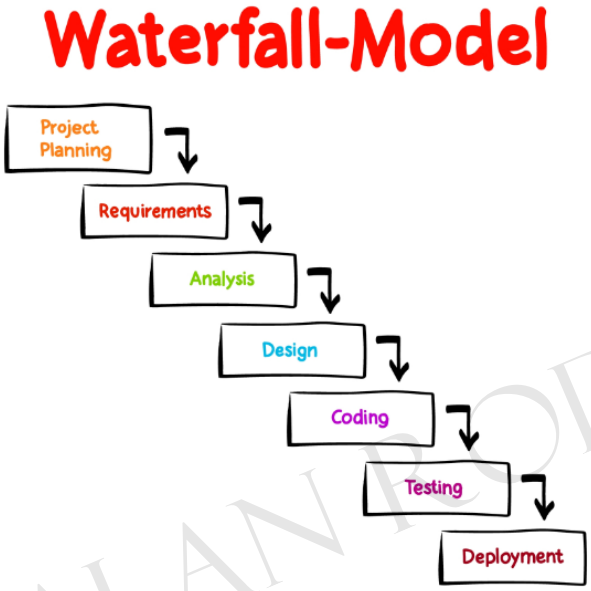
Important Note – All of the images in the diagrams should be used for individual learning purposes only. They are not to be re-distributed in any form or manner.

Introduction

Primer to DevOps - Project lifecycle



Advantages

1. Clear demarcation between one phase and another

2. The requirements can be solidifed up front.

3. It gives the Project manager a clear insight into aspects such as delivery dates, cost estimates etc.

Disadvantages

1. The customer might get to see the end product only at the end of the entire lifecycle

2. Changes in scope.

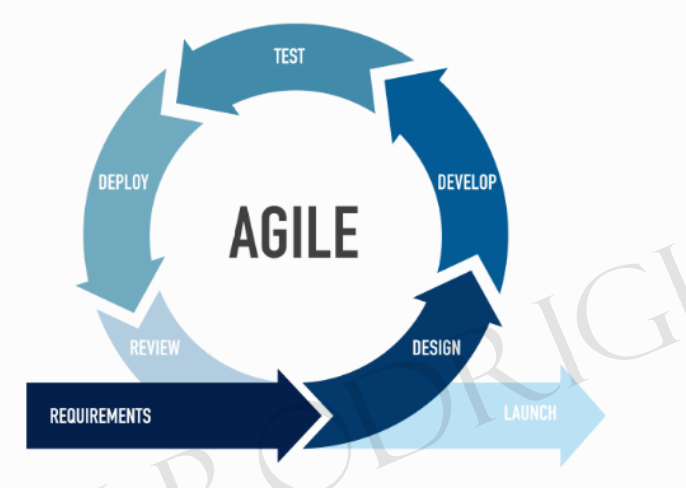
3. Bugs in the testing phase

Primer to DevOps - Agile Methodology

Agile software development

In 2001, 17 software developers met to discuss lighter development methods and came up with the manifesto for Agile Software Development

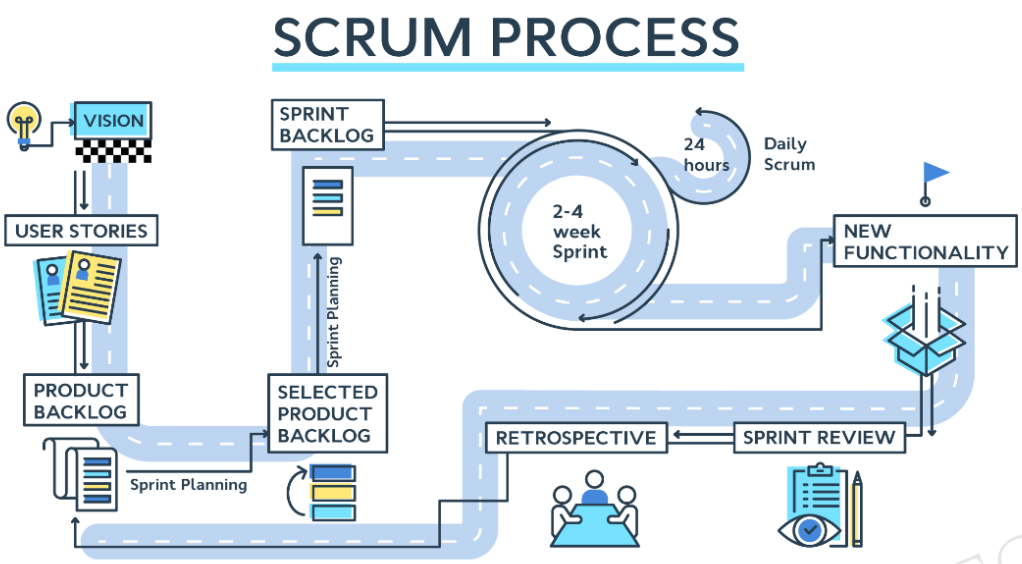
In software development, agile practices include requirements discovery and solutions improvement through the collaborative effort of self-organizing and cross-functional teams with their customer(s)/end user(s), adaptive planning, evolutionary development, early delivery, continual improvement, and flexible responses to changes in requirements, capacity, and understanding of the problems to be solved



Primer to DevOps - Scrum process

Scrum

This is an agile development methodolgy



User Story - This is a feature that the user wants. This is written from the users perspective.

Product Backlog - This is the list of items that need to be done. The list is based off the requirements, features , enhancements. This is normally managed by the product owner or the product manager.

Items are then taken from the Product Backlog and then assigned to a sprint. The sprint is normally a duration of 2 weeks. The items assigned to the sprint are made part of the sprint backlog.

Sprint Review - Here the team showcases what was done in the sprint. Here the decision can be made as to whether the deliverable should be promoted to production.

Sprint Restropective - The team comes together to see what worked and what did not work.

Development team is developing an application

Testing team tests the application

Application is deployed to a production environment

And then the operations team takes over

Server operations - Take cares of the servers

Database operators - Takes care of the databases

Sometimes developers try to apply quick fixes if they are under a time constraint.

Maybe the testing times for the applications are cut short

Operations teams are hesistant to deploy the changes.

They are in the direct line of fire. If the changes goes wrong, then it could lead to a downtime for the application.

There is always this constant tussle between development and operations.

The entire purpose of DevOps is to ensure that developers and IT operations work in collaboration.

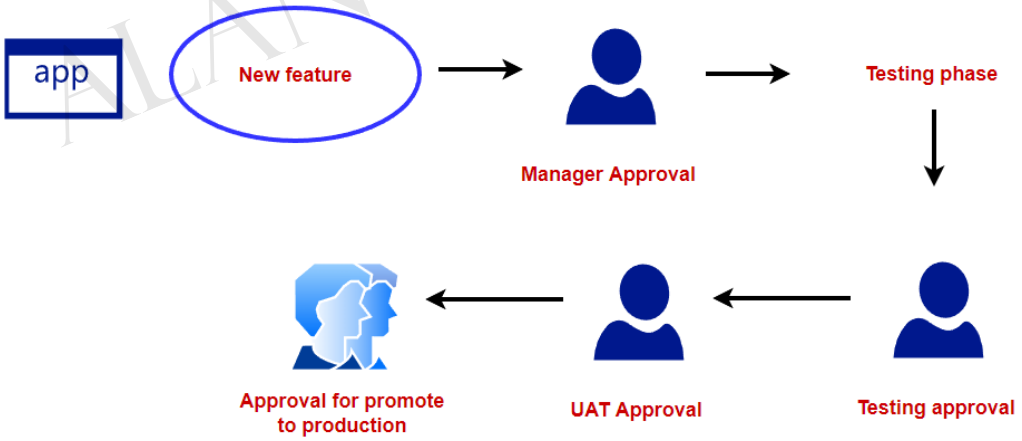
Meetings that are held with stakeholders normally have the Developers and Operations teams.

Automation is a key aspect.

Faster delivery of application features.

Adoption of the right tools.

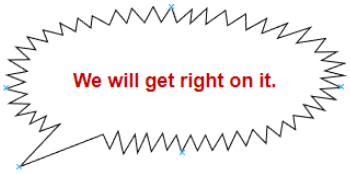
Big shift in the mindset and processes.



Configure processes and communications

Let's start with planning

LEADERSHIP



IT department

LEADERSHIP

Human Resource Business department

Focus on Application Delivery

Focus on adding features

Focus on collaboration with end users

Traditional Approach

Approach to the project

Traditional Approach

LEADERSHIP

IT department

TEAM

Project team

Assign a Project Manager

Get the budget approved.

Hire the people, get the team in place.

Project Manager would try to setup a plan.

Business Analysts would setup meetings with the end users to gather requirements.

Could take around 2 weeks to a month.

Design the screens

Design the data store

Design the application modules

Could take a month

Developers start with the coding phase

Testing the application

Could take months

Software in place

Our Approach

Scrum process

Scrum team

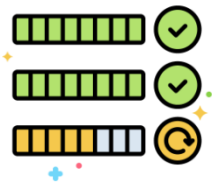
Small group of people focused on achieving an objective

Gather requirements from the users

User stories

Product Backlog

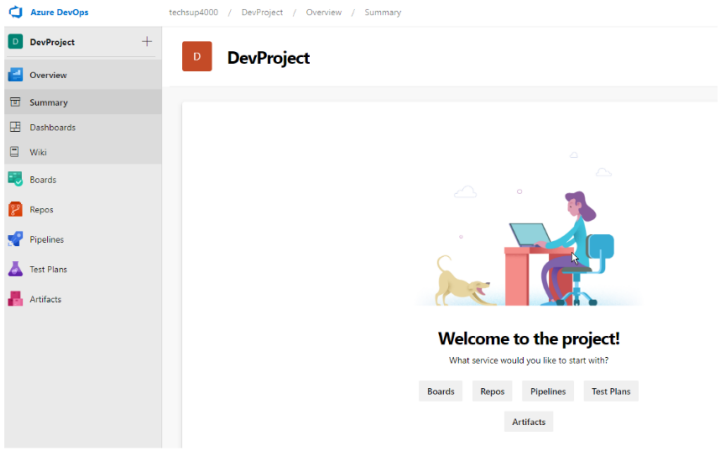
Sprint Backlog



Check the status of your sprints

We need a software to track all of this

Getting started with Azure Boards



Project

This provides a place for storing the source code. Here users can plan, track progress, collaborate.

When you create a project, a team of the same name as the project is created.

Organization

This can contain a group of related projects.

For example , you could have an organization for each business unit.

Each organization gets its own *free tier* of services (up to five users for each service type) as follows. You can use all the services, or choose only what you need to complement your existing workflows.

- Azure Pipelines: One hosted job with 1,800 minutes per month for CI/CD and one self-hosted job
- Azure Boards: Work item tracking and Kanban boards
- Azure Repos: Unlimited private Git repos
- Azure Artifacts: Package management
- Unlimited Stakeholders
  - Five Azure DevOps users (Basic)
  - Free tier of Microsoft-hosted CI/CD (one concurrent job, up to 30 hours per month)
  - 2 GiB of Azure Artifacts storage
  - One self-hosted CI/CD concurrent job

https://docs.microsoft.com/en-us/azure/devops/user-guide/plan-your-azure-devops-org-structure?view=azure-devops

Creating user stories

User Stories

1. Each department admin must be able to add a job posting

2. There should be an inbuilt workflow for the job posting

3. Once the job posting is published, no edits should be possible on the job posting

Epic

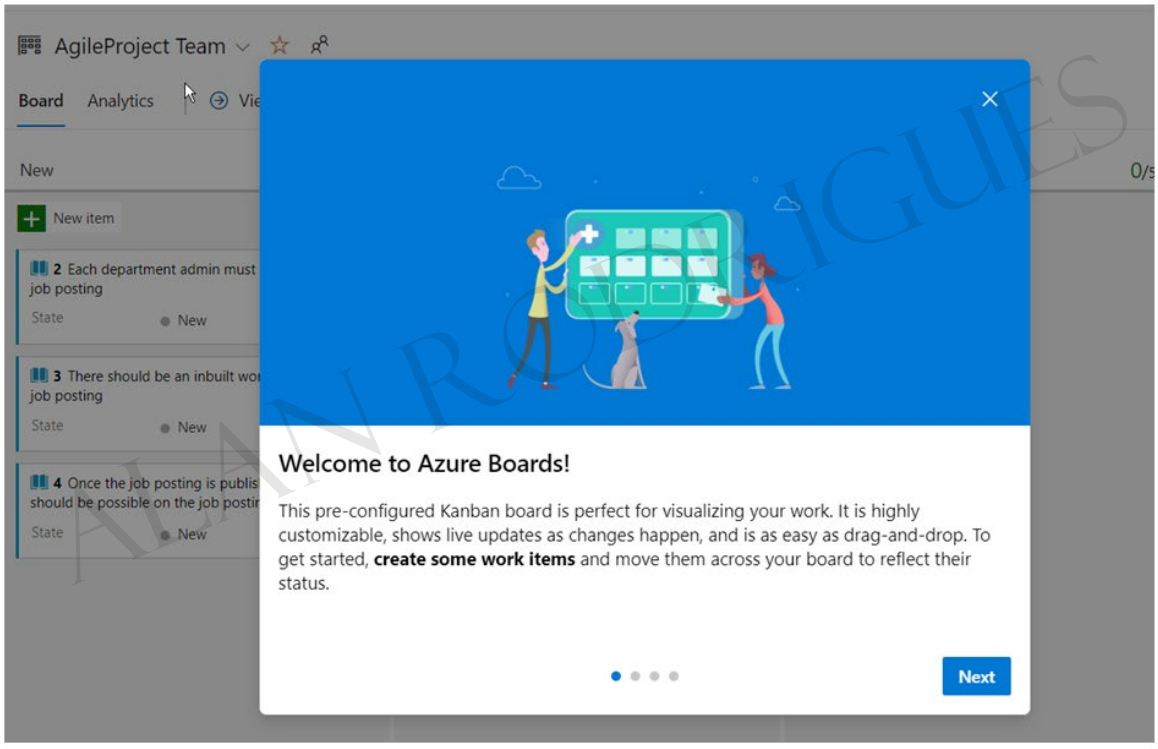
Jobs application - Job Postings

Azure Boards

Kanban

This is a framework available that can be used to implement agile and DevOps

Use of Kanban boards



Understanding permissions

Permissions

When a user is added to Azure DevOps, they are added to a default security group

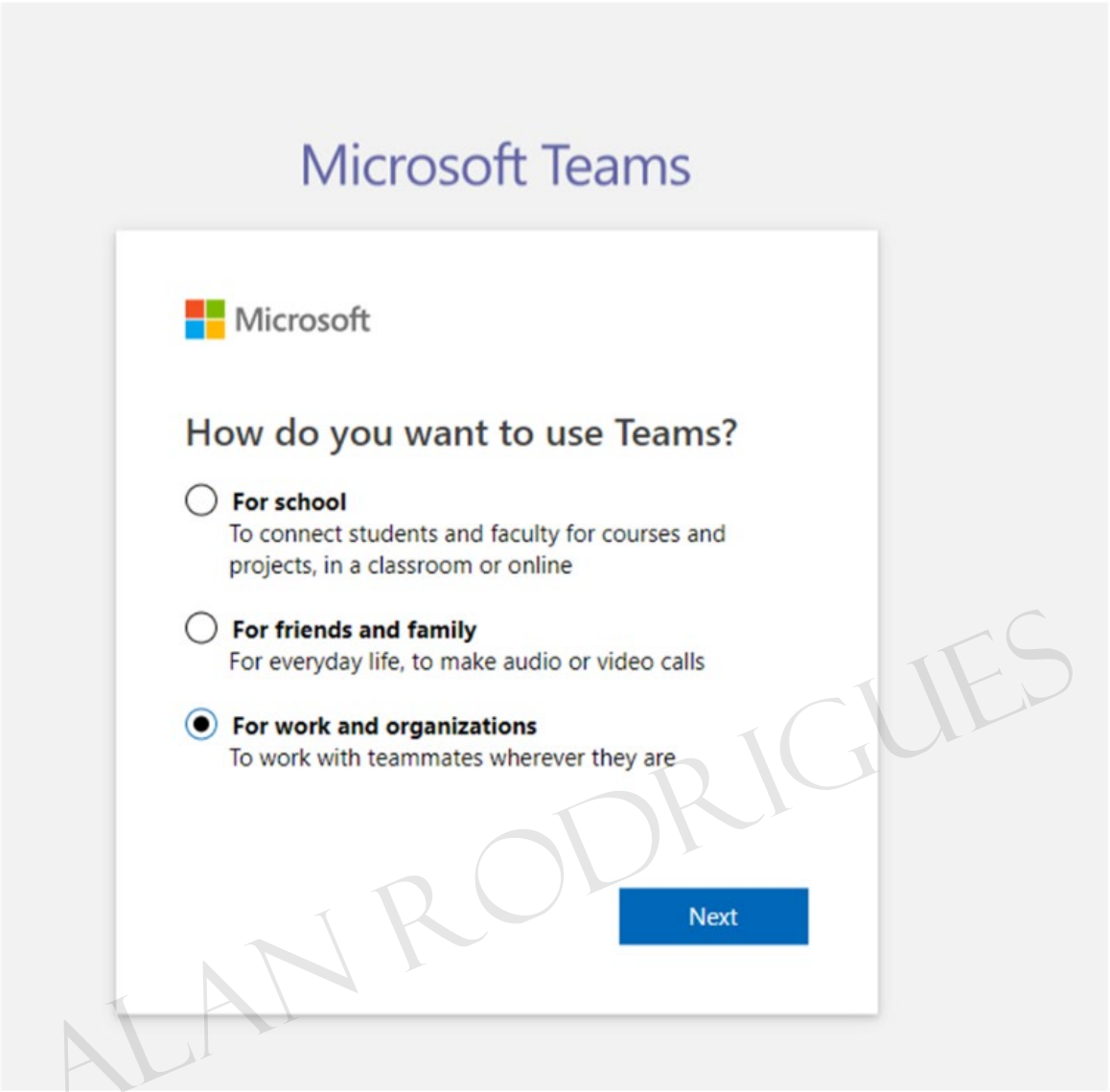
Permissions can be assigned at an organization, project or object level.

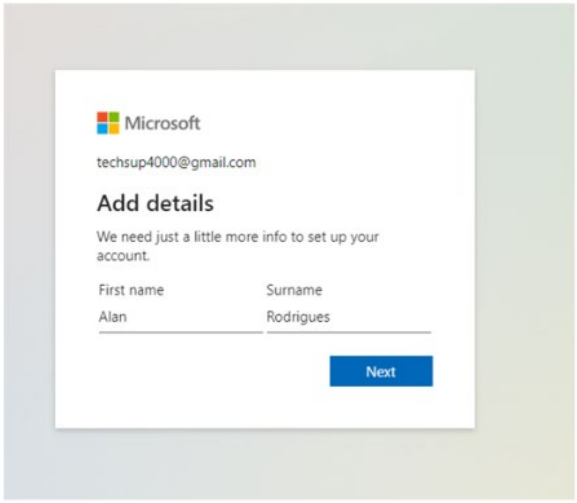
Default security groups

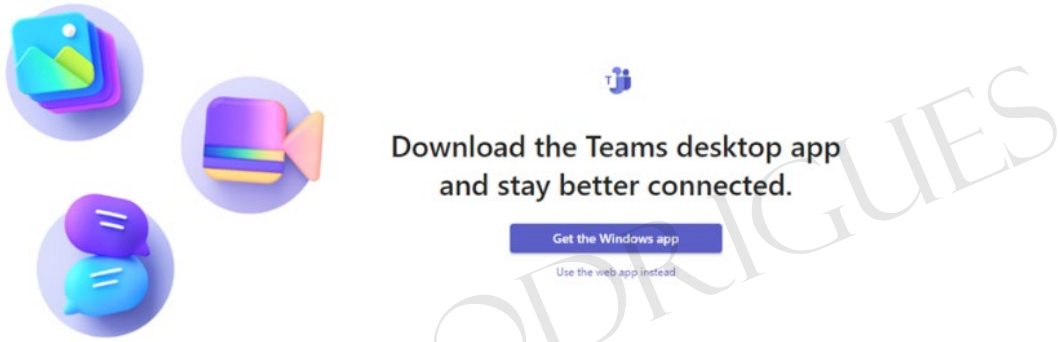
Project	Organization or Collection
- Build Administrators - Contributors - Project Administrators - Project Valid Users - Readers - Release Administrators - *TeamName* Team	- Project Collection Administrators - Project Collection Build Administrators - Project Collection Build Service Accounts - Project Collection Proxy Service Accounts - Project Collection Service Accounts - Project Collection Test Service Accounts - Project Collection Valid Users - Project-Scoped Users - Security Service Group

https://docs.microsoft.com/en-us/azure/devops/organizations/security/about-permissions?view=azure-devops&tabs=preview-page

Azure Boards - Integration with Microsoft Teams

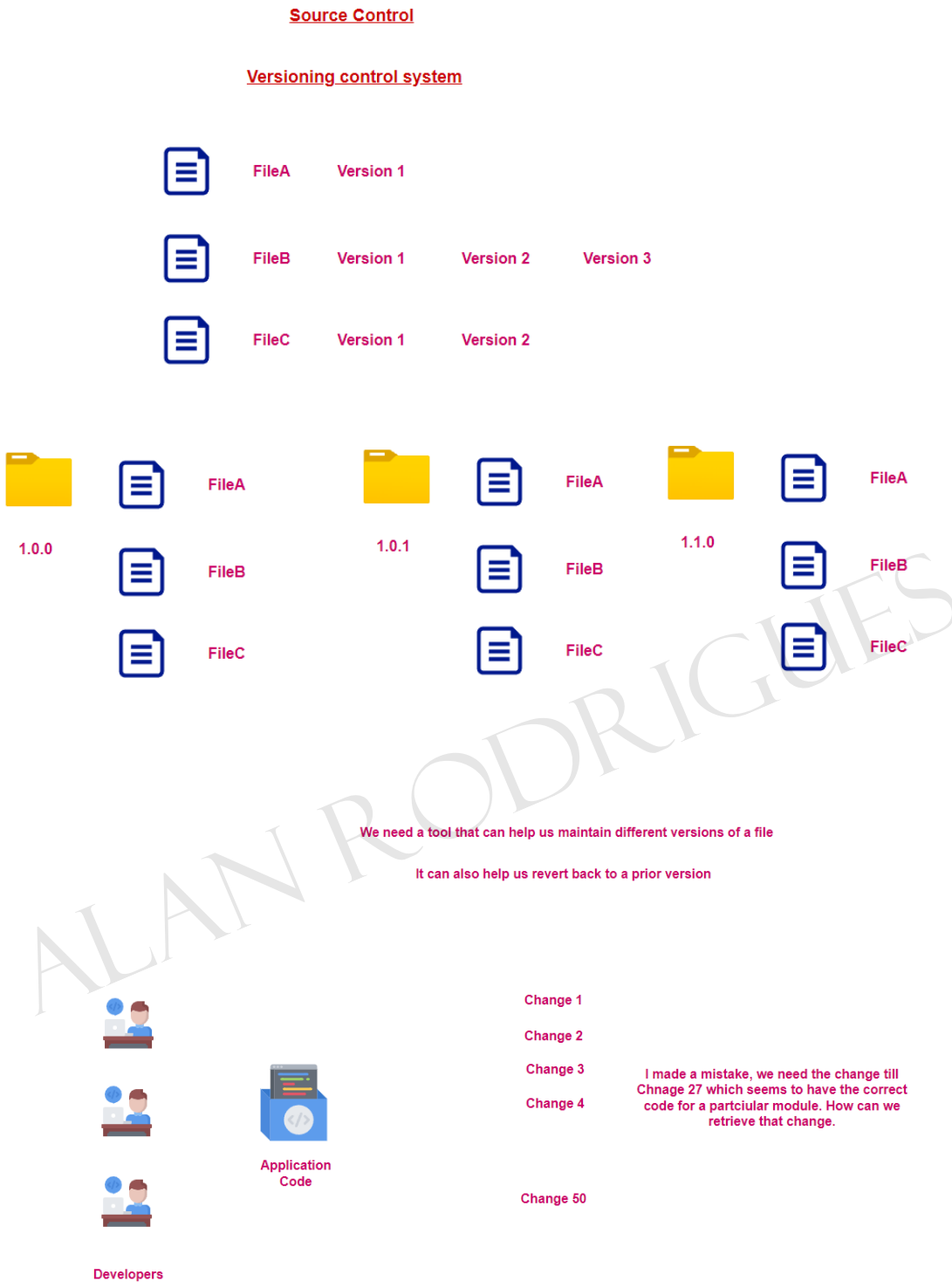






Design and implement source control

What is source control



What is Git

Source Control

Versioning control system

FileA Version 1

FileB Version 1 Version 2 Version 3

FileC Version 1 Version 2

Git is the most commonly used version control system

This is because of its distributed nature.

Subversion

Subversion client

Checkout the files required.

Make changes to the code.

Check in the code with the required changes.

Central Server

Subversion Server software

Subversion client

Application Code

Subversion client

Git

Git client

Git client

Git client

Application Code

Application Code

Application Code

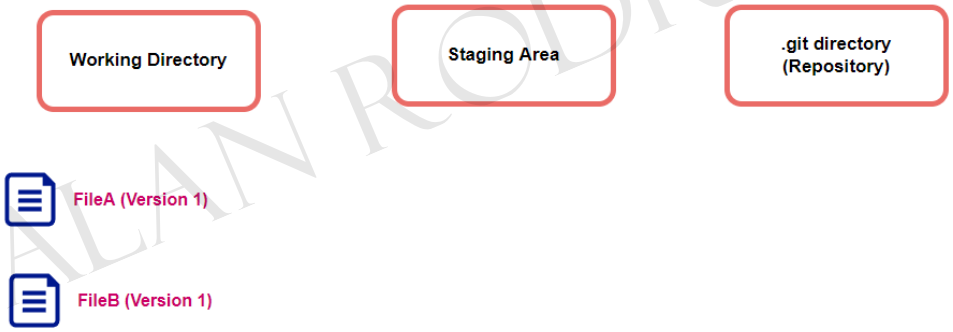
Other advantages

Better overall performance

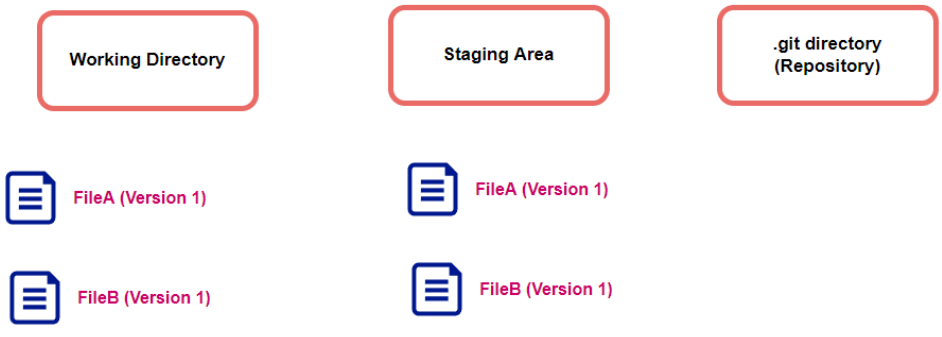
Easily manage aspects like creating branches

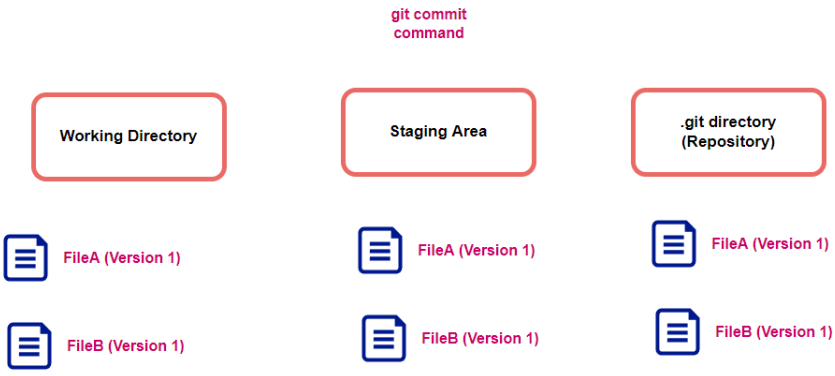
Adding to the git repository

1. Install the git tool
2. Initialize an empty repository onto your file system
3. Start working with your files on your local system

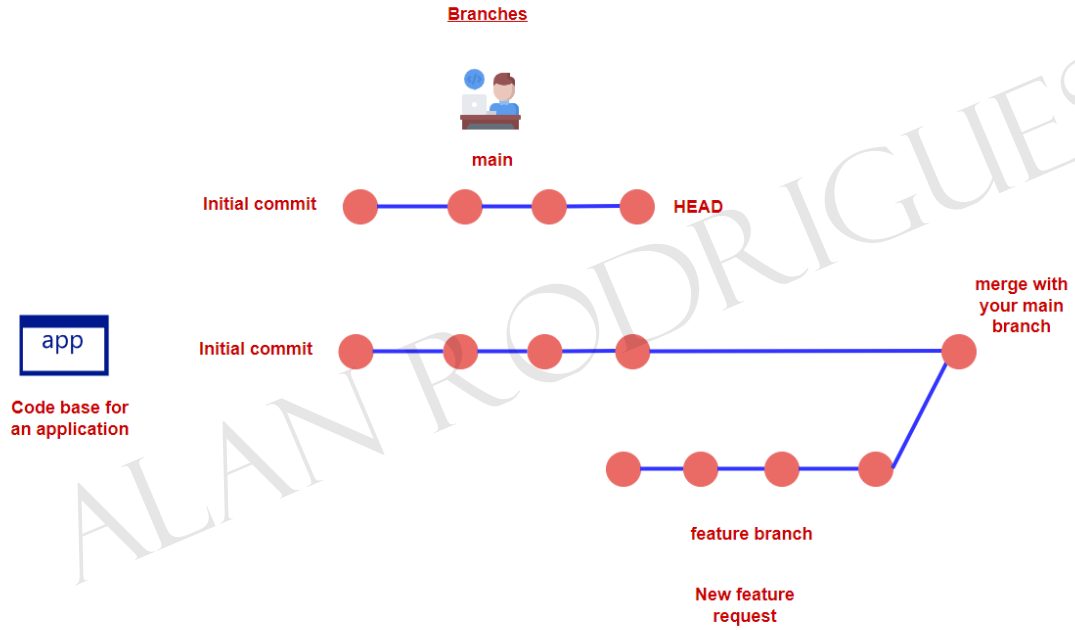


git add command





Git branches



Using a remote repository

Git

Git client

Git client

Git client

Application Code

Application Code

Application Code

Git client

Remote repository

Git client

Application Code

Application Code

Application Code

1. Clone the remote repository

2. Make changes to the local repository

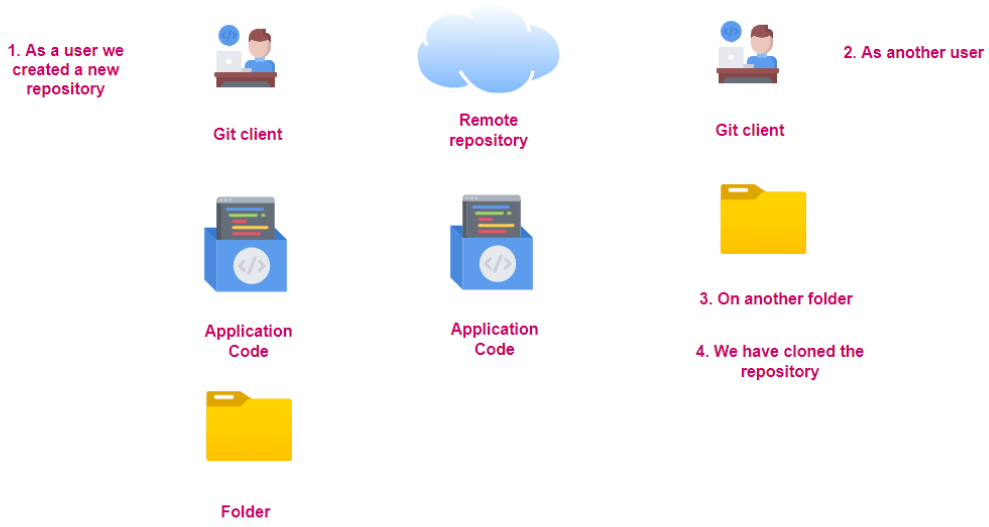
3. Merge the changes from the local to the remote repository

1. Clone the remote repository

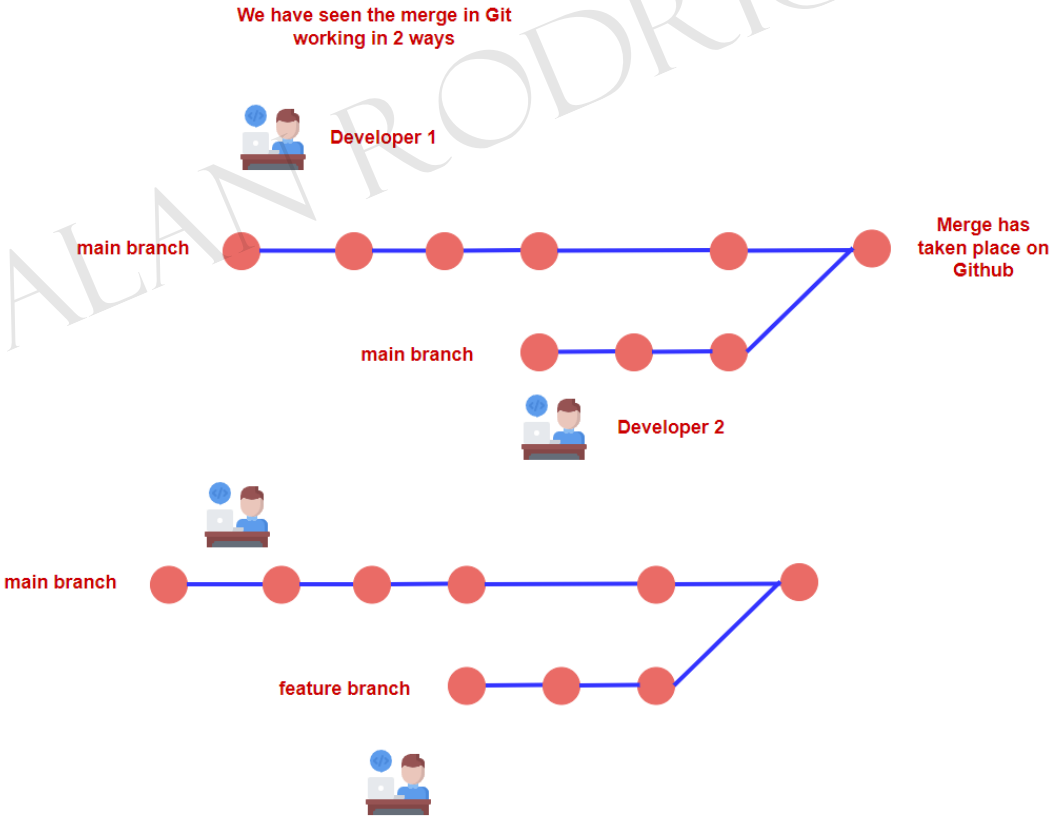
2. Make changes to the local repository

3. Merge the changes from the local to the remote repository

Now let's clone the repository as another user



More on merges



```
PROBLEMS  OUTPUT  DEBUG CONSOLE  TERMINAL

PS C:\Application> git checkout main
Switched to branch 'main'
Your branch is up to date with 'origin/main'.
PS C:\Application> git log --pretty=format:"%h %s" --graph
* d8af16d Added FileC
* cc636ac Made a change to FileA
* 872b55b This is the initial commit
PS C:\Application> git log --graph
* commit d8af16d7f8092531b2507ef9315524b2477929bd (HEAD -> main, origin/main, FeatureA)
| Author: Alan <techsup4000@gmail.com>
| Date:   Sat Jul 16 14:58:41 2022 +0400
|
|     Added FileC
|
* commit cc636aca1f0ad304bc92c7fcf88e7b2d2557ef30
| Author: Alan Rodrigues <techsup4000@gmail.com>
| Date:   Sat Jul 16 13:01:26 2022 +0400
|
|     Made a change to FileA
|
* commit 872b55b8641cb4a4de54c89565e9c6faab20c481
  Author: Alan Rodrigues <techsup4000@gmail.com>
  Date:   Sat Jul 16 11:25:16 2022 +0400

      This is the initial commit
PS C:\Application>
```

Earlier example

1. We had the main branch

2. We created the FeatureA branch

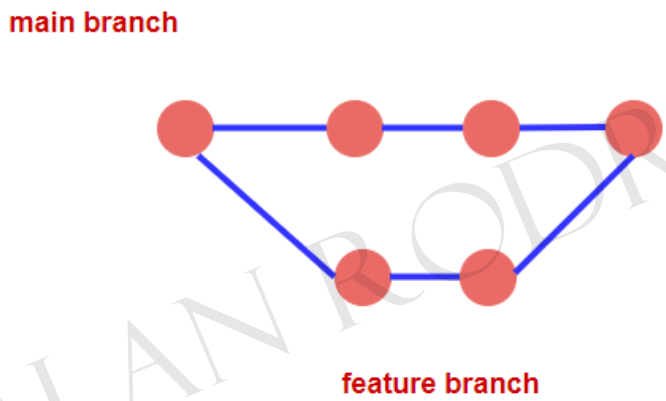
3. In FeatureA branch we added a File - FileC.txt

4. We then merged FeatureA and the main branch.

5. When we made changes to the FeatureA branch, there were no changes made to the main branch during that time.

Hence a simple fast-forward merge happened wherein the main branch just pointed to the latest commit of the feature branch.

Branching strategy



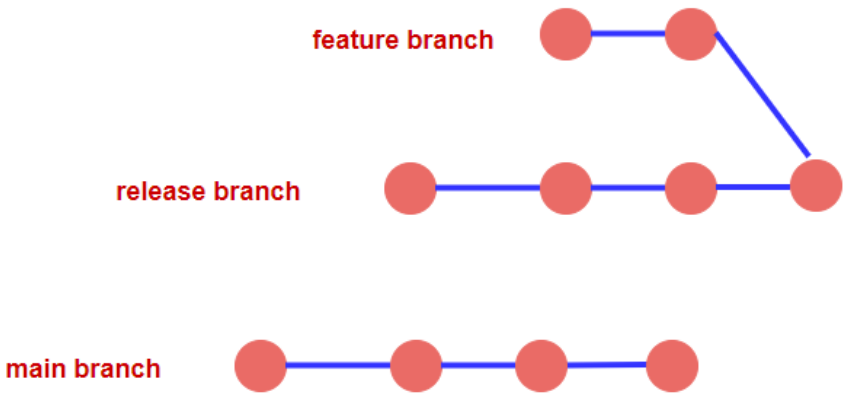
1. Always maintain a high quality for your main branch

2. Contain the working copy of your production code

3. Create feature branches for your features and bug fixes

4. Use pull requests to merge your feature branches into your main branch.

5. Don't create long feature branches, keep them short-lived.



You also need to ensure that your feature branch is merged onto both your release and main branches

Here you need to maintain your release and main branches as well.

Design and implement build pipelines

What is Continuous Integration

Continuous Integration

Automatically building and testing code every time a team member commits code changes to version control.

Our local machine

In Visual Studio , when we run an application, a build of the application is conducted first.

The build tool builds the project and the depedencies into a set of binaries.

The binaries can then run on the target machine with the help of the .NET runtime.

Coded an application using the .NET 6.0 SDK

The machine needs to have .NET runtime installed to run the application.

Deploy the application on a virtual machine

Now going back to continuous integration

You normally have multiple developers working on an application

Each developer might be working on multiple changes that can take time.

8 changes

3 weeks

app

Developer pusblishes the updates.

If there is an issue it becomes difficult to diagnose the issue

1 change

2 days

app

Developer publishes the update to the code base

Automation is key

Changed Code is published

The code needs to be built

The code needs to be tested

And this is the concept behind continuous integration

Self-hosted agent

```yaml
# ASP.NET Core (.NET Framework)
# Build and test ASP.NET Core projects targeting the full .NET Framework.
# Add steps that publish symbols, save build artifacts, and more:
# https://docs.microsoft.com/azure/devops/pipelines/languages/dotnet-core

trigger:
- main

pool:
  vmImage: 'ubuntu-latest'

variables:
  solution: '**/*.sln'
  buildPlatform: 'Any CPU'
  buildConfiguration: 'Release'

steps:
Settings
- task: UseDotNet@2
  displayName: Install .NET 6
  inputs:
    packageType: 'sdk'
    version: 6.x

Settings
- task: DotNetCoreCLI@2
  displayName: Build
  inputs:
    command: build
    projects: '**/*.csproj'
    arguments: '--configuration $(buildConfiguration)'
```

The entire pipeline is making use of a Microsoft hosted agent.

This is the simplest way to run the pipeline.

A fresh virtual machine is created for each new job of the pipeline.

After the job is run, the virtual machine is discarded.

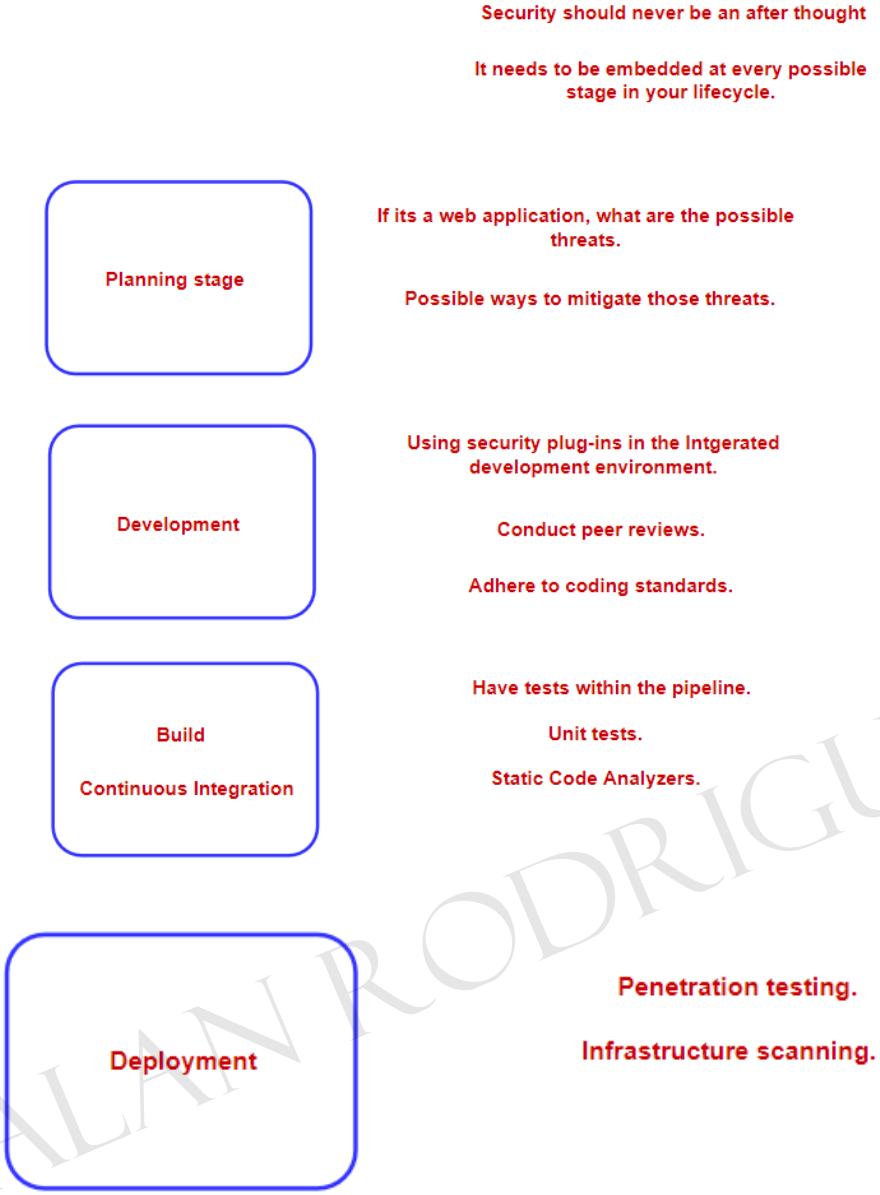
All maintenance and upgrades are handled by Microsoft when it comes to the hosted agents.

You want to create your own agent.

You want to persist the builds.

Have custom software installed.

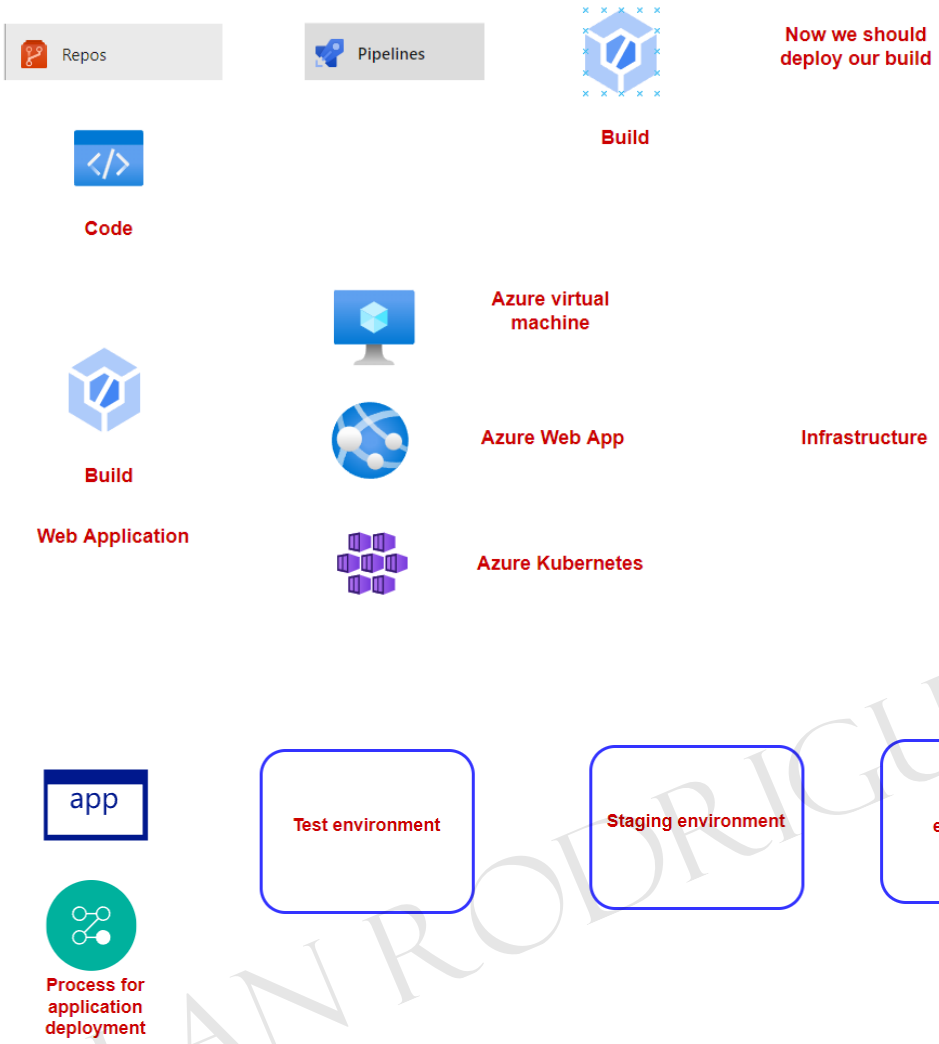
Security at every stage



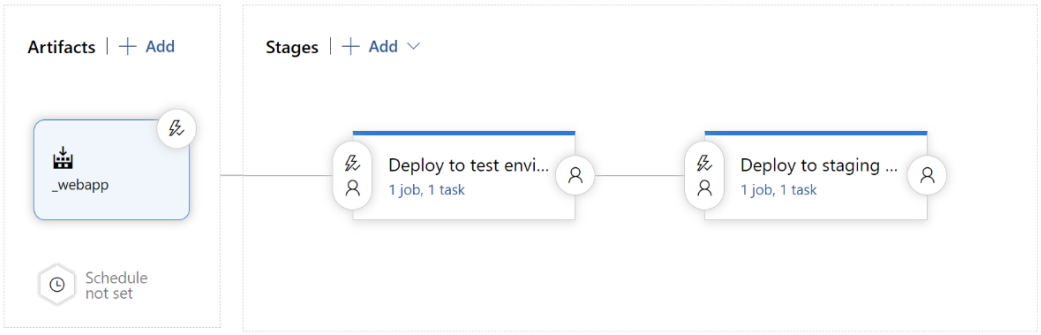
What have we seen so far

Design and implement release pipelines

Understanding deployment



Multiple stages in the pipeline



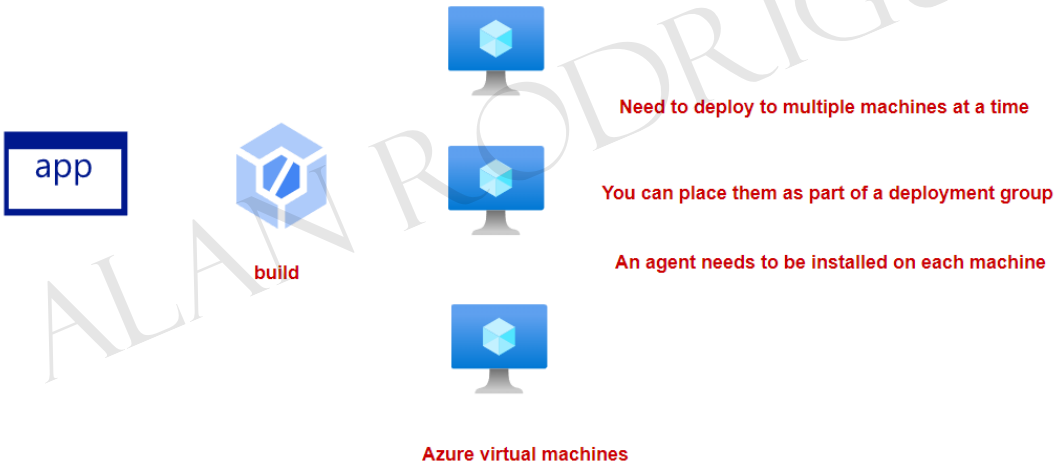
Pre-deployment approval
A user needs to validate the change request so that the deployment can be done to that stage

Post-deployment approval
A user needs to sign-off on the deployment done so that it can move to another stage.

Pre-deployment gate
A user wants to ensure that no work items are active for the build to be deployed to a stage.

Post-deployment gate
A user wants to ensure that no issues are tagged against a deployment before it can proceed to the next stage.

Lab - Deployment Groups – Implementation



Azure Web App - Azure SQL database

Azure Web App

Azure SQL database

Table

1. Build the ASP.NET Core application

2. Release pipelines - 2 tasks

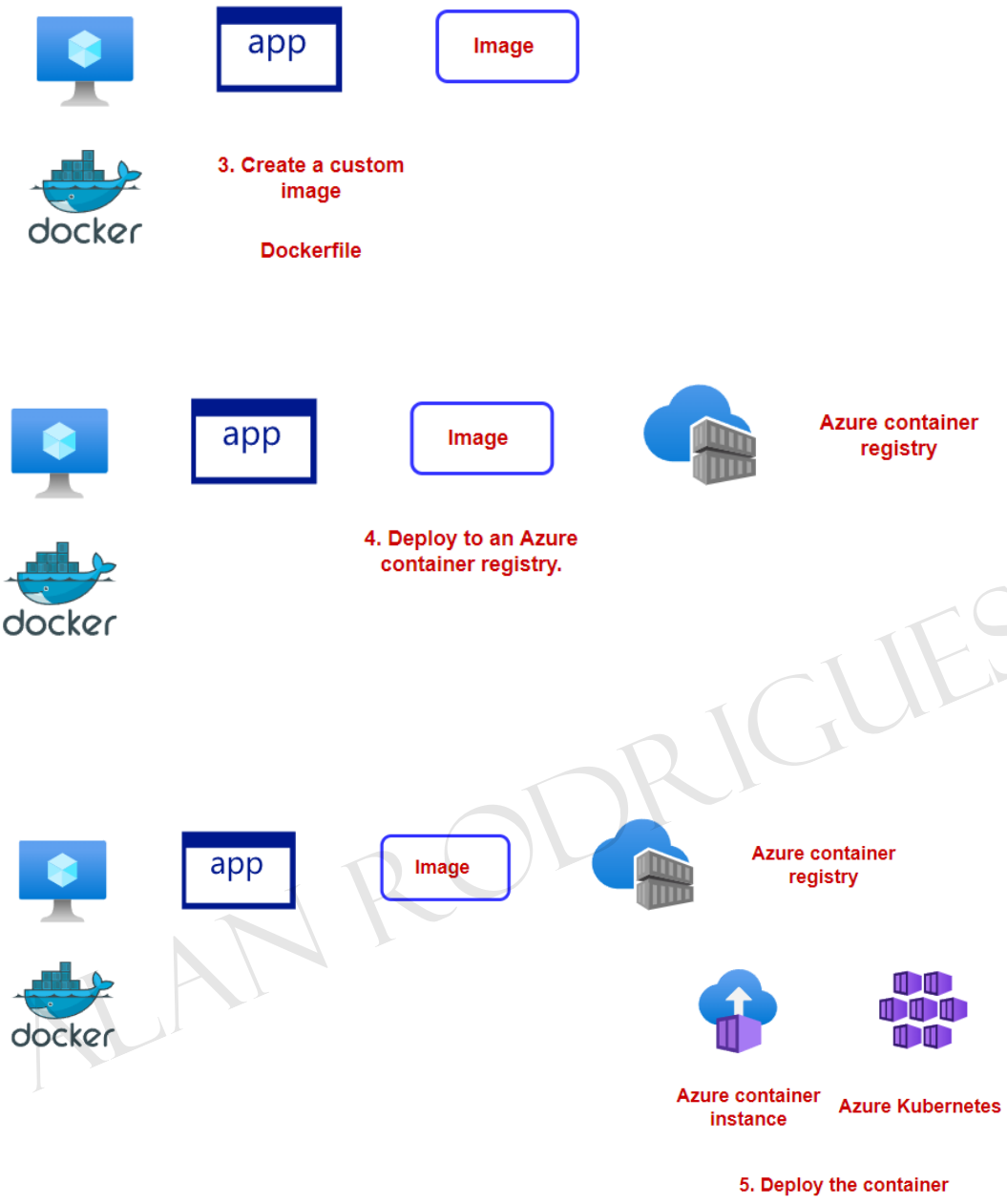
2a. Deploy the table and data in the Azure SQL database.

2b. Deploy the .NET application to the Azure Web App.

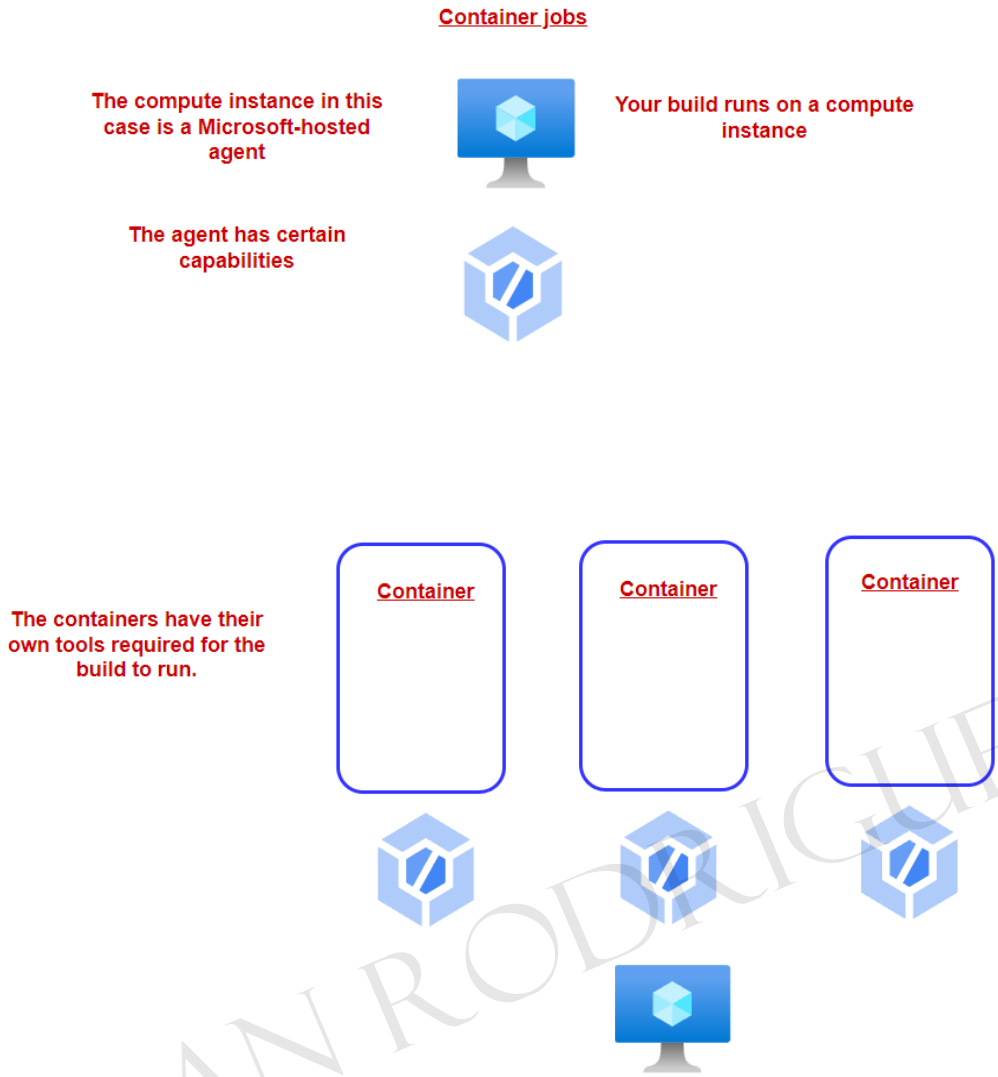
The next step – Containers

1. Install Docker on a virtual machine

2. Publish the .NET application onto the VM.



About Container jobs



Design and Implement Infrastructure as Code

About managing infrastructure

Managing infrastructure

Azure virtual machine

Web server

Azure virtual machine

Database server

Azure Web App

Azure SQL database

1. Creating your infrastructure

2. Making changes

3. Replicating the same infrastructure across multiple environments

4. Sometimes you might not document properly how you built your infrastructure

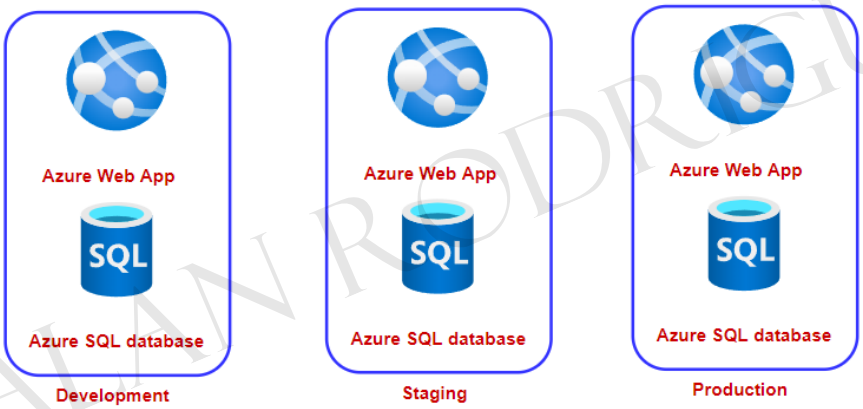
You develop your infrastructure as code

This helps clearly define how you infrastructure should look like

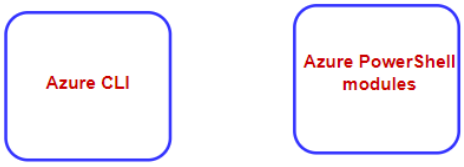
You can easily make changes to your infrastructure with the help of changes to the code file

You can also version control the code file that is used to define your infrastructure

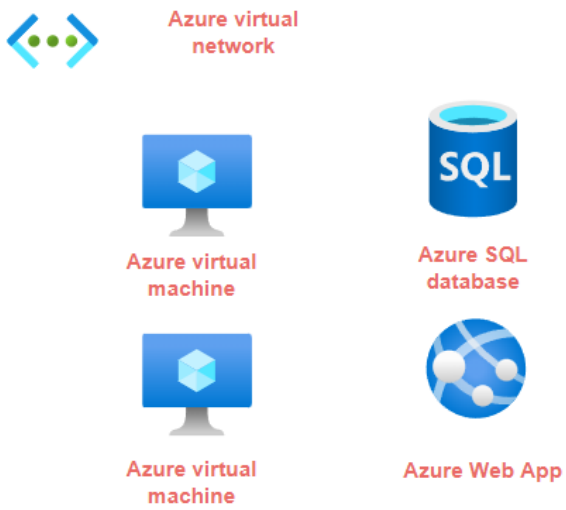
Replicating your infrstructure across multiple environments



Remember you can also create scripts to manage your Azure resources



About ARM templates



You define your infrastruture as code

Create an Azure Resource Manager template

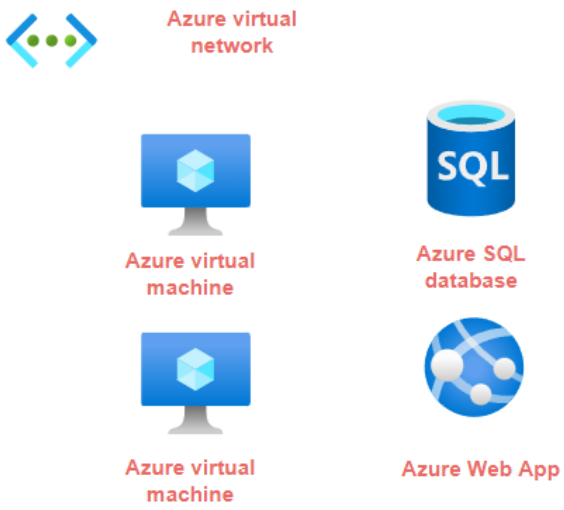
This is a JavaScript Object Notation file that actually contains the definition of the infrastructure

You can store the ARM templates in your source code repository along with your application code

Microsoft has also release a new language called Bicep that has the same capabilities as ARM templates.

Bicep just uses a syntax that is easier to use.

Modularize templates



Sometimes your templates can become really large because of the number of resources that need to be deployed.

In this case, you can see whether you can create nested or linked templates.

Here the definition of the nested resource is defined withint the main template itself.

Nested Template

Here resources are defined as different templates. And the templates are referenced within other templates.

Linked Template

Deployment modes

Incremental mode - Here resources defined in the template are deployed. It does not interfere with other resources defined in the resource group which are not defined in the template.

Complete mode - Here resources defined in the template will only be in the resource group. If there are other resources in the resource group, they will be deleted.

About Terraform

Deploying your infrastructure

Application Server

Database server

1. Deploy the infrastructure
2. Configure your infrastructure

Infrastructure as code

Code file

Application Server

Database server

Change the code whenever required

Share the code

Create different versions of the code

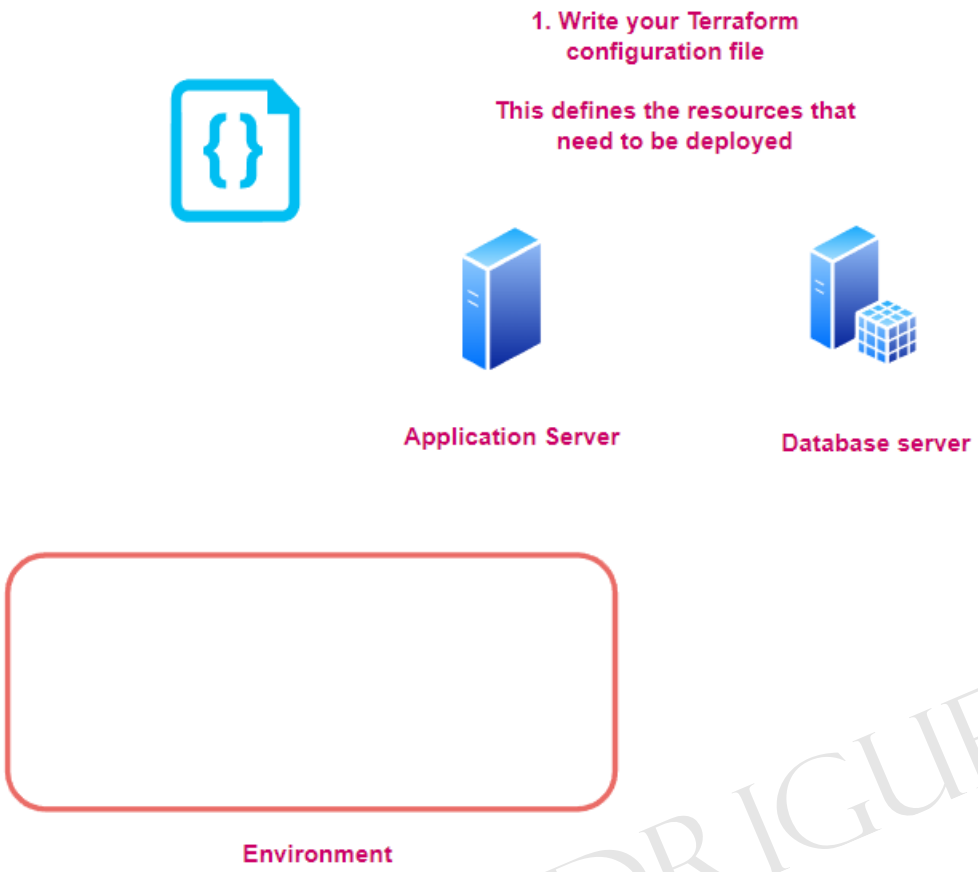
What makes Terraform popular

It works with a variety of cloud platforms.

The code is human-readable

Avid community

Open-source project



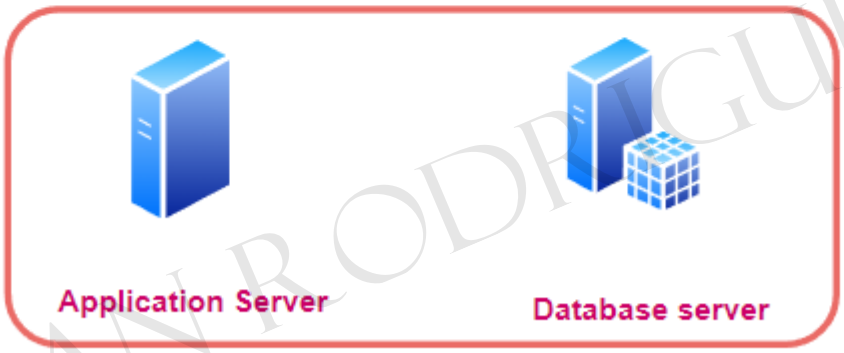
2. Terraform plan

Terraform looks at the configuration file and decides what needs to be deployed or changed.

It actually maintains a state file.

3. Terraform apply

Apply all of the changes as per the Terraform configuration file



Configuration File

Provision the infrastructure as per the details specified in the configuration file.

Desired State Configuration

Desired State Configuration

The machine has tools or software installed to support the application.

Azure virutal machine

For example - Internet Information Services for a web application.

It has to be ensured that the configuration of the machine does not drift or it could impact the application.

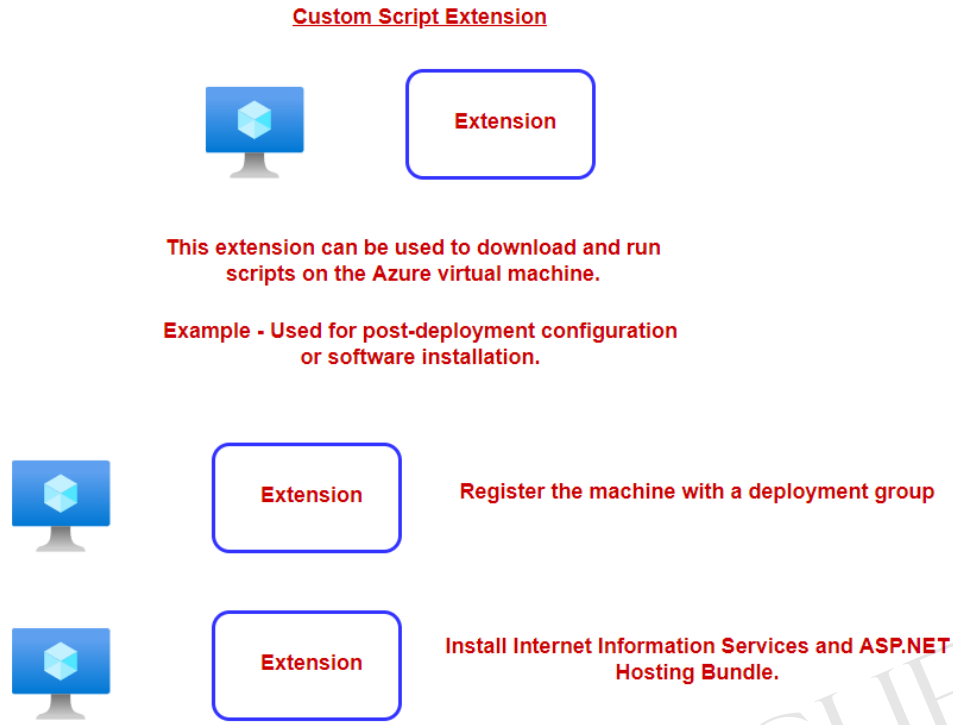
For this you can make use of PowerShell DSC

Azure Automation DSC

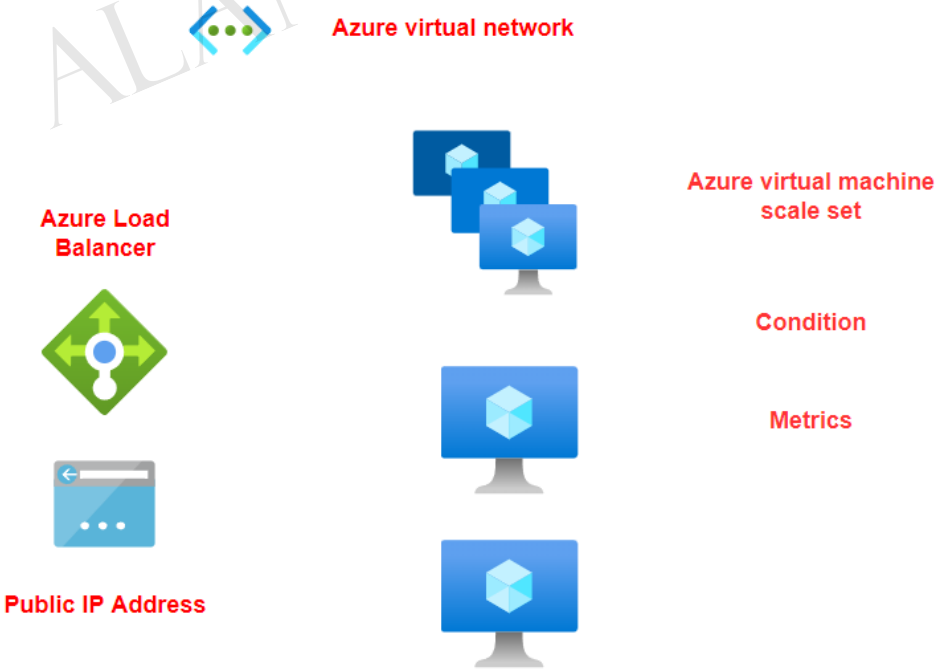
Here there is an in-built server that ensures all machines receive the desired configurations.

You can manage all configurations and nodes from the Azure Portal.

Using VM extensions



Virtual Machine Scale Sets



Deployments, Packages and Test Plans

The fear of changes

User's ask for changes to the application

Make code changes that need to be deployed

But there is always that fear factor

What happens if the change fails

The application stops working

Customers are not happy

Risk to the business

That is why companies strive a lot to make changes as seamless as possible

Blue-Green Deployments

Blue environment

Green environment

All user traffic is directed to the Blue environment which is the current production environment.

If a software change needs to be made , then a duplicate environment is setup. The changed application is deployed to this environment.

Test is conducted on this environment.

Blue environment

Green environment

Once testing is completed , users are then directed to the Green environment.

This now becomes the production environment.

Azure Web App - Deployment Slots

Deployment Slots

Staging Environments for App Service Plans

Version 1

Version 2

Production Slot

Staging slot

Standard , Premium and Isolated App Service Plan

Applications in deployment slots have their own host names

1. You have the chance to validate all application changes in the staging deployment slot

2. You can then swap the staging slot with the production slot

3. This helps eliminate the downtime for your application when new changes are deployed

4. You can also easily roll back the changes

Canary deployments

Canary deployments

Production Environments

Users are directed to the production environment

When a new feature is released for the application, it is only made available to a subset of users.

You can direct a percentage of users onto maybe a new environment with the new feature.

Or maybe use feature toggles to toggle a feature on or off.

Azure Traffic Manager

Azure Traffic Manager

This is a DNS-based traffic load balancer.

You can distribute traffic to public facing applications across different Azure regions.

You can direct traffic based on different routing methods.

Azure Traffic Manager Profile

Priority Routing Method

North Europe

Azure Web App

UK South

Azure Web App

Azure Traffic Manager Profile

Weighted Routing method

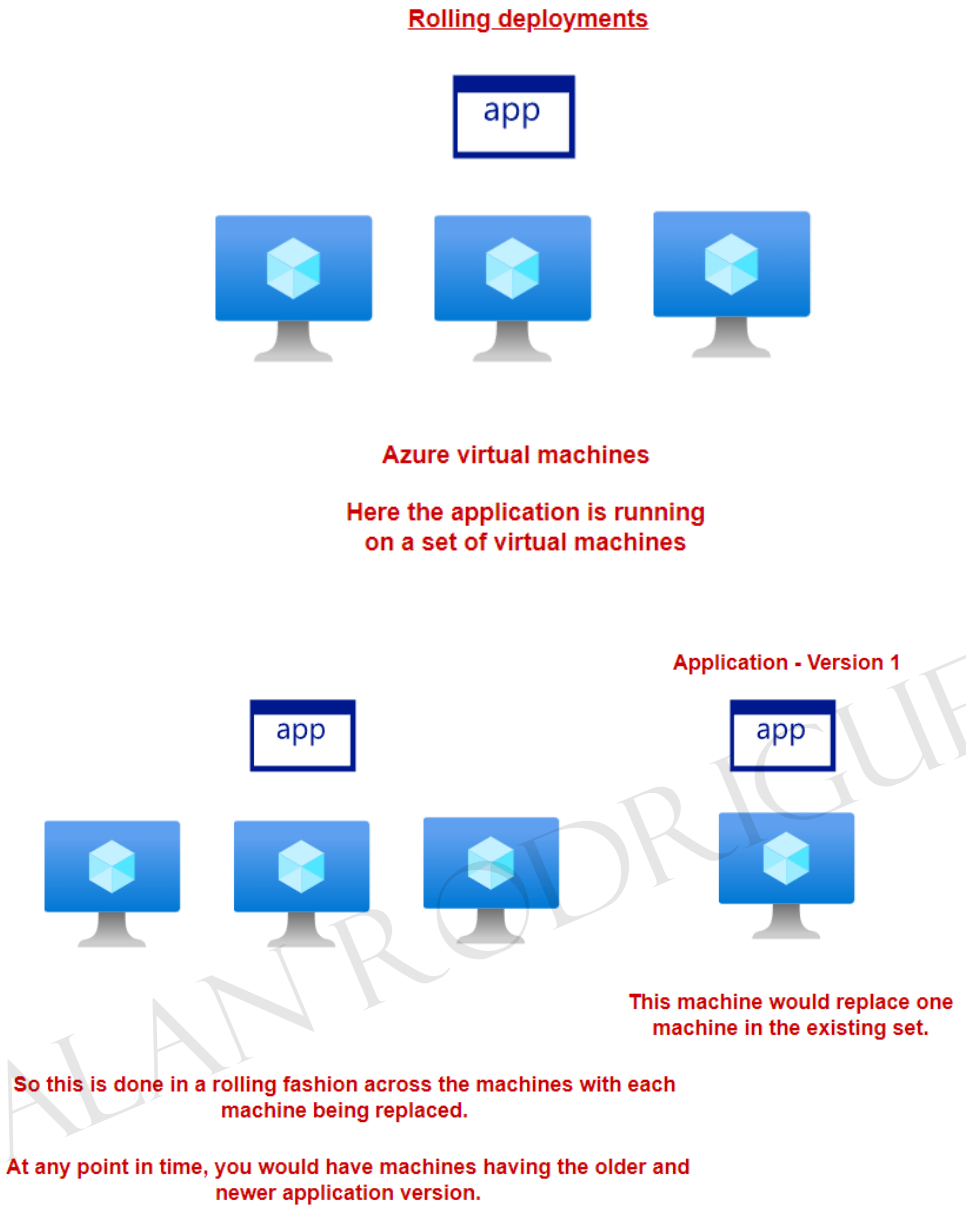
North Europe

Azure Web App

UK South

Azure Web App

Using a rolling deployment



Using a Load Balancer

Using an Azure Load Balancer

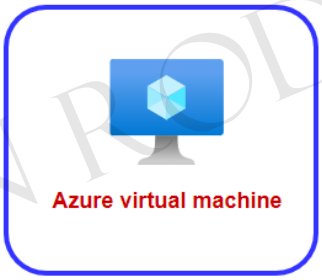
Azure Load Balancer

Health probe

Load Balancing Rules

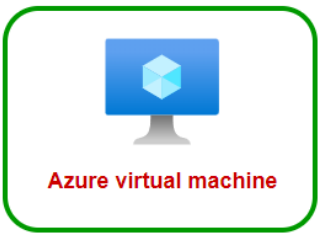
Azure virtual machines

Backend pool



All users are directed to the current production environment

Blue environment

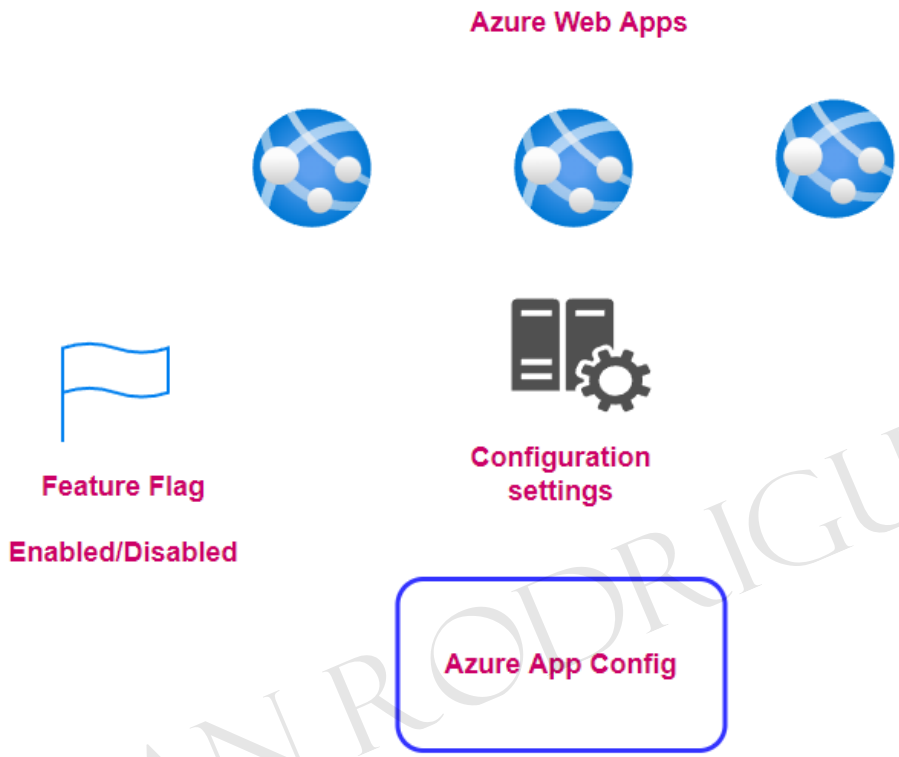


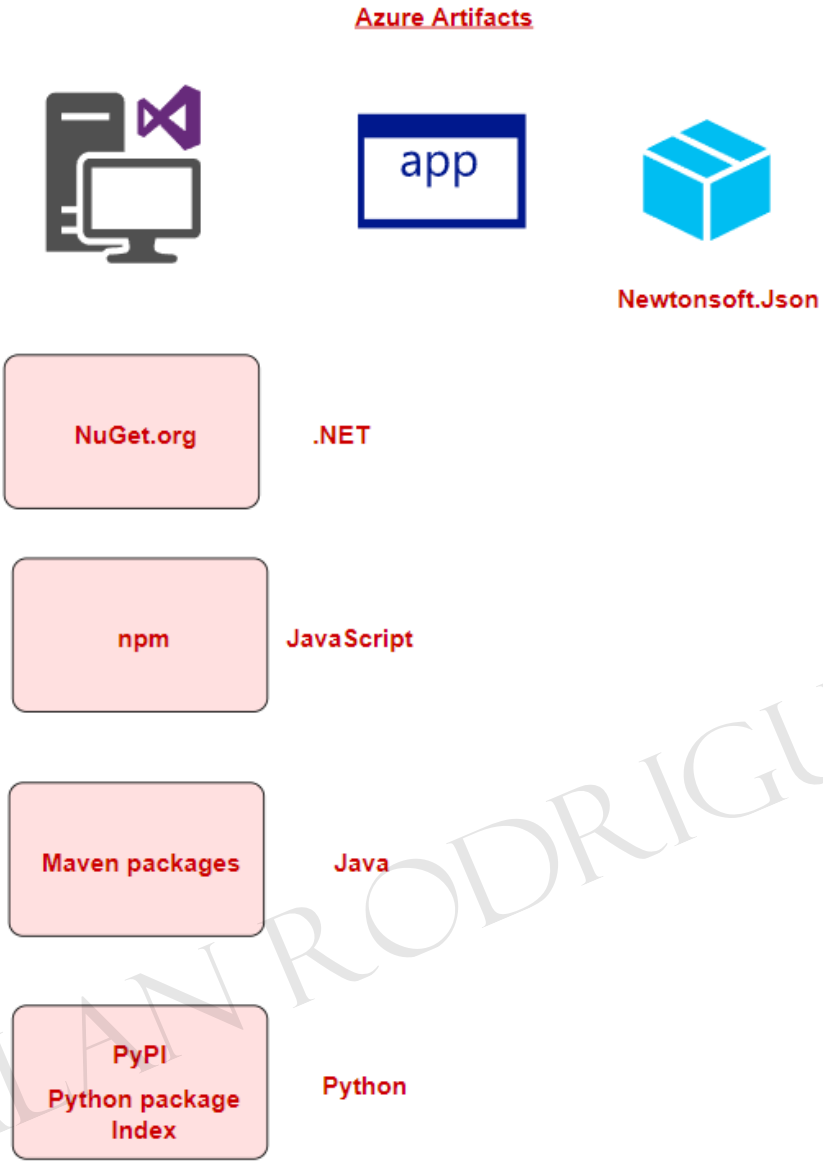
New application version

Green environment

Package Management

Azure App Config





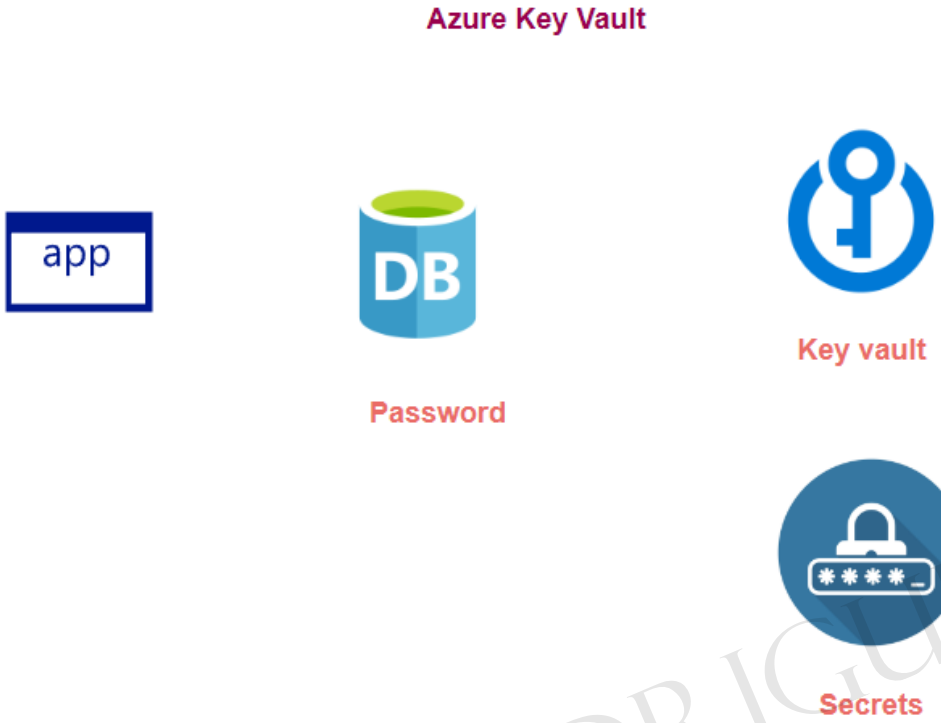
Developers can publish their packages to Azure Artifacts

Other developers can then consume their packages from Azure Artifacts

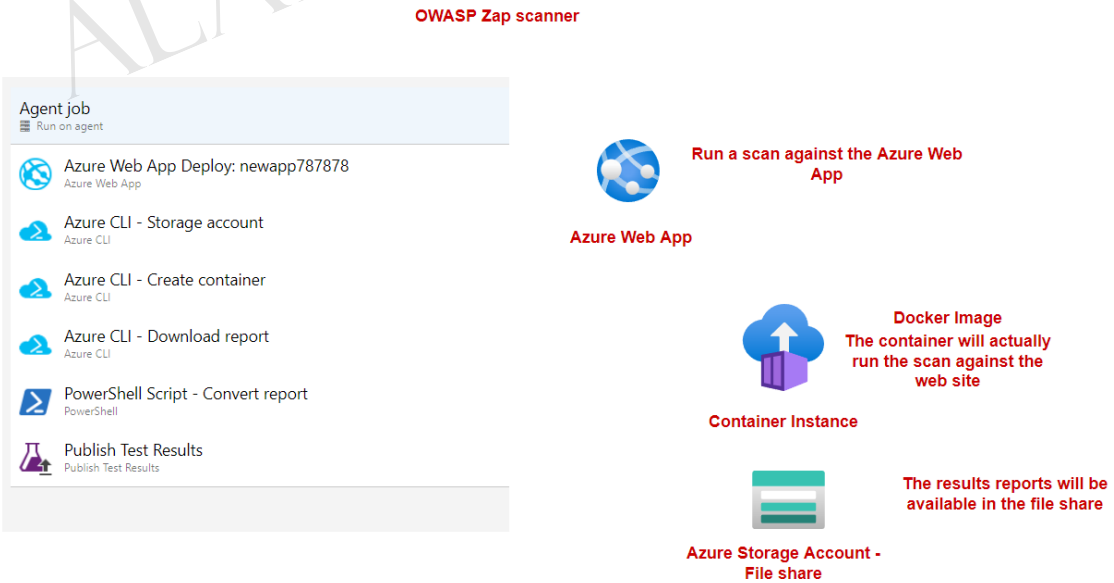
Developers can additionally also consume their packages from the public feeds such as NuGet.org, npm etc.

Develop a security and compliance plan

Lab - Azure Key Vault



Using OWASP Tool - Build pipeline



Implement an instrumentation strategy

Log Analytics workspace