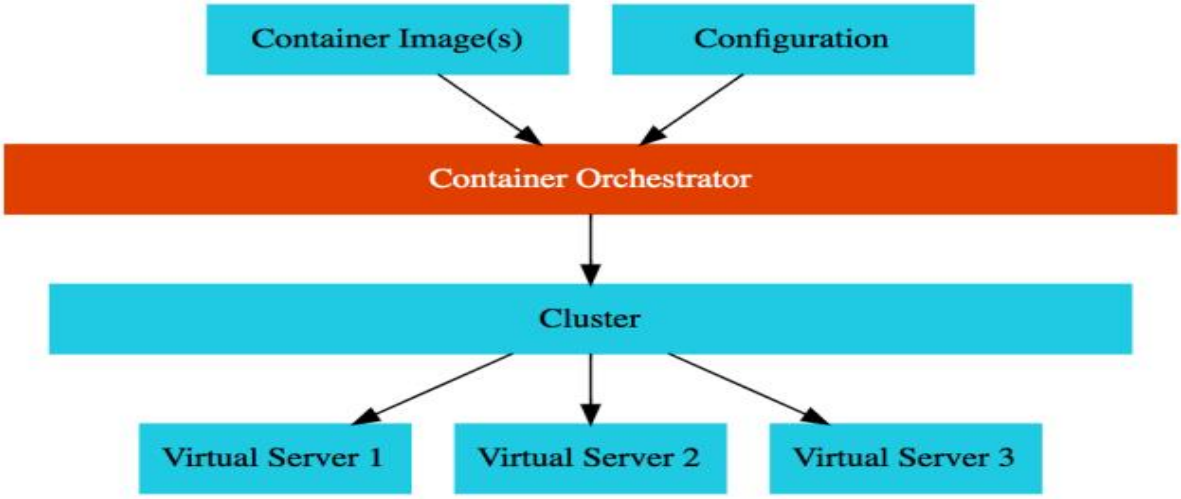
Google Kubernetes Engine (GKE)

- Most popular open source container orchestration solution.
- Provides Cluster Management (including upgrades).
- Each cluster can have different types of virtual machines.
- Provides all important container orchestration features:
  - Auto Scaling
  - Service Discovery
  - Load Balancer
  - Self Healing
- Zero Downtime Deployments



- Managed Kubernetes service.
- Minimize operations with auto-repair (repair failed nodes) and auto-upgrade (use latest version of K8S always) features.
- Provides Pod and Cluster Autoscaling.
- Enable Cloud Logging and Cloud Monitoring with simple configuration.
- Uses Container-Optimized OS, a hardened OS built by Google.
- Provides support for Persistent disks and Local SSD.

Kubernetes - A Microservice Journey - Getting Started

* Let's Have Some Fun: Let's get on a journey with Kubernetes:
* Let's create a cluster, deploy a microservice and play with it in 13 steps!

* 1: Create a Kubernetes cluster with the default node pool.

* gcloud container clusters create or use cloud console.

* 2: Login to Cloud Shell.

* 3: Connect to the Kubernetes Cluster.

* gcloud container clusters get-credentials my-cluster --region us-central1 --project my-kubernetes-project-416406

* 4: Deploy Microservice to Kubernetes:

* Create deployment & service using kubectl commands.

* kubectl create deployment hello-world-rest-api --image=in28min/hello-world-rest-api:0.0.1.RELEASE.

* kubectl expose deployment hello-world-rest-api --type=LoadBalancer --port=8080.

* 5: Increase number of instances of your microservice:

* kubectl scale deployment hello-world-rest-api --replicas=3.

* 6: Increase number of nodes in your Kubernetes cluster:

* gcloud container clusters resize my-cluster --node-pool my-node-pool --num-nodes 5 –zone=us-central1-c

* You are NOT happy about manually increasing number of instances and nodes!

* 7: Setup auto scaling for your microservice:

* kubectl autoscale deployment hello-world-rest-api --max=10 --cpu-percent=70

* Also called horizontal pod autoscaling - HPA - kubectl get hpa
* 8: Setup auto scaling for your Kubernetes Cluster.

* gcloud container clusters update cluster-name --enable-autoscaling --min-nodes=1 -- max-nodes=10.

* 9: Add some application configuration for your microservice.

* **Config Map** - kubectl create configmap hello-world-config --from-literal=RDS_DB_NAME=todos.

10: Add password configuration for your microservice.

* **Kubernetes Secrets** - kubectl create secret generic hello-world-secrets-1 --from-literal=RDS_PASSWORD=dummytodos

* gcloud container node-pools list --zone= us-central1-c --cluster=my-cluster

* gcloud container clusters delete my-cluster --region=us-central1

* kubectl set image deployment hello-world-rest-api hello-world-rest-api=in28min/hello-world-rest-api:0.0.2.RELEASE

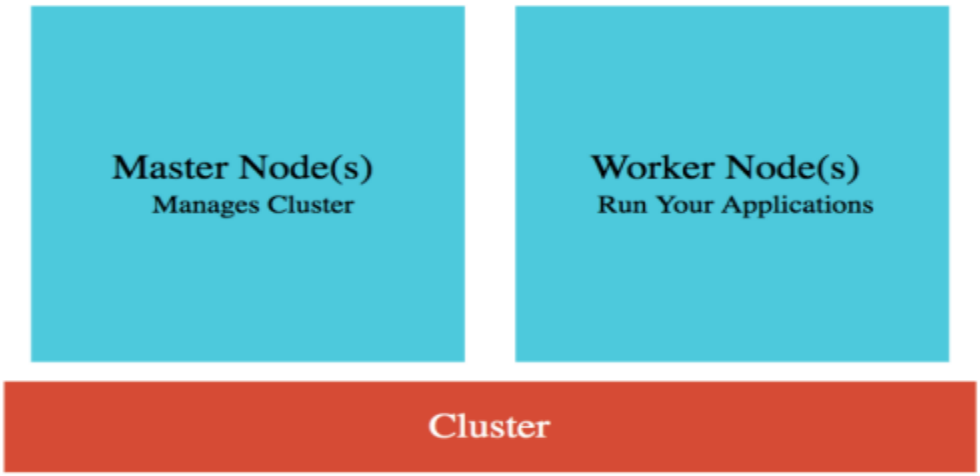
```
apiVersion: apps/v1
kind: Deployment
metadata:
  labels:
    app: hello-world-rest-api
  name: hello-world-rest-api
  namespace: default
spec:
  replicas: 3
  selector:
    matchLabels:
      app: hello-world-rest-api
  template:
    metadata:
      labels:
        app: hello-world-rest-api
    spec:
      containers:
      - image: in28min/hello-world-rest-api:0.0.3.RELEASE
        name: hello-world-rest-api
```

```yaml
apiVersion: v1
kind: Service
metadata:
  labels:
    app: hello-world-rest-api
  name: hello-world-rest-api
  namespace: default
spec:
  ports:
  - port: 8080
    protocol: TCP
    targetPort: 8080
  selector:
    app: hello-world-rest-api
  sessionAffinity: None
  type: LoadBalancer
```

Kubernetes - A Microservice Journey - The End!

- 11: Deploy a new microservice which needs nodes with a GPU attached.
- Attach a new node pool with GPU instances to your cluster.
- gcloud container node-pools create POOL_NAME --cluster CLUSTER_NAME
- gcloud container node-pools list --cluster CLUSTER_NAME
- Deploy the new microservice to the new pool by setting up nodeSelector in the deployment.yaml.
- nodeSelector: cloud.google.com/gke-nodepool: POOL_NAME
- 12: Delete the Microservices
- **Delete service** - kubectl delete service

- **Delete deployment** - kubectl delete deployment
- 13: **Delete the Cluster** gcloud container clusters delete



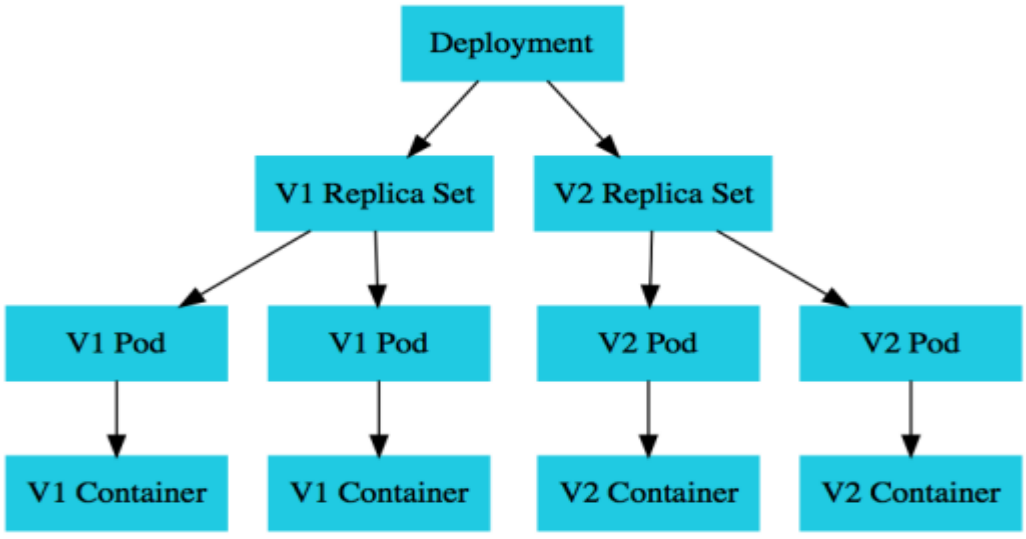
* Cluster : Group of Compute Engine instances:

- Master Node(s) - Manages the cluster
- Worker Node(s) - Run your workloads (pods)
- Master Node (Control plane) components:
- API Server - Handles all communication for a K8S cluster (from nodes and outside)
- Scheduler - Decides placement of pods
- Control Manager - Manages deployments & replicasets
- etcd - Distributed database storing the cluster state
- Worker Node components:
- Runs your pods
- Kubelet - Manages communication with master node(s)

GKE Cluster Types

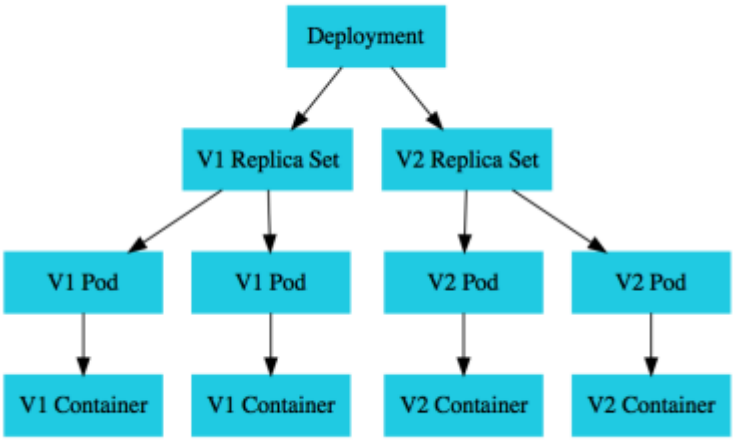
Type	Description
Zonal Cluster	**Single Zone** - Single Control plane. Nodes running in the same zone.
	Multi-zonal - Single Control plane but nodes running in multiple zones
Regional cluster	Replicas of the control plane runs in multiple zones of a given region. Nodes also run in same zones where control plane runs.
Private cluster	VPC-native cluster. Nodes only have internal IP addresses.
Alpha cluster	Clusters with alpha APIs - early feature API's. Used to test new K8S features.

Kubernetes - Pods



- Smallest deployable unit in Kubernetes.
- A Pod contains one or more containers.
- Each Pod is assigned an ephemeral IP address.
- All containers in a pod share:
- Network
- Storage
- IP Address
- Ports and Volumes (Shared persistent disks)
- POD statuses : Running /Pending /Succeeded /Failed /Unknown

Kubernetes - Deployment vs Replica Set



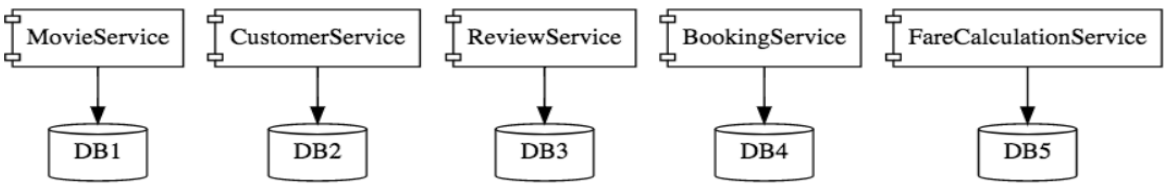
- A deployment is created for each microservice:
- kubectl create deployment m1 --image=m1:v1
- Deployment represents a microservice (with all its releases)
- Deployment manages new releases ensuring zero downtime
- Replica set ensures that a specific number of pods are running for a specific microservice version
- kubectl scale deployment m2 --replicas=2
- Even if one of the pods is killed, replica set will launch a new one
- Deploy V2 of microservice - Creates a new replica set
- kubectl set image deployment m1 m1=m1:v2
- V2 Replica Set is created
- Deployment updates V1 Replica Set and V2 Replica Set based on the release strategies.

Kubernetes – Service

- Each Pod has its own IP address:
- How do you ensure that external users are not impacted when:
- A pod fails and is replaced by replica set
- A new release happens and all existing pods of old release are replaced by ones of new release
- Create Service

- kubectl expose deployment name --type=LoadBalancer --port=80
- Expose PODs to outside world using a stable IP Address
- Ensures that the external world does not get impacted as pods go down and come up
- Three Types:
- **ClusterIP**: Exposes Service on a cluster-internal IP
- Use case: You want your microservice only to be available inside the cluster (Intra cluster communication).
- **LoadBalancer:** Exposes Service externally using a cloud provider's load balancer.
- Use case: You want to create individual Load Balancer's for each microservice .
- **NodePort:** Exposes Service on each Node's IP at a static port (the NodePort)
- Use case: You DO not want to create an external Load Balancer for each microservice (You can create one Ingress component to load balance multiple microservices).

Container Registry - Image Repository



- You've created docker images for your microservices:
- Where do you store them?
- Container Registry - fully-managed container registry provided by GCP
- (Alternative) Docker Hub
- Can be integrated to CI/CD tools to publish images to registry
- You can secure your container images. Analyze for vulnerabilities and enforce deployment policies.
- Naming: HostName/ProjectID/Image:Tag - gcr.io/projectname/helloworld:1

GKE – Remember

- Replicate master nodes across multiple zones for high availability.
- (REMEMBER) Some CPU on the nodes is reserved by Control Plane:
- 1st core - 6%, 2nd core - 1%, 3rd/4th - 0.5, Rest - 0.25
- Creating Docker Image for your microservices(Dockerfile):
- Build Image: docker build -t in28min/hello-world-rest-api:0.0.1.RELEASE .
- Test it Locally: docker run -d -p 8080:8080 in28min/hello-world-rest-api:0.0.1.RELEASE

- Push it to Container Repository: docker push in28min/hello-world-rest-api:0.0.1.RELEASE
- Kubernetes supports Stateful deployments like Kafka, Redis, ZooKeeper:
- StatefulSet - Set of Pods with unique, persistent identities and stable hostnames.
- How do we run services on nodes for log collection or monitoring?
- DaemonSet - One pod on every node! (for background services).
- (Enabled by default) Integrates with Cloud Monitoring and Cloud Logging Cloud Logging System and Application Logs can be exported to Big Query or Pub/Sub.

GKE - Cluster Management - Command Line

Description	Command
Create Cluster	gcloud container clusters **create** my-cluster --zone us-central1-a --node-locations us-central1-c,us-central1-b
Resize Cluster	gcloud container clusters **resize** my-cluster --node-pool my-node-pool --num-nodes 10
Autoscale Cluster	gcloud **container clusters update** cluster-name --enable-autoscaling --min-nodes=1 --max-nodes=10
Delete Cluster	gcloud container clusters **delete** my-cluster
Adding Node Pool	gcloud container **node-pools create** new-node-pool-name --cluster my-cluster
List Images	gcloud container images list

GKE - Workload Management - Command Line

Description	Command
List Pods/Service/Replica Sets	kubectl **get pods/services/replicasets**
Create Deployment	kubectl **apply -f** deployment.yaml or kubectl **create deployment**
Create Service	kubectl **expose deployment** hello-world-rest-api --type=LoadBalancer --port=8080
Scale Deployment	kubectl **scale deployment** hello-world --replicas 5
Autoscale Deployment	kubectl **autoscale deployment** --max --min --cpu-percent
Delete Deployment	kubectl **delete deployment** hello-world
Update Deployment	kubectl **apply -f** deployment.yaml
Rollback Deployment	kubectl **rollout undo deployment** hello-world --to-revision=1

Google Kubernetes Engine - Scenarios – 1

Scenario	Solution
You want to keep your costs low and optimize your GKE implementation	Consider Preemptible VMs, Appropriate region, Committed-use discounts. E2 machine types are cheaper than N1. Choose right environment to fit your workload type (Use multiple node pools if needed).
You want an efficient, completely auto scaling GKE solution	Configure Horizontal Pod Autoscaler for deployments and Cluster Autoscaler for node pools
You want to execute untrusted third-party code in Kubernetes Cluster	Create a new node pool with GKE Sandbox. Deploy untrused code to Sandbox node pool.

Google Kubernetes Engine - Scenarios – 2

Scenario	Solution
You want enable ONLY internal communication between your microservice deployments in a Kubernetes Cluster	Create Service of type ClusterIP
My pod stays pending	Most probably Pod cannot be scheduled onto a node(insufficient resources)
My pod stays waiting	Most probably failure to pull the image