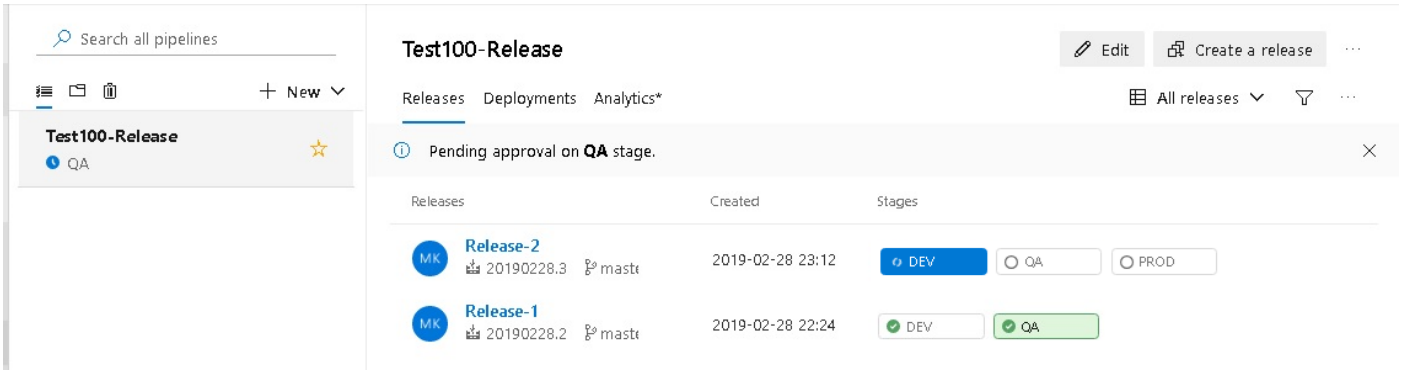


Let wait for completing the Build and withing few minutes we will see that Build has completed as follows.

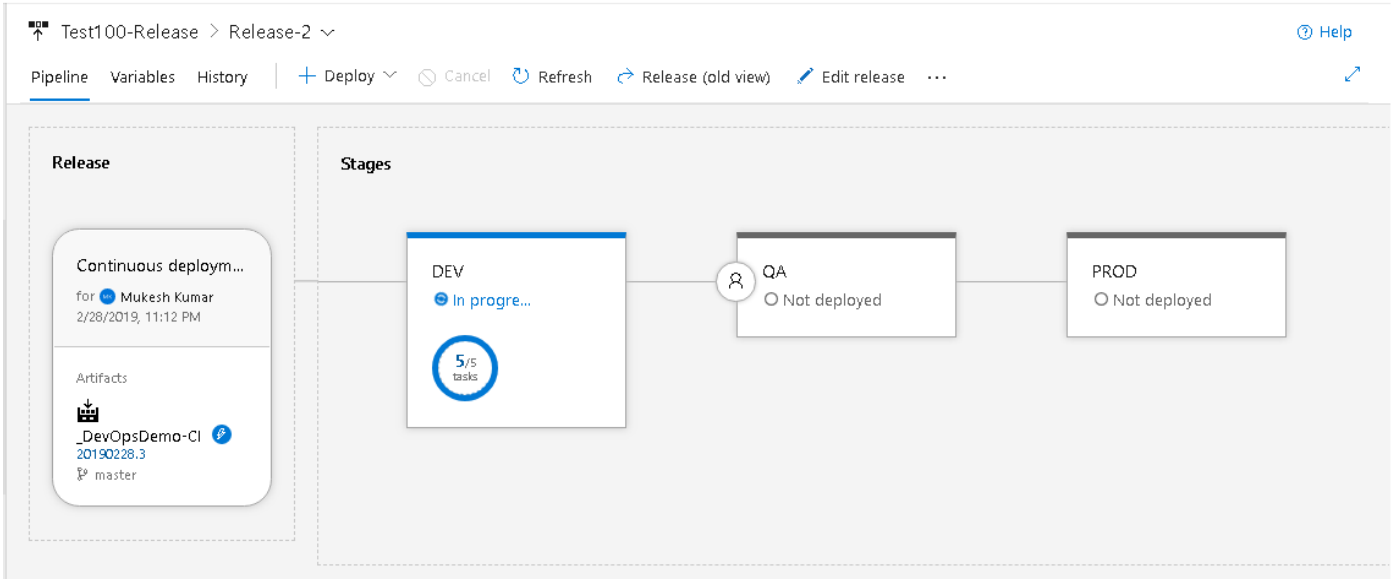


Let move to **Release Pipeline** for this **(TechHubOrg > DevOpsDemo > Pipeline > Releases > Test100-Release)**. Here we will find new release has initiated as **Release 2** and **Continous Deployment** is started on **DEV**.

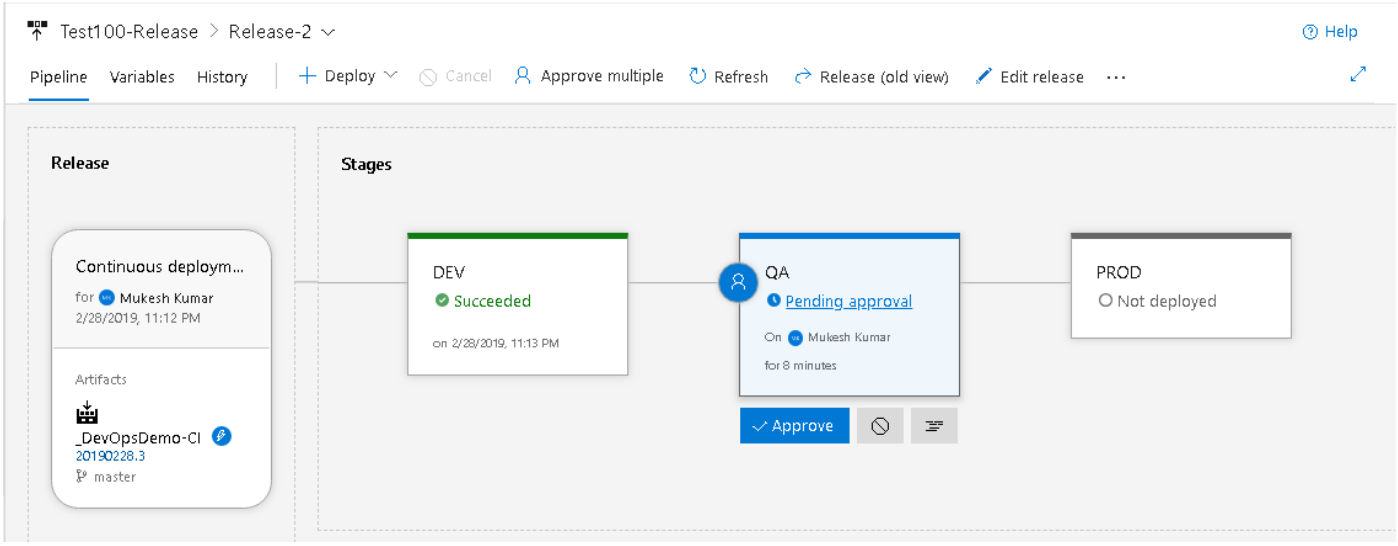
(By: Mukesh Kumar)



Let open the **Release-2** and we will find that **Continuous Deployment** is in progress on **DEV** environment. Let wait for completing it.

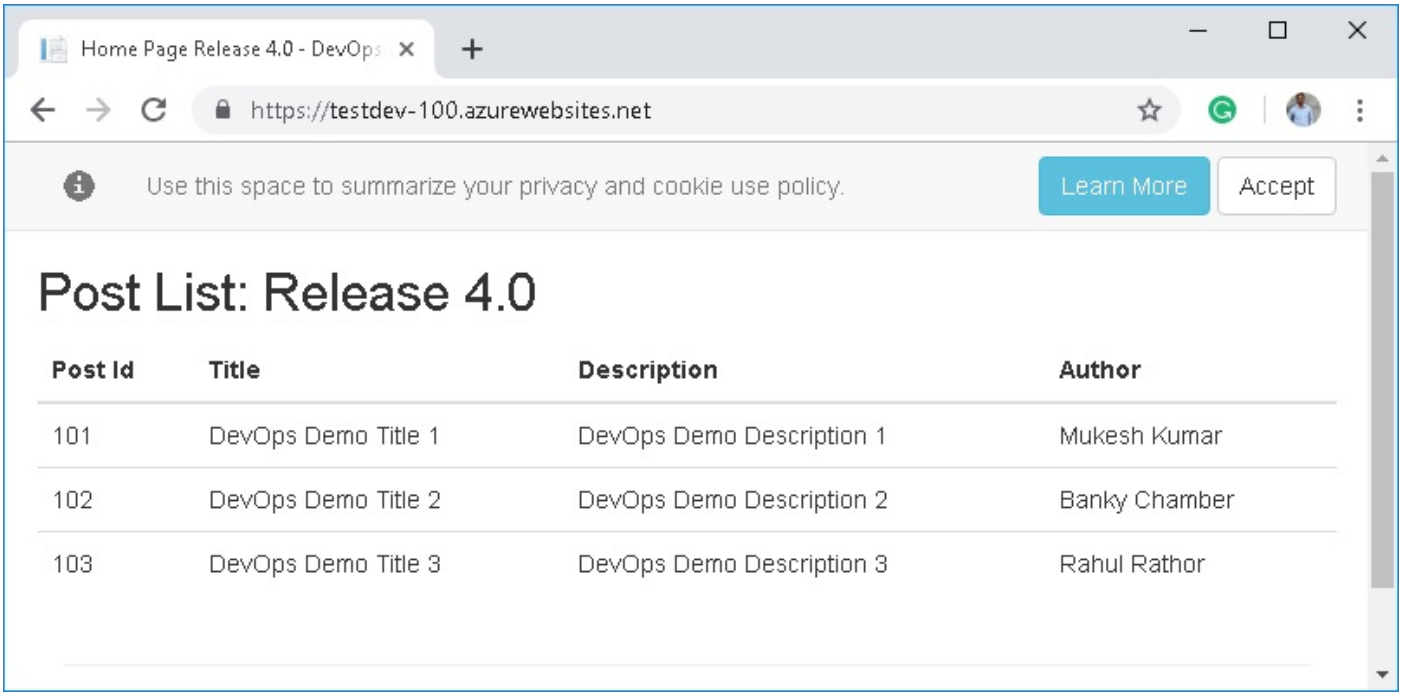


After few minutes, it will complete the deployment on **DEV** and move to **QA**. But as we have configured that approval is required before deployment on QA. It will ask for **Approval**.

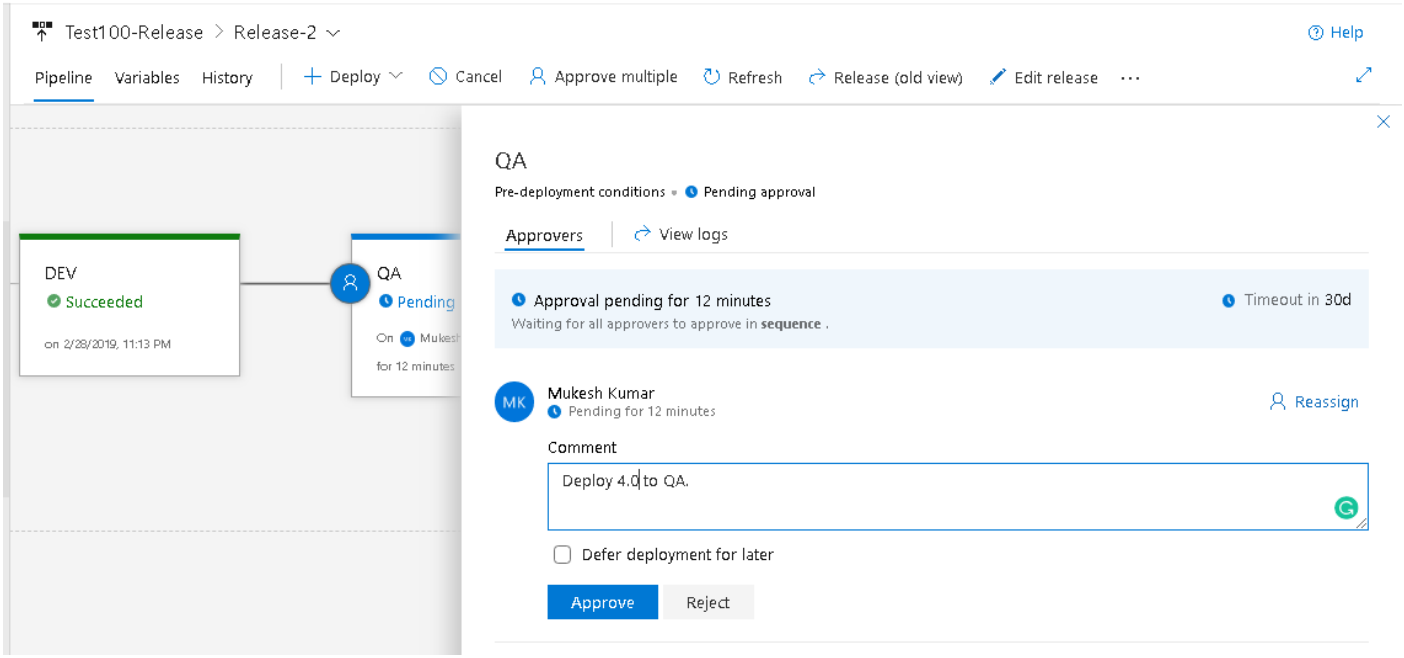


(By: Mukesh Kumar)

Before approving for QA. Let check what changes has deployed on **DEV (TestDEV-100 App Service)**. So, open the URL for DEV server as https://testdev-100.azurewebsites.net and here we go. Good, we have deployed **Release 4.0** to **DEV** server successfully.

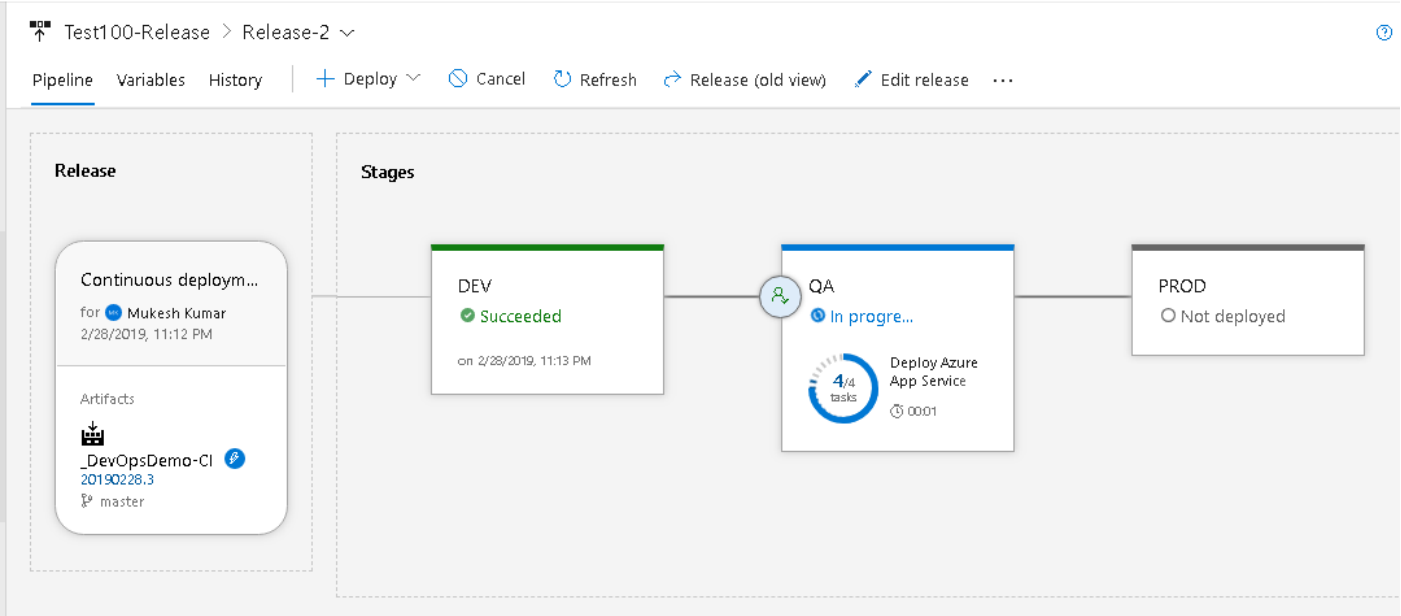


Now, its time to approve the pending approval for **QA**. So, click on Approve. It will ask for comment. Provide the comment like **'Deploy 4.0 to QA'** and click to **Approve** button.

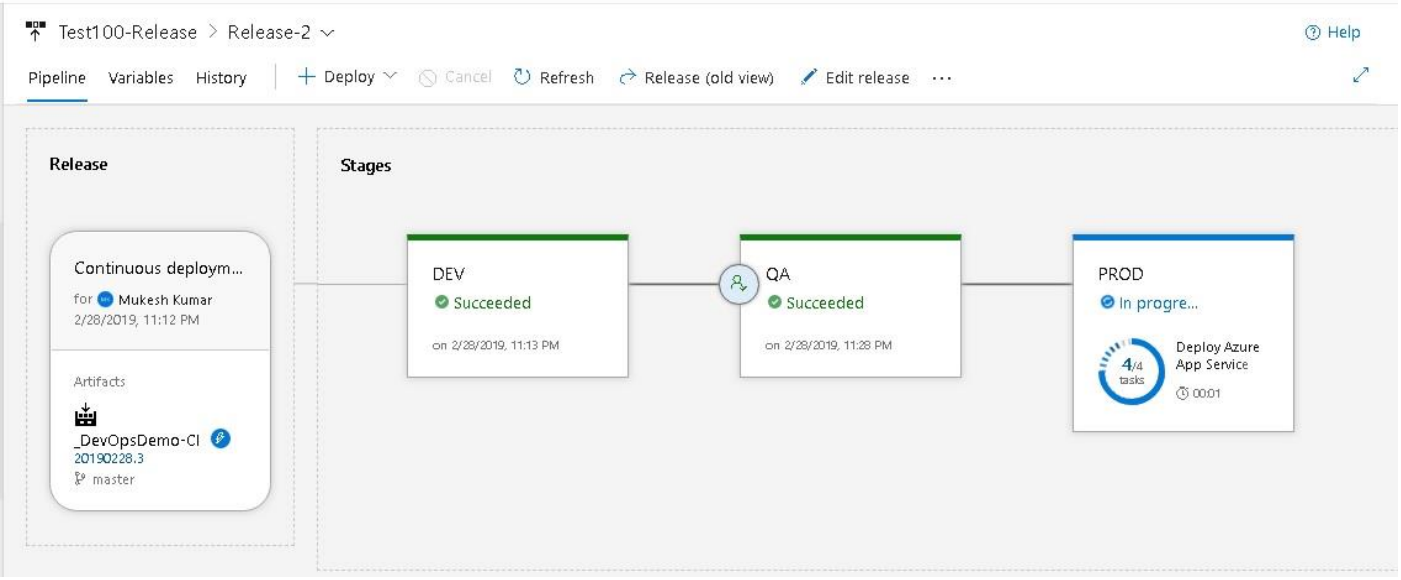


As we have approved, it will start the deployment on QA server. As we can see with following image. Continuous Deployment on QA is in progress.

(By: Mukesh Kumar)

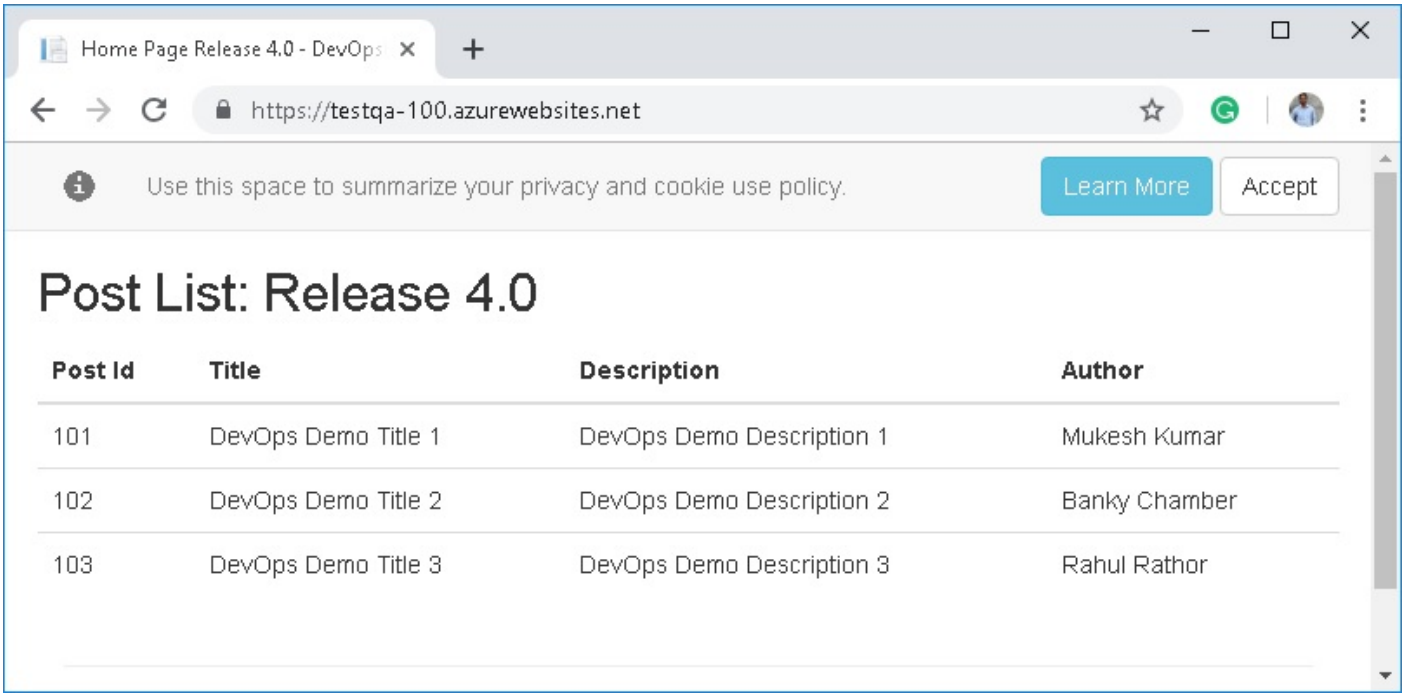


After few minutes, it will done with **Continouse Deployment on QA**.

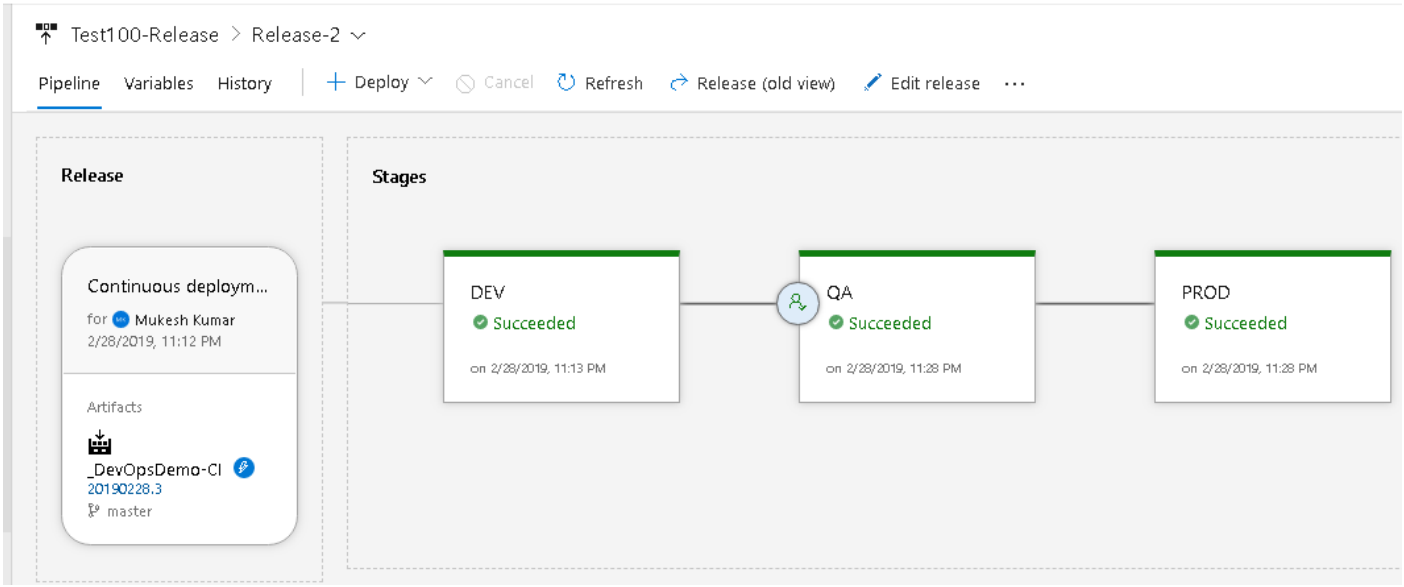


Let open the QA environment **(TestQA-100 App Service)** URL https://testqa-100.azurewebsites.net in browser and here we go. Great, **Release 4.0** is also deployed on **QA**.

(By: Mukesh Kumar)

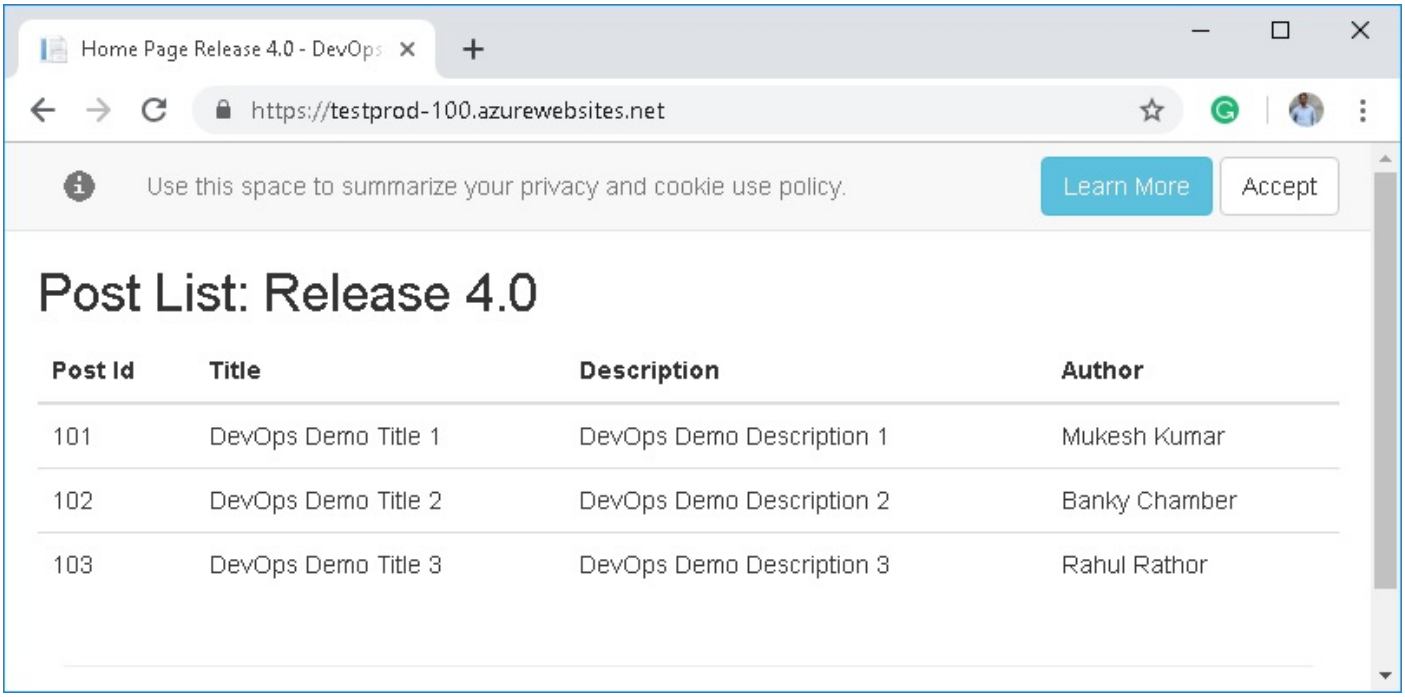


As we didn't configure any approval before **PROD** deployment. So, after deployment on QA, it will auto deploy on PROD. So, **Release 4.0 has deployed to DEV, QA and PROD as well**.



Let open the PROD server and see that release 4.0 has deployed or not. Open the **PROD** environment URL as https://testprod-100.azurewebsites.net. Great, we have also deployed **release 4.0 on PRDO** as well.

(By: Mukesh Kumar)



(By: Mukesh Kumar)

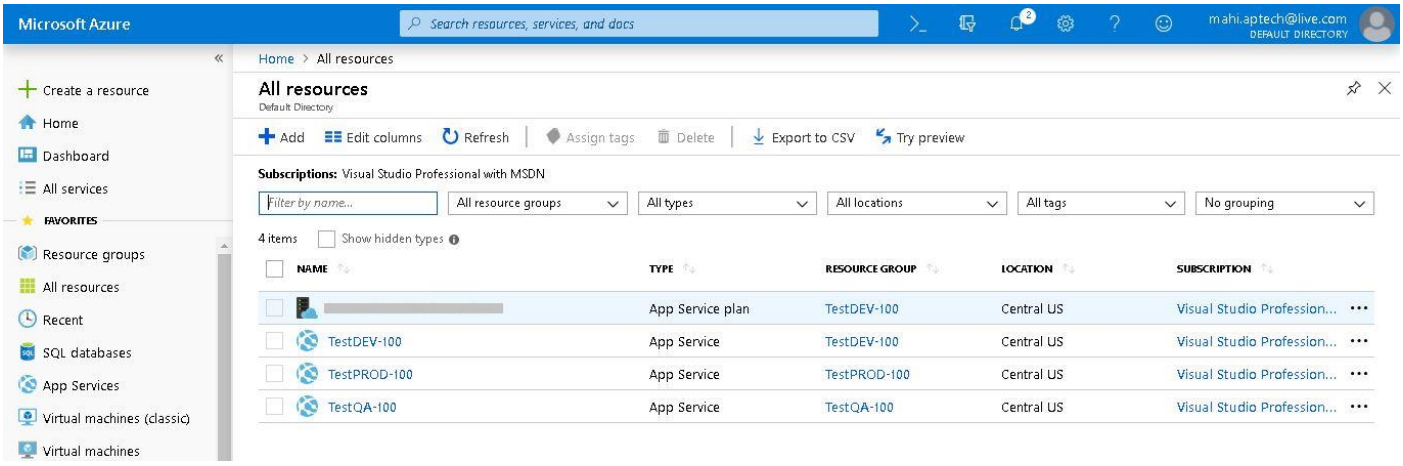
9. Add Slot

Go to https://portal.azure.com and All Resources page, here we can see listed all the available resource which we had created till now. Here we would like to add one more stage between QA and PROD. Actually, the reason for using the **Staging** environment is that we don't want directly publish the changes from QA to PROD. First we will verify the changes and functionality and if everything is working as expected then we will move the changes on PROD using **SWAP**.

Slots allow you to deploy your application to a separate live app service, warm it up and make sure it's ready for use in production, and then swap the slots to provide seamless traffic redirection. You can slot swap manually (in the portal or command line) or you can automate the slot swap with Auto-swap or in a script.

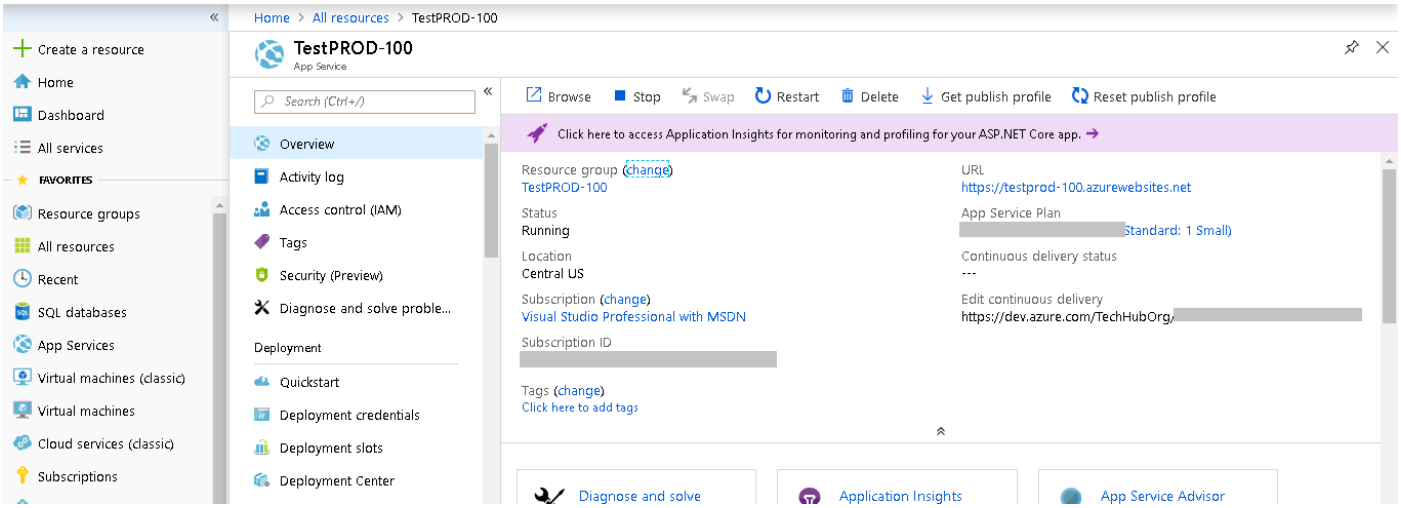
SWAP is basically is a feature of Azure DevOps where we use two different environments for deployments where one is slot, using SWAP, we can swap the production evironment with some staging (slot) environment with 0 downtimes. So, it is a very great feature for PROD deployment.

As we are going to create one more staging environmnet just before PROD. So, let open the PROD app service from the **All Resources page**.



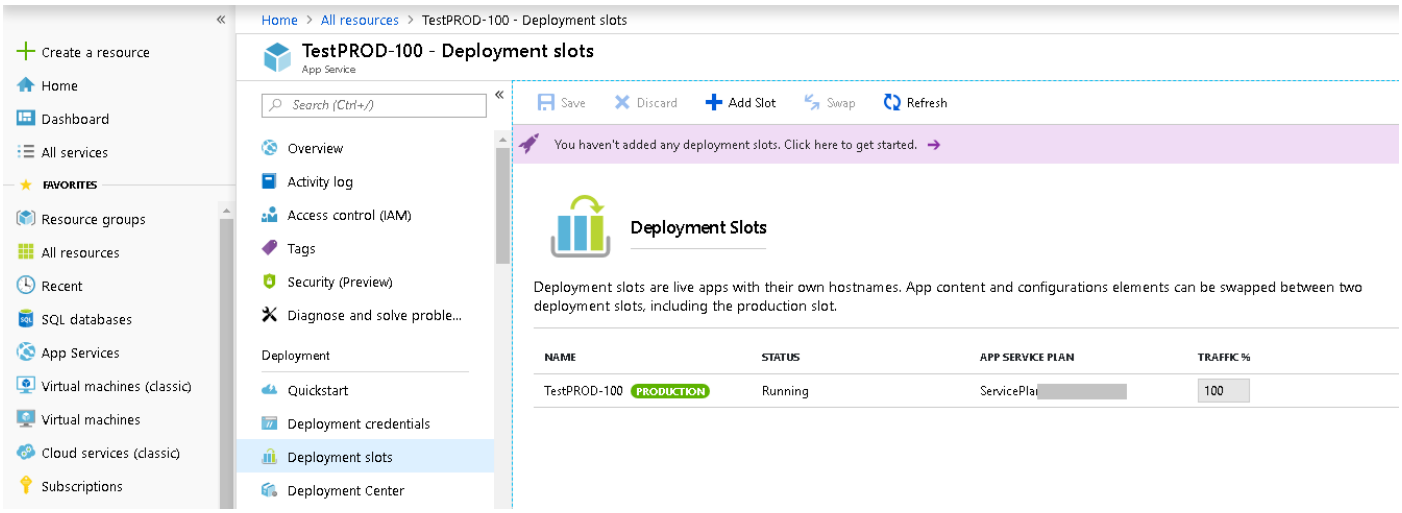
Once open the **PROD (TestPROD-100)** environment, here we can see all configuration related to this App Service. Apart from this, we have an option to create **Slot** in Deployment section as **'Deployment Slots'**. Using Deployment Slots option, we can create new slot **(staging environment)**. So, let click on the **Deployment Slots**.

(By: Mukesh Kumar)



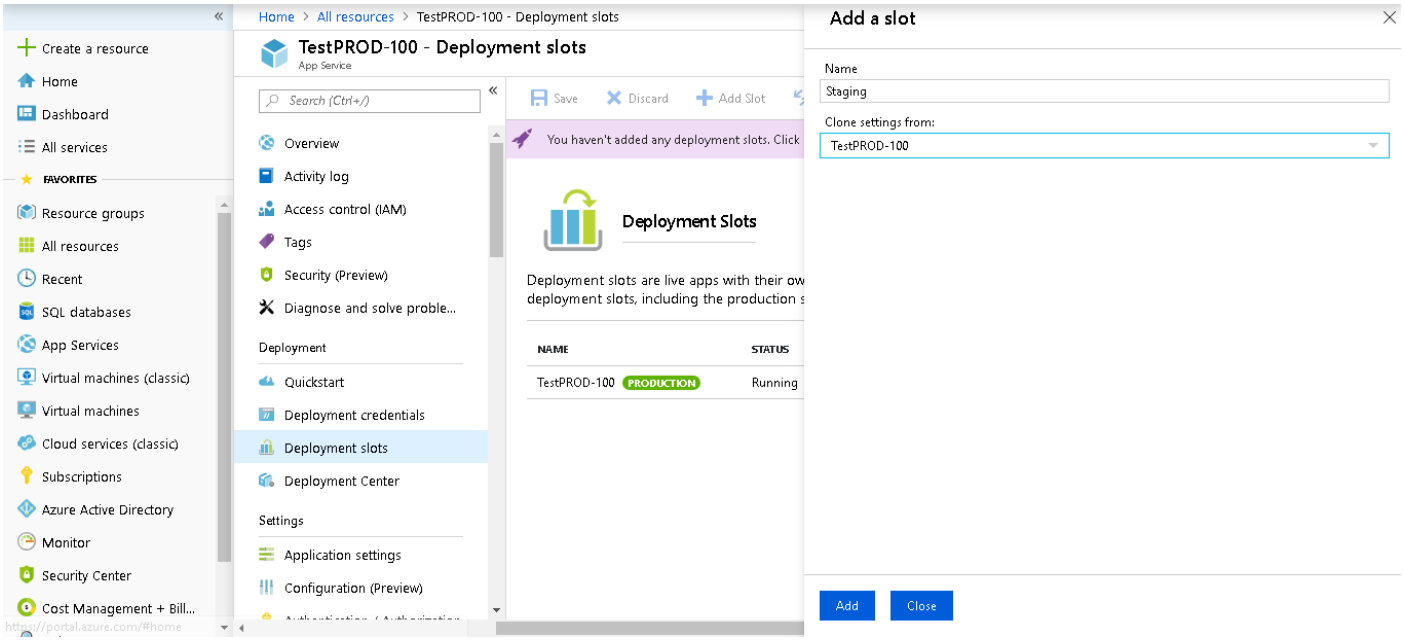
Next page will be deployment slots page. Here we can see that **PROD** environment is running with **100% traffic**. It means all the traffics which are going to access PROD environment will hit to **TestPROD-100 App Service**.

At the top, we have one button as **'Add Slot'**. For adding new slot, just click on **'Add Slot'**.

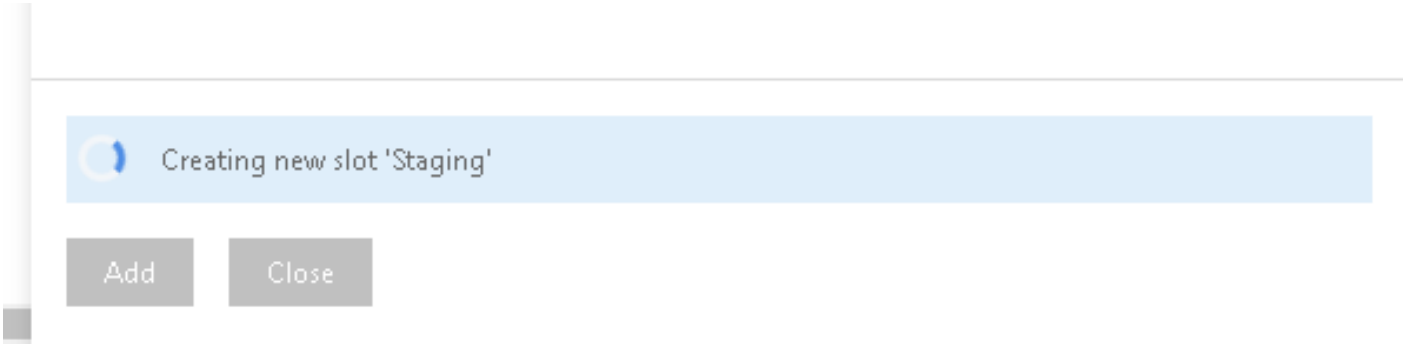


A dialog window will open in right side and ask for the name of the new slot. Here we will give the name as **'Staging'** and use the **TestPROD-100** for **clone** setting. It means, new **Staging** environment will be created to clone of **PROD** environment. Let click to **Add** button for adding **new Slot**.

(By: Mukesh Kumar)

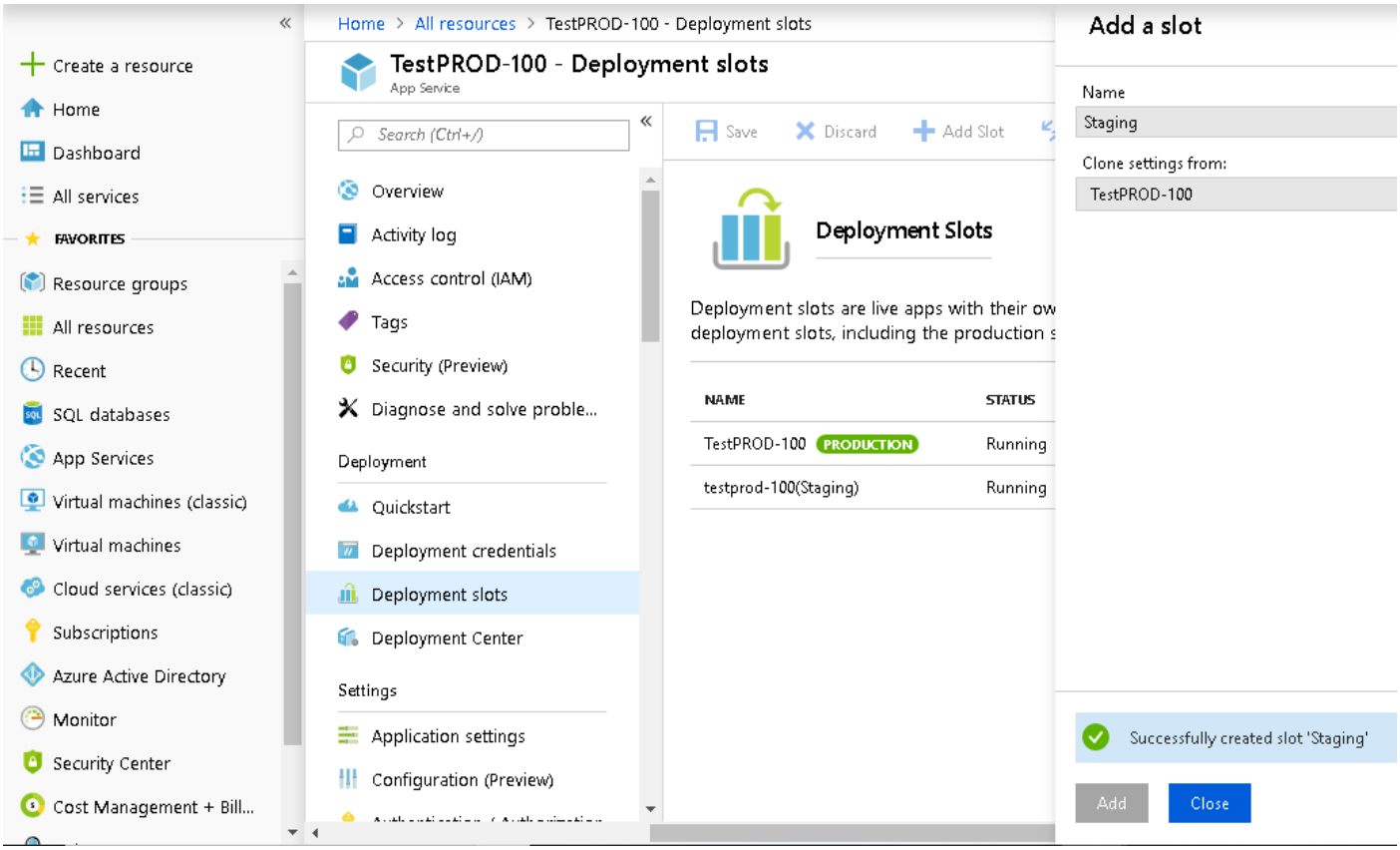


It will take few minutes to create the new **Staging environment**.

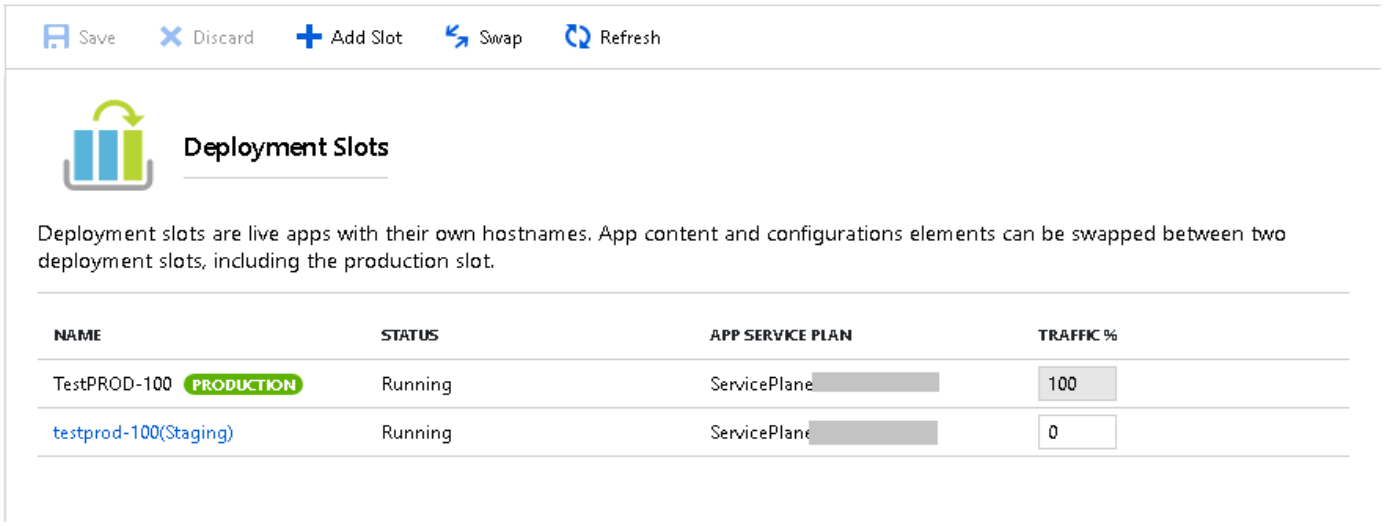


Once it will be done, it will show a **Success** message as follow. Just close this dialog window.

(By: Mukesh Kumar)

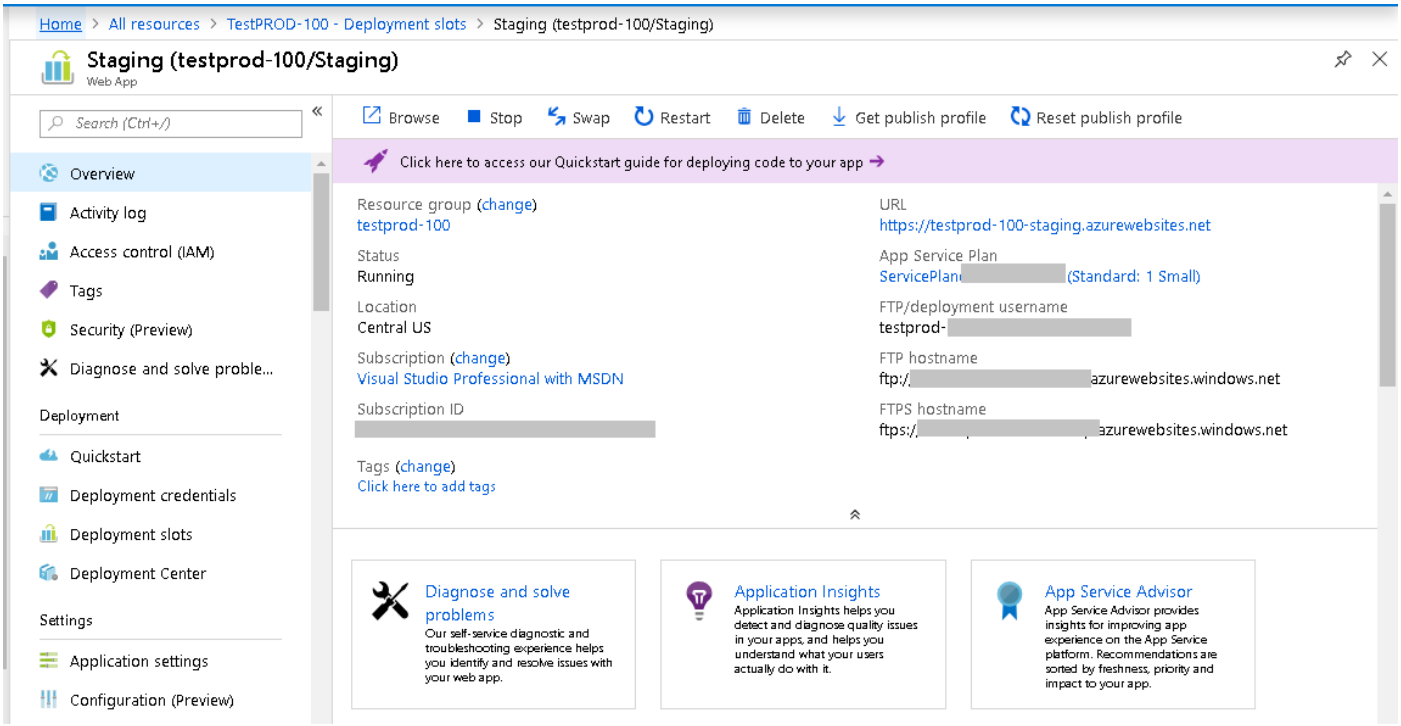


Now, we have one Staging environment for **TestPROD-100 as TestPROD-100(Staging)**. It is also running but right now, there is no any traffic on this.

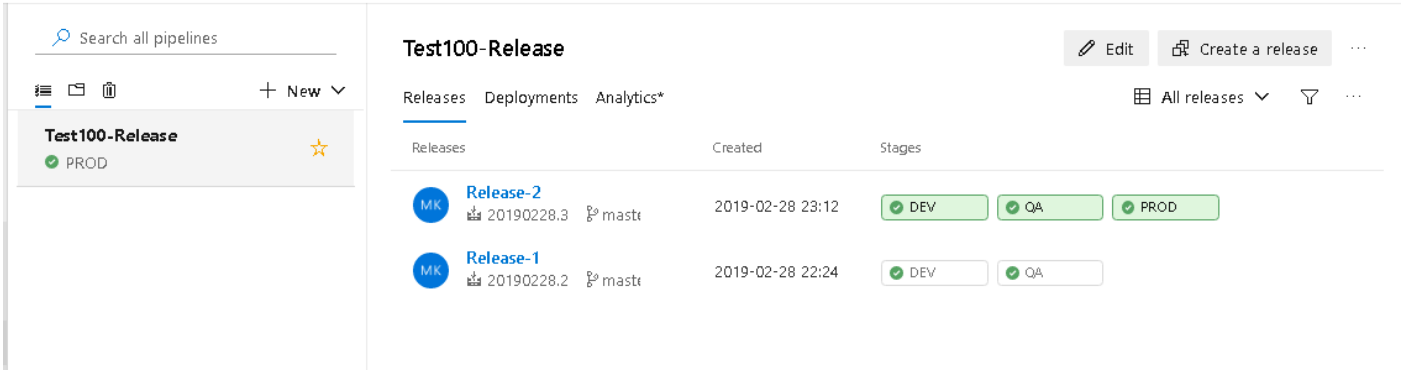


Let click on the name of staging environment **TestPROD-100(Staging).** It will open the configuration page for this Staging evironment. Here we can see the URL for the staging environment which will be used to access it. We have several options for this Staging environment like **STOP, SWAP, RESTART, DELETE** etc.

(By: Mukesh Kumar)

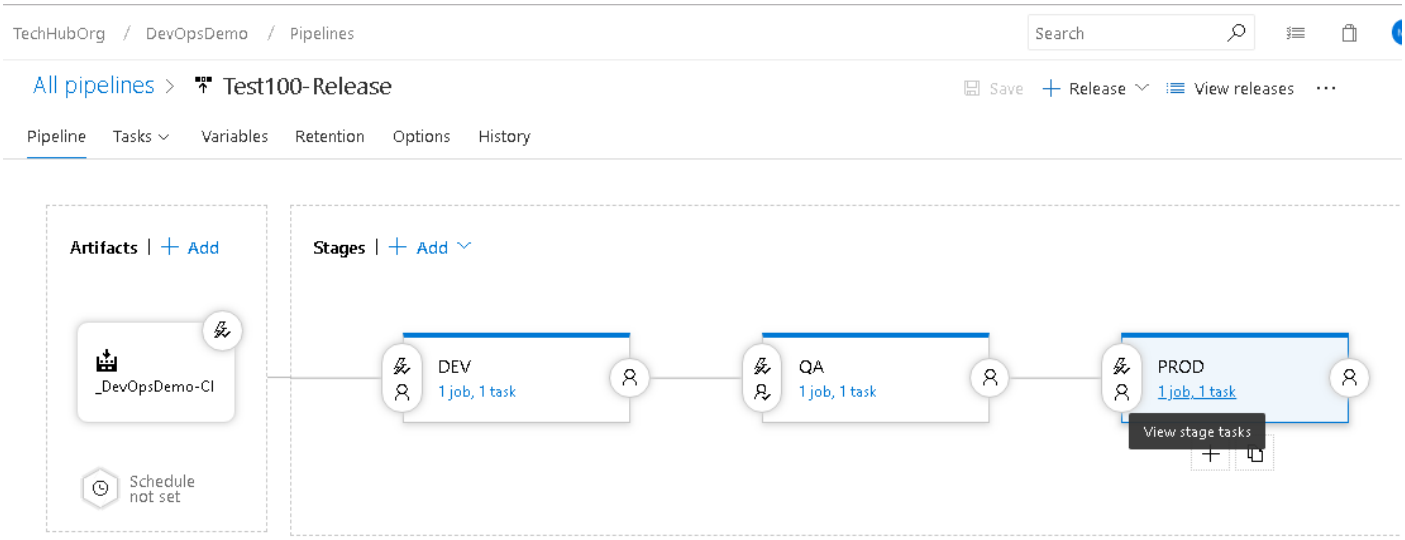


Staging environment is available now. Let configure it in the **Release** pipeline. So, open https://dev.azure.com/TechHubOrg/DevOpsDemo and release pipeline as **Test100-Release** and **Edit** it.



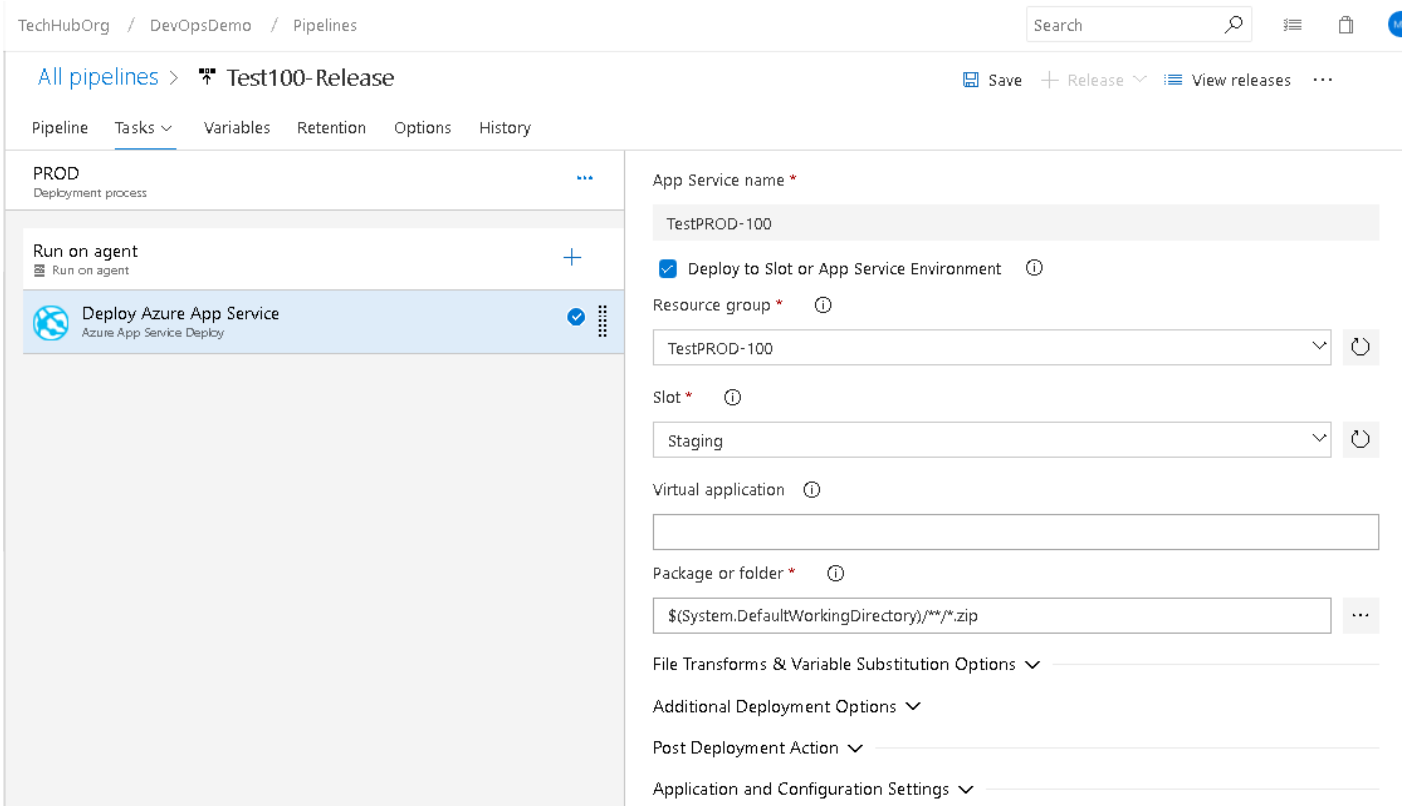
Once **Test100-Release** will open in **Edit** mode. Just click on **PROD stage**. Actually we will configure the Staging environment with PRDO. If any new **build artifact** will be available and going to deploy on **PROD** after **QA** then it will first deploy on Staging environment. Later user can use the **SWAP** functionality to **SWAP** the production environment with staging environment.

(By: Mukesh Kumar)



In PROD stage, Go to **Tasks** tab and it will open a dialog window in right. Here check the option as **'Deploy to Slot or App Service Environmnet'** and select the **Resouce Group name as 'TestPROD-100'**. Next option is to **choose the Slot**. So, in the Slot dropdown, we have to select the **'Staging'**.

So far, so good, we have done implementing the sloting in PROD environment. We don't need to change any other options for now. So, now just clik on **SAVE** button to save the **Release pipeline**.



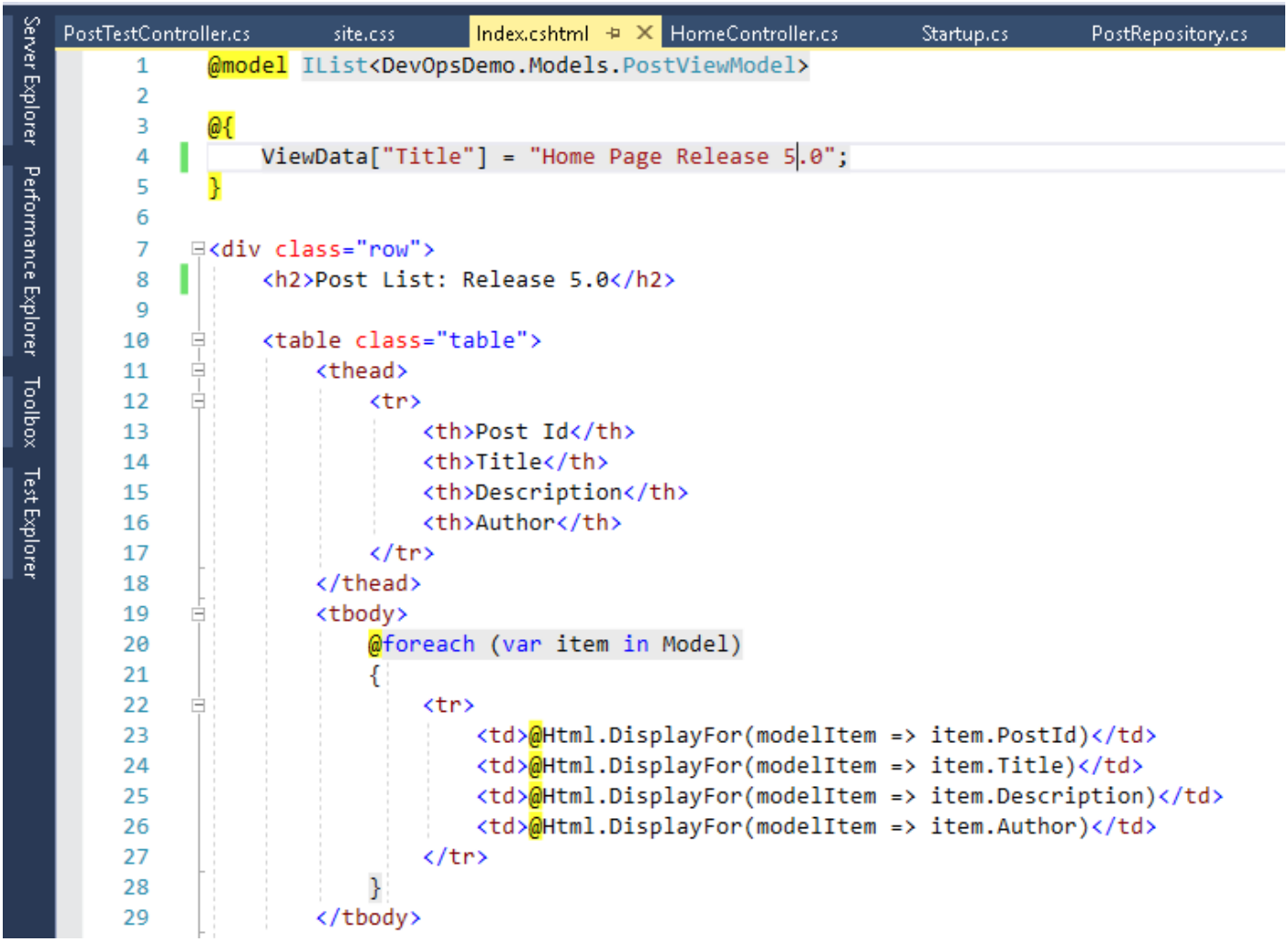
Above we are done with adding the **Sloting functionality with RPDO enviornment**. So, let make the changes in the code and check in the code. When we will check in the code, what should happen? First, it should make the build

(By: Mukesh Kumar)

artifact in Build Cycle and deploy the artifact on DEV server in Release cycle and after approval, it should deploy on QA and then deploy to Staging environment. It should not deploy anything on **PROD**. We will deploy on the PROD using **SWAP** feature.

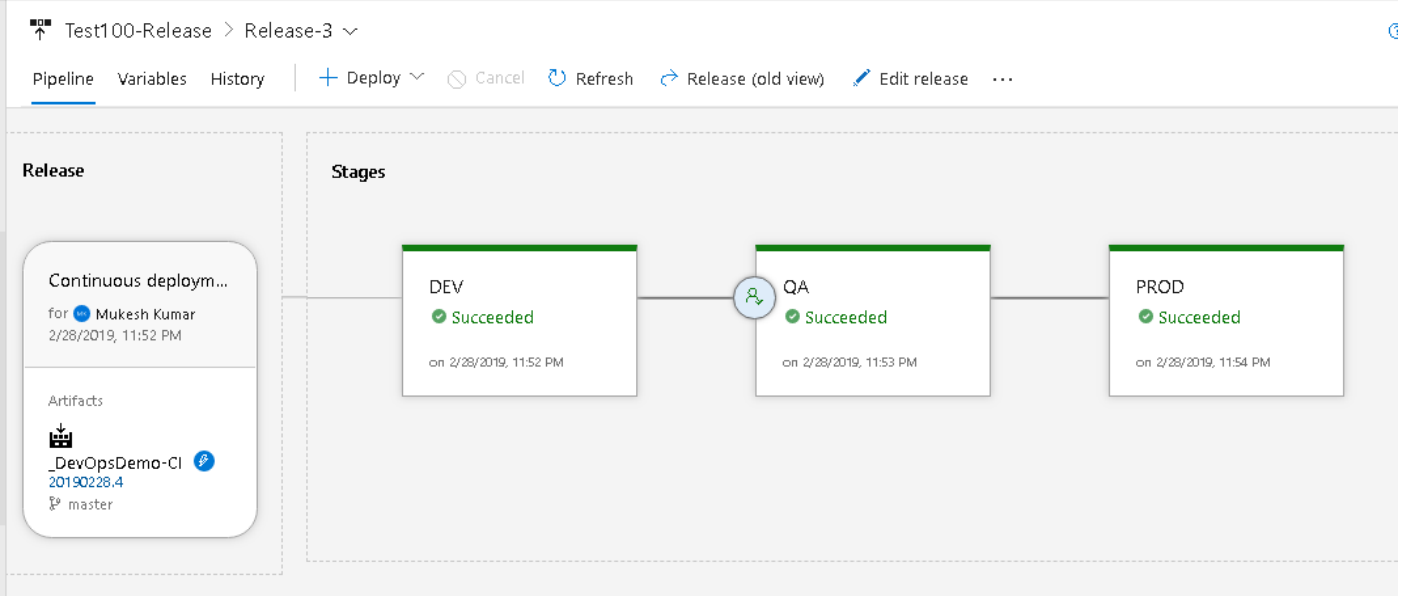
10. Run and Test Azure DevOps Pipeline

So, open the **Visual Studio 2017 or higher version** one more time and open the **Index.cshtm**. Here we will only change the version number in page title and post title. So, change version number from **4.0 to 5.0**.

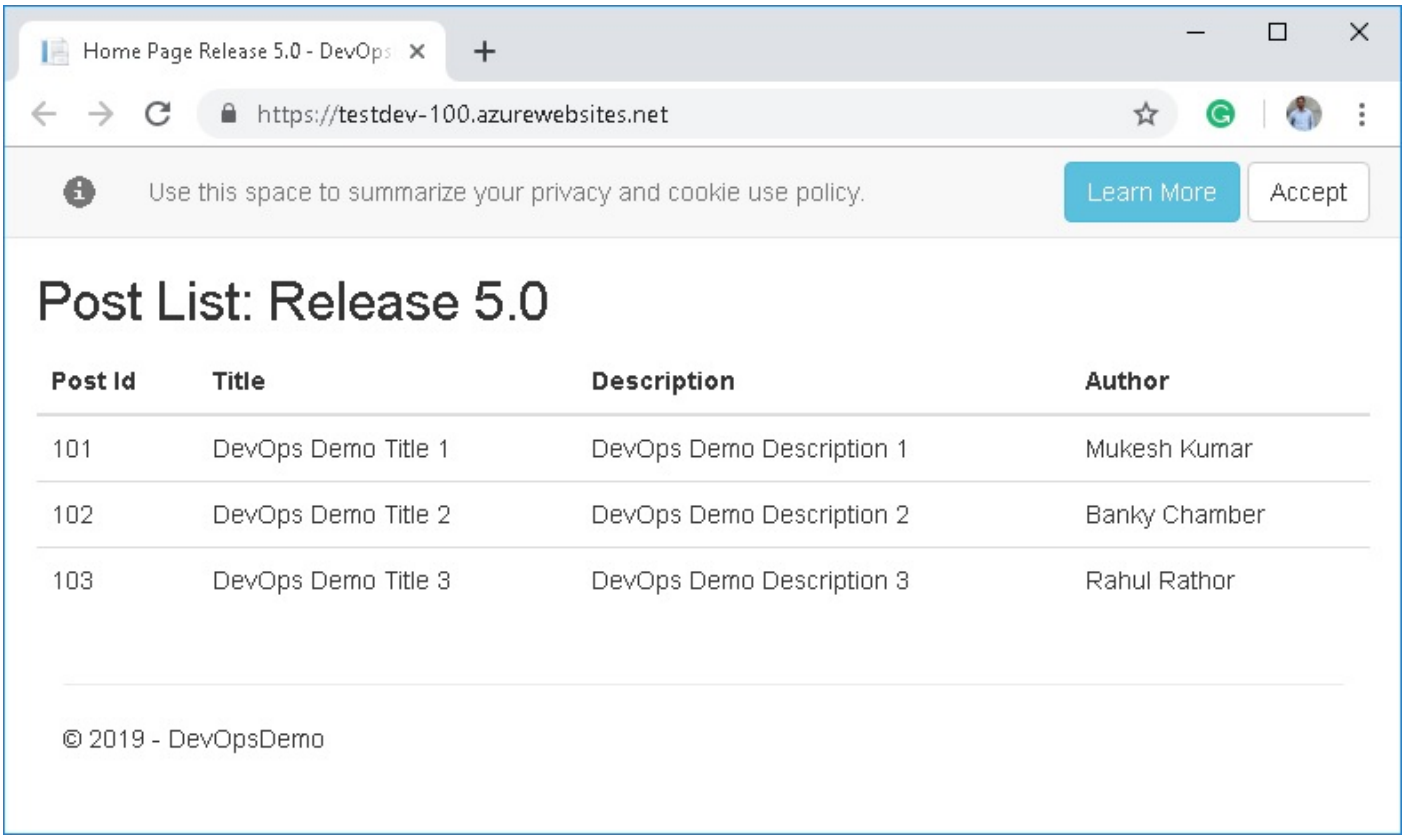


Save the changes and Go to **Team Explorer** and **check in the code** as we have done prevously. Once the code checks in then wait for the completion of **Azure DevOps Build pipeline**. After creating the **build artifact**, it auto will deploy on the **DEV** and ask for approval before deploying on **QA**. Let approve and it will deploy **QA and Staging (PROD)**.

(By: Mukesh Kumar)



Let check first, how **DEV (TestDEV-100)** is working. Here we can see that our latest changes has deployed on the DEV environment as follows. **[Latest Release is 5.0].**



Let open the **QA environment (TestQA-100)** using URL https://testqa-100.azurewebsites.net and here we can see. Latest build artifact has deployed successfully on **QA environment** as well.

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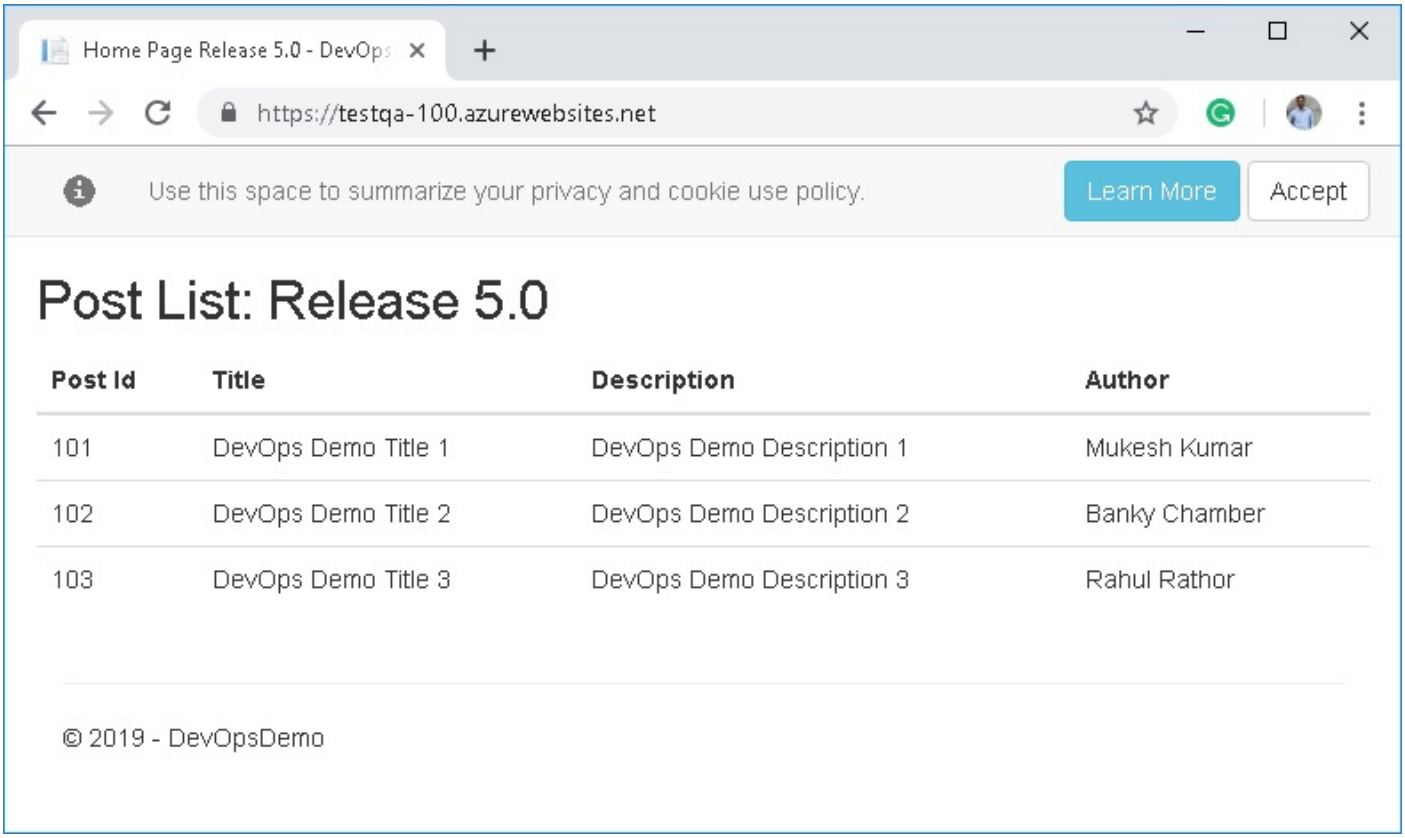
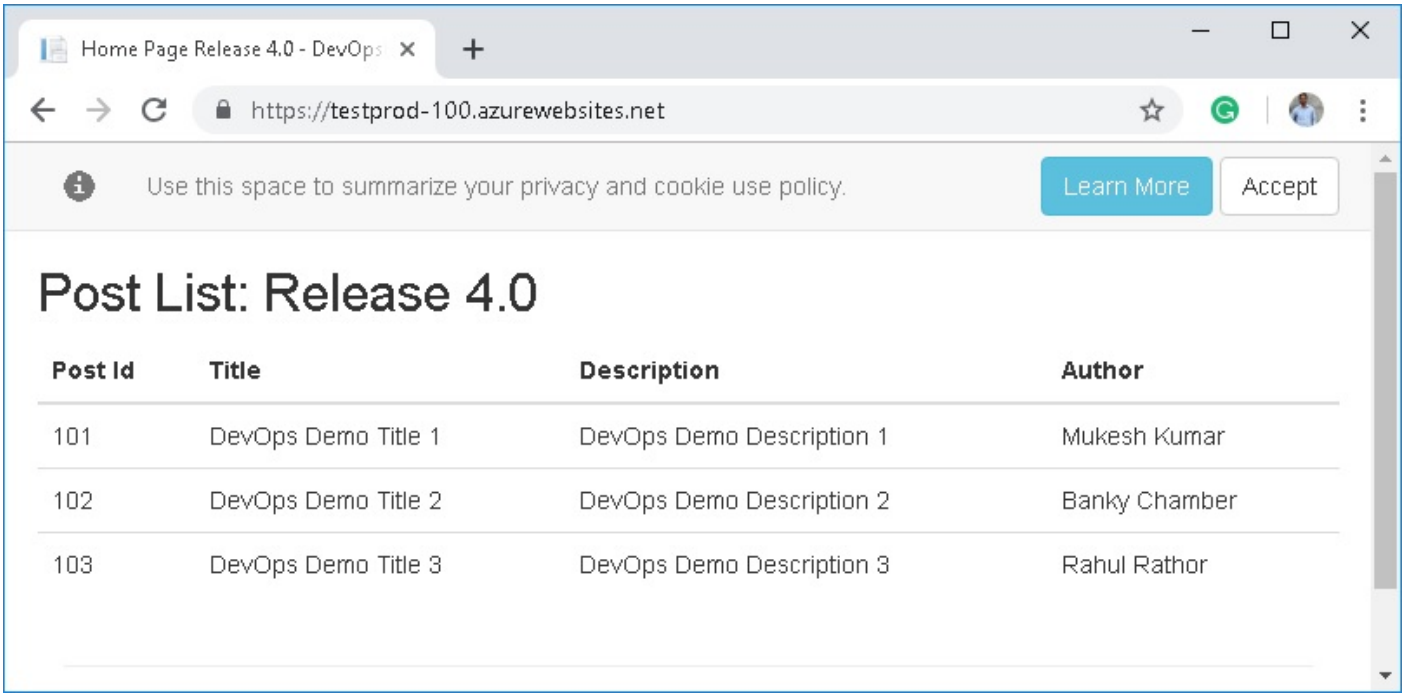


Now, its time to check the changes has deployed on PROD or not. It should not be deployed. Because we have already configured one stage between QA and PROD. The deployment should heppen on Staging environment after QA. So, let open the **PROD (TestPROD-100)** environment using the URL https://testprod-100.azurewebsites.net and here we go.

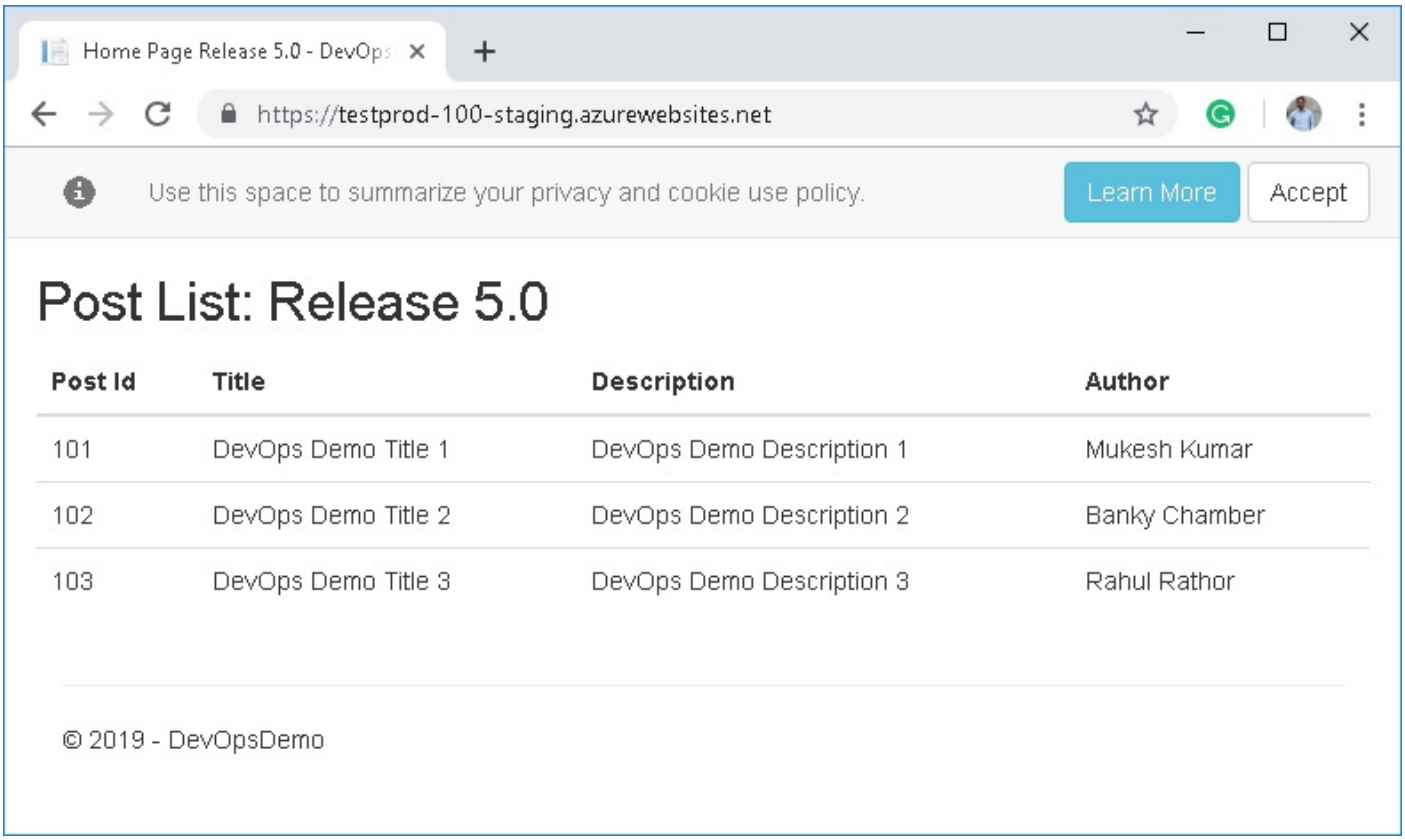
Good, our **PROD** environment is **not deployed** the latest changes yet.



(By: Mukesh Kumar)

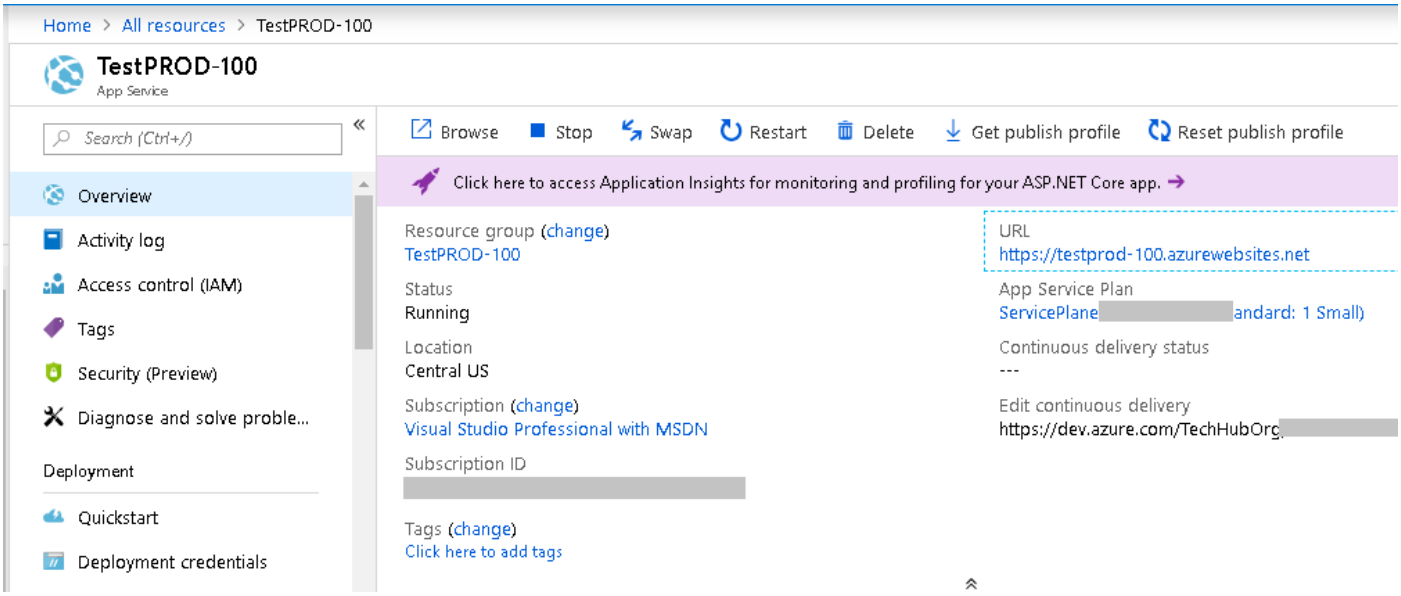
Let check the Staging environment using URL https://testprod-100-staging.azurewebsites.net in the **browser** and here we go. Yes, latest changes has deployed on Staging environment.

It means, our Release deployment has done in this way **DEV > QA (After Approval) > Staging > PROD (Not Yet Deployed).**



As we know and learn above that we will use the **SWAP** feature the swap the environment. Here we will **swap between Staging and PROD**. **After swapping, Staging environment will become PROD and PROD environment will become the Staging.**

Let go to https://portal.azure.com and open the **RPOD app service (TestPROD-100)** from the **All resource in Azure Portal**. Now click on the **SWAP** button at the top just after **STOP**.



It will open the **SWAP** dialog window in right. Here we have to provide the **Source environment** and **Target environment**. As our build artifact has already deployed on Staging environment, so Staging will be part of Source and PROD where we have to deploy will be part of Target.

After defining the **Source** and **Target** for **SWAPPING**, we will just click on **SWAP** button.

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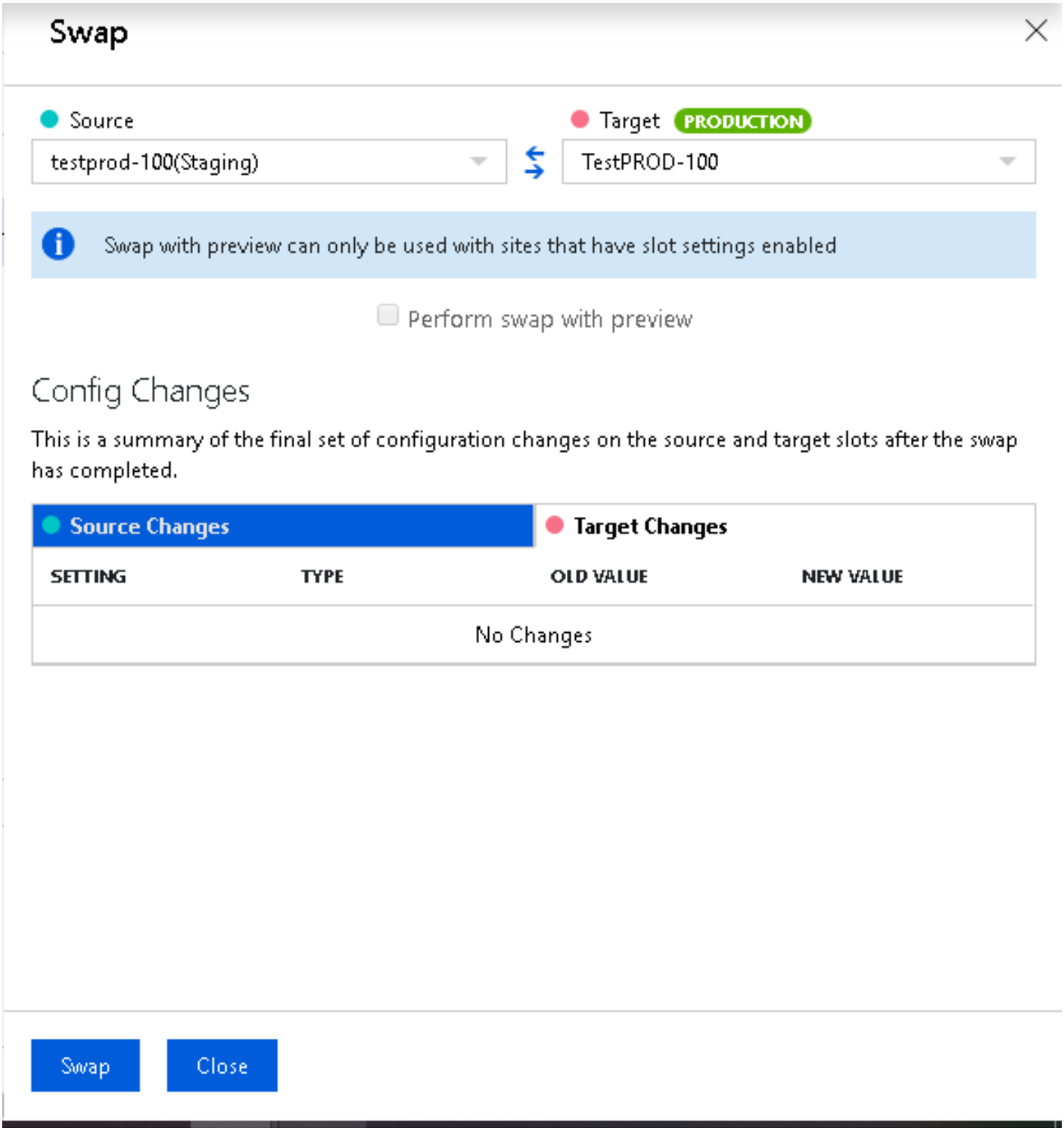

It will take few minutes to **swap** between **Staging** and **Prod**.

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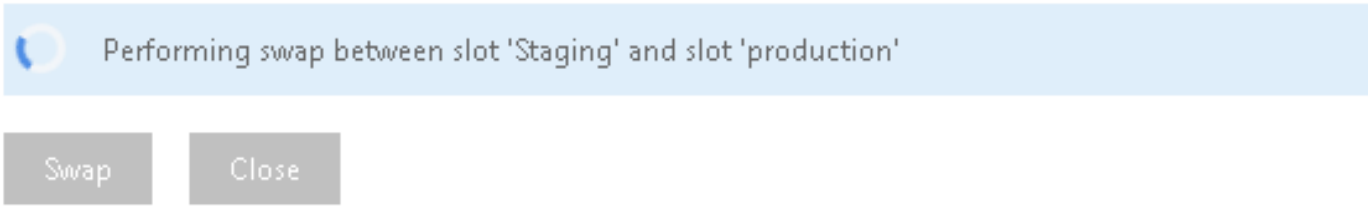
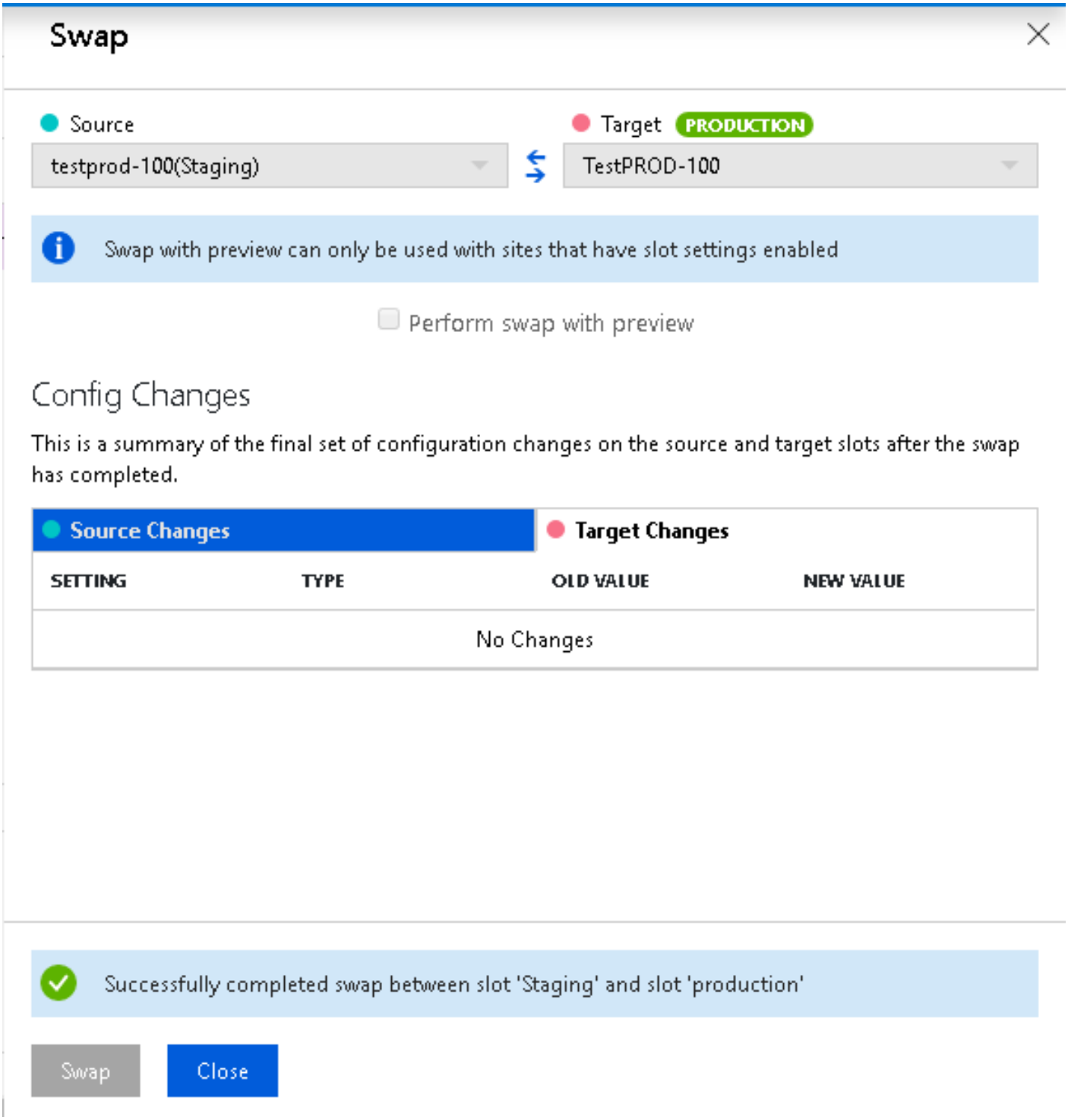


Once **swapping** will complete, it will give us proper **success** message for confirmation.



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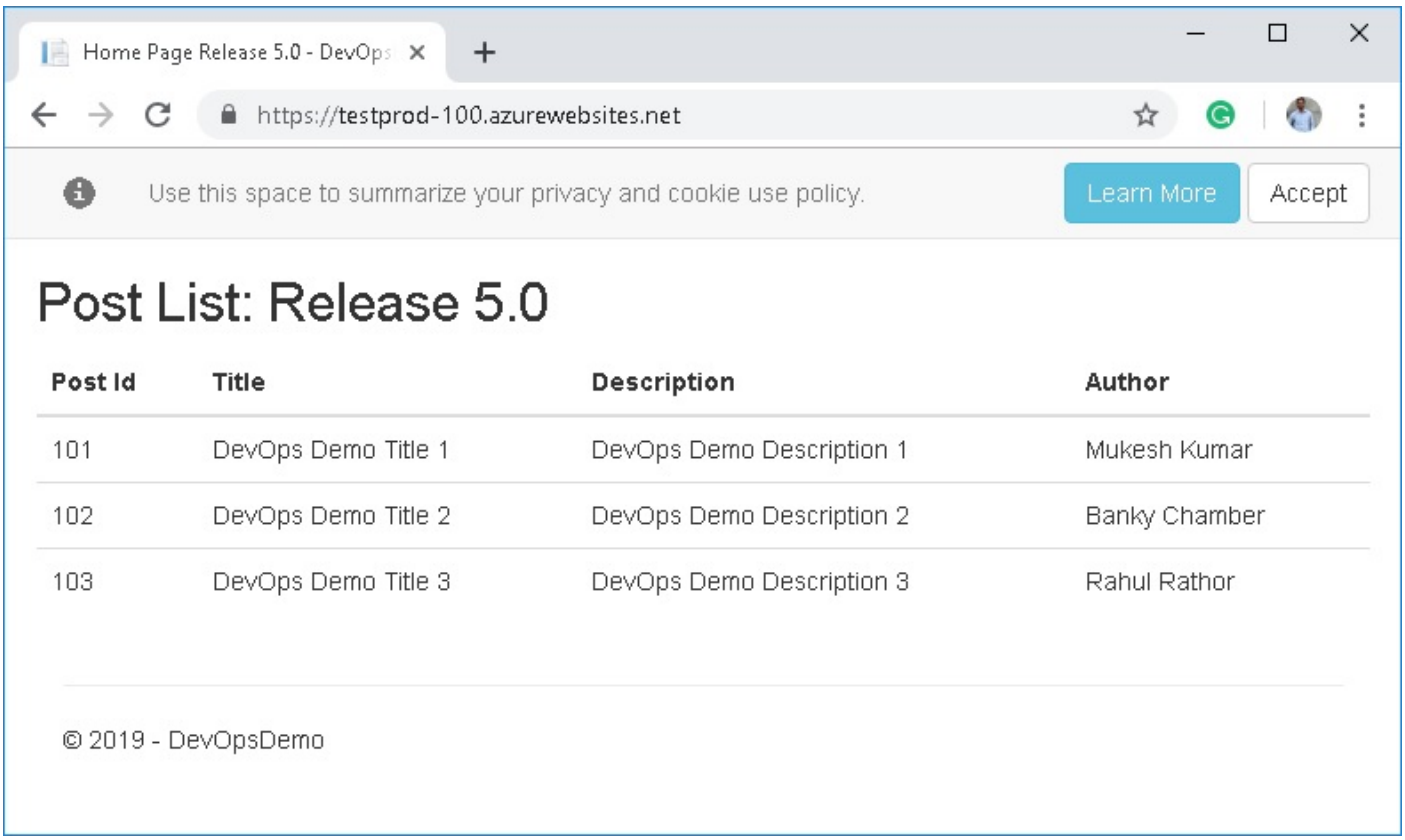
So, let open the **PROD (TestPROD-100)** environment and see the changes. Good, we have got the latest changes on the **PROD environment as Release 5.0**.



Let move and check the **Staging** environment and we will find that earlier **PROD changes has deployed on Staging environment**. **It means, earlier which was Staging has become the PROD and which was PROD has become the Staging.**

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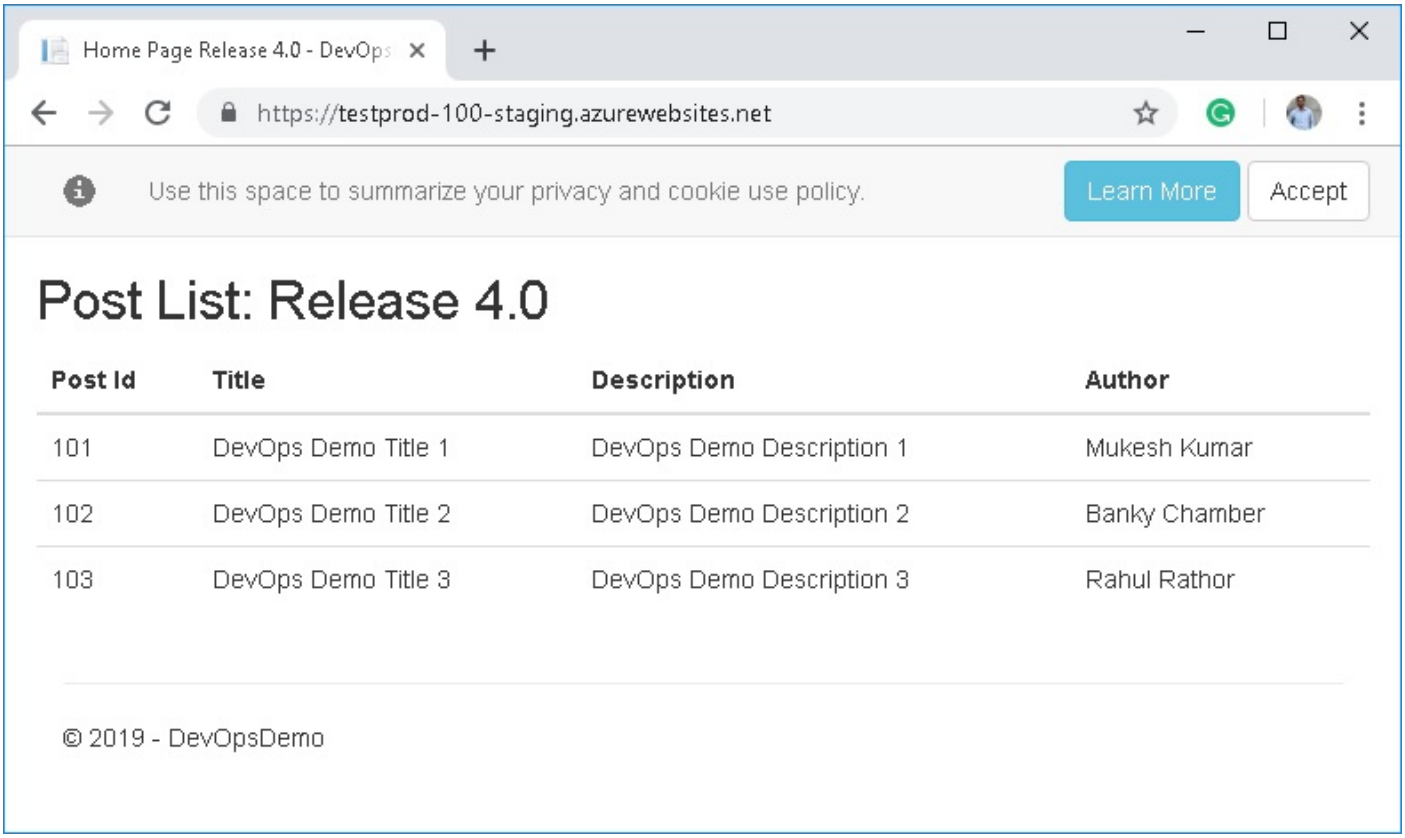

So, we have learned about Azure DevOps and implement the Continuous Integration and Continuous Delivery using live Asp.NET Core application with step by step. We hope, you have enjoyed a lot and learned a lot.

Thanks.

(By: Mukesh Kumar)