

Docker, Kubernetes, Helm Ansible & Terraform (48 hrs)

This document provides the curriculum outline of the Knowledge, Skills and Abilities that a **Docker, Kubernetes, Helm, Ansible and Terraform** can be expected to demonstrate.

Prerequisite:

- Linux/Unix Systems Fundamentals
- Familiarity with Command Line Interface (CLI)
- Fundamental knowledge of editors on Linux (any one of vi/nano/emacs)
- Familiarity with at least one scripting/programming language
- Good Internet Connectivity

GitOps

Understanding GitOps

- Intro and Overview
- Understanding What GitOps Is
- Understanding the Need for GitOps
- Understanding the Benefits of GitOps
- Understanding the Difference between GitOps and DevOps
- Understanding the Difference between GitOps and IaC
- GitOps Principles and Practices
- Summary

Understanding GitOps Architecture and Tooling

- Intro and Topics
- Understanding GitOps Tooling
- Understanding a GitOps Architecture
- Understanding GitOps Architectural Decision Points
- Demo: Deploy New Application Using Argo CD GitOps Too
- Summary

Understanding GitOps Workflow

- Intro and Topics
- Enabling a GitOps IaC Workflow
- Enabling a GitOps Workflow Using Flux
- Demo: GitOps in Action with Azure Arc Enabled Kubernetes
- Summary

Adopting GitOps Next Steps

- Intro and Topics
- Understanding How GitOps Applies to Your Career
- Selling GitOps to Your Leadership
- Understanding How to Onboard GitOps On Your Next Project
- Understanding Resources For GitOps
- Summary

Docker

1. Docker Introduction

- What is Docker?
- Why Docker?
- Containerization v/s Virtualization
- Docker Architecture
- Understanding the Docker components
- Docker Terminologies
- Docker Internals

2. Docker Installation

- Docker Editions
- Hardware and Software Requirements
- Installing Docker
- Docker Config Files and Settings

Lab: Installing Docker on Linux

3. Managing Container Lifecycle

- Creating, Starting and Listing Containers
- Attaching and Detaching from Container
- Fetching Container details using "inspect"
- Executing Commands inside a Container
- Pause, Stop, Start, Restart and Kill a Container
- Container Metrics via stats
- Limiting Memory and CPU utilization
- Storage Utilization of a Container

- Expose Container Application using Host Port

Lab: Managing Container Lifecycle

4. Working with Docker Images

- Searching, Filtering and Pulling Images
- Docker Image save/load
- Commit Container State
- Understanding Docker Image Directives
- Understanding the use of Base Images
- What is "FROM scratch"?
- RUN vs CMD
- COPY vs ADD
- Building Custom Images using Dockerfile
- Understanding Image Layers
- Publishing the Custom Image
- Flatten an Image using export/import
- Tagging Images
- Working with Docker Hub
- Pushing Docker Images to Docker Hub
- Working with Local Registry Service

Lab: Working with Docker Images

Lab: Building Custom Images

Lab: Working with Docker Hub

Lab: Setting up Local Registry Service

5. Docker Volume Management

- Understanding need of Volume service in Docker
- Understanding various Volume Plug-ins
- Create and Manage Volumes
- Start a container with a Volume
- Populate data in a Volume using a Container
- Use a read-only Volume
- Migrating Volumes between Containers

Lab: Creating and Manage volumes

6. Docker Networking

- Understanding various Network Plug-ins
- Understanding the default Docker Networking
- Working with Bridge Network

- Working with Host and None Networks

Lab: Managing Docker Networking

7. Docker Compose

- Introduction to Compose
- Understanding docker-compose file
- Docker Compose Use Cases

Lab: Deploying Multi-tier App with Docker Compose

8. Docker Swarm

- Introduction to Docker Swarm
- Docker Swarm vs Kubernetes

Kubernetes

9. Kubernetes Platform

- Orchestration and Various Tools
- History of Kubernetes
- Features of Kubernetes
- What Kubernetes is not!
- Kubernetes Versions

10. Kubernetes Architecture

- Kubernetes Terminology
- Kubernetes Components
- Kubernetes Cluster Architecture
- Understanding Kubernetes Master Components
 - Kube-apiserver
 - ETCD
 - Kube-scheduler
 - Kube-controller
 - Kube-DNS
- Understanding Kubernetes Node Components
 - Kube-proxy
 - Kubelet
 - Container Runtime
- Understanding the difference between the master and worker nodes

11. Kubernetes Setup and Validation

- Understanding different tools for deploying Kubernetes Cluster
- Release Binaries, Provisioning and Types of Clusters
- Building the Kubernetes Cluster using kubeadm
- Installing Kubernetes Master and Nodes
- Configuring Secure Cluster Communications
- Testing the Cluster

Lab: Deploying Kubernetes Cluster using Kubeadm

Lab: Adding Nodes to Kubernetes Cluster

12. Working with Pod

- Pod Overview
 - Creating a Pod with imperative syntax
 - Creating a Pod with declarative syntax
 - Reading the Pod's information and metadata
 - Listing the objects in JSON or YAML
 - Backing up your resource using the list operation
 - Getting more information from the list operation
 - Accessing a Pod from the outside world
 - Entering a container inside a Pod
 - Deleting a Pod
 - Understanding Pod Lifecycle
- Multi-container Pod
 - Concrete scenarios where you need multi-container Pods
 - When not to create a multi-container Pod
 - Creating a Pod made up of two containers
 - What happens when Kubernetes fails to launch one container in a Pod?
 - Deleting a multi-container Pod
 - Understanding the Pod deletion grace period
 - Accessing a specific container inside a multi-container Pod
 - Running commands in containers
 - Overriding the default commands run by your containers
- Static Pod
- Init Containers
- Sidecar container pattern
- Labeling and annotating the Pods
- What are labels and why do we need them
- What are annotations and how do they differ from labels
- Adding a label
- Listing labels attached to a Pod
- Adding or updating a label to/of a running Pod

- Deleting a label attached to a running Pod
- Adding an annotation

Lab: Imperative Commands and Formatting Output with kubectl

Lab: Working with Single Container Pods

Lab: Creating multi container Pod

Lab: Creating init container Pod

Lab: Working with Static Pod

Lab: Working with label and selector

13. kubernetes Networking and Service

- Cluster Communications
- Pod and Node Networking
- Container Network Interface (CNI)
- Service Networking
- ClusterIP, NodePort & Load Balancer
- Understanding Pod IP assignment
- Understanding Pod IP assignment is dynamic
- Never hardcode a pod's IP addresses in your application code
- Understanding how services route traffic to Pods
- Understanding how DNS names are generated for services
- Understanding the different types of services
- Why do you need ClusterIP services?
- ClusterIP services to expose my Pods?
- Listing ClusterIP services
- Creating ClusterIP services using the imperative way
- Describing ClusterIP services
- Creating ClusterIP services using the declarative way
- Deleting ClusterIP services
- Understanding headless services
- Why do you need NodePort services?
- Understanding NodePort
- YAML definition
- Making sure NodePort works as expected
- Listing NodePort services
- Adding more Pods to NodePort services
- Describing NodePort services
- Deleting NodePort services
- NodePort or kubectl port-forward?
- Ingress Rules
- Cluster DNS

Lab: Exposing Applications using various types of Services

Lab: Install and Configure Ingress Controller to expose nginx based Service

14. Application Lifecycle Management using kubernetes Controllers

- Controllers:
- Creating a ReplicaSet object
- Testing the behavior of ReplicaSet
- Scaling ReplicaSet
- Deleting a ReplicaSet object
- Creating a Deployment object
- Exposing Deployment Pods using Service objects
- Scaling a Deployment object
- Deleting a Deployment object
- How does a Deployment object manage revisions and version rollout?
- Updating a Deployment object
- Rolling back a Deployment object
- Deployment object best practices
- Use declarative object management for Deployments
- Do not use the Recreate strategy for production workloads
- Do not create Pods that match an existing Deployment label selector
- Carefully set up your container probes
- Use meaningful and semantic image tags
- Migrating from older versions of Kubernetes

Lab: Deploying Application using Replication Controller

Lab: Deploying Application using Replica Set

Lab: Rolling Updates and Rollbacks using Deployment

Lab: Deploying Application using Daemon Set

Lab: Deploying StatefulSet Application

Lab: Deploying Multi-Tier Application

Lab: working with Job and CronJob

15. Logging and Monitoring

- Describe Resources
- Pod/container logs
- Metric Server & top command
- Events

Lab: Working on Logs and Events

Lab: Working with Metric Server

Lab: working with HPA

16. Working with Kubernetes Scheduler (Advance Scheduling)

- Pod Scheduling within the Kubernetes Cluster
- Configuring the Kubernetes Scheduler
- Running Multiple Schedulers for Multiple Pods
- NodeName Taints, Tolerances, Node Selector, labels & Selectors
- Taint vs Tolerations vs Node Affinity/AntiAffinity
- Scheduling Pods with Resource Limits and Label Selectors
- Displaying Scheduler Events

17. Storage

- Managing Data in the Kubernetes Cluster
- EmptyDir, hostPath, PV, PVC, StorageClass
- Volume Access Modes
- Applications with Persistent Storage
- ConfigMaps
- Secrets

Lab: Working with Kubernetes Volume Service

Lab: Configuring Dynamic Volume Service

Lab: Working with ConfigMaps and Secrets

18. Application Health

- Application LivenessProbe
 - What is LivenessProbe and why do you need it?
 - Implementing LivenessProbe
- Application ReadinessProbe
 - Why do you need ReadinessProbe?
 - Implementing ReadinessProbe
 - Using ReadinessProbe and LivenessProbe together
- Application Startupprobe

Lab: Working with LivenessProbe and ReadinessProbe

19. Using RBAC Authorization

- Role and ClusterRole
- RoleBinding and ClusterRoleBinding
- Referring to resources
- Aggregated ClusterRoles
- Referring to subjects
- Default roles and role bindings
- Auto-reconciliation
- API discovery roles
- User-facing roles
- Privilege escalation prevention and bootstrapping

- Restrictions on role creation or update
- Restrictions on role binding creation or update

20. Securing your Pods using the NetworkPolicy object

- Why do you need NetworkPolicy?
- Understanding Pods are not isolated by default
- **Basics**
 - DENY all traffic to an application
 - LIMIT traffic to an application
 - ALLOW all traffic to an application
- **Namespace's level**
 - ALLOW traffic to an application from all namespaces
 - ALLOW all traffic from a namespace
 - ALLOW traffic from some pods in another namespace
- **Advanced**
 - ALLOW traffic only to certain port numbers of an application
 - ALLOW traffic from apps using multiple selectors

Managing Clusters

- Managing the Kubernetes Cluster
- Upgrading the Kubernetes Cluster
- ETCD Backing Up and Restoring a Kubernetes Cluster

Lab: Upgrading Kubernetes Cluster

Lab: ETCD Backing Up and Restoring a Kubernetes Cluster

Helm

21. Helm-Introduction

- Installing Helm
- Using Helm
- Chart Development Tips And Tricks
- Syncing Your Chart Repository
- Chart Releaser Action To Automate GitHub Page Charts
- Charts
- Chart Hooks
- Chart Tests
- Library Charts
- Helm Provenance And Integrity
- The Chart Repository Guide
- Registries
- Helm Architecture

Ansible

22. Introduction to Ansible

- What is Ansible and Features
- History and Releases
- Agent versus Agentless
- Ansible Architecture
- Infrastructure as Code
- Idempotency
- Use cases

23. Module 2: Installing Ansible

- Environment Setup
- Hardware and Software requirements
- How to install Ansible?
- How Ansible works?
- Ansible CLI

24. Module 3: Deploying Ansible

- Building an Ansible Inventory
- Ansible Configuration Files
- Running Ad Hoc Commands
- Managing Dynamic Inventories
- Ansible Modules
- Ansible Plugins

25. Module 4: Ansible Playbooks Anatomy

- Hosts
- Tasks
- Plays
- Playbook Execution

26. Module 5: Ansible Foundation

- Managing Variables
- Managing Facts

27. Module 6: Ansible Task control execution

- Loops and Conditionals
- Handlers
- Limiting Execution by Hosts (limit)
- Limiting Execution by Tasks (tag)

- Adding and Meeting Conditionals
- Handling Errors
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28. Modular Configuration with Ansible Roles and Galaxy

- Ansible Roles Structure
- Creating Roles
- Deploying Roles with Ansible Galaxy

29. Optimizing Ansible

- Selecting Hosts with Host Pattern
- Configuring Delegation
- Configuring Parallelism

30. SSH Key and Credentials Management

- SSH Keys
- Configure Ansible Vault
- Securing Passwords Using Vault
- Executing with Ansible Vault

31. Automate Linux administration tasks

Automate common Linux system administration tasks with Ansible.

32. Troubleshooting, Testing, and Validation

- Troubleshooting Playbooks
- Troubleshooting Ansible Managed Hosts
- Ordering Problems
- Jumping to Specific Tasks
- Retrying Failed Hosts
- Syntax-Check and Dry-Run
- Debugging

TERRAFORM

33. Infrastructure as Code

- Introduction to IaC
- Difference between GUI, CLI and IaC
- Why IaC
- Multiple Tools and services available for IaC
- Terraform Basics

34. Terraform Introduction

- Why Terraform – picking the right tool
- Desired and current states

- Understanding Resources and Providers
- Terraform Code
- AWS Fundamentals & Services offered
- Automated deployment on AWS

35. Terraform Fundamentals

- Terraform commands & state files.
- Destroying Infra with Terraform
- Understanding Attributes and Output Values in Terraform
- Understanding Provisioners in Terraform
- Understanding terraform HCL
- Terraform Variable
- Terraform Variable Types
- Outputting attributes
- Data Sources
- Terraform Modules
- Interpolation
- Conditionals
- For & For-Each loop

Jenkins

36. DevOps Practices and Methodologies

- Continuous Integration
- Continuous Delivery
- Continuous Deployment
- Source Control Management
- Branches
- Artifacts
- Code Testing
- Code Vulnerabilities Scan
- Distributed Builds
- Jenkins Installation
- Ubuntu
- CentOS/RedHat
- MacOS
- Windows
- Docker Container
- Deploying Jenkins in Public Cloud (AWS)

36. Jenkins Graphical User Interface

- Exploring the GUI
- System Configuration
- Security Configuration
- Jenkins
- Job Configuration
- Jenkins Plugins
- Managing Plugins
- Updating Plugins

- Adding Plugins

37. Freestyle Jobs

- Basic Job Structure
- Parameters
- Build Environment
- Build Step
- Post Build Step
- Notifications
- Building a Free Style Job in Jenkins

38. Agents and Distributed Builds

- Setting up a Build Agent
- Distributing a Build
- Monitoring Build Agents

39. Source Control Management, Build Tools and Test Reports

- SCM in Builds
- Build Tools (Maven)
- Testing and Test Reports

40. Upstream, Downstream and Triggers

- Artifacts and Fingerprints
- Linking Jobs
- Automating Jobs
- Triggering Builds with Git Hooks

41. Jenkins Pipeline

- Pipeline Jobs
- The Blue Ocean Editor
- Scripted Pipelines
- Declarative Pipelines
- Groovy and DSL
- Jenkins File Basics
- Pipeline Triggers
- Multi branch Pipelines
- Global Libraries
- Variables and Credentials
- Dockerizing an app
- Deploying a Docker Container with Jenkins Pipelines

42. Jenkins in Docker

- Introduction
- Docker and the Kernel
- A Linux Container Running on Windows 10
- What Is a Kernel?

- Running Linux Containers on Windows
- Jenkins on Docker
- Jenkins in a Container

43. Maintaining State outside the Container

- The Docker File System
- Understanding Copy on Write
- Mounting a Volume to Your Container

44. Jenkins Integrations

- Upload Artifacts to Jfrog artifactory
- Send Build Notifications using Slack
- Continuous Deployment to Tomcat Apache using Deploy plugin
- Integration with SonarQube to scan source code with vulnerabilities

45. Jenkins Administration

- Permissions
- Configuration
- Updates and Maintenance
- Notifications and Alerts (Email) and Logging