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Devops B2

Lab Exercise 14- Implementing Resource Quota in Kubernetes

Objective:

In Kubernetes, Resource Quotas are used to control the resource consumption of namespaces. They help in managing and enforcing limits on the usage of resources like CPU, memory, and the number of objects (e.g., Pods, Services) within a namespace. This exercise will guide you through creating and managing Resource Quotas to limit the resources used by applications in a specific namespace.

Step 1: Understand Resource Quotas

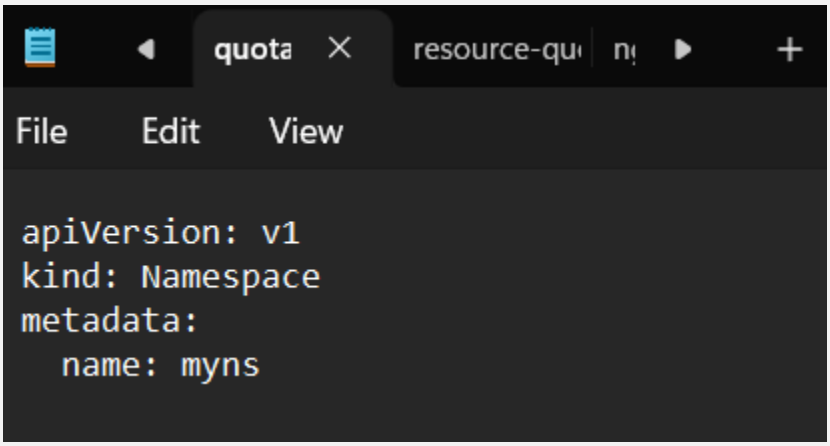
Resource Quotas allow you to:

- Limit the amount of CPU and memory a namespace can use.
- Control the number of certain types of resources (e.g., Pods, Services, PersistentVolumeClaims) in a namespace.
- Prevent a namespace from consuming more resources than allocated, ensuring fair usage across multiple teams or applications.

Step 2: Create a Namespace

First, create a namespace where you will apply the Resource Quota. This helps in isolating and controlling resource usage within that specific namespace.
Create a YAML file named **quota-namespace.yaml** with the following content:

```
apiVersion: v1
kind: Namespace
metadata:
  name: myns
```



Apply the YAML to create the namespace:

```
kubectl apply -f quota-namespace.yaml
```

```
C:\Users\prati>kubectl apply -f quota-namespace.yaml
namespace/myns created
```

Verify that the namespace is created:

```
kubectl get namespaces
```

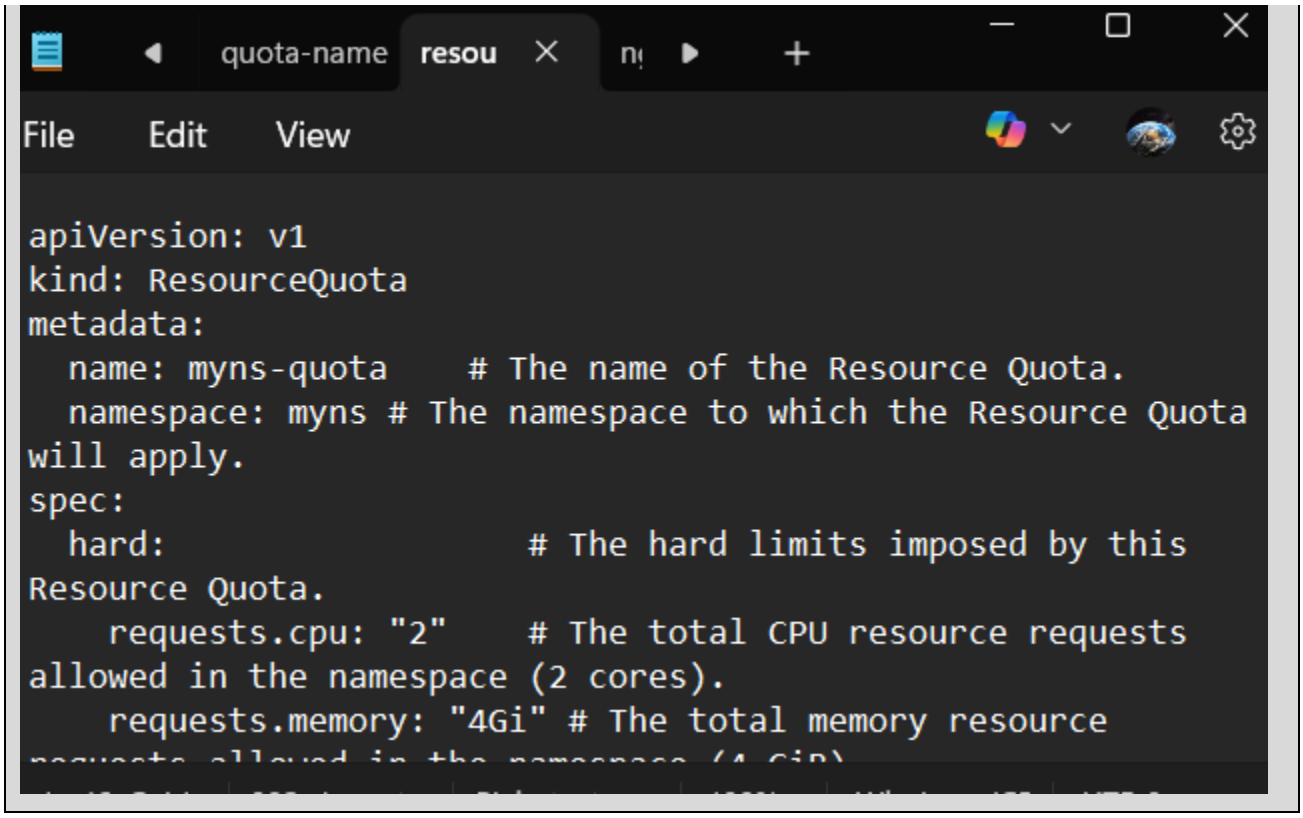
```
C:\Users\prati>kubectl get namespaces
NAME                   STATUS   AGE
default                Active   11d
kube-node-lease        Active   11d
kube-public            Active   11d
kube-system            Active   11d
kubernetes-dashboard   Active   29m
myns                   Active   9s
```

You should see quota-example listed in the output.

Step 3: Define a Resource Quota

Next, create a Resource Quota YAML file named **resource-quota.yaml** with the following content:

```
apiVersion: v1
kind: ResourceQuota
metadata:
  name: myns-quota    # The name of the Resource Quota.
  namespace: myns # The namespace to which the Resource Quota will apply.
spec:
  hard:               # The hard limits imposed by this Resource Quota.
    requests.cpu: "2"    # The total CPU resource requests allowed in the namespace (2 cores).
    requests.memory: "4Gi" # The total memory resource requests allowed in the namespace (4 GiB).
    limits.cpu: "4"      # The total CPU resource limits allowed in the namespace (4 cores).
    limits.memory: "8Gi" # The total memory resource limits allowed in the namespace (8 GiB).
    pods: "10"           # The total number of Pods allowed in the namespace.
    persistentvolumeclaims: "5" # The total number of PersistentVolumeClaims allowed in the namespace.
    configmaps: "10"     # The total number of ConfigMaps allowed in the namespace.
    services: "5"        # The total number of Services allowed in the namespace.
```



Step 4: Apply the Resource Quota

Apply the Resource Quota YAML to the namespace:

```
kubectl apply -f resource-quota.yaml
```

```
C:\Users\prati>kubectl apply -f resource-quota.yaml
resourcequota/myns-quota created
```

Verify that the Resource Quota is applied:

```
kubectl get resourcequota -n myns
```

```
C:\Users\prati>kubectl get resourcequota -n myns
NAME         REQUEST                                                 LIMIT
                  AGE
myns-quota   configmaps: 1/10, persistentvolumeclaims: 0/5, pods: 0/10, requ
ests.cpu: 0/2, requests.memory: 0/4Gi, services: 0/5   limits.cpu: 0/4, limi
ts.memory: 0/8Gi   6s
```

To see the details of the applied Resource Quota:

kubectl describe resourcequota myns-quota -n myns

```
C:\Users\prati>kubectl describe resourcequota myns-quota -n myns
Name:                   myns-quota
Namespace:              myns
Resource                Used  Hard
--------                ----  ----
configmaps              1     10
limits.cpu              0     4
limits.memory           0     8Gi
persistentvolumeclaims  0     5
pods                    0     10
requests.cpu            0     2
requests.memory         0     4Gi
services                0     5
```

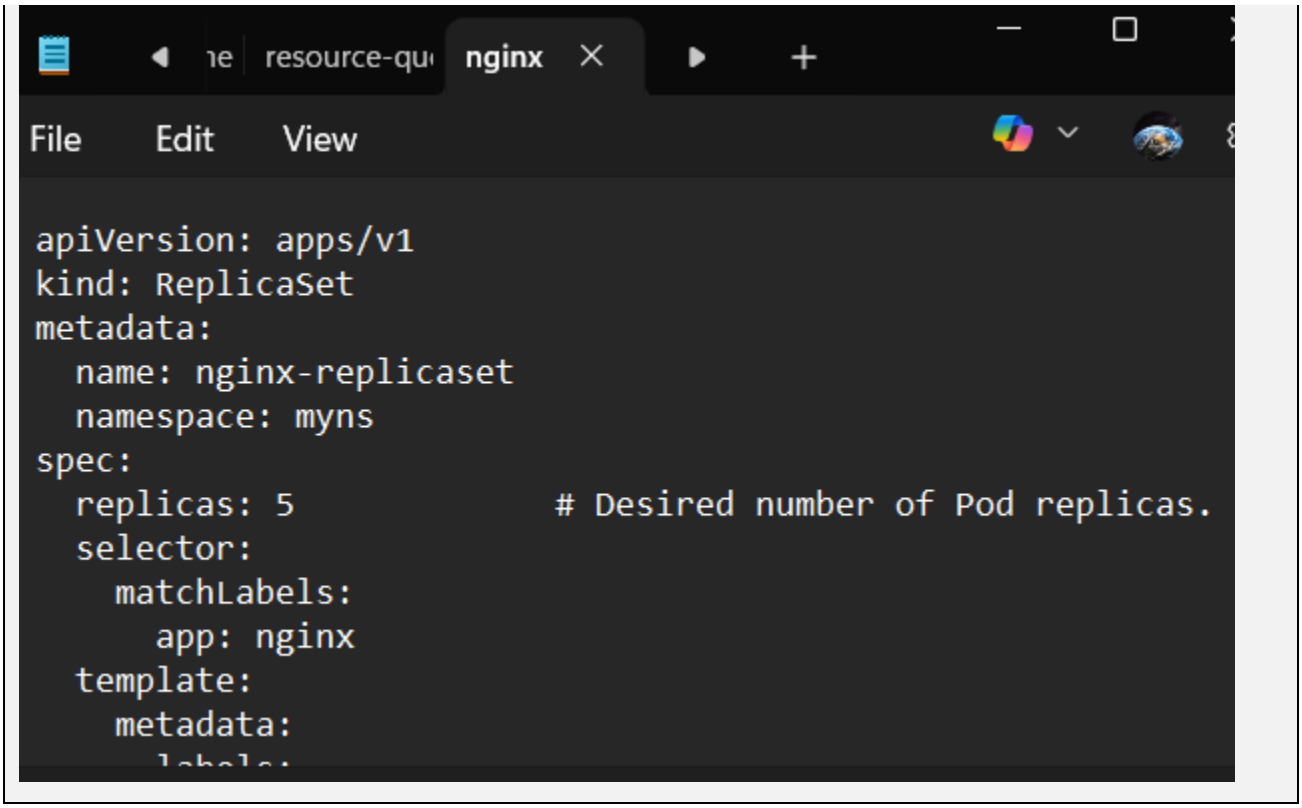
Step 5: Test the Resource Quota

Let's create some resources in the quota-example namespace to see how the Resource Quota affects them.

Deploy a ReplicaSet with Resource Requests and Limits
Create a YAML file named **nginx-replicaset-quota.yaml** with the following content:

```
apiVersion: apps/v1
kind: ReplicaSet
metadata:
```

```
  name: nginx-replicaset
  namespace: myns
spec:
  replicas: 5           # Desired number of Pod replicas.
  selector:
    matchLabels:
      app: nginx
  template:
    metadata:
      labels:
        app: nginx
    spec:
      containers:
      - name: nginx
        image: nginx:latest
        ports:
        - containerPort: 80
        resources:        # Define resource requests and limits.
          requests:
            memory: "100Mi"
            cpu: "100m"
          limits:
            memory: "200Mi"
            cpu: "200m"
```



Explanation:

This ReplicaSet requests a total of 500m CPU and 500Mi memory across 5 replicas.
It also limits each replica to use a maximum of 200m CPU and 200Mi memory.

Apply this YAML to create the ReplicaSet:

```
kubectl apply -f nginx-replicaset-quota.yaml
```

```
C:\Users\prati>kubectl apply -f nginx-replicaset-quota.yaml
replicaset.apps/nginx-replicaset created
```

Check the status of the Pods and ensure they are created within the constraints of the Resource Quota:

```
kubectl get pods -n myns
```

```
C:\Users\prati>kubectl get pods -n myns
NAME                     READY   STATUS              RESTARTS   AGE
nginx-replicaset-57xt6   0/1     ContainerCreating   0          7s
nginx-replicaset-5jmf2   1/1     Running             0          7s
nginx-replicaset-5nlbw   0/1     ContainerCreating   0          7s
nginx-replicaset-llqtx   0/1     ContainerCreating   0          7s
nginx-replicaset-smtq9   0/1     ContainerCreating   0          7s
```

To describe the Pods and see their resource allocations:

kubectl describe pods -l app=nginx -n quota-example

```
C:\Users\prati>kubectl describe pods -l app=nginx -n quota-example
No resources found in quota-example namespace.
```

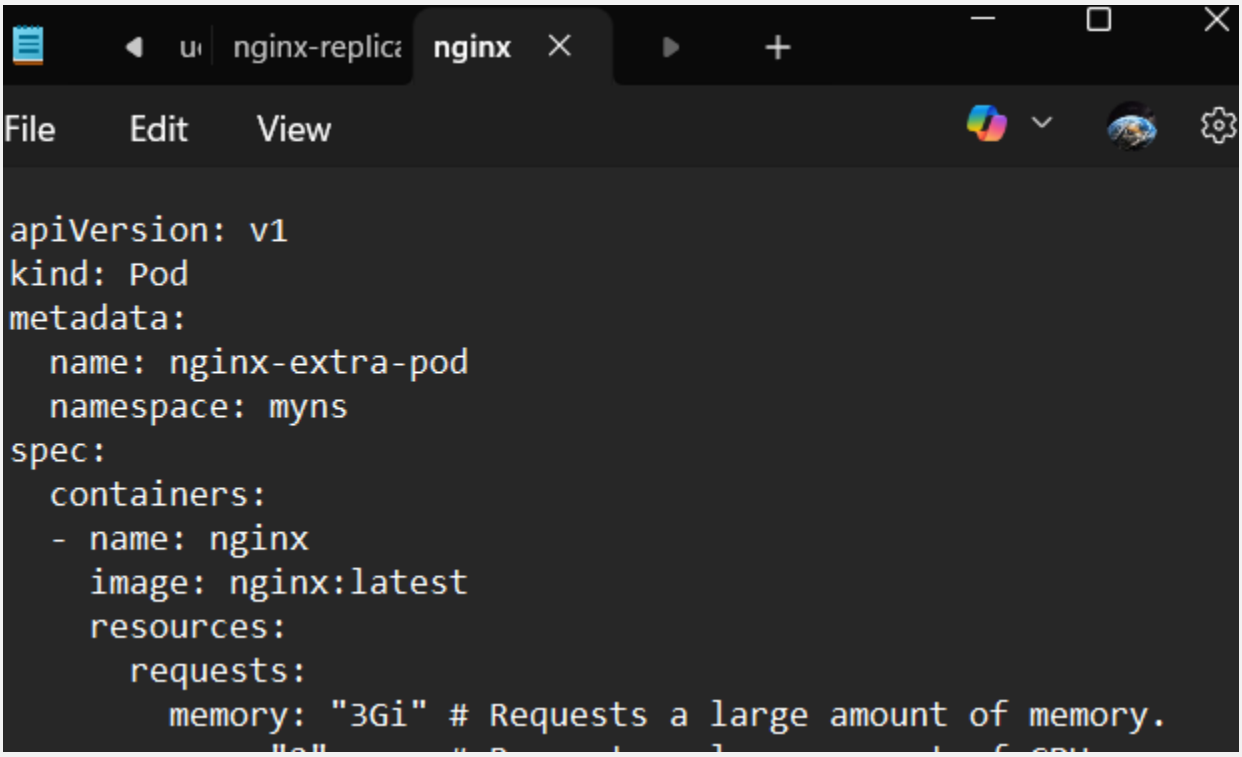
Attempt to Exceed the Resource Quota

Try creating additional resources to see if they are rejected when exceeding the quota. For example, create more Pods or increase the CPU/memory requests to exceed the quota limits.

Create a YAML file named **nginx-extra-pod.yaml** with the following content:

```
apiVersion: v1
kind: Pod
metadata:
  name: nginx-extra-pod
  namespace: myns
spec:
  containers:
  - name: nginx
    image: nginx:latest
    resources:
      requests:
```

```
    memory: "3Gi" # Requests a large amount of memory.
    cpu: "2"      # Requests a large amount of CPU.
  limits:
    memory: "4Gi"
    cpu: "2"
```



Apply this YAML to create the Pod:

```
kubectl apply -f nginx-extra-pod.yaml
```

```
C:\Users\prati>kubectl apply -f nginx-extra-pod.yaml
Error from server (Forbidden): error when creating "nginx-extra-pod.yaml": p
ods "nginx-extra-pod" is forbidden: exceeded quota: myns-quota, requested: r
equests.cpu=2, used: requests.cpu=500m, limited: requests.cpu=2
```

This should fail due to exceeding the Resource Quota. Check the events to see the failure reason:

```
kubectl get events -n quota-example
```

```
C:\Users\prati>kubectl get events -n quota-example
No resources found in quota-example namespace.
```

Look for error messages indicating that the Pod creation was denied due to resource constraints.

Step 6: Clean Up Resources

To delete the resources you created:

kubectl delete -f nginx-replicaset-quota.yaml

kubectl delete -f nginx-extra-pod.yaml

kubectl delete -f resource-quota.yaml

kubectl delete namespace myns

```
C:\Users\prati>kubectl delete -f nginx-replicaset-quota.yaml
replicaset.apps "nginx-replicaset" deleted from myns namespace

C:\Users\prati>kubectl delete -f nginx-extra-pod.yaml
Error from server (NotFound): error when deleting "nginx-extra-pod.yaml": po
ds "nginx-extra-pod" not found

C:\Users\prati>kubectl delete -f resource-quota.yaml
resourcequota "myns-quota" deleted from myns namespace

C:\Users\prati>kubectl delete namespace myns
namespace "myns" deleted
```