# **DevOps Interview Preparation (Quick Glance)**

**AWS**

**Check Availability Zone Availability**

aws ec2 describe-instance-type-offerings \

    --location-type availability-zone \

    --filters "Name=instance-type,Values=$instance\_type" "Name=location,Values=$1" \

    --region $region \

    --query 'InstanceTypeOfferings[?InstanceType==`'${instance\_type}'`].Location' \

    --output text

**Key Pairs**

**Check if Key Pair Exists:**

if ! aws ec2 describe-key-pairs --key-names ${key\_pair\_name} --region ${region} &>/dev/null; then

**Create Key Pair:**

aws ec2 create-key-pair --key-name ${key\_pair\_name} --query 'KeyMaterial' --output text --region ${region} > CentosComplexKeyPair.pem

**Set Permissions:**

chmod 400 CentosComplexKeyPair.pem

**VPC**

**Describe VPCs:**

aws ec2 describe-vpcs --filters "Name=cidr,Values=${vpc\_cidr}" --query 'Vpcs[0].VpcId' --output text --region

${region}

**Create VPC:**

aws ec2 create-vpc --cidr-block ${vpc\_cidr} --query 'Vpc.VpcId' --output text --region ${region}

**Internet Gateway**

**Check if Internet Gateway Exists:**

igw\_id=$(aws ec2 describe-internet-gateways --filters "Name=attachment.vpc-id,Values=${vpc\_id}" --query 'InternetGateways[0].InternetGatewayId' --output text --region ${region})

if [ "$igw\_id" == "None" ]; then

**Create Internet Gateway:**

igw\_id=$(aws ec2 create-internet-gateway --query 'InternetGateway.InternetGatewayId' --output text --region ${region})

**Attach Internet Gateway:**

aws ec2 attach-internet-gateway --internet-gateway-id ${igw\_id} --vpc-id ${vpc\_id} --region ${region}

**Subnets**

**Check if Public Subnet 1 Exists:**

public\_subnet\_id\_1=$(aws ec2 describe-subnets --filters "Name=vpc-id,Values=${vpc\_id}" "Name=cidr-block,Values=${public\_subnet\_cidr\_1}" --query 'Subnets[0].SubnetId' --output text --region ${region})

if [ "$public\_subnet\_id\_1" == "None" ]; then

**Create Public Subnet 1:**

public\_subnet\_id\_1=$(aws ec2 create-subnet --vpc-id ${vpc\_id} --cidr-block ${public\_subnet\_cidr\_1} --availability-zone ${available\_zone\_1} --query 'Subnet.SubnetId' --output text --region ${region})

**Route Tables**

**Check if Route Table for Public Subnet 1 Exists:**

public\_route\_table\_id\_1=$(aws ec2 describe-route-tables --filters "Name=vpc-id,Values=${vpc\_id}" "Name=association.subnet-id,Values=${public\_subnet\_id\_1}" --query 'RouteTables[0].RouteTableId' --output text --region ${region})

if [ "$public\_route\_table\_id\_1" == "None" ]; then

**Create Route Table for Public Subnet 1:**

public\_route\_table\_id\_1=$(aws ec2 create-route-table --vpc-id ${vpc\_id} --query 'RouteTable.RouteTableId' --output text --region ${region})

**Associate Route Table with Public Subnet 1:**

aws ec2 associate-route-table --route-table-id ${public\_route\_table\_id\_1} --subnet-id ${public\_subnet\_id\_1} --region ${region}

**Create Route in Route Table for Public Subnet 1:**

aws ec2 create-route --route-table-id ${public\_route\_table\_id\_1} --destination-cidr-block 0.0.0.0/0 --gateway-id ${igw\_id} --region ${region}

**NAT Gateway**

**Allocate Elastic IP:**

eip\_allocation\_id\_1=$(aws ec2 allocate-address --domain vpc --query 'AllocationId' --output text --region ${region})

**Create NAT Gateway:**

nat\_gateway\_id\_1=$(aws ec2 create-nat-gateway --subnet-id ${public\_subnet\_id\_1} --allocation-id ${eip\_allocation\_id\_1} --query 'NatGateway.NatGatewayId' --output text --region ${region})

**Update Private Route Table 1:**

aws ec2 create-route --route-table-id ${private\_route\_table\_id\_1} --destination-cidr-block 0.0.0.0/0 --nat-gateway-id ${nat\_gateway\_id\_1} --region ${region}

echo "Updated Private Route Table 1 to use NAT Gateway 1"

**Security Groups**

**Check if Bastion Security Group Exists:**

bastion\_security\_group\_id=$(aws ec2 describe-security-groups --filters "Name=vpc-id,Values=${vpc\_id}" "Name=group-name,Values=${bastion\_security\_group\_name}" --query 'SecurityGroups[0].GroupId' --output text --region ${region})

if [ "$bastion\_security\_group\_id" == "None" ]; then

**Create Bastion Security Group:**

bastion\_security\_group\_id=$(aws ec2 create-security-group --group-name ${bastion\_security\_group\_name} --description "Bastion security group" --vpc-id ${vpc\_id} --query 'GroupId' --output text --region ${region})

**Add Inbound Rules to Bastion Security Group:**

aws ec2 authorize-security-group-ingress --group-id ${bastion\_security\_group\_id} --protocol tcp --port 22 --cidr 0.0.0.0/0 --region ${region}

**Check if Application Security Group Exists:**

app\_security\_group\_id=$(aws ec2 describe-security-groups --filters "Name=vpc-id,Values=${vpc\_id}" "Name=group-name,Values=${app\_security\_group\_name}" --query 'SecurityGroups[0].GroupId' --output text --region ${region})

if [ "$app\_security\_group\_id" == "None" ]; then

**Create Application Security Group:**

app\_security\_group\_id=$(aws ec2 create-security-group --group-name ${app\_security\_group\_name} --description "Application security group" --vpc-id ${vpc\_id} --query 'GroupId' --output text --region ${region})

**Add Inbound Rules to Application Security Group:**

aws ec2 authorize-security-group-ingress --group-id ${app\_security\_group\_id} --protocol tcp --port 22 --source-group ${bastion\_security\_group\_id} --region ${region}

aws ec2 authorize-security-group-ingress --group-id ${app\_security\_group\_id} --protocol tcp --port 80 --cidr 0.0.0.0/0 --region ${region}

**IAM Role**

**Trust Policy:**

cat > trust-policy.json <<EOF

{

"Version": "2012-10-17",

"Statement": [

{

"Effect": "Allow",

"Principal": {

"Service": "ec2.amazonaws.com"

},

"Action": "sts:AssumeRole"

},

{

"Effect": "Allow",

"Principal": {

"Service": "lambda.amazonaws.com"

},

"Action": "sts:AssumeRole"

}

]

}

EOF

**Create Role:**

aws iam create-role --role-name ${role\_name} --assume-role-policy-document file://trust-policy.json --region ${region}

**Attach Policy:**

aws iam attach-role-policy --role-name ${role\_name} --policy-arn ${policy\_arn} --region ${region}

**Create Instance Profile:**

aws iam create-instance-profile --instance-profile-name ${instance\_profile\_name} --region ${region}

**Add Role to Instance Profile:**

aws iam add-role-to-instance-profile --instance-profile-name ${instance\_profile\_name} --role-name ${role\_name} --region ${region}

**Launch EC2 Instance with Instance Profile:**

aws ec2 run-instances --image-id ami-0abcdef1234567890 --count 1 --instance-type t2.micro --iam-instance-profile Name=MyInstanceProfile --region us-west-2

**Placement Group**

**Create Placement Group:**

aws ec2 create-placement-group --group-name ${placement\_group\_name} --strategy spread --region ${region}

--group-name ${placement\_group\_name} : Specifies the name of the placement group.

strategy spread : Specifies the placement strategy (spread in this case).

* --region ${region} : Specifies the AWS region.

**Cluster Placement Group**

**Use Case:** High-performance computing (HPC) applications, big data workloads, and applications that require high network throughput.

aws ec2 create-placement-group --group-name my-cluster-group --strategy cluster --region us-west-2

**Spread Placement Group**

**Use Case:** Applications that require high availability and need to be isolated from failures, such as critical applications.

aws ec2 create-placement-group --group-name my-spread-group --strategy spread --region us-west-2

**Partition Placement Group**

**Use Case:** Large distributed and replicated workloads, such as Hadoop, Cassandra, and Kafka.

aws ec2 create-placement-group --group-name my-partition-group --strategy partition --partition-count 3 --region us-west-2

This command creates a partition placement group named my-partition-group with 3 partitions in the us-west-2 region.

**Launch Instances in the Partition Placement Group:**

aws ec2 run-instances --image-id ami-0abcdef1234567890 --count 3 --instance-type t2.micro --placement "GroupName=my-partition-group,PartitionNumber=0" --region us-west-2

aws ec2 run-instances --image-id ami-0abcdef1234567890 --count 3 --instance-type t2.micro --placement "GroupName=my-partition-group,PartitionNumber=1" --region us-west-2

aws ec2 run-instances --image-id ami-0abcdef1234567890 --count 3 --instance-type t2.micro --placement "GroupName=my-partition-group,PartitionNumber=2" --region us-west-2

**S3 Bucket**

**Create S3 Bucket:**

aws s3api create-bucket --bucket ${bucket\_name} --region ${region} --create-bucket-configuration LocationConstraint=${region}

**Create Sample File:**

echo "This is a sample file for S3 bucket." > sample\_file.txt

**Upload Sample File:**

aws s3 cp sample\_file.txt s3://${bucket\_name}/sample\_file.txt --region ${region}

**RDS**

**Create RDS Instance:**

aws rds create-db-instance \

    --db-instance-identifier ${db\_instance\_identifier} \

    --db-instance-class ${db\_instance\_class} \

    --engine ${engine} \

    --master-username ${master\_username} \

    --master-user-password ${master\_user\_password} \

    --allocated-storage 20 \

    --db-name ${db\_name} \

    --vpc-security-group-ids ${app\_security\_group\_id} \

    --db-subnet-group-name ${db\_subnet\_group\_name} \

    --multi-az \

    --no-publicly-accessible \

    --region ${region}

**Wait for Availability:**

aws rds wait db-instance-available --db-instance-identifier ${db\_instance\_identifier} --region ${region}

**Get RDS Endpoint:**

db\_endpoint=$(aws rds describe-db-instances --db-instance-identifier ${db\_instance\_identifier} --query 'DBInstances[0].Endpoint.Address' --output text --region ${region})

echo "RDS instance endpoint: ${db\_endpoint}"

**Create DB Subnet Group:**

aws rds create-db-subnet-group \

    --db-subnet-group-name ${db\_subnet\_group\_name} \

    --db-subnet-group-description "My DB Subnet Group" \

    --subnet-ids ${private\_subnet\_id\_1} ${private\_subnet\_id\_2} \

    --region ${region}

**AWS CloudWatch**

**Create CloudWatch Alarm:**

aws cloudwatch put-metric-alarm --alarm-name ${alarm\_name} \

    --metric-name CPUUtilization --namespace AWS/EC2 \

    --statistic Average --period 300 --threshold 80 \

    --comparison-operator GreaterThanOrEqualToThreshold \

    --dimensions Name=InstanceId,Value=${instance\_ids[0]} \

    --evaluation-periods 2 --alarm-actions ${sns\_topic\_arn} \

    --region ${region}

**Launch Instances User Data Script:**

cat > userDataCentOsComplex.sh <<EOF

#!/bin/bash

# Install httpd, unzip, and aws-cli

yum update -y

yum install -y httpd unzip aws-cli

# Start httpd service

systemctl start httpd

s

# Enable httpd service to start on boot

systemctl enable httpd

# Create a sample log file

echo "This is a sample log file." > ./sample\_log.txt

# Upload the log file to S3 bucket

bucket\_name=$(grep bucket\_name ./resource\_ids\_centos.txt | cut -d'=' -f2)

aws s3 cp ./sample\_log.txt s3://${bucket\_name}/sample\_log.txt

# Download and unzip the website files

cd /var/www/html

wget https://www.tooplate.com/download/2137\_barista\_cafe -O barista\_cafe.zip

EOF

**Launch Instances:**

aws ec2 run-instances \

    --image-id ami-0abcdef1234567890 \

    --count 2 \

    --instance-type t3.micro \

    --key-name ${key\_pair\_name} \

    --security-group-ids ${app\_security\_group\_id} \

    --subnet-id ${private\_subnet\_id\_2} \

    --user-data file://userDataCentOsComplex.sh \

    --tag-specifications 'ResourceType=instance,Tags=[{Key=Name,Value='${instance\_name}\_2'}]' \

    --region ${region} \

    --monitoring "Enabled=false" \

    --iam-instance-profile Name=${instance\_profile\_name} \

    --block-device-mappings '[{"DeviceName":"/dev/sdh","Ebs":{"VolumeSize":8,"DeleteOnTermination":true}}]' \

    --placement "AvailabilityZone=${available\_zone\_2},GroupName=${placement\_group\_name}" \

    --instance-initiated-shutdown-behavior "terminate" \

    --query 'Instances[\*].InstanceId' --output text

**Wait for Running State:**

aws ec2 wait instance-running --instance-ids ${instance\_ids} --region ${region}

**Wait for Status Checks to Pass:**

aws ec2 wait instance-status-ok --instance-ids ${instance\_ids} --region ${region}

**Load Balancers**

**Create Load Balancer:**

load\_balancer\_arn=$(aws elbv2 create-load-balancer \

--name my-load-balancer \

--subnets ${public\_subnet\_id\_1} ${public\_subnet\_id\_2} \

--security-groups ${app\_security\_group\_id} \

--query 'LoadBalancers[0].LoadBalancerArn' --output text --region ${region})

**Create Target Group:**

target\_group\_arn=$(aws elbv2 create-target-group \

--name my-target-group \

--protocol HTTP \

--port 80 \

--vpc-id ${vpc\_id} \

--query 'TargetGroups[0].TargetGroupArn' --output text --region ${region})

**AutoScaling Group**

**Create Launch Template:**

launch\_template\_id=$(aws ec2 create-launch-template \

    --launch-template-name ${launch\_template\_name} \

    --version-description "v1" \

    --launch-template-data '{

        "ImageId": "'${image\_id}'",

        "InstanceType": "t3.micro",

        "KeyName": "'${key\_pair\_name}'",

        "SecurityGroupIds": ["'${app\_security\_group\_id}'"],

        "IamInstanceProfile": {"Name": "'${instance\_profile\_name}'"},

        "UserData": "'$(base64 -w 0 ./userDataCentOsComplex.sh)'",

        "BlockDeviceMappings": [{

            "DeviceName": "/dev/sdh",

            "Ebs": {

                "VolumeSize": 8,

                "DeleteOnTermination": true

            }

        }]

    }' --query 'LaunchTemplate.LaunchTemplateId' --output text --region ${region})

**Create Auto Scaling Group:**

aws autoscaling create-auto-scaling-group \

--auto-scaling-group-name ${auto\_scaling\_group\_name} \

--launch-template "LaunchTemplateId=${launch\_template\_id},Version=1" \

--min-size ${min\_size} \

--max-size ${max\_size} \

--desired-capacity ${desired\_capacity} \

--vpc-zone-identifier "${subnet\_ids}" \

--region ${region}

**Scale Up Policy:**

scale\_up\_policy\_arn=$(aws autoscaling put-scaling-policy \

    --auto-scaling-group-name ${auto\_scaling\_group\_name} \

    --policy-name ScaleUpPolicy \

    --scaling-adjustment 1 \

    --adjustment-type ChangeInCapacity \

    --region ${region} \

    --query 'PolicyARN' --output text)

**Scale Down Policy:**

scale\_down\_policy\_arn=$(aws autoscaling put-scaling-policy \

    --auto-scaling-group-name ${auto\_scaling\_group\_name} \

    --policy-name ScaleDownPolicy \

    --scaling-adjustment -1 \

    --adjustment-type ChangeInCapacity \

    --region ${region} \

    --query 'PolicyARN' --output text)

**High CPU Utilization Alarm:**

aws cloudwatch put-metric-alarm \

    --alarm-name HighCPUUtilization \

    --metric-name CPUUtilization \

    --namespace AWS/EC2 \

    --statistic Average \

    --period 300 \

    --threshold 80 \

    --comparison-operator GreaterThanOrEqualToThreshold \

    --dimensions Name=AutoScalingGroupName,Value=${auto\_scaling\_group\_name} \

    --evaluation-periods 2 \

    --alarm-actions ${scale\_up\_policy\_arn} \

    --region ${region}

**Low CPU Utilization Alarm:**

aws cloudwatch put-metric-alarm \

    --alarm-name LowCPUUtilization \

    --metric-name CPUUtilization \

    --namespace AWS/EC2 \

    --statistic Average \

    --period 300 \

    --threshold 20 \

    --comparison-operator LessThanOrEqualToThreshold \

    --dimensions Name=AutoScalingGroupName,Value=${auto\_scaling\_group\_name} \

    --evaluation-periods 2 \

    --alarm-actions ${scale\_down\_policy\_arn} \

    --region ${region}

**Kubernetes**

**Pod**

apiVersion: v1

kind: Pod

metadata:

    name: my-pod

    labels:

        app: my-app

spec:

    containers:

    - name: my-container

        image: nginx:1.14.2

        ports:

        - containerPort: 80

        resources:

            requests:

                cpu: "100m"

                memory: "128Mi"

            limits:

                cpu: "500m"

                memory: "256Mi"

        readinessProbe:

            httpGet:

                path: /

                port: 80

            initialDelaySeconds: 5

            periodSeconds: 10

        livenessProbe:

            httpGet:

                path: /healthz

                port: 80

            initialDelaySeconds: 15

            periodSeconds: 20

    restartPolicy: Always

    nodeSelector:

        disktype: ssd

    tolerations:

    - key: "key"

        operator: "Equal"

        value: "value"

        effect: "NoSchedule"

**ReplicaSet**

apiVersion: apps/v1

kind: ReplicaSet

metadata:

    name: my-replicaset

    labels:

        app: my-app

spec:

    replicas: 3

    selector:

        matchLabels:

            app: my-app

    template:

        metadata:

            labels:

                app: my-app

        spec:

            containers:

            - name: my-container

                image: nginx:1.14.2

                ports:

                - containerPort: 80

**Deployment**

apiVersion: apps/v1

kind: Deployment

metadata:

    name: my-deployment

    labels:

        app: my-app

spec:

    replicas: 3

    strategy:

        type: RollingUpdate

        rollingUpdate:

            maxSurge: 1

            maxUnavailable: 0

    selector:

        matchLabels:

            app: my-app

    template:

        metadata:

            labels:

                app: my-app

        spec:

            containers:

            - name: my-container

                image: nginx:1.14.2

                ports:

                - containerPort: 80

                imagePullPolicy: IfNotPresent

**Service**

apiVersion: v1

kind: Service

metadata:

    name: my-service

    annotations:

        service.beta.kubernetes.io/aws-load-balancer-type: "nlb"

spec:

    selector:

        app: my-app

    ports:

    - protocol: TCP

        port: 80

        targetPort: 80

        name: http

    type: LoadBalancer

    sessionAffinity: ClientIP

    externalTrafficPolicy: Local

**ConfigMap**

apiVersion: v1

kind: ConfigMap

metadata:

    name: my-config

data:

    config.property: "some-value"

    another.property: |

        line1

        line2

binaryData:

    binaryFile: <base64 encoded>

**Secret**

apiVersion: v1

kind: Secret

metadata:

    name: my-secret

type: Opaque

data:

    username: dXNlcm5hbWU=  # base64 encoded

    password: cGFzc3dvcmQ=  # base64 encoded

stringData:

    config.yaml: |

        apiUrl: "https://myapi.com"

        token: "my-token"

**PersistentVolume**

apiVersion: v1

kind: PersistentVolume

metadata:

    name: pv0001

spec:

    capacity:

        storage: 5Gi

    accessModes:

    - ReadWriteOnce

    persistentVolumeReclaimPolicy: Retain

    storageClassName: standard

    nfs:

        server: nfs-server.example.com

        path: "/exports"

**PersistentVolumeClaim**

apiVersion: v1

kind: PersistentVolumeClaim

metadata:

    name: my-claim

spec:

    accessModes:

    - ReadWriteOnce

    resources:

        requests:

            storage: 5Gi

    storageClassName: standard

    volumeMode: Filesystem

    volumeName: pv0001  # optional, binds to a specific PV

**Namespace**

apiVersion: v1

kind: Namespace

metadata:

    name: my-namespace

    labels:

        environment: development

**DaemonSet**

apiVersion: apps/v1

kind: DaemonSet

metadata:

    name: my-daemonset

    namespace: kube-system

spec:

    selector:

        matchLabels:

            app: my-app

    template:

        metadata:

            labels:

                app: my-app

        spec:

            nodeSelector:

                node-role.kubernetes.io/master: ""

            tolerations:

            - key: "node-role.kubernetes.io/master"

                effect: NoSchedule

            containers:

            - name: my-container

                image: nginx:1.14.2

**Job**

apiVersion: batch/v1

kind: Job

metadata:

    name: my-job

spec:

    completions: 5

    parallelism: 2

    backoffLimit: 6

    template:

        spec:

            containers:

            - name: my-job-container

                image: busybox

                command: ["/bin/sh", "-c", "echo Hello, Kubernetes! && sleep 30"]

            restartPolicy: OnFailure

**CronJob**

apiVersion: batch/v1beta1

kind: CronJob

metadata:

    name: my-cronjob

spec:

    schedule: "\*/1 \* \* \* \*"

    concurrencyPolicy: Forbid

    failedJobsHistoryLimit: 1

    successfulJobsHistoryLimit: 3

    suspend: false

    jobTemplate:

        spec:

            template:

                spec:

                    containers:

                    - name: my-cronjob-container

                        image: busybox

                        command:

                        - /bin/sh

                        - -c

                        - date; echo Hello from the Kubernetes cron job

                    restartPolicy: OnFailure

**StatefulSet**

apiVersion: apps/v1

kind: StatefulSet

metadata:

    name: my-statefulset

spec:

    serviceName: "my-service"

    replicas: 3

    selector:

        matchLabels:

            app: my-app

    template:

        metadata:

            labels:

                app: my-app

        spec:

            containers:

            - name: my-container

                image: nginx:1.14.2

                volumeMounts:

                - name: www

                    mountPath: /usr/share/nginx/html

    volumeClaimTemplates:

    - metadata:

            name: www

        spec:

            accessModes: ["ReadWriteOnce"]

            resources:

                requests:

                    storage: 1Gi

**Ingress**

apiVersion: networking.k8s.io/v1

kind: Ingress

metadata:

    name: my-ingress

    annotations:

        kubernetes.io/ingress.class: "nginx"

        nginx.ingress.kubernetes.io/rewrite-target: /$2

spec:

    rules:

    - host: example.com

        http:

            paths:

            - path: /path/(.\*)

                pathType: Prefix

                backend:

                    service:

                        name: my-service

                        port:

                            number: 80

**HorizontalPodAutoscaler**

apiVersion: autoscaling/v2beta2

kind: HorizontalPodAutoscaler

metadata:

    name: my-hpa

spec:

    scaleTargetRef:

        apiVersion: apps/v1

        kind: Deployment

        name: my-deployment

    minReplicas: 1

    maxReplicas: 10

    metrics:

    - type: Resource

        resource:

            name: cpu

            target:

                type: Utilization

                averageUtilization: 50

    - type: Pods

        pods:

            metric:

                name: packets-per-second

            target:

                type: AverageValue

                averageValue: 1k

**VerticalPodAutoscaler**

**Requires additional installation of Vertical Pod Autoscaler:**

apiVersion: autoscaling.k8s.io/v1

kind: VerticalPodAutoscaler

metadata:

    name: my-vpa

spec:

    targetRef:

        apiVersion: "apps/v1"

        kind: Deployment

        name: my-deployment

    updatePolicy:

        updateMode: "Auto"

    resourcePolicy:

        containerPolicies:

        - containerName: '\*'

            minAllowed:

                cpu: 250m

                memory: 64Mi

            maxAllowed:

                cpu: 2

                memory: 4Gi

**NetworkPolicy**

apiVersion: networking.k8s.io/v1

kind: NetworkPolicy

metadata:

    name: my-network-policy

spec:

    podSelector:

        matchLabels:

            role: db

    policyTypes:

    - Ingress

    - Egress

    ingress:

    - from:

        - podSelector:

                matchLabels:

                    role: frontend

        ports:

        - protocol: TCP

            port: 6379

    egress:

    - to:

        - ipBlock:

                cidr: 10.0.0.0/24

                except:

                - 10.0.0.0/28

        ports:

        - protocol: TCP

            port: 5978

**ServiceAccount**

apiVersion: v1

kind: ServiceAccount

metadata:

    name: my-service-account

    namespace: my-namespace

secrets:

- name: my-secret

imagePullSecrets:

- name: regcred

**Endpoints**

apiVersion: v1

kind: Endpoints

metadata:

    name: my-endpoints

subsets:

    - addresses:

        - ip: 192.168.1.1

            nodeName: worker1

        ports:

        - port: 80

            name: http

**ResourceQuota**

apiVersion: v1

kind: ResourceQuota

metadata:

    name: my-quota

spec:

    hard:

        pods: "10"

        requests.cpu: "4"

        requests.memory: 6Gi

        limits.cpu: "10"

        limits.memory: 10Gi

        configmaps: "10"

        secrets: "10"

        services: "5"

        services.loadbalancers: "1"

**LimitRange**

apiVersion: v1

kind: LimitRange

metadata:

    name: my-limitrange

spec:

    limits:

    - type: Pod

        max:

            cpu: "2"

            memory: 1Gi

        min:

            cpu: 200m

            memory: 6Mi

    - type: Container

        default:

            cpu: 500m

            memory: 512Mi

        defaultRequest:

            cpu: 100m

            memory: 128Mi

**Roles and RoleBindings**

# Role

apiVersion: rbac.authorization.k8s.io/v1

kind: Role

metadata:

    namespace: my-namespace

    name: pod-reader

rules:

- apiGroups: [""]

    resources: ["pods"]

    verbs: ["get", "watch", "list"]

# RoleBinding

apiVersion: rbac.authorization.k8s.io/v1

kind: RoleBinding

metadata:

    name: read-pods

    namespace: my-namespace

subjects:

- kind: User

    name: my-user

    apiGroup: rbac.authorization.k8s.io

roleRef:

    kind: Role

    name: pod-reader

    apiGroup: rbac.authorization.k8s.io

**ClusterRoles and ClusterRoleBindings**

# ClusterRole

apiVersion: rbac.authorization.k8s.io/v1

kind: ClusterRole

metadata:

    name: secret-reader

rules:

- apiGroups: [""]

    resources: ["secrets"]

    verbs: ["get", "watch", "list"]

# ClusterRoleBinding

apiVersion: rbac.authorization.k8s.io/v1

kind: ClusterRoleBinding

metadata:

    name: read-secrets-global

subjects:

- kind: User

    name: my-user

    apiGroup: rbac.authorization.k8s.io

roleRef:

    kind: ClusterRole

    name: secret-reader

    apiGroup: rbac.authorization.k8s.io

**CustomResourceDefinition**

apiVersion: apiextensions.k8s.io/v1

kind: CustomResourceDefinition

metadata:

    name: crontabs.stable.example.com

spec:

    group: stable.example.com

    versions:

    - name: v1

        served: true

        storage: true

        schema:

            openAPIV3Schema:

                type: object

                properties:

                    spec:

                        type: object

                        properties:

                            cronSpec:

                                type: string

                            image:

                                type: string

                            replicas:

                                type: integer

        subresources:

            status: {}

    scope: Namespaced

    names:

        plural: crontabs

        singular: crontab

        kind: CronTab

        shortNames:

        - ct

**StorageClass**

apiVersion: storage.k8s.io/v1

kind: StorageClass

metadata:

    name: standard

provisioner: kubernetes.io/aws-ebs

parameters:

    type: gp2

    zones: us-west-2a, us-west-2b

reclaimPolicy: Retain

allowVolumeExpansion: true

mountOptions:

    - debug

volumeBindingMode: WaitForFirstConsumer

**PodDisruptionBudget**

apiVersion: policy/v1beta1

kind: PodDisruptionBudget

metadata:

    name: my-pdb

spec:

    minAvailable: 2

    selector:

        matchLabels:

            app: my-app

Use kubectl apply -f <filename>.yaml to deploy them to your Kubernetes cluster.

* **Pod**: **kubectl run my-pod --image=nginx --port=80 --restart=Never --dry-run=client -o yaml > pod.yaml**
* **Service**: **kubectl expose deployment my-deployment --type=LoadBalancer --port=80 --target-port=8080 --name=my-service**
* **ConfigMap**: **kubectl create configmap my-config --from-file=config.properties**
* **Secret**: **kubectl create secret generic my-secret --from-literal=username=user --from-literal=password=pass**
* **Namespace**: **kubectl create namespace my-namespace**
* **Deployment**: **kubectl create deployment my-deployment --image=nginx --replicas=3 --dry-run=client -o yaml > deploy.yaml**
* **HorizontalPodAutoscaler**: **kubectl autoscale deployment my-deployment --min=1 --max=10 --cpu-percent=50**

**Important Kubernetes Commands:**

* **kubectl get pods**: Lists all pods in the current namespace.
  + Syntax: kubectl get pods [-n <namespace>] [-o <output\_format>]
  + Example: **kubectl get pods -n default -o wide**
* **kubectl get nodes**: Shows all nodes in the cluster.
  + Syntax: kubectl get nodes [-o <output\_format>]
  + Example: **kubectl get nodes -o json**
* **kubectl get services**: Lists all services in the current namespace.
  + Syntax: kubectl get services [-n <namespace>] [-o <output\_format>]
  + Example: **kubectl get services -n kube-system**
* **kubectl describe pod**: Provides detailed information about a specific pod.
  + Syntax: kubectl describe pod <pod-name> [-n <namespace>]
  + Example: **kubectl describe pod my-pod -n my-namespace**
* **kubectl logs**: Retrieves logs from a container in a pod.
  + Syntax: kubectl logs <pod-name> [-c <container-name>] [--previous] [-f]
  + Example: **kubectl logs my-pod -c my-container --previous**
* **kubectl exec -it -- /bin/bash**: Opens an interactive shell into a container within a pod.
  + Syntax: kubectl exec -it <pod-name> [-c <container-name>] -- <command>
  + Example: **kubectl exec -it my-pod -c main-container -- /bin/bash**
* **kubectl apply -f .yaml**: Applies a configuration to a resource by filename or stdin.
  + Syntax: kubectl apply -f <file-name>.yaml [-n <namespace>]
  + Example: **kubectl apply -f deployment.yaml**
* **kubectl delete pod**: Deletes a pod.
  + Syntax: kubectl delete pod <pod-name> [-n <namespace>]
  + Example: **kubectl delete pod my-pod**
* **kubectl scale --replicas=3 deployment/**: Scales the number of pods for a deployment.
  + Syntax: kubectl scale --replicas=<number> deployment/<deployment-name> [-n <namespace>]
  + Example: **kubectl scale --replicas=3 deployment/my-app**
* **kubectl rollout status deployment/**: Checks the status of a deployment rollout.
  + Syntax: kubectl rollout status deployment/<deployment-name> [-n <namespace>]
  + Example: **kubectl rollout status deployment/my-deployment**
* **kubectl rollout undo deployment/**: Rolls back to the previous deployment revision.
  + Syntax: kubectl rollout undo deployment/<deployment-name> [-n <namespace>]
  + Example: **kubectl rollout undo deployment/my-deployment**
* **kubectl create deployment --image=**: Creates a new deployment with the specified image.
  + Syntax: kubectl create deployment <deployment-name> --image=<image-name> [-n <namespace>]
  + Example: **kubectl create deployment nginx --image=nginx**
* **kubectl get deployments**: Lists all deployments in the current namespace.
  + Syntax: kubectl get deployments [-n <namespace>] [-o <output\_format>]
  + Example: **kubectl get deployments -o yaml**
* **kubectl port-forward :**: Forwards traffic from a local port to a port on the pod.
  + Syntax: kubectl port-forward <pod-name> <local-port>:<pod-port> [-n <namespace>]
  + Example: **kubectl port-forward my-pod 8080:80**
* **kubectl label nodes =**: Adds or updates a label on a node.
  + Syntax: kubectl label nodes <node-name> <key>=<value> [--overwrite]
  + Example: **kubectl label nodes worker1 disktype=ssd**
* **kubectl taint nodes =:**: Adds a taint on a node, which can repel pods unless they tolerate the taint.
  + Syntax: kubectl taint nodes <node-name> <key>=<value>:<effect> [--overwrite]
  + Example: **kubectl taint nodes worker2 apptype=legacy:NoSchedule**
* **kubectl get events**: Shows all events in the current namespace.
  + Syntax: kubectl get events [-n <namespace>] [-o <output\_format>]
  + Example: **kubectl get events -n my-namespace --sort-by='.lastTimestamp'**
* **kubectl config view**: Displays current kubeconfig settings.
  + Syntax: kubectl config view [--minify] [--flatten]
  + Example: **kubectl config view --minify**
* **kubectl cluster-info**: Displays endpoint information about the master and services in the cluster.
  + Syntax: kubectl cluster-info
  + Example: **kubectl cluster-info**

**How do you mount a ConfigMap as an environment variable or volume in a Pod?**

For environment variables:

env:

- name: SPECIAL\_LEVEL\_KEY

    valueFrom:

        configMapKeyRef:

            name: special-config

            key: special.how

For volumes:

volumes:

- name: config-volume

    configMap:

        name: special-config

volumeMounts:

- mountPath: /etc/config

    name: config-volume

**How would you securely use Secrets in a Pod?**

Mount Secrets as files in a volume for minimal exposure or use them as environment variables. For file mounts:

volumes:

- name: secret-volume

    secret:

        secretName: mysecret

volumeMounts:

- name: secret-volume

    readOnly: true

    mountPath: "/etc/secrets"

For environment variables:

env:

- name: SECRET\_USERNAME

    valueFrom:

        secretKeyRef:

            name: mysecret

            key: username

**How can you schedule Pods on speci c nodes?**

Use nodeSelector in the pod spec to match node labels:

nodeSelector:

    disktype: ssd

Or use nodeAffinity for more complex rules. Taints and tolerations can also be used to repel or attract pods to nodes.

**Describe how you would con gure an Ingress to route tra c to different services.**

De ne rules in the Ingress resource:

apiVersion: networking.k8s.io/v1

kind: Ingress

metadata:

    name: example-ingress

spec:

    rules:

    - host: example.com

        http:

            paths:

            - path: /api

                pathType: Prefix

                backend:

                    service:

                        name: api-service

                        port:

                            number: 80

            - path: /

                pathType: Prefix

                backend:

                    service:

                        name: web-service

                        port:

                            number: 80

**How do you implement a NetworkPolicy to restrict pod communication?**

Define a NetworkPolicy with selectors and rules for ingress/egress:

apiVersion: networking.k8s.io/v1

kind: NetworkPolicy

metadata:

    name: allow-from-namespace

spec:

    podSelector:

        matchLabels:

            role: frontend

    policyTypes:

    - Ingress

    ingress:

    - from:

        - namespaceSelector:

                matchLabels:

                    environment: production

        ports:

        - protocol: TCP

            port: 80

**How can you bind a ServiceAccount to a Role or ClusterRole?**

Use RoleBindings or ClusterRoleBindings:

apiVersion: rbac.authorization.k8s.io/v1

kind: RoleBinding

metadata:

    name: read-pods

    namespace: default

subjects:

- kind: ServiceAccount

    name: my-service-account

    namespace: default

roleRef:

    kind: Role

    name: pod-reader

    apiGroup: rbac.authorization.k8s.io

**How would you set up ResourceQuotas to prevent a namespace from using too many resources?**

Define a ResourceQuota in the namespace:

apiVersion: v1

kind: ResourceQuota

metadata:

    name: compute-resources

spec:

    hard:

        pods: "4"

        requests.cpu: "1"

        requests.memory: 1Gi

        limits.cpu: "2"

        limits.memory: 2Gi

**Update kubecon g for EKS:**

aws eks update-kubeconfig --name my-cluster --region ap-south-1

The script sets up port forwarding for Prometheus to access it locally.

kubectl port-forward $(kubectl get pods -l app=prometheus -o jsonpath='{.items[0].metadata.name}') 9090:9090 > /dev/null 2>&1 &

**mysql-secret.yaml**

apiVersion: v1

kind: Secret

metadata:

    name: mysql-secret

type: Opaque

data:

    MYSQL\_ROOT\_PASSWORD: cGFzc3dvcmQ=  # base64 encoded value of "password"

**backend-service.yaml**

apiVersion: v1

kind: Service

metadata:

    name: backend-service

spec:

    selector:

        app: backend

    ports:

        - protocol: TCP

            port: 3000

            targetPort: 3000

    type: LoadBalancer

**backenddeployment.yaml**

apiVersion: apps/v1

kind: Deployment

metadata:

    name: backend

spec:

    replicas: 2

    selector:

        matchLabels:

            app: backend

    template:

        metadata:

            labels:

                app: backend

        spec:

            initContainers:

            - name: init-mysql

                image: mysql:8.0

                env:

                - name: MYSQL\_ROOT\_PASSWORD

                    valueFrom:

                        secretKeyRef:

                            name: mysql-secret

                            key: MYSQL\_ROOT\_PASSWORD

                - name: DB\_HOST

                    value: "${db\_host}"

                - name: DB\_PORT

                    value: "${db\_port}"

                volumeMounts:

                - name: init-sql

                    mountPath: /docker-entrypoint-initdb.d

                command: [ "sh", "-c", "mysql -h ${db\_host} -P ${db\_port} -u admin -p${MYSQL\_ROOT\_PASSWORD} < /docker-entrypoint-initdb.d/init.sql" ]

            containers:

            - name: backend

                image: jeevan2001/backend:latest

                env:

                - name: DB\_HOST

                    value: "${db\_host}"

                - name: DB\_PORT

                    value: "${db\_port}"

                - name: MYSQL\_ROOT\_PASSWORD

                    valueFrom:

                        secretKeyRef:

                            name: mysql-secret

                            key: MYSQL\_ROOT\_PASSWORD

                ports:

                - containerPort: 3000

            volumes:

            - name: init-sql

                configMap:

                    name: init-sql-config

**Get the Backend LoadBalancer DNS**

export BACKEND\_LOADBALANCER\_DNS=$(kubectl get service backend-service -o jsonpath='{.status.loadBalancer.ingress[0].hostname}')

**frontendservice.yaml**

apiVersion: v1

kind: Service

metadata:

    name: frontend-service

spec:

    selector:

        app: frontend

    ports:

        - protocol: TCP

            port: 80

            targetPort: 80

    type: LoadBalancer

**frontenddeployment.yaml**

apiVersion: apps/v1

kind: Deployment

metadata:

    name: frontend

spec:

    replicas: 2

    selector:

        matchLabels:

            app: frontend

    template:

        metadata:

            labels:

                app: frontend

        spec:

            containers:

            - name: frontend

                image: jeevan2001/frontend:latest

                ports:

                - containerPort: 80

                imagePullPolicy: Always

**hpa-backend.yaml**

apiVersion: autoscaling/v1

kind: HorizontalPodAutoscaler

metadata:

    name: hpa-backend

spec:

    scaleTargetRef:

        apiVersion: apps/v1

        kind: Deployment

        name: backend-deployment

    minReplicas: 1

    maxReplicas: 10

    targetCPUUtilizationPercentage: 50

**cluster-autoscaler.yaml**

apiVersion: apps/v1

kind: Deployment

metadata:

    name: cluster-autoscaler

    namespace: kube-system

    labels:

        app: cluster-autoscaler

spec:

    replicas: 1

    selector:

        matchLabels:

            app: cluster-autoscaler

    template:

        metadata:

            labels:

                app: cluster-autoscaler

        spec:

            containers:

            - name: cluster-autoscaler

                image: k8s.gcr.io/autoscaling/cluster-autoscaler:v1.20.0

                command:

                - ./cluster-autoscaler

                - --v=4

                - --stderrthreshold=info

                - --cloud-provider=aws

                - --skip-nodes-with-local-storage=false

                - --expander=least-waste

                - --nodes=1:10:my-node-group

                env:

                - name: AWS\_REGION

                    value: ap-south-1

                resources:

                    limits:

                        cpu: 100m

                        memory: 300Mi

                    requests:

                        cpu: 100m

                        memory: 300Mi

                volumeMounts:

                - name: ssl-certs

                    mountPath: /etc/ssl/certs/ca-certificates.crt

                    readOnly: true

            volumes:

            - name: ssl-certs

                hostPath:

                    path: /etc/ssl/certs/ca-certificates.crt

**cluster-autoscaler-policy.json**

{

        "Version": "2012-10-17",

        "Statement": [

                {

                        "Action": [

                                "autoscaling:DescribeAutoScalingGroups",

                                "autoscaling:DescribeAutoScalingInstances",

                                "autoscaling:DescribeLaunchConfigurations",

                                "autoscaling:DescribeTags",

                                "autoscaling:SetDesiredCapacity",

                                "autoscaling:TerminateInstanceInAutoScalingGroup",

                                "ec2:DescribeLaunchTemplateVersions"

                        ],

                        "Resource": "\*",

                        "Effect": "Allow"

                }

        ]

}

**Terraform**

**AWS Provider**

provider "aws" {

region = "ap-south-1"

}

**Kubernetes Provider**

provider "kubernetes" {

    host                   = aws\_eks\_cluster.my\_cluster.endpoint

    cluster\_ca\_certificate = base64decode(aws\_eks\_cluster.my\_cluster.certificate\_authority[0].data)

    token                  = data.aws\_eks\_cluster\_auth.my\_cluster.token

}

**Data Sources**

**aws\_eks\_cluster\_auth**

data "aws\_eks\_cluster\_auth" "my\_cluster" {

name = aws\_eks\_cluster.my\_cluster.name

}

**aws\_availability\_zones**

data "aws\_availability\_zones" "available" {}

**Network Resources**

**aws\_vpc**

resource "aws\_vpc" "eks\_vpc" {

cidr\_block = "10.0.0.0/16"

}

**aws\_subnet**

resource "aws\_subnet" "eks\_public\_subnet" {

    count                   = 3

    vpc\_id                  = aws\_vpc.eks\_vpc.id

    cidr\_block              = cidrsubnet(aws\_vpc.eks\_vpc.cidr\_block, 8, count.index)

    availability\_zone       = element(data.aws\_availability\_zones.available.names, count.index)

    map\_public\_ip\_on\_launch = true

}

**aws\_subnet (Private)**

resource "aws\_subnet" "eks\_private\_subnet" {

    count                   = 3

    vpc\_id                  = aws\_vpc.eks\_vpc.id

    cidr\_block              = cidrsubnet(aws\_vpc.eks\_vpc.cidr\_block, 8, count.index + 3)

    availability\_zone       = element(data.aws\_availability\_zones.available.names, count.index)

    map\_public\_ip\_on\_launch = false

}

**aws\_internet\_gateway**

resource "aws\_internet\_gateway" "eks\_igw" {

vpc\_id = aws\_vpc.eks\_vpc.id

}

**aws\_route\_table**

resource "aws\_route\_table" "eks\_public\_route\_table" {

    vpc\_id = aws\_vpc.eks\_vpc.id

    route {

        cidr\_block = "0.0.0.0/0"

        gateway\_id = aws\_internet\_gateway.eks\_igw.id

    }

}

**aws\_route\_table\_association**

resource "aws\_route\_table\_association" "eks\_public\_route\_table\_association" {

    count          = 3

    subnet\_id      = element(aws\_subnet.eks\_public\_subnet[\*].id, count.index)

    route\_table\_id = aws\_route\_table.eks\_public\_route\_table.id

}

**aws\_nat\_gateway**

resource "aws\_nat\_gateway" "eks\_nat\_gateway" {

    count         = 3

    allocation\_id = aws\_eip.nat\_eip[count.index].id

    subnet\_id     = element(aws\_subnet.eks\_public\_subnet[\*].id, count.index)

}

**aws\_eip**

resource "aws\_eip" "nat\_eip" {

    count  = 3

    domain = "vpc"

}

**aws\_route\_table (Private)**

resource "aws\_route\_table" "eks\_private\_route\_table" {

    vpc\_id = aws\_vpc.eks\_vpc.id

    route {

        cidr\_block     = "0.0.0.0/0"

        nat\_gateway\_id = element(aws\_nat\_gateway.eks\_nat\_gateway[\*].id, 0)

    }

}

**aws\_route\_table\_association (Private)**

resource "aws\_route\_table\_association" "eks\_private\_route\_table\_association" {

    count          = 3

    subnet\_id      = element(aws\_subnet.eks\_private\_subnet[\*].id, count.index)

    route\_table\_id = aws\_route\_table.eks\_private\_route\_table.id

}

**Security**

**aws\_security\_group**

resource "aws\_security\_group" "eks\_security\_group" {

    vpc\_id = aws\_vpc.eks\_vpc.id

    egress {

        from\_port   = 0

        to\_port     = 0

        protocol    = "-1"

        cidr\_blocks = ["0.0.0.0/0"]

    }

    ingress {

        from\_port   = 3306

        to\_port     = 3306

        protocol    = "tcp"

        cidr\_blocks = ["10.0.0.0/16"]

    }

}

**Database**

**aws\_db\_instance**

resource "aws\_db\_instance" "mydb" {

    allocated\_storage      = 20

    storage\_type           = "gp2"

    engine                 = "mysql"

    engine\_version         = "8.0"

    instance\_class         = "db.t3.micro"

    db\_name                = "mydatabase"

    username               = "admin"

    password               = "password"

    db\_subnet\_group\_name   = aws\_db\_subnet\_group.mydb\_subnet\_group.name

    vpc\_security\_group\_ids = [aws\_security\_group.rds\_security\_group.id]

    skip\_final\_snapshot    = true

}

**aws\_db\_subnet\_group**

resource "aws\_db\_subnet\_group" "mydb\_subnet\_group" {

    name       = "mydb-subnet-group"

    subnet\_ids = aws\_subnet.eks\_private\_subnet[\*].id

}

**IAM**

**aws\_iam\_role**

resource "aws\_iam\_role" "eks\_cluster\_role" {

    name = "eks-cluster-role"

    assume\_role\_policy = jsonencode({

        Version = "2012-10-17"

        Statement = [

            {

                Effect = "Allow"

                Principal = {

                    Service = "eks.amazonaws.com"

                }

                Action = "sts:AssumeRole"

            },

        ]

    })

}

**aws\_iam\_role\_policy\_attachment**

resource "aws\_iam\_role\_policy\_attachment" "eks\_cluster\_role\_attachment" {

    role       = aws\_iam\_role.eks\_cluster\_role.name

    policy\_arn = "arn:aws:iam::aws:policy/AmazonEKSClusterPolicy"

}

**EKS**

**aws\_eks\_cluster**

resource "aws\_eks\_cluster" "my\_cluster" {

    name     = "my-cluster"

    role\_arn = aws\_iam\_role.eks\_cluster\_role.arn

    vpc\_config {

        subnet\_ids         = aws\_subnet.eks\_public\_subnet[\*].id

        security\_group\_ids = [aws\_security\_group.eks\_security\_group.id]

    }

}

**aws\_eks\_node\_group**

resource "aws\_eks\_node\_group" "my\_node\_group" {

    cluster\_name    = aws\_eks\_cluster.my\_cluster.name

    node\_group\_name = "my-node-group"

    node\_role\_arn   = aws\_iam\_role.eks\_node\_role.arn

    subnet\_ids      = aws\_subnet.eks\_private\_subnet[\*].id

    scaling\_config {

        desired\_size = 5

        max\_size     = 7

        min\_size     = 3

    }

    instance\_types = ["t3.small"]

    remote\_access {

        ec2\_ssh\_key = "my-key"

    }

    tags = {

        Name = "eks-node-group"

    }

}

**Local Resources and Data**

**local\_file**

resource "local\_file" "website\_content\_configmap" {

    content  = data.template\_file.website\_content\_configmap.rendered

    filename = "${path.module}/website-content-configmap.yaml"

}

**data.template\_file**

data "template\_file" "website\_content\_configmap" {

    template = file("${path.module}/website-content-configmap.tpl.yaml")

    vars = {

        db\_host = aws\_db\_instance.mydb.endpoint

    }

}

**kubernetes\_config\_map**

resource "kubernetes\_config\_map" "init\_sql\_config" {

    metadata {

        name = "init-sql-config"

    }

    data = {

        "init.sql" = file("${path.module}/init.sql")

    }

}

**VPC**

resource "aws\_vpc" "eks\_vpc" {

    cidr\_block = "10.0.0.0/16"

}

resource "aws\_subnet" "eks\_public\_subnet" {

    count                   = 3

    vpc\_id                  = aws\_vpc.eks\_vpc.id

    cidr\_block              = cidrsubnet(aws\_vpc.eks\_vpc.cidr\_block, 8, count.index)

    availability\_zone       = element(data.aws\_availability\_zones.available.names, count.index)

    map\_public\_ip\_on\_launch = true

}

resource "aws\_subnet" "eks\_private\_subnet" {

    count                   = 3

    vpc\_id                  = aws\_vpc.eks\_vpc.id

    cidr\_block              = cidrsubnet(aws\_vpc.eks\_vpc.cidr\_block, 8, count.index + 3)

    availability\_zone       = element(data.aws\_availability\_zones.available.names, count.index)

}

**Security Groups**

**AWS Security Group:**

resource "aws\_security\_group" "eks\_security\_group" {

    vpc\_id = aws\_vpc.eks\_vpc.id

    ingress {

        from\_port   = 80

        to\_port     = 80

        protocol    = "tcp"

        cidr\_blocks = ["0.0.0.0/0"]

    }

    egress {

        from\_port   = 0

        to\_port     = 0

        protocol    = "-1"

        cidr\_blocks = ["0.0.0.0/0"]

    }

}

**Kubernetes Network Policy:**

apiVersion: networking.k8s.io/v1

kind: NetworkPolicy

metadata:

  name: allow-web

  namespace: default

spec:

  podSelector:

    matchLabels:

      app: web

  ingress:

  - from:

    - podSelector:

        matchLabels:

          app: frontend

    ports:

    - protocol: TCP

      port: 80

**EKS Cluster**

**EKS Cluster:**

resource "aws\_eks\_cluster" "my\_cluster" {

    name     = "my-cluster"

    role\_arn = aws\_iam\_role.eks\_cluster\_role.arn

    vpc\_config {

        subnet\_ids = [aws\_subnet.eks\_public\_subnet.\*.id]

    }

}

**IAM Role for EKS Cluster:**

resource "aws\_iam\_role" "eks\_cluster\_role" {

    name = "eks-cluster-role"

    assume\_role\_policy = jsonencode({

        Version = "2012-10-17"

        Statement = [

            {

                Effect = "Allow"

                Principal = {

                    Service = "eks.amazonaws.com"

                }

                Action = "sts:AssumeRole"

            },

        ]

    })

}

resource "aws\_iam\_role\_policy\_attachment" "eks\_cluster\_policy" {

    role       = aws\_iam\_role.eks\_cluster\_role.name

    policy\_arn = "arn:aws:iam::aws:policy/AmazonEKSClusterPolicy"

}

**AWS & Kubernetes Integration with Terraform**

provider "aws" {

    region = "ap-south-1"

}

provider "kubernetes" {

    host                   = aws\_eks\_cluster.my\_cluster.endpoint

    cluster\_ca\_certificate = base64decode(aws\_eks\_cluster.my\_cluster.certificate\_authority[0].data)

    token                  = data.aws\_eks\_cluster\_auth.my\_cluster.token

}

resource "aws\_eks\_cluster" "my\_cluster" {

    name     = "my-cluster"

    role\_arn = aws\_iam\_role.eks\_cluster\_role.arn

    vpc\_config {

        subnet\_ids = [aws\_subnet.eks\_public\_subnet.\*.id]

    }

}

**Code Example:**

**ConfigMap:**

apiVersion: v1

kind: ConfigMap

metadata:

  name: db-config

data:

  DB\_HOST: mydb.example.com

  DB\_PORT: "3306"

**Secret:**

apiVersion: v1

kind: Secret

metadata:

  name: db-secret

type: Opaque

data:

  DB\_PASSWORD: cGFzc3dvcmQ=  # base64 encoded password

**Using ConfigMap and Secret in a Pod:**

apiVersion: v1

kind: Pod

metadata:

  name: my-app

spec:

  containers:

  - name: my-app-container

    image: my-app-image

    env:

    - name: DB\_HOST

      valueFrom:

        configMapKeyRef:

          name: db-config

          key: DB\_HOST

    - name: DB\_PORT

      valueFrom:

        configMapKeyRef:

          name: db-config

          key: DB\_PORT

    - name: DB\_PASSWORD

      valueFrom:

        secretKeyRef:

          name: db-secret

          key: DB\_PASSWORD

**Autoscaling using Kubernetes and AWS**

**AWS Auto Scaling Group:**

resource "aws\_autoscaling\_group" "example" {

    launch\_configuration = aws\_launch\_configuration.example.id

    min\_size             = 1

    max\_size             = 5

    desired\_capacity     = 2

    vpc\_zone\_identifier  = [aws\_subnet.eks\_public\_subnet.\*.id]

}

**Kubernetes HPA:**

apiVersion: autoscaling/v1

kind: HorizontalPodAutoscaler

metadata:

  name: my-app-hpa

spec:

  scaleTargetRef:

    apiVersion: apps/v1

    kind: Deployment

    name: my-app

  minReplicas: 1

  maxReplicas: 10

  targetCPUUtilizationPercentage: 50

* **Pods**: The smallest and simplest Kubernetes object. A Pod represents a single instance of a running process in your cluster.
* **ReplicaSets**: Ensures a specified number of pod replicas are running at any given time.
* **Deployments**: Provides declarative updates for Pods and ReplicaSets.
* **Services**: An abstraction which defines a logical set of Pods and a policy by which to access them - like load-balancers.
* **ConfigMaps**: Used to store configuration data in key-value pairs which can be consumed by pods.
* **Secrets**: Manages sensitive information, like passwords, OAuth tokens, and ssh keys, which can be referenced in pod definitions.
* **PersistentVolumes (PV)**: A piece of storage in the cluster that has been provisioned by an administrator or dynamically provisioned using Storage Classes.
* **PersistentVolumeClaims (PVC)**: Requests storage resources defined by a PersistentVolume.
* **Namespaces**: Provides a scope for names. Resources like Pods, Services, and Deployments can be isolated within namespaces.
* **Nodes**: A worker machine in Kubernetes, either virtual or physical, where containers will be launched by Kubernetes.
* **DaemonSets**: Ensures that all (or some) Nodes run a copy of a Pod. As nodes are added to the cluster, Pods are added to them. As nodes are removed from the cluster, those Pods are garbage collected.
* **Jobs**: Creates one or more Pods and ensures that a specified number of them successfully terminate. Good for batch processes.
* **CronJobs**: Manages time-based Jobs, similar to cron in Unix-like systems.
* **StatefulSets**: Manages the deployment and scaling of a set of Pods, and provides guarantees about the ordering and uniqueness of these Pods.
* **Ingress**: Manages external access to the services in a cluster, typically HTTP.
* **HorizontalPodAutoscaler**: Scales a Deployment, ReplicaSet, or ReplicationController based on observed CPU utilization or other select metrics.
* **VerticalPodAutoscaler**: Automatically adjusts the compute resources of pods based on usage.
* **NetworkPolicies**: Specifies how groups of pods are allowed to communicate with each other and other network endpoints.
* **ServiceAccounts**: Provides an identity for processes that run in a Pod, which can be used for authenticating to the API server.
* **Endpoints**: Exposes the IP addresses of a service's backing pods.
* **ResourceQuotas**: Provides constraints that limit aggregate resource consumption per namespace.
* **LimitRanges**: Constrains resource allocations (to Pods or Containers) in a namespace.
* **Roles and RoleBindings (for RBAC - Role-Based Access Control)**: Define permissions for users or service accounts within a namespace.
* **ClusterRoles and ClusterRoleBindings**: Similar to Roles but cluster-wide, not namespace-specific.
* **CustomResourceDefinitions (CRDs)**: Allows users to create new types of resources without adding another API server.
* **StorageClasses**: Describes different classes or profiles of storage in the cluster.
* **PodDisruptionBudgets**: Ensures that a specified number of pods are available even during voluntary disruptions like node drains or upgrades.

**-**-------------------------------------------

**Priority Order of Learning Kubernetes Resources (Quickie)**

**--------------------------------------------**

**Priority 1: Must-Know Kubernetes Resources for Interviews**

**--------------------------------------------**

Pod

Deployment

Service

ConfigMap

Secret

PersistentVolume

PersistentVolumeClaim

Namespace

StatefulSet

Ingress

HorizontalPodAutoscaler

**--------------------------------------------**

**Priority 2: Nice-to-Know Resources (Learn if You Have Time)**

**--------------------------------------------**

Replicaset

DaemonSet

Job and CronJob

NetworkPolicy

ServiceAccount

ResourceQuota

LimitRange

**--------------------------------------------**

**Priority 3: Skip for Now (Unless Specialized)**

**--------------------------------------------**

VerticalPodAutoscaler

PodDisruptionBudget

CustomResourceDefinition

StorageClass

Endpoints

Roles

RoleBindings

ClusterRoles

ClusterRoleBindings

**-------------------------------------------**

**Priority 1: Must-Know Kubernetes Resources for Interviews**

**Pod**

**The smallest and simplest Kubernetes object. A Pod represents a single instance of a running process in your cluster.**

apiVersion: v1

kind: Pod

metadata:

name: simple-pod

labels:

app: my-app

spec:

containers:

- name: app-container

image: nginx:latest

ports:

- containerPort: 80

resources:

requests:

cpu: "100m"

memory: "128Mi"

limits:

cpu: "500m"

memory: "256Mi"

**Deployment**

**Provides declarative updates for Pods and ReplicaSets.**

apiVersion: apps/v1

kind: Deployment

metadata:

name: my-deployment

labels:

app: my-app

spec:

replicas: 3

strategy:

type: RollingUpdate

rollingUpdate:

maxSurge: 1

maxUnavailable: 0

selector:

matchLabels:

app: my-app

template:

metadata:

labels:

app: my-app

spec:

containers:

- name: my-container

image: nginx:1.14.2

ports:

- containerPort: 80

resources:

requests:

memory: "256Mi"

cpu: "200m"

limits:

memory: "512Mi"

cpu: "500m"

livenessProbe:

httpGet:

path: /health

port: 80

initialDelaySeconds: 30

periodSeconds: 10

readinessProbe:

httpGet:

path: /ready

port: 80

initialDelaySeconds: 5

periodSeconds: 5

env:

- name: ENVIRONMENT

value: "production"

**Service**

**An abstraction which defines a logical set of Pods and a policy by which to access them - like loadbalancers.**

apiVersion: v1

kind: Service

metadata:

name: my-service

spec:

selector:

app: my-app

ports:

- protocol: TCP

port: 80

targetPort: 8080

name: http

type: LoadBalancer

**ConfigMap**

**Used to store configuration data in key-value pairs which can be consumed by pods.**

apiVersion: v1

kind: ConfigMap

metadata:

name: my-config

data:

app.env: "production"

config.file: |

key1=value1

key2=value2

**Secret**

**Manages sensitive information, like passwords, OAuth tokens, and ssh keys, which can be referenced in pod definitions.**

apiVersion: v1

kind: Secret

metadata:

name: my-secret

type: Opaque

data:

username: YWRtaW4= *# "admin"*

password: UEA1NXcwcmQ= *# "P@55w0rd"*

**PersistentVolume**

**A piece of storage in the cluster that has been provisioned by an administrator or dynamically provisioned using Storage Classes.**

apiVersion: v1

kind: PersistentVolume

metadata:

name: pv0001

spec:

capacity:

storage: 5Gi

accessModes:

- ReadWriteOnce

persistentVolumeReclaimPolicy: Retain

storageClassName: standard

nfs:

server: nfs-server.example.com

path: "/exports"

**PersistentVolumeClaim**

**Requests storage resources defined by a PersistentVolume.**

apiVersion: v1

kind: PersistentVolumeClaim

metadata:

name: my-claim

spec:

accessModes:

- ReadWriteOnce

resources:

requests:

storage: 5Gi

storageClassName: standard

**Namespace**

**Provides a scope for names. Resources like Pods, Services, and Deployments can be isolated within namespaces.**

apiVersion: v1

kind: Namespace

metadata:

  name: my-namespace

  labels:

    environment: production

**StatefulSet**

**Manages the deployment and scaling of a set of Pods, and provides guarantees about the ordering and uniqueness of these Pods.**

apiVersion: apps/v1

kind: StatefulSet

metadata:

  name: my-statefulset

spec:

  serviceName: my-service

  replicas: 3

  selector:

    matchLabels:

      app: my-app

  template:

    metadata:

      labels:

        app: my-app

    spec:

      containers:

        - name: my-container

          image: nginx:1.14.2

          volumeMounts:

            - name: www

              mountPath: "/usr/share/nginx/html"

  volumeClaimTemplates:

    - metadata:

        name: www

      spec:

        accessModes:

          - ReadWriteOnce

        resources:

          requests:

            storage: 1Gi

**Ingress**

**Manages external access to the services in a cluster, typically HTTP.**

apiVersion: networking.k8s.io/v1

kind: Ingress

metadata:

  name: my-ingress

  annotations:

    kubernetes.io/ingress.class: "nginx"

spec:

  rules:

    - host: example.com

      http:

        paths:

          - path: /app

            pathType: Prefix

            backend:

              service:

                name: my-service

                port:

                  number: 80

**HorizontalPodAutoscaler**

**Scales a Deployment, ReplicaSet, or ReplicationController based on observed CPU utilization or other select metrics.**

apiVersion: autoscaling/v2

kind: HorizontalPodAutoscaler

metadata:

  name: my-hpa

spec:

  scaleTargetRef:

    apiVersion: apps/v1

    kind: Deployment

    name: my-deployment

  minReplicas: 2

  maxReplicas: 10

  metrics:

    - type: Resource

      resource:

        name: cpu

        target:

          type: Utilization

          averageUtilization: 70

**Priority 2: Nice-to-Know Resources (Learn if You Have Time)**

**Replicaset**

**Ensures a specified number of pod replicas are running at any given time.**

apiVersion: apps/v1

kind: ReplicaSet

metadata:

  name: my-replicaset

  labels:

    app: my-app

spec:

  replicas: 3

  selector:

    matchLabels:

      app: my-app

  template:

    metadata:

      labels:

        app: my-app

    spec:

      containers:

        - name: my-container

          image: nginx:1.14.2

          ports:

            - containerPort: 80

**DaemonSet**

**Ensures that all (or some)Nodes run a copy of a Pod. As nodes are added to the cluster, Pods are added to them. As nodes are removed**

**from the cluster, those Pods are garbage collected.**

apiVersion: apps/v1

kind: DaemonSet

metadata:

  name: my-daemonset

spec:

  selector:

    matchLabels:

      app: my-app

  template:

    metadata:

      labels:

        app: my-app

    spec:

      nodeSelector:

        kubernetes.io/role: worker

      tolerations:

        - key: "node-role.kubernetes.io/control-plane"

          effect: "NoSchedule"

      containers:

        - name: my-container

          image: nginx:1.14.2

**Job**

**Creates one or more Pods and ensures that a specified number of them successfully terminate. Good for batch processes.**

apiVersion: batch/v1

kind: Job

metadata:

  name: my-job

spec:

  completions: 5

  parallelism: 2

  backoffLimit: 4

  template:

    spec:

      containers:

        - name: my-job-container

          image: busybox

          command: ["/bin/sh", "-c", "echo Hello, Kubernetes!"]

      restartPolicy: OnFailure

**CronJob**

**Manages time-based Jobs, similar to cron in Unix-like systems.**

apiVersion: batch/v1

kind: CronJob

metadata:

  name: my-cronjob

spec:

  schedule: "0 \*/1 \* \* \*"  # Every hour

  concurrencyPolicy: Forbid

  jobTemplate:

    spec:

      template:

        spec:

          containers:

            - name: my-cronjob-container

              image: busybox

              command: ["/bin/sh", "-c", "echo Hello"]

          restartPolicy: OnFailure

**NetworkPolicy**

**Specifies how groups of pods are allowed to communicate with each other and other network**

**endpoints.**

apiVersion: networking.k8s.io/v1

kind: NetworkPolicy

metadata:

  name: my-network-policy

spec:

  podSelector:

    matchLabels:

      role: db

  policyTypes:

    - Ingress

    - Egress

  ingress:

    - from:

        - podSelector:

            matchLabels:

              role: frontend

      ports:

        - protocol: TCP

          port: 6379

  egress:

    - to:

        - ipBlock:

            cidr: 10.0.0.0/24

      ports:

        - protocol: TCP

          port: 3306

**ServiceAccount**

**Provides an identity for processes that run in a Pod, which can be used for authenticating to the API server.**

apiVersion: v1

kind: ServiceAccount

metadata:

  name: my-service-account

  namespace: devops-interview

imagePullSecrets:

  - name: regcred

**ResourceQuota**

**Provides constraints that limit aggregate resource consumption per namespace.**

apiVersion: v1

kind: ResourceQuota

metadata:

  name: my-quota

  namespace: devops-interview

spec:

  hard:

    pods: "10"

    requests.cpu: "4"

    requests.memory: "6Gi"

    limits.cpu: "10"

    limits.memory: "10Gi"

**LimitRange**

**Constrains resource allocations (to Pods or Containers) in a namespace.**

apiVersion: v1

kind: LimitRange

metadata:

  name: my-limitrange

  namespace: devops-interview

spec:

  limits:

    - type: Container

      max:

        cpu: "1"

        memory: "512Mi"

      min:

        cpu: "100m"

        memory: "64Mi"

      default:

        cpu: "500m"

        memory: "512Mi"

      defaultRequest:

        cpu: "200m"

        memory: "256Mi"

**Priority 3: Skip for Now (Unless Specialized)**

**VerticalPodAutoscaler**

**Automatically adjusts the compute resources of pods based on usage.**

apiVersion: autoscaling.k8s.io/v1

kind: VerticalPodAutoscaler

metadata:

  name: my-vpa

spec:

  targetRef:

    apiVersion: "apps/v1"

    kind: Deployment

    name: my-deployment

  updatePolicy:

    updateMode: "Auto"

  resourcePolicy:

    containerPolicies:

      - containerName: "\*"

        minAllowed:

          cpu: "250m"

          memory: "128Mi"

        maxAllowed:

          cpu: "2"

          memory: "4Gi"

**PodDisruptionBudget**

**Ensures that a specified number of pods are available even during voluntary disruptions like node drains or upgrades.**

apiVersion: policy/v1

kind: PodDisruptionBudget

metadata:

  name: my-pdb

spec:

  minAvailable: 2

  selector:

    matchLabels:

      app: my-app

**CustomResourceDefinition**

**Allows users to create new types of resources without adding another API server.**

apiVersion: apiextensions.k8s.io/v1

kind: CustomResourceDefinition

metadata:

  name: crontabs.stable.example.com

spec:

  group: stable.example.com

  scope: Namespaced

  names:

    plural: crontabs

    singular: crontab

    kind: CronTab

  versions:

    - name: v1

      served: true

      storage: true

      schema:

        openAPIV3Schema:

          type: object

          properties:

            spec:

              type: object

              properties:

                cronSpec:

                  type: string

                image:

                  type: string

**StorageClass**

**Describes different classes or profiles of storage in the cluster.**

apiVersion: storage.k8s.io/v1

kind: StorageClass

metadata:

  name: standard

provisioner: kubernetes.io/aws-ebs

parameters:

  type: gp2

reclaimPolicy: Retain

allowVolumeExpansion: true

volumeBindingMode: WaitForFirstConsumer

**Endpoints**

**Exposes the IP addresses of a service's backing pods.**

apiVersion: v1

kind: Endpoints

metadata:

  name: my-endpoints

spec:

  subsets:

    - addresses:

        - ip: 192.168.1.1

      ports:

        - port: 80

          name: http

**Roles**

**Define permissions for users or service accounts within a namespace.**

apiVersion: rbac.authorization.k8s.io/v1

kind: Role

metadata:

  name: pod-reader

  namespace: devops-interview

rules:

  - apiGroups: [""]

    resources: ["pods"]

    verbs: ["get", "list", "watch"]

**RoleBindings**

**Define permissions for users or service accounts within a namespace.**

apiVersion: rbac.authorization.k8s.io/v1

kind: RoleBinding

metadata:

  name: read-pods

  namespace: devops-interview

subjects:

  - kind: User

    name: my-user

    apiGroup: rbac.authorization.k8s.io

roleRef:

  kind: Role

  name: pod-reader

  apiGroup: rbac.authorization.k8s.io

**ClusterRoles**

**Similar to Roles but cluster-wide, not namespace-specific.**

apiVersion: rbac.authorization.k8s.io/v1

kind: ClusterRole

metadata:

  name: secret-reader

rules:

  - apiGroups: [""]

    resources: ["secrets"]

    verbs: ["get", "list", "watch"]

**ClusterRoleBindings**

**Similar to Roles but cluster-wide, not**

**namespace-specific**

apiVersion: rbac.authorization.k8s.io/v1

kind: ClusterRoleBinding

metadata:

  name: read-secrets-global

subjects:

  - kind: User

    name: my-user

    apiGroup: rbac.authorization.k8s.io

roleRef:

  kind: ClusterRole

  name: secret-reader

  apiGroup: rbac.authorization.k8s.io

**Ansible**

**Program 1: Ansible Basics and Core Workflow**

**What is Ansible? (Core concepts, agentless, YAML, SSH)**

**Ansible is an open-source automation tool that uses an agentless architecture (no software installed on managed nodes), relies on SSH for communication, and uses YAML for configuration files like playbooks and inventory.**

**Ansible Inventory (Static vs. dynamic, host grouping)**

**The inventory defines the hosts Ansible manages. It can be static (a simple file) or dynamic (script-generated), with hosts organized into groups.**

**Ansible Ad-Hoc Commands (Basic usage, quick tasks)**

**Quick, one-line commands to perform tasks on hosts without writing a full playbook (e.g., ansible all -m ping).**

**Ansible Idempotence (Understanding the concept)**

**Ansible ensures tasks are idempotent, meaning running them multiple times produces the same result without unintended changes.**

**Step 1: Set Up a Static Inventory**

**Create a file named hosts.ini to define managed hosts and groups.**

# File: hosts.ini

[webservers]

web1.example.com

web2.example.com

[dbservers]

db1.example.com

[all:vars]

ansible\_user=admin

ansible\_ssh\_private\_key\_file=~/.ssh/id\_rsa

**Explanation:**

* **[webservers] and [dbservers] are host groups.**
* **ansible\_user and ansible\_ssh\_private\_key\_file are variables for SSH access, showcasing Ansible’s agentless nature (uses SSH, no agents needed).**

**Step 2: Run an Ad-Hoc Command**

**Use an ad-hoc command to check host uptime.**

ansible -i hosts.ini all -m command -a "uptime"

**Output (example):**

web1.example.com | SUCCESS | rc=0 >>

14:35:23 up 5 days, 3:12, 1 user, load average: 0.10, 0.15, 0.20

web2.example.com | SUCCESS | rc=0 >>

14:35:23 up 3 days, 10:45, 2 users, load average: 0.05, 0.08, 0.12

db1.example.com | SUCCESS | rc=0 >>

14:35:23 up 7 days, 1:23, 1 user, load average: 0.25, 0.30, 0.35

**Explanation:**

* **-i hosts.ini: Specifies the inventory file.**
* **all: Targets all hosts in the inventory.**
* **-m command: Uses the command module to execute uptime.**

**This demonstrates quick tasks without a playbook and Ansible’s SSH-based communication.**

**Step 3: Demonstrate Idempotence**

**Run a simple idempotent ad-hoc command multiple times.**

ansible -i hosts.ini webservers -m file -a "path=/tmp/test.txt state=touch"

**First Run Output:**

web1.example.com | CHANGED => {"changed": true, "path": "/tmp/test.txt"}

web2.example.com | CHANGED => {"changed": true, "path": "/tmp/test.txt"}

**Second Run Output:**

web1.example.com | SUCCESS => {"changed": false, "path": "/tmp/test.txt"}

web2.example.com | SUCCESS => {"changed": false, "path": "/tmp/test.txt"}

**Explanation:**

* **The file module with state=touch creates /tmp/test.txt if it doesn’t exist.**
* **First run: File is created (changed: true).**
* **Second run: File already exists, so no change (changed: false), proving idempotence.**

**Step 4: Tie It Together**

**Ansible’s core concepts are shown:**

* **Agentless: No software installed on web1, web2, or db1; SSH handles everything.**
* **YAML: Inventory uses a simple, readable format (though not strict YAML here, it’s YAML-compatible).**
* **SSH: Connection relies on SSH keys defined in the inventory.**

**Key Takeaways for Notes:**

* **Inventory organizes hosts and groups for targeting.**
* **Ad-hoc commands are fast, playbook-free ways to manage systems.**
* **Idempotence ensures consistent results, a core Ansible principle.**

**Execution Command:**

# Check connectivity

ansible -i hosts.ini all -m ping

# Run uptime command

ansible -i hosts.ini all -m command -a "uptime"

# Test idempotence

ansible -i hosts.ini webservers -m file -a "path=/tmp/test.txt state=touch"

**Program 2: Ansible Playbooks and Task Management**

**Topics Included:**

* **Ansible Playbooks (Structure, purpose, basic syntax)**
  + **Playbooks are YAML files defining a series of tasks to automate workflows.**
* **Ansible Modules (Common modules like command, shell, copy, service, package, file, template)**
  + **Modules are reusable units of work (e.g., copy for files, service for managing services).**
* **Ansible Loops (loop, basic iteration)**
  + **Loops allow repeating tasks over a list of items.**
* **Ansible Conditionals (when, basic operators)**
  + **Conditionals control task execution based on conditions (e.g., OS type).**
* **Ansible Tags (Purpose, usage, running specific tasks)**
  + **Tags label tasks for selective execution.**
* **Ansible Blocks (Basic usage, grouping tasks)**
  + **Blocks group related tasks for better organization or error handling.**
* **Ansible Command Module vs. Shell Module (Differences, when to use which)**
  + **command: Runs simple commands without shell features.**
  + **shell: Runs commands with shell capabilities (e.g., pipes).**

**Step 1: Create a Playbook**

**Create a file named setup\_webserver.yml.**

# File: setup\_webserver.yml

---

- name: Set up a basic web server

hosts: webservers

tasks:

# Block for package installation

- name: Install required packages

block:

- name: Install httpd and unzip

ansible.builtin.package:

name: "{{ item }}"

state: present

loop:

- httpd

- unzip

tags: install

# Task with conditional

- name: Copy index.html to web server

ansible.builtin.copy:

src: ./files/index.html

dest: /var/www/html/index.html

mode: '0644'

when: ansible\_os\_family == "RedHat"

tags: configure

# Task comparing command vs shell

- name: Check httpd version with command module

ansible.builtin.command: httpd -v

register: httpd\_version\_cmd

tags: check

- name: Check disk usage with shell module

ansible.builtin.shell: df -h | grep /dev

register: disk\_usage

tags: check

# Service management

- name: Ensure httpd is running

ansible.builtin.service:

name: httpd

state: started

enabled: yes

tags: service

**Explanation:**

* **Playbook Structure: Starts with ---, defines a play targeting webservers.**
* **Modules: Uses package, copy, command, shell, and service.**
* **Loops: Installs multiple packages (httpd, unzip) with loop.**
* **Conditionals: Copies index.html only on RedHat-based systems.**
* **Tags: Labels tasks as install, configure, check, or service.**
* **Blocks: Groups package installation tasks.**
* **Command vs. Shell: command runs httpd -v (no shell needed); shell runs df -h | grep /dev (needs pipe).**

**Step 2: Prepare Supporting Files**

**Create a simple index.html file in a files/ directory.**

<!-- File: files/index.html -->

<h1>Welcome to My Web Server</h1>

**Step 3: Use an Inventory**

**Reuse the hosts.ini from Program 1 (assuming webservers group exists).**

# File: hosts.ini

[webservers]

web1.example.com

web2.example.com

[all:vars]

ansible\_user=admin

ansible\_ssh\_private\_key\_file=~/.ssh/id\_rsa

**Step 4: Run the Playbook**

**Execute the full playbook:**

ansible-playbook -i hosts.ini setup\_webserver.yml

**Run specific tagged tasks:**

ansible-playbook -i hosts.ini setup\_webserver.yml --tags "install,configure"

**Output (example):**

TASK [Install httpd and unzip] \*\*\*\*\*\*\*\*\*\*\*\*

changed: [web1.example.com] => (item=httpd)

changed: [web1.example.com] => (item=unzip)

TASK [Copy index.html to web server] \*\*\*\*\*\*

changed: [web1.example.com]

TASK [Check httpd version with command module] \*\*\*\*

changed: [web1.example.com]

TASK [Check disk usage with shell module] \*\*\*\*

changed: [web1.example.com]

TASK [Ensure httpd is running] \*\*\*\*\*\*\*\*\*\*\*\*

changed: [web1.example.com]

**Step 5: Verify Results**

**Check outputs stored in register: Add a debug task (optional) to see httpd\_version\_cmd and disk\_usage:**

- name: Debug outputs

ansible.builtin.debug:

var: httpd\_version\_cmd.stdout

- name: Debug disk usage

ansible.builtin.debug:

var: disk\_usage.stdout

**Rerun to see idempotence (most tasks show changed: false on second run).**

**Key Takeaways for Notes:**

* **Playbooks: Automate multi-step workflows in YAML.**
* **Modules: Building blocks for tasks (e.g., copy for files, service for daemons).**
* **Loops: Simplify repetitive tasks.**
* **Conditionals: Add logic to adapt to environments.**
* **Tags: Enable selective task execution.**
* **Blocks: Organize related tasks.**
* **Command vs. Shell: Use command for simple tasks, shell for complex shell features.**

**Execution Commands:**

# Run full playbook

ansible-playbook -i hosts.ini setup\_webserver.yml

# Run only installation and configuration

ansible-playbook -i hosts.ini setup\_webserver.yml --tags "install,configure"

# Run checks only

ansible-playbook -i hosts.ini setup\_webserver.yml --tags "check"

**Program 3: Advanced Playbook Features and Reusability**

**Topics Included:**

* **Ansible Roles (Organization, reusability, basic structure)**
  + **Roles organize tasks, variables, and files into reusable units.**
* **Ansible Variables (Types, scope, usage)**
  + **Variables store dynamic data (e.g., package names) with different scopes (play, role, host).**
* **Ansible Facts (Purpose, usage, basic facts)**
  + **Facts are system details (e.g., OS, IP) gathered from managed nodes.**
* **Ansible Handlers (Purpose, usage, notify)**
  + **Handlers are tasks triggered by notify when changes occur (e.g., restart a service).**
* **Ansible Templates (Jinja2, basic usage)**
  + **Templates use Jinja2 to generate dynamic files (e.g., config files).**

**Step 1: Set Up a Role Structure**

**Create a role named webserver with the standard directory layout.**

mkdir -p roles/webserver/{tasks,handlers,templates,vars,files}

**Explanation: Roles organize code into tasks/ (main logic), handlers/ (triggered tasks), templates/ (dynamic files), vars/ (variables), and files/ (static files).**

**Step 2: Define Role Components**

**Main Tasks (roles/webserver/tasks/main.yml):**

---

- name: Install web server package

ansible.builtin.package:

name: "{{ web\_package }}"

state: present

notify: Restart web service

- name: Copy static index.html

ansible.builtin.copy:

src: index.html

dest: "{{ web\_doc\_root }}/index.html"

mode: '0644'

- name: Generate httpd.conf from template

ansible.builtin.template:

src: httpd.conf.j2

dest: /etc/httpd/conf/httpd.conf

mode: '0644'

notify: Restart web service

- name: Ensure web service is running

ansible.builtin.service:

name: "{{ web\_service }}"

state: started

enabled: yes

**Variables (roles/webserver/vars/main.yml):**

---

web\_package: httpd

web\_service: httpd

web\_doc\_root: /var/www/html

**Handlers (roles/webserver/handlers/main.yml):**

---

- name: Restart web service

ansible.builtin.service:

name: "{{ web\_service }}"

state: restarted

**Template (roles/webserver/templates/httpd.conf.j2):**

Listen {{ ansible\_default\_ipv4.address }}:80

ServerName {{ ansible\_hostname }}

DocumentRoot "{{ web\_doc\_root }}"

<Directory "{{ web\_doc\_root }}">

AllowOverride All

Require all granted

</Directory>

**Static File (roles/webserver/files/index.html):**

<h1>Hello from {{ ansible\_hostname }}!</h1>

Step 3: Create a Playbook to Use the Role

**Create deploy\_web.yml:**

---

- name: Deploy web server using role

hosts: webservers

pre\_tasks:

- name: Gather facts

ansible.builtin.setup:

- name: Debug OS and IP

ansible.builtin.debug:

msg: "Running on {{ ansible\_os\_family }} with IP {{ ansible\_default\_ipv4.address }}"

roles:

- webserver

**Explanation:**

* **Roles: The webserver role is applied to webservers.**
* **Variables: web\_package, web\_service, etc., are defined in the role’s vars/.**
* **Facts: ansible\_os\_family, ansible\_hostname, and ansible\_default\_ipv4.address are used dynamically.**
* **Handlers: Notified when the package or config changes.**
* **Templates: httpd.conf.j2 uses Jinja2 to insert facts like IP and hostname.**

**Step 4: Use an Inventory**

**Reuse hosts.ini from previous programs:**

# File: hosts.ini

[webservers]

web1.example.com

web2.example.com

[all:vars]

ansible\_user=admin

ansible\_ssh\_private\_key\_file=~/.ssh/id\_rsa

**Step 5: Run the Playbook**

**Execute the playbook:**

ansible-playbook -i hosts.ini deploy\_web.yml

**Output (example):**

TASK [Debug OS and IP] \*\*\*\*\*\*\*\*\*\*\*\*

ok: [web1.example.com] => {

"msg": "Running on RedHat with IP 192.168.1.10"

}

TASK [webserver : Install web server package] \*\*\*\*

changed: [web1.example.com]

TASK [webserver : Copy static index.html] \*\*\*\*

changed: [web1.example.com]

TASK [webserver : Generate httpd.conf from template] \*\*\*\*

changed: [web1.example.com]

TASK [webserver : Ensure web service is running] \*\*\*\*

changed: [web1.example.com]

HANDLER [webserver : Restart web service] \*\*\*\*

changed: [web1.example.com]

**Step 6: Verify Results**

**On web1.example.com, check:**

* **curl http://192.168.1.10: Should show "Hello from web1!" (hostname from facts).**
* **/etc/httpd/conf/httpd.conf: Contains the IP and hostname from the template.**

**Key Takeaways for Notes:**

* **Roles: Modularize tasks for reusability (e.g., webserver role can be reused across projects).**
* **Variables: Define constants (e.g., web\_package) in vars/ for flexibility.**
* **Facts: Automatically gather system info (e.g., ansible\_hostname) for dynamic configs.**
* **Handlers: Trigger actions (e.g., service restart) only when needed.**
* **Templates: Use Jinja2 to create dynamic files based on facts and variables.**

**Execution Command:**

ansible-playbook -i hosts.ini deploy\_web.yml

**Program 4: Security and Operational Control**

**Topics Included:**

* **Ansible Vault (Basic encryption, usage)**
  + **Vault encrypts sensitive data (e.g., passwords) in files.**
* **Ansible Privilege Escalation (become, become\_user)**
  + **become escalates privileges (e.g., to root) for tasks requiring elevated access.**
* **Ansible Check Mode (Dry Run) (--check)**
  + **Check mode simulates tasks without making changes.**
* **Ansible Best Practices (Organization, security, readability)**
  + **Best practices include clear naming, modular structure, and secure handling of secrets.**

**Step 1: Encrypt Sensitive Data with Ansible Vault**

**Create an encrypted file secrets.yml for sensitive variables.**

ansible-vault create secrets.yml

**Enter a vault password (e.g., mypassword) when prompted, then add:**

# File: secrets.yml

db\_password: "securepass123"

**Explanation: Vault encrypts secrets.yml to protect db\_password.**

**Step 2: Create a Playbook with Security Features**

**Create secure\_setup.yml:**

---

- name: Securely set up a database server

hosts: dbservers

vars\_files:

- secrets.yml # Include encrypted variables

tasks:

- name: Install MariaDB package

ansible.builtin.package:

name: mariadb-server

state: present

become: yes # Escalate privileges to root

become\_user: root

tags: install

- name: Ensure MariaDB service is running

ansible.builtin.service:

name: mariadb

state: started

enabled: yes

become: yes

become\_user: root

tags: service

- name: Set database root password

ansible.builtin.shell: mysqladmin -u root password "{{ db\_password }}"

when: ansible\_os\_family == "RedHat"

become: yes

become\_user: root

tags: configure

no\_log: true # Hide sensitive output (best practice)

**Explanation:**

* **Vault: secrets.yml provides db\_password.**
* **Privilege Escalation: become: yes and become\_user: root allow installing packages and managing services.**
* **Check Mode: Can be tested with --check.**
* **Best Practices:**
  + **Clear task names (e.g., "Install MariaDB package").**
  + **no\_log: true hides sensitive data in logs.**
  + **Modular structure with tags (install, service, configure).**

**Step 3: Use an Inventory**

**Reuse or adapt hosts.ini:**

# File: hosts.ini

[dbservers]

db1.example.com

[all:vars]

ansible\_user=admin

ansible\_ssh\_private\_key\_file=~/.ssh/id\_rsa

**Step 4: Run the Playbook**

**Dry Run (Check Mode):**

ansible-playbook -i hosts.ini secure\_setup.yml --check --ask-vault-pass

**Enter the vault password (mypassword) when prompted.**

**Output (example):**

TASK [Install MariaDB package] \*\*\*\*\*\*\*\*\*\*\*\*

ok: [db1.example.com] => (skipped, in check mode)

TASK [Ensure MariaDB service is running] \*\*\*\*

ok: [db1.example.com] => (skipped, in check mode)

TASK [Set database root password] \*\*\*\*\*\*\*\*\*

ok: [db1.example.com] => (skipped, in check mode)

Full Execution:

ansible-playbook -i hosts.ini secure\_setup.yml --ask-vault-pass

Output (example):

TASK [Install MariaDB package] \*\*\*\*\*\*\*\*\*\*\*\*

changed: [db1.example.com]

TASK [Ensure MariaDB service is running] \*\*\*\*

changed: [db1.example.com]

TASK [Set database root password] \*\*\*\*\*\*\*\*\*

changed: [db1.example.com]

**Step 5: Verify Results**

**On db1.example.com:**

* **Check if mariadb-server is installed (rpm -q mariadb-server).**
* **Verify MariaDB is running (systemctl status mariadb).**
* **Test the root password (mysql -u root -p with securepass123).**

**Key Takeaways for Notes:**

* **Vault: Encrypts sensitive data (e.g., db\_password) for security.**
* **Privilege Escalation: become ensures tasks requiring root access succeed.**
* **Check Mode: --check previews changes without applying them.**
* **Best Practices:**
  + **Use descriptive names and tags.**
  + **Hide sensitive output with no\_log.**
  + **Store secrets in Vault, not plaintext.**

**Execution Commands:**

# Create/edit Vault file

ansible-vault edit secrets.yml --ask-vault-pass

# Dry run

ansible-playbook -i hosts.ini secure\_setup.yml --check --ask-vault-pass

# Full run

ansible-playbook -i hosts.ini secure\_setup.yml --ask-vault-pass

**Program 5: Debugging and Validation**

**Topics Included:**

* **Ansible Debugging (Basic techniques, -v, debug module)**
  + **Debugging tools like verbose mode (-v) and the debug module help troubleshoot issues.**
* **Ansible Check Mode (Dry Run) (--check)**
  + **Check mode simulates playbook execution without applying changes.**

**Step 1: Create a Playbook for Debugging**

**Create debug\_validate.yml:**

---

- name: Debug and validate system setup

hosts: webservers

tasks:

- name: Gather facts

ansible.builtin.setup:

tags: facts

- name: Debug system OS and memory

ansible.builtin.debug:

msg: "OS: {{ ansible\_os\_family }}, Free Memory: {{ ansible\_memfree\_mb }} MB"

tags: debug

- name: Install httpd package

ansible.builtin.package:

name: httpd

state: present

register: install\_result # Store task output

tags: install

- name: Debug installation result

ansible.builtin.debug:

var: install\_result

when: install\_result is defined

tags: debug

- name: Ensure httpd is running

ansible.builtin.service:

name: httpd

state: started

register: service\_result

tags: service

- name: Debug service status

ansible.builtin.debug:

msg: "Service changed: {{ service\_result.changed }}, State: {{ service\_result.state }}"

when: service\_result is defined

tags: debug

**Explanation:**

* **Debugging: Uses debug module to print facts (e.g., OS, memory) and task results.**
* **Check Mode: Can simulate package installation and service management.**
* **Register: Captures task outputs (install\_result, service\_result) for inspection.**

**Step 2: Use an Inventory**

**Reuse hosts.ini from previous programs:**

# File: hosts.ini

[webservers]

web1.example.com

[all:vars]

ansible\_user=admin

ansible\_ssh\_private\_key\_file=~/.ssh/id\_rsa

**Step 3: Run the Playbook with Debugging**

**Verbose Mode (Basic):**

ansible-playbook -i hosts.ini debug\_validate.yml -v

**Verbose Mode (Detailed):**

ansible-playbook -i hosts.ini debug\_validate.yml -vvv

**Output (example with -v):**

TASK [Debug system OS and memory] \*\*\*\*\*\*\*\*\*\*\*\*

ok: [web1.example.com] => {

"msg": "OS: RedHat, Free Memory: 2048 MB"

}

TASK [Install httpd package] \*\*\*\*\*\*\*\*\*\*\*\*

changed: [web1.example.com] => {"changed": true, "name": "httpd"}

TASK [Debug installation result] \*\*\*\*\*\*\*\*\*\*\*\*

ok: [web1.example.com] => {

"install\_result": {"changed": true, "name": "httpd", "state": "present"}

}

**Explanation:**

* **-v shows task outputs; -vvv adds detailed execution info (e.g., SSH commands).**

**Step 4: Run in Check Mode**

**Simulate execution:**

ansible-playbook -i hosts.ini debug\_validate.yml --check

**Output (example):**

TASK [Debug system OS and memory] \*\*\*\*\*\*\*\*\*\*\*\*

ok: [web1.example.com] => {

"msg": "OS: RedHat, Free Memory: 2048 MB"

}

TASK [Install httpd package] \*\*\*\*\*\*\*\*\*\*\*\*

ok: [web1.example.com] => (skipped, in check mode)

TASK [Debug installation result] \*\*\*\*\*\*\*\*\*\*\*\*

skipping: [web1.example.com] # Skipped because install\_result isn’t set in check mode

TASK [Ensure httpd is running] \*\*\*\*\*\*\*\*\*\*\*\*

ok: [web1.example.com] => (skipped, in check mode)

**Explanation: Check mode runs debug tasks but skips changes (e.g., package install).**

**Step 5: Verify Debugging Output**

**Rerun with tags to focus on debugging:**

ansible-playbook -i hosts.ini debug\_validate.yml --tags "debug" -v

**Output (example):**

TASK [Debug system OS and memory] \*\*\*\*\*\*\*\*\*\*\*\*

ok: [web1.example.com] => {

"msg": "OS: RedHat, Free Memory: 2048 MB"

}

TASK [Debug installation result] \*\*\*\*\*\*\*\*\*\*\*\*

ok: [web1.example.com] => {

"install\_result": {"changed": false, "name": "httpd"}

}

TASK [Debug service status] \*\*\*\*\*\*\*\*\*\*\*\*

ok: [web1.example.com] => {

"msg": "Service changed: false, State: started"

}

**Key Takeaways for Notes:**

* **Debugging:**
  + **-v to -vvv: Increases verbosity for troubleshooting.**
  + **debug module: Prints variables, facts, or task results (e.g., ansible\_memfree\_mb).**
* **Check Mode: --check validates playbook logic without altering systems.**
* **Combine register with debug to inspect task outcomes.**

**Execution Commands:**

# Run with basic verbosity

ansible-playbook -i hosts.ini debug\_validate.yml -v

# Run with maximum verbosity

ansible-playbook -i hosts.ini debug\_validate.yml -vvv

# Run in check mode

ansible-playbook -i hosts.ini debug\_validate.yml --check

# Run debug tasks only

ansible-playbook -i hosts.ini debug\_validate.yml --tags "debug"

**Program 6: Ansible Ecosystem and Reusable Content Management**

**Topics Included:**

* **Ansible Galaxy (Purpose, usage, finding roles)**
* **Ansible Collections (Purpose, benefits, basic usage)**
* **Ansible Playbook Includes and Imports (Differences, usage)**

**Rationale: Ansible Galaxy and Ansible Collections are both part of Ansible's ecosystem for managing reusable content (roles and collections). Galaxy is a hub for finding roles, while Collections extend this concept with modular, reusable code including roles, modules, and plugins. Playbook Includes and Imports tie into this by allowing you to integrate Galaxy roles or Collection content into your playbooks dynamically (import\_role, include\_tasks) or statically. s Program Example: A playbook that pulls a role from Galaxy (e.g., configuring an Nginx server), uses a Collection for additional utilities (e.g., community.general), and demonstrates import\_role vs. include\_tasks for modularity.**

**Program:**

- name: Deploy Nginx using Galaxy Role and Collections

hosts: webservers

tasks:

- name: Import Nginx role from Galaxy

ansible.builtin.import\_role:

name: geerlingguy.nginx # Fetched via ansible-galaxy

- name: Use Collection module for additional setup

community.general.package\_facts:

manager: apt

- name: Include dynamic tasks

ansible.builtin.include\_tasks: setup\_firewall.yml

**Program 7: Data Manipulation and Dynamic Playbooks**

**Topics Included:**

* **Ansible Filters (Basic usage, data manipulation)**
* **Ansible Lookup Plugins (Basic understanding, usage)**
* **Ansible Playbook Variables Precedence (Understanding the order)**

**Rationale: Filters and Lookup Plugins are tools for manipulating and retrieving data dynamically within playbooks. Filters transform data (e.g., | json\_query), while Lookups fetch external data (e.g., lookup('file', 'path')). Variables Precedence is critical here because it determines how variables (used in filters or lookups) are overridden or prioritized (e.g., playbook vars vs. role vars).**

**Program Example: A playbook that reads data from a file using a lookup, manipulates it with filters, and respects variable precedence for customization.**

**Program:**

- name: Process server data dynamically

hosts: all

vars:

default\_port: 80

tasks:

- name: Read config from file using lookup

ansible.builtin.set\_fact:

config\_data: "{{ lookup('file', 'config.json') | from\_json }}"

- name: Filter and transform data

ansible.builtin.debug:

msg: "Server: {{ config\_data.servers | map(attribute='name') | join(', ') }}"

- name: Show variable precedence (playbook vars override defaults)

ansible.builtin.debug:

msg: "Port: {{ port | default(default\_port) }}"

**Program 8: Robust Automation with Error Handling and Scaling**

**Topics Included:**

* **Ansible Dynamic Inventory (Basic concept, benefits)**
* **Ansible Error Handling (ignore\_errors, failed\_when)**
* **Ansible Forks (Basic understanding)**

**Rationale: Dynamic Inventory allows Ansible to adapt to changing environments (e.g., cloud instances), which pairs well with Forks for parallel execution across multiple hosts. Error Handling ensures robustness by managing failures (e.g., ignoring non-critical errors or defining custom failure conditions).**

**Program Example: A playbook that uses a dynamic inventory (e.g., AWS EC2), handles errors gracefully, and scales with forks.**

**Program:**

- name: Manage cloud servers with error handling

hosts: all

# Dynamic inventory assumed (e.g., ec2.py script)

forks: 10 # Parallel execution

tasks:

- name: Install package with error handling

ansible.builtin.package:

name: httpd

state: present

ignore\_errors: yes # Continue despite failures

- name: Check service status

ansible.builtin.command: systemctl status httpd

register: result

failed\_when: "'running' not in result.stdout" # Custom failure condition

- name: Debug result

ansible.builtin.debug:

msg: "Service is {{ 'up' if 'running' in result.stdout else 'down' }}"

**Program 9: Controlled Deployment with Rolling Updates**

**Topics Included:**

* **Ansible Rolling Updates (serial)**

**Rationale: Rolling Updates (serial) is a standalone but critical concept for managing deployments in production environments, ensuring minimal downtime by updating hosts in batches. This can sbe a dedicated program as it’s often used independently or combined with other features (e.g., error handling from Set 3).**

**Program Example: A playbook that updates a web application across multiple servers in batches.**

**Program:**

- name: Perform rolling update on web servers

hosts: webservers

serial: 2 # Update 2 hosts at a time

tasks:

- name: Update application package

ansible.builtin.package:

name: myapp

state: latest

- name: Restart service

ansible.builtin.service:

name: myapp

state: restarted

- name: Verify application

ansible.builtin.uri:

url: "http://{{ inventory\_hostname }}/health"

status\_code: 200

**GitHub Actions: (Definitely Needed)**

**Revision Notes: GitHub Actions CI/CD Pipeline**

**Program: .github/workflows/ci-cd.yml**

name: CI-CD Pipeline # Step 1: Naming the workflow

on: # Step 1: Basic trigger setup

push:

branches: # Step 3: Branch filters

- main

- 'feature/\*'

pull\_request:

branches:

- main

env: # Step 5: Environment variables

NODE\_ENV: test # Global env var for consistency

jobs:

lint: # Step 4: First job in a multi-job setup

runs-on: ubuntu-latest # Step 1: Runner specification

steps:

- name: Checkout code *# Step 2: Accessing repo code*

uses: actions/checkout@v4

- name: Set up Node.js *# Step 2: Preparing environment*

uses: actions/setup-node@v4

with:

node-version: '20'

- name: Install dependencies *# Step 2: Running a script*

run: npm install

- name: Run linting *# Step 2: Executing a task*

run: npm run lint

test: *# Step 4: Second job with dependency*

needs: lint *# Step 4: Job dependency*

runs-on: ubuntu-latest

steps:

- name: Checkout code *# Step 2: Repeated for isolation*

uses: actions/checkout@v4

- name: Set up Node.js

uses: actions/setup-node@v4

with:

node-version: '20'

- name: Install dependencies

run: npm install

- name: Run tests *# Step 3: Adding testing*

run: npm test

deploy: *# Step 4: Third job with dependency*

needs: test *# Step 4: Depends on test passing*

if: github.ref == 'refs/heads/main' *# Step 5: Conditional deployment*

runs-on: ubuntu-latest

steps:

- name: Checkout code

uses: actions/checkout@v4

- name: Set up Node.js

uses: actions/setup-node@v4

with:

node-version: '20'

- name: Install dependencies

run: npm install

- name: Build site *# Step 5: Using env vars*

run: npm run build

env:

DEPLOY\_ENV: production *# Step 5: Job-specific env var*

- name: Deploy to GitHub Pages *# Step 5: Deployment with secrets*

uses: peaceiris/actions-gh-pages@v3

with:

github\_token: ${{ secrets.GITHUB\_TOKEN }} *# Step 5: Secret usage*

publish\_dir: ./dist

**Required Repo Files**

**package.json**

{

"name": "my-project",

"version": "1.0.0",

"scripts": {

"lint": "eslint .",

"test": "jest",

"build": "mkdir -p dist && echo '<h1>Deployed!</h1>' > dist/index.html"

},

"devDependencies": {

"eslint": "^8.57.0",

"jest": "^29.7.0"

}

}

**index.test.js**

test('basic test', () => {

expect(1 + 1).toBe(2);

});

**.eslintrc.json**

**Basic config—use eslint:recommended.**

**Concept Explanations (Your Revision Notes)**

**Step 1: Basic Workflow Setup**

**What: Defines the workflow’s name (name) and trigger (on).**

**In the Code: name: CI-CD Pipeline and on: push/pull\_request start the pipeline on code pushes or PRs.**

**Relatable Explanation: “It’s like setting an alarm clock—tells GitHub when to wake up and run my tasks, like pushing code is the trigger.”**

**Why It Matters: Every pipeline needs a starting point—interviewers ask this first.**

**Step 2: Checking Out Code and Running a Script**

**What: Uses actions/checkout@v4 to access repo files and run to execute commands (e.g., npm install, node index.js).**

**In the Code: Each job has uses: actions/checkout@v4 and runs scripts like npm install or npm run lint.**

**Relatable Explanation: “Imagine borrowing a book from the library (checkout) and then reading it aloud (run)—I need the code before I can do anything with it.”**

**Why It Matters: Without this, the runner’s a blank slate—core to any task.**

**Step 3: Adding Testing and Branch Filters**

**What: Runs tests (npm test) and limits triggers to specific branches (branches: [main, 'feature/\*']).**

**In the Code: test job runs npm test, and on: push: branches filters to main and feature/\*.**

**Relatable Explanation: “It’s like only studying for specific exams (branches) and then taking a quiz (test) to check my work—keeps things focused.”**

**Why It Matters: Testing ensures quality; filters save resources—standard CI stuff.**

**Step 4: Multiple Jobs with Dependencies**

**What: Splits tasks into jobs (lint, test, deploy) with needs to enforce order.**

**In the Code: lint runs first, test needs lint, and deploy needs test—a chain of tasks.**

**Relatable Explanation: “Think of a relay race—lint passes the baton to test, then test to deploy. No one runs until the previous runner’s done.”**

**Why It Matters: Shows you can organize complex workflows—mid-level skill.**

**Step 5: Env Vars, Secrets, and Deployment**

**What: Uses env for configuration, secrets for sensitive data, and deploys (e.g., to GitHub Pages).**

**In the Code: env: NODE\_ENV: test globally, DEPLOY\_ENV in deploy, secrets.GITHUB\_TOKEN for auth, and peaceiris/actions-gh-pages@v3 for deployment.**

**Relatable Explanation: “It’s like setting the thermostat (env), locking my diary (secrets), and mailing a package (deploy)—configures, secures, and ships my app.”**

**Why It Matters: Real-world pipelines need these—interviewers test this often.**

**How It Works (Big Picture)**

* **Push to feature/\*: Lint, then test—no deploy.**
* **Push to main: Lint, test, deploy to GitHub Pages if all pass.**
* **PR to main: Lint and test as a check before merging.**
* **Env/Secrets: NODE\_ENV sets test mode; GITHUB\_TOKEN securely authenticates deployment.**

**Revision Tips**

* **Memorize the Flow: Trigger → Lint → Test → Deploy (if main).**
* **Key Lines: on: push, uses: actions/checkout@v4, needs:, secrets.GITHUB\_TOKEN.**
* **Practice Explaining: Use the relatable analogies—interviewers love clarity.**

**Github Actions (Add on concepts):**

**Below, I’ve created a comprehensive revision note for your GitHub Actions learning, merging Steps 6 through 10 into a single, cohesive program where possible. Since some concepts (like self-hosted runners) can’t fully merge into a single YAML file without real infrastructure, I’ll provide a main workflow with most features and a separate note for self-hosted runners. Each section includes the code and a relatable explanation tailored for your revision—think of it as a cheat sheet you can revisit before interviews!**

**Revision Notes: GitHub Actions Master Workflow**

**Goal**

**This is a production-ready CI/CD pipeline for a Node.js project that tests across environments, deploys dynamically, and handles errors—covering Steps 6-10.**

**Main Workflow Program: .github/workflows/ci-cd.yml**

name: Advanced CI-CD Pipeline

*# Triggers (Step 9: Dynamic Workflows)*

on:

push:

branches: [main, 'feature/\*']

pull\_request:

branches: [main]

workflow\_dispatch:

inputs:

environment:

description: 'Deploy environment (staging/production)'

required: true

default: 'staging'

log-level:

description: 'Log verbosity'

default: 'info'

*# Global Env Vars*

env:

NODE\_ENV: production

jobs:

*# Step 6: Matrix Builds*

test:

runs-on: ubuntu-latest *# Could be self-hosted (Step 8)*

strategy:

matrix:

node-version: [18, 20]

fail-fast: false *# Step 10: Error Handling*

container: *# Step 8: Docker*

image: node:${{ matrix.node-version }}

steps:

- name: Checkout Code

uses: actions/checkout@v4

*# Step 7: Caching*

- name: Cache Node Modules

id: cache-npm

uses: actions/cache@v3

with:

path: ~/.npm

key: ${{ runner.os }}-node-${{ matrix.node-version }}-${{ hashFiles('\*\*/package-lock.json') }}

restore-keys: ${{ runner.os }}-node-${{ matrix.node-version }}-

- name: Install Dependencies

if: steps.cache-npm.outputs.cache-hit != 'true' *# Step 7: Conditionals*

run: npm install

- name: Run Tests

run: npm test

continue-on-error: true *# Step 10: Error Handling*

*# Step 6: Custom Action*

- name: Custom Failure Alert

if: failure() *# Step 7: Conditionals, Step 10: Error Handling*

uses: ./.github/actions/failure-alert

with:

message: 'Tests failed on Node ${{ matrix.node-version }}'

*# Step 7: Artifacts*

- name: Upload Test Logs

if: always() *# Step 7: Conditionals*

uses: actions/upload-artifact@v3

with:

name: test-logs-node-${{ matrix.node-version }}

path: ./test-logs/\*.log

*# Step 10: Status Checks*

status-check:

needs: test

if: github.event\_name == 'pull\_request'

runs-on: ubuntu-latest

steps:

- name: Verify Status

run: |

if [ "${{ job.status }}" == "success" ]; then

echo "All tests passed!"

exit 0

else

echo "Tests failed - check logs."

exit 1

fi

*# Step 9: Dynamic Workflows + Step 10: Advanced Deployment*

deploy:

needs: test

if: (github.ref == 'refs/heads/main' || github.event\_name == 'workflow\_dispatch') && success()

runs-on: ubuntu-latest

environment: ${{ github.event.inputs.environment || 'production' }}

steps:

- name: Checkout Code

uses: actions/checkout@v4

- name: Set Up Node.js

uses: actions/setup-node@v4

with:

node-version: '20'

- name: Install Dependencies

run: npm install

*# Step 9: Dynamic Step*

- name: Generate Dynamic Build Command

id: dynamic-build

run: |

echo "build-cmd=npm run build -- --env ${{ github.event.inputs.environment || 'production' }}" >> $GITHUB\_OUTPUT

- name: Build Site

run: ${{ steps.dynamic-build.outputs.build-cmd }}

- name: Deploy to GitHub Pages

uses: peaceiris/actions-gh-pages@v3

with:

github\_token: ${{ secrets.GITHUB\_TOKEN }}

publish\_dir: ./dist

*# Step 10: Error Handling Post-Deploy*

- name: Verify Deployment

run: |

if [ $? -eq 0 ]; then

echo "Deployed to ${{ github.event.inputs.environment || 'production' }} successfully!"

else

echo "Deployment failed!" && exit 1

**Custom Action: .github/actions/failure-alert/action.yml**

name: 'Failure Alert'

description: 'Logs a failure message'

inputs:

message:

description: 'Failure message'

required: true

runs:

using: 'node16'

main: 'index.js'

**.github/actions/failure-alert/index.js**

const core = require('@actions/core');

const message = core.getInput('message');

console.log(`ALERT: ${message}`);

**Supporting Files (Assumptions for Revision)**

**package.json:**

{

"scripts": {

"test": "jest --outputFile=./test-logs/test.log",

"build": "mkdir -p dist && echo '<h1>Built for $DEPLOY\_ENV</h1>' > dist/index.html"

},

"devDependencies": { "jest": "^29.7.0" }

}

**Repo Setup: Ensure test-logs/ exists and branch protection rules require status-check.**

**Concept-by-Concept Explanation**

**Step 6: Matrix Builds and Custom Actions**

* **Code: strategy: matrix runs tests on Node 18 and 20; custom action at .github/actions/failure-alert.**
* **Explanation: Matrix builds test all combos at once, like a factory QC check. The custom action alerts when something breaks.**
* **Interview Bit: “I used a matrix to ensure compatibility and a custom action to alert on failures—keeps things modular.”**

**Step 7: Conditionals, Caching, and Artifacts**

* **Code: if: steps.cache-npm.outputs.cache-hit != 'true', actions/cache@v3, and actions/upload-artifact@v3.**
* **Explanation: Caching speeds up builds, conditionals skip redundant steps, and artifacts let you debug later.**
* **Interview Bit: “Caching speeds up builds, conditionals skip redundant steps, and artifacts let me debug later.”**

**Step 8: Docker and Self-Hosted Runners**

* **Code: container: image: node:${{ matrix.node-version }} (Docker); runs-on: self-hosted (not fully merged—see below).**
* **Explanation: Docker ensures a consistent environment; self-hosted runners give control for special cases.**
* **Interview Bit: “Docker ensures my env is consistent; self-hosted runners give me control for special cases.”**

**Separate Note for Self-Hosted:**

* **Replace runs-on: ubuntu-latest with runs-on: self-hosted after configuring a runner in repo settings.**

**Step 9: Dynamic Workflows and Reusability**

* **Code: workflow\_dispatch with inputs, dynamic step via echo ... >> $GITHUB\_OUTPUT.**
* **Explanation: Dynamic workflows let you customize runs manually; reusability keeps code DRY.**
* **Interview Bit: “Dynamic workflows let me customize runs manually; reusability keeps code DRY.”**

**Step 10: Error Handling, Status Checks, and Advanced Deployment**

* **Code: continue-on-error, fail-fast: false, status-check job, environment: with post-deploy check.**
* **Explanation: Error handling ensures tests can stumble but still finish. Status checks enforce PR quality. Advanced deployment targets and verifies delivery.**
* **Interview Bit: “I handle errors gracefully, enforce PR quality, and deploy with precision.”**