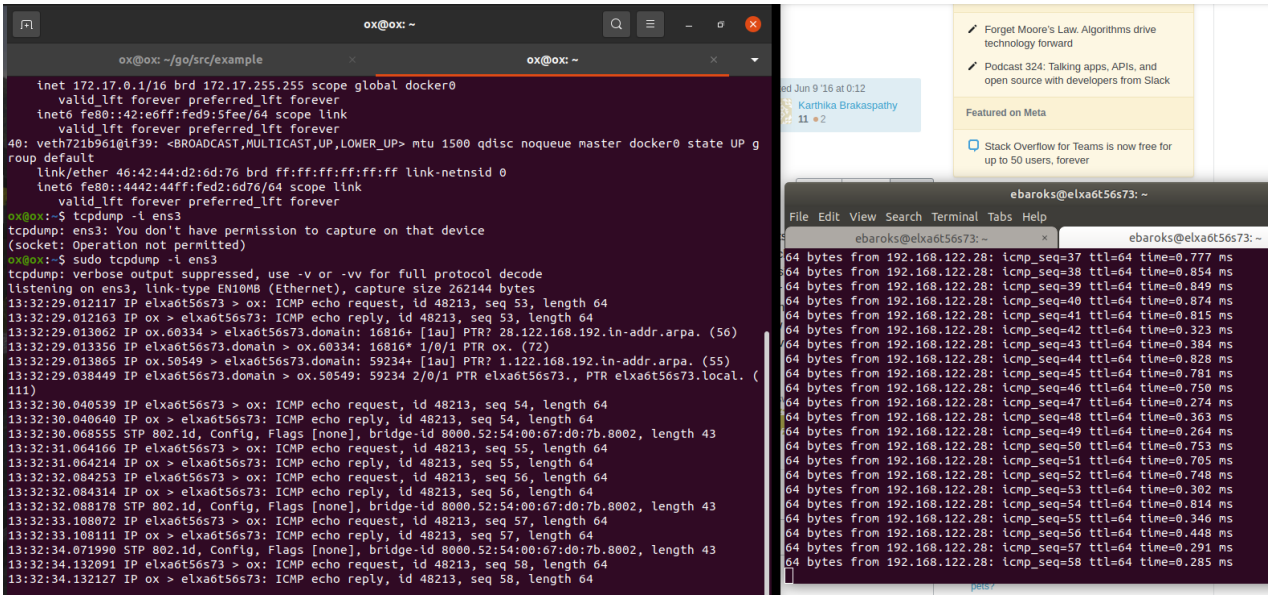
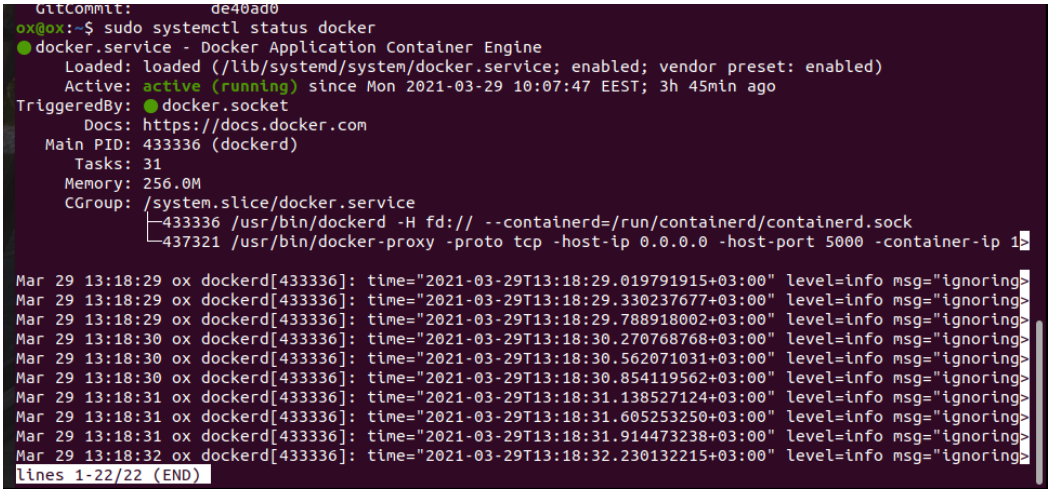
Task 1: Ubuntu VM creation, docker apache container

- Create an Ubuntu VM on a local machine.
- make sure you are able to ping the VM IP from the laptop
- Install docker on the VM
- Run apache2 container
- Open browser in laptop and access apache2 container test page which was started in the previous step.

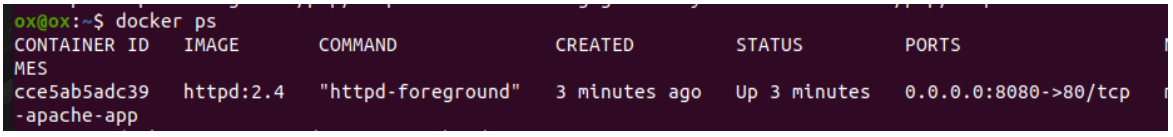
Checking connectivity between VM and host:



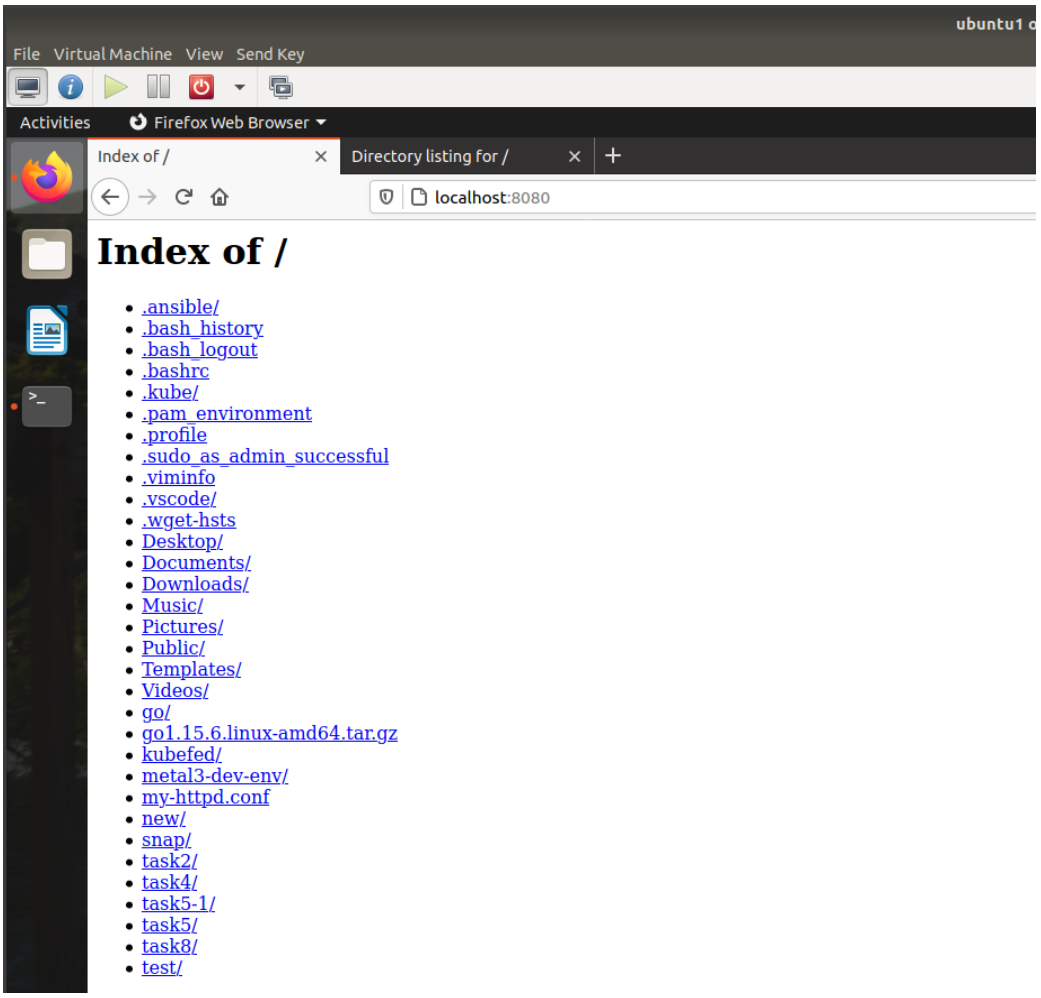
Checking the docker status:



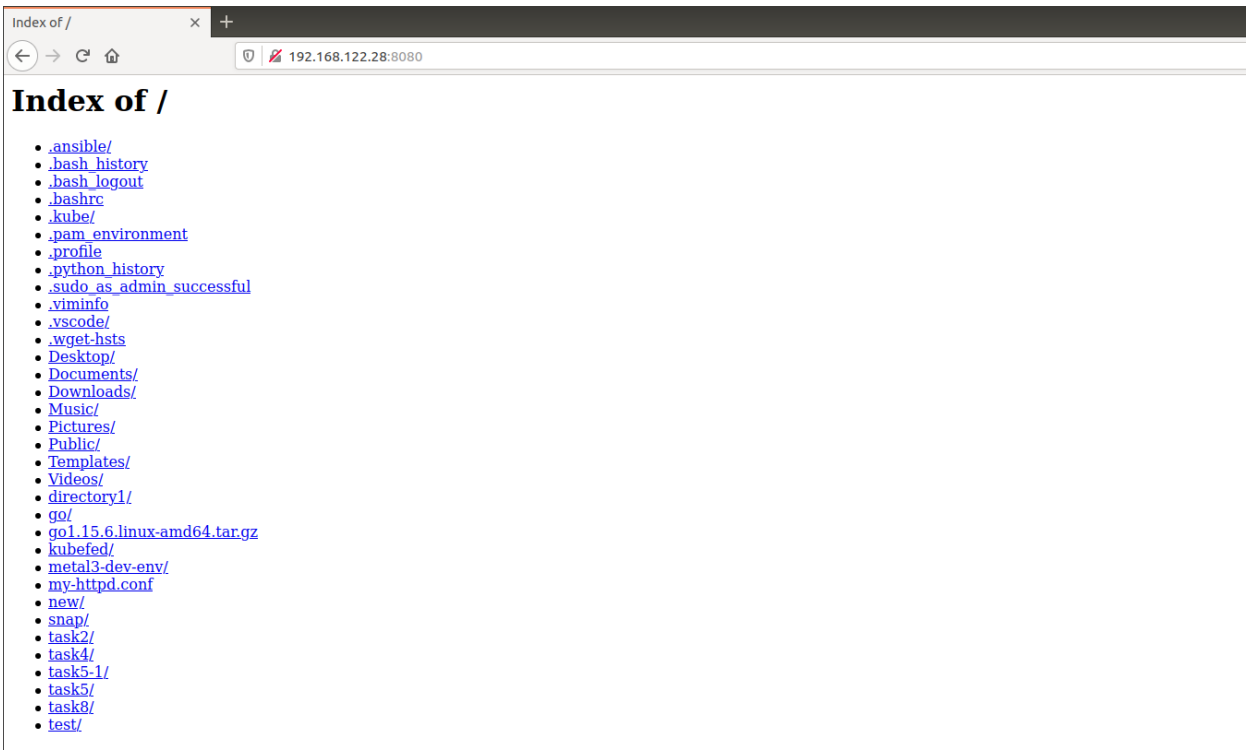
Running contaner $ `docker run -dit --name my-apache-app -p 8080:80 -v "$PWD":/usr/local/apache2/htdocs/ httpd:2.4`



Access from VM:



Access from host machine:



Task 2: Container RUN_COUNT

- Create a container by using new Dockerfile. The container should run a shell script which creates a test file and write this string in file "RUN_COUNT = 1" in it and the container should exit. When you run the container next time, it should read the file which was created on the previous run. Increment the read count value and write the updated value to the file. e.g the second time you run the container, the value in the file should be "RUN_COUNT = 2". And similarly, next time it should be "RUN_COUNT = 3"

Dockerfile

```
FROM ubuntu:18.04
WORKDIR /opt
CMD /opt/script.sh
```

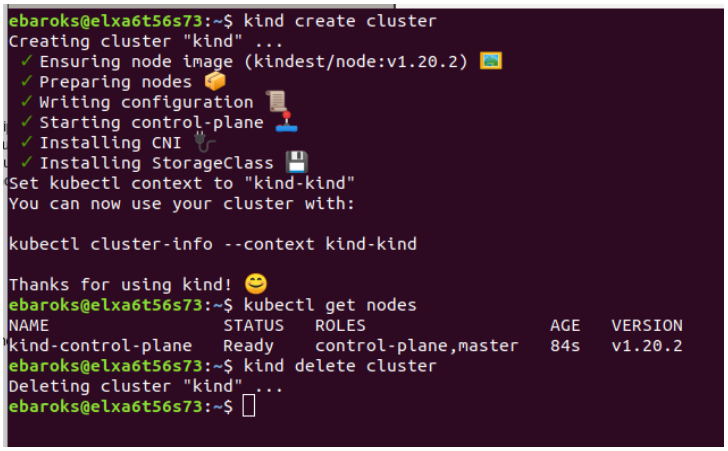
script.sh

```
#!/bin/bash

if [ ! -f /opt/test.txt ];
then
        touch /opt/test.txt
        echo "RUN_COUNT = 1" > /opt/test.txt
else
        value=`awk '{print $3}' /opt/test.txt`
        i=$(($value+1))
        echo "RUN_COUNT = $i" > /opt/test.txt
fi
```

```
ox@ox:~/task2/opt$ vi Dockerfile
ox@ox:~/task2/opt$ ls
Dockerfile  script.sh
ox@ox:~/task2/opt$ docker build -t task2:latest .
Sending build context to Docker daemon  3.072kB
Step 1/3 : FROM ubuntu:18.04
18.04: Pulling from library/ubuntu
6e0aa5e7af40: Pull complete
d47239a868b3: Pull complete
49cbb10cca85: Pull complete
Digest: sha256:122f506735a26c0a1aff2363335412cfc4f84de38326356d31ee00c2cbe52171
Status: Downloaded newer image for ubuntu:18.04
 ---> 3339fde08fc3
Step 2/3 : WORKDIR /opt
 ---> Running in e7c9cc45b00e
Removing intermediate container e7c9cc45b00e
 ---> 5c802cada013
Step 3/3 : CMD /opt/script.sh
 ---> Running in d4a1ebee2c83
Removing intermediate container d4a1ebee2c83
 ---> 0a9154e39fa8
Successfully built 0a9154e39fa8
Successfully tagged task2:latest
ox@ox:~/task2/opt$ ls
Dockerfile  script.sh
ox@ox:~/task2/opt$ mv Dockerfile ..
ox@ox:~/task2/opt$ ls
script.sh
ox@ox:~/task2/opt$ cd ..
ox@ox:~/task2$ ls
Dockerfile  opt
ox@ox:~/task2$ docker run -it -v ${PWD}/opt:/opt --name mycontianer task2:latest
ox@ox:~/task2$ ls
Dockerfile  opt
ox@ox:~/task2$ ls opt
script.sh  test.txt
ox@ox:~/task2$ cat opt/test.txt
RUN_COUNT = 1
ox@ox:~/task2$ docker start mycontianer
mycontianer
ox@ox:~/task2$ cat opt/test.txt
RUN_COUNT = 2
ox@ox:~/task2$ docker start mycontianer
mycontianer
ox@ox:~/task2$ cat opt/test.txt
RUN_COUNT = 3
ox@ox:~/task2$
```

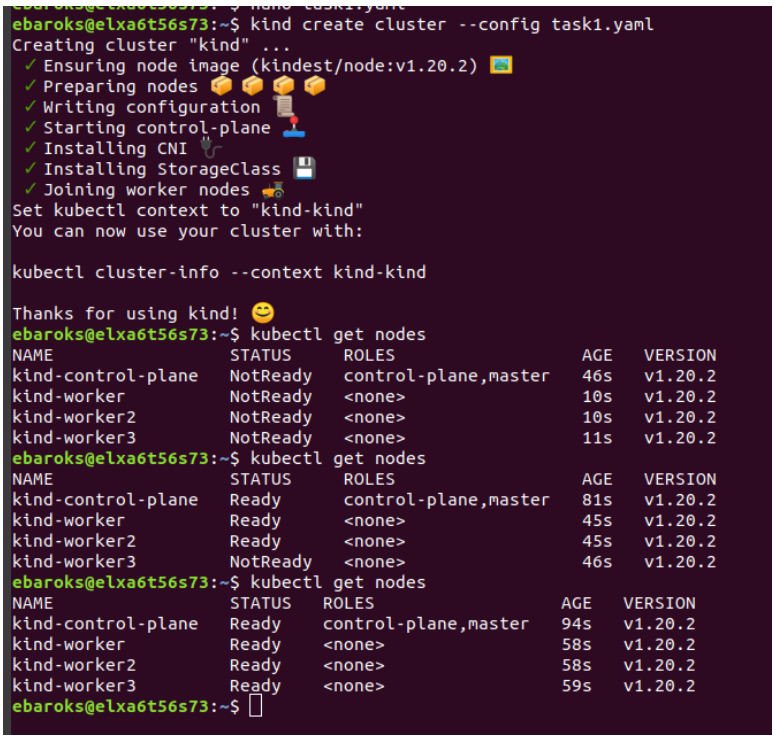
Task 3: Create Kubernetes cluster in Ubuntu VM (Using kind cluster)

- Create a kind cluster in the Ubuntu VM by following the instructions here.
https://kind.sigs.k8s.io/docs/user/quick-start/
- Once cluster is setup, run "kubectl get nodes" and verify how many kubernetes nodes exist in the cluster
- destroy the cluster
- create the kind cluster again with 4 worker nodes.



Config for multiple nodes creation:

```
# this config file contains all config fields with comments
# NOTE: this is not a particularly useful config file
kind: Cluster
apiVersion: kind.x-k8s.io/v1alpha4
# patch the generated kubeadm config with some extra settings
kubeadmConfigPatches:
- |
  apiVersion: kubelet.config.k8s.io/v1beta1
  kind: KubeletConfiguration
  evictionHard:
    nodefs.available: "0%"
# patch it further using a JSON 6902 patch
kubeadmConfigPatchesJSON6902:
- group: kubeadm.k8s.io
  version: v1beta2
  kind: ClusterConfiguration
  patch: |
    - op: add
      path: /apiServer/certSANs/-
      value: my-hostname
# 1 control plane node and 3 workers
nodes:
# the control plane node config
- role: control-plane
# the three workers
- role: worker
- role: worker
- role: worker
```



Task 4: Golang for reading YAML file

- Write a program in golang to read the following YAML file
https://stackoverflow.com/questions/30947534/how-to-read-a-yaml-file

Text

```
---
this:
  is:
    - my
    - test
    - yaml file
```

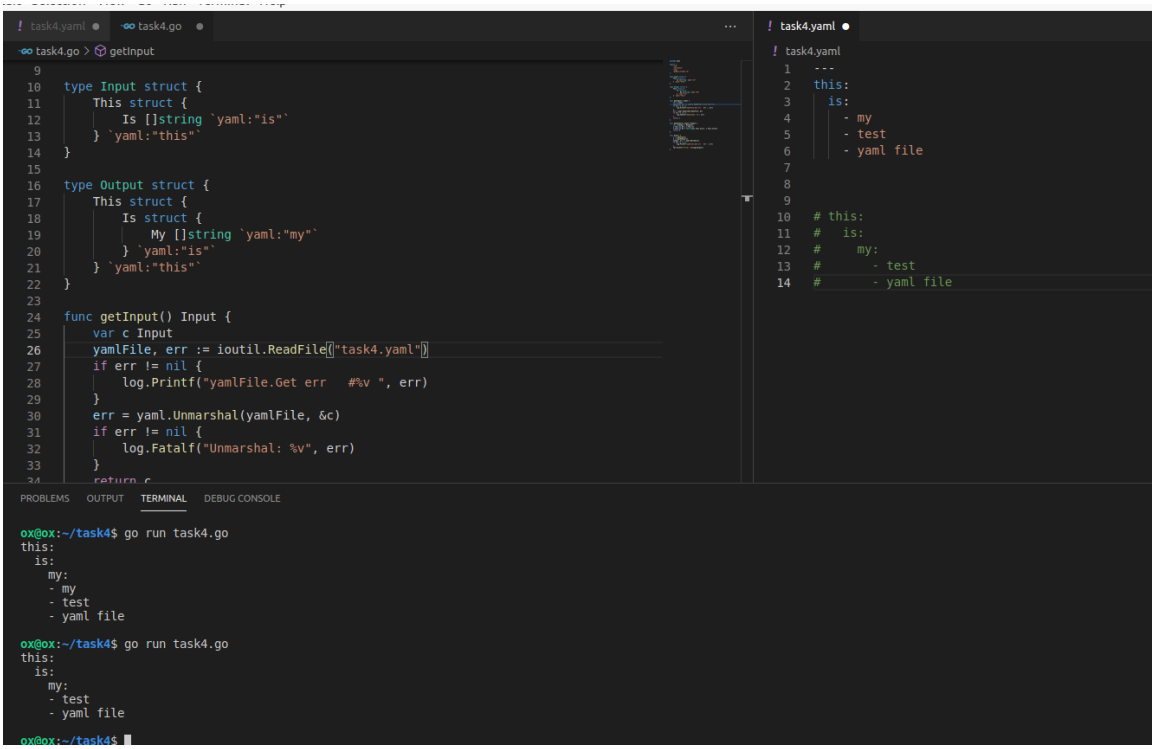
- Modify it the YAML file so that it looks like below

Text

```
---
this:
  is:
    my:
      - test
      - yaml file
```

task4.go

```
package main

import (
	"fmt"
	"io/ioutil"
	"log"

	"gopkg.in/yaml.v2"
)

type Input struct {
	This struct {
		Is []string `yaml:"is"`
	} `yaml:"this"`
}
type Output struct {
	This struct {
		Is struct {
			My []string `yaml:"my"`
		} `yaml:"is"`
	} `yaml:"this"`
}
func getInput() Input {
	var c Input
	yamlFile, err := ioutil.ReadFile("task4.yaml")
	if err != nil {
		log.Printf("yamlFile.Get err   #%v ", err)
	}
	err = yaml.Unmarshal(yamlFile, &c)
	if err != nil {
		log.Fatalf("Unmarshal: %v", err)
	}
	return c
}
func getOutput(c Input) Output {
	var o Output = Output{}
	o.This.Is.My = c.This.Is
	o.This.Is.My = []string{c.This.Is[1], c.This.Is[2]}
	return o
}
func main() {
	c := getInput()
	o := getOutput(c)
	output, err := yaml.Marshal(o)
	if err != nil {
		log.Printf("yamlFile.Get err   #%v ", err)
	}
	fmt.Printf("%+v\n", string(output))
}
```



Task 5: Use Golang Cobra to read input parameters

- Modify the program in Task 4 to take two parameters as an input, which are described below. Use Golang Cobra framework to read input parameters:

Param1 : full path for input yaml file

Param2 : username

- This time, it should read the yaml file modified by the program in the last step and modify "my:" to give the String username "username:". Check the example below

Text

```
---
this:
  is:
    username:
      - test
      - yaml file
```

MAIN.GO

```
package main

import (
	"task5_yaml/cmd"
)

func main() {
	cmd.Execute()
}
```

ROOT.GO

```
package cmd

import (
	"fmt"
	"log"
	"regexp"
	"github.com/spf13/cobra"
	"gopkg.in/yaml.v2"
)

var (
	// Used for flags.
	rootCmd = &cobra.Command{
		Use:   "task5",
		Short: "task5 application",
		Args:  cobra.ExactArgs(2),
		Run: func(cmd *cobra.Command, args []string) {
			validateUsername(args[1])
			validateYamlFile(args[0])
			C := getInput(args[0], args[1])
			output, err := yaml.Marshal(C)
			if err != nil {
				log.Printf("yamlFile.Get err   #%v ", err)
			}
			//C.This.Is = map[string][]string{args[1]: C.This.Is["username"]}
			//fmt.Println(C)
			fmt.Printf("%+v\n", string(output))
		},
	}
)

func validateUsername(username string) {
	r, _ := regexp.Compile("^[a-zA-z][a-zA-z_0-9]{0,10}")
	if !r.MatchString(username) {
		log.Fatalf("Provide a valid username")
	}
	if len(username) > 10 || len(username) < 4 {
		log.Fatalf("Provide at least 4 characters, or your username is too long")
	}
}

func validateYamlFile(filename string) {
	r, _ := regexp.Compile("^.*(yaml)$")
	if !r.MatchString(filename) {
		log.Fatalf("Provide a yaml file")
	}
}

func Execute() error {
	return rootCmd.Execute()
}
```

TASK5.GO

```
package cmd

import (
	"io/ioutil"
```

```
	"log"
	"gopkg.in/yaml.v2"
)

type Input struct {
	This struct {
		Is map[string][]string `yaml:"is"`
	} `yaml:"this"`
}

func getInput(filename string, username string) Input {
	var c Input
	yamlFile, err := ioutil.ReadFile(filename)
	if err != nil {
		log.Printf("yamlFile.Get err   #%v ", err)
	}
	err = yaml.Unmarshal(yamlFile, &c)
	if err != nil {
		log.Fatalf("Unmarshal: %v", err)
	}
	c.This.Is[username] = c.This.Is["my"]
	delete(c.This.Is, "my")
	return c
}
```

Task 6: Packaging and running program in kubernetes

- Create a container to package the binary built in Task 5. make sure the container does not exit after the binary has exited and hang indefinitely until the container is killed.
- Push the container to any publicly accessible docker registry
- write manifests so that the container is run on the kind cluster created in Task 3
- You should be able to provide the input YAML file using a config map.
- Check the output of the program by going to the container running in Kubernetes and verify the file is modified.

Dockerfile

```
FROM golang:1.16-alpine AS build

WORKDIR /app/
#COPY main.go go.* /app/
COPY . /app
RUN CGO_ENABLED=0 go build

FROM alpine
WORKDIR /app/
COPY script.sh /app
COPY --from=build /app/task5_yaml /app/task5_yaml
ENTRYPOINT ["/app/script.sh"]
```

script.sh

```
#!/bin/sh
./task5_yaml $*
while true; do sleep 1000; done
```

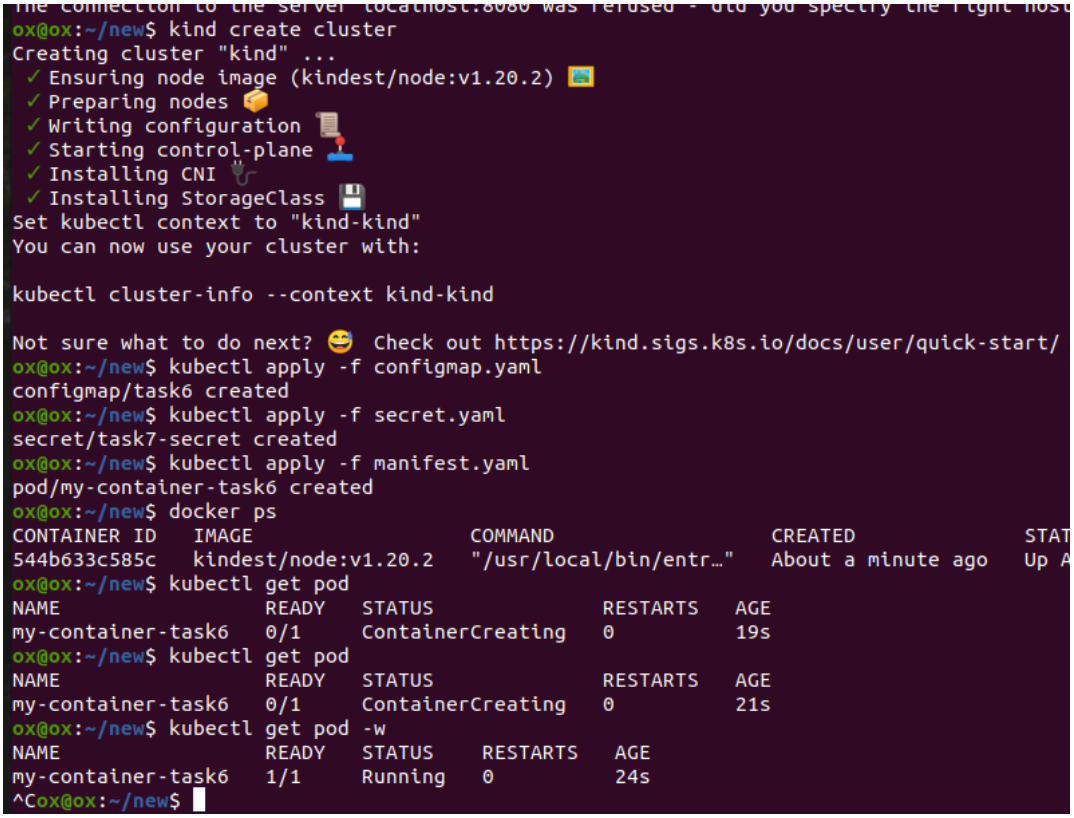
manifest.yaml

```
        apiVersion: v1
        kind: Pod
        metadata:
          name: my-container-task6
        spec:
          hostNetwork: true
          containers:
            - name: task5image
              image: ebaroks/imagetask6
              args: ['/tmp/task5.yaml', 'username']
              volumeMounts:
              - name: configvolume
                mountPath: /tmp/task5.yaml
                subPath: task5.yaml
              env:
              - name: CONFIG_USERNAME
                valueFrom:
                  secretKeyRef:
                    name: task7-secret
                    key: username
              - name: CONFIG_PASSWORD
                valueFrom:
                  secretKeyRef:
                    name: task7-secret
                    key: password
          volumes:
            - name: configvolume
              configMap:
                name: task6
```

configmap.yaml

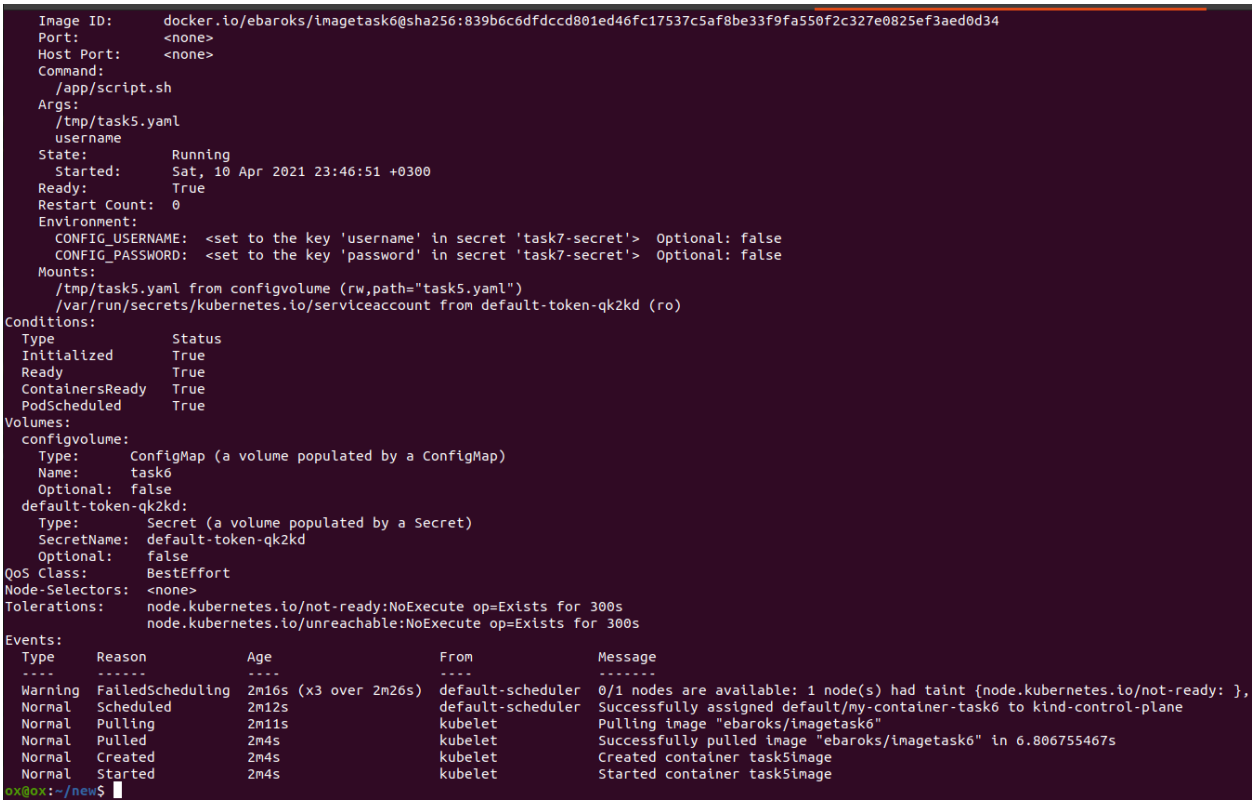
```
apiVersion: v1
kind: ConfigMap
metadata:
  name: task6
data:
  task5.yaml: |
    this:
      is:
        my:
          - test
          - yaml file
```

Running the container with a binary inside:



```
The connection to the server localhost:8080 was refused - did you specify the right host
ox@ox:~/new$ kind create cluster
Creating cluster "kind" ...
 ✓ Ensuring node image (kindest/node:v1.20.2) 🖼
 ✓ Preparing nodes 📦
 ✓ Writing configuration 📜
 ✓ Starting control-plane 🕹️
 ✓ Installing CNI 🔌
 ✓ Installing StorageClass 💾
Set kubectl context to "kind-kind"
You can now use your cluster with:

kubectl cluster-info --context kind-kind

Not sure what to do next? 😅  Check out https://kind.sigs.k8s.io/docs/user/quick-start/
ox@ox:~/new$ kubectl apply -f configmap.yaml
configmap/task6 created
ox@ox:~/new$ kubectl apply -f secret.yaml
secret/task7-secret created
ox@ox:~/new$ kubectl apply -f manifest.yaml
pod/my-container-task6 created
ox@ox:~/new$ docker ps
CONTAINER ID   IMAGE                  COMMAND                  CREATED              STAT
544b633c585c   kindest/node:v1.20.2   "/usr/local/bin/entr…"   About a minute ago   Up A
ox@ox:~/new$ kubectl get pod
NAME                READY   STATUS              RESTARTS   AGE
my-container-task6   0/1     ContainerCreating   0          19s
ox@ox:~/new$ kubectl get pod
NAME                READY   STATUS              RESTARTS   AGE
my-container-task6   0/1     ContainerCreating   0          21s
ox@ox:~/new$ kubectl get pod -w
NAME                READY   STATUS    RESTARTS   AGE
my-container-task6   1/1     Running   0          24s
^Cox@ox:~/new$
```

Description of the running container



```
    Image ID:      docker.io/ebaroks/imagetask6@sha256:839b6c6dfdccd801ed46fc17537c5af8be33f9fa550f2c327e0825ef3aed0d34
    Port:          <none>
    Host Port:     <none>
    Command:
      /app/script.sh
    Args:
      /tmp/task5.yaml
      username
    State:          Running
      Started:      Sat, 10 Apr 2021 23:46:51 +0300
    Ready:          True
    Restart Count:  0
    Environment:
      CONFIG_USERNAME:  <set to the key 'username' in secret 'task7-secret'>  Optional: false
      CONFIG_PASSWORD:  <set to the key 'password' in secret 'task7-secret'>  Optional: false
    Mounts:
      /tmp/task5.yaml from configvolume (rw,path="task5.yaml")
      /var/run/secrets/kubernetes.io/serviceaccount from default-token-qk2kd (ro)
Conditions:
  Type              Status
  Initialized       True
  Ready             True
  ContainersReady   True
  PodScheduled      True
Volumes:
  configvolume:
    Type:      ConfigMap (a volume populated by a ConfigMap)
    Name:      task6
    Optional:  false
  default-token-qk2kd:
    Type:        Secret (a volume populated by a Secret)
    SecretName:  default-token-qk2kd
    Optional:    false
QoS Class:       BestEffort
Node-Selectors:  <none>
Tolerations:     node.kubernetes.io/not-ready:NoExecute op=Exists for 300s
                 node.kubernetes.io/unreachable:NoExecute op=Exists for 300s
Events:
  Type     Reason            Age                  From               Message
  ----     ------            ----                 ----               -------
  Warning  FailedScheduling  2m16s (x3 over 2m26s)  default-scheduler  0/1 nodes are available: 1 node(s) had taint {node.kubernetes.io/not-ready: },
  Normal   Scheduled         2m12s                default-scheduler  Successfully assigned default/my-container-task6 to kind-control-plane
  Normal   Pulling           2m11s                kubelet            Pulling image "ebaroks/imagetask6"
  Normal   Pulled            2m4s                 kubelet            Successfully pulled image "ebaroks/imagetask6" in 6.806755467s
  Normal   Created           2m4s                 kubelet            Created container task5image
  Normal   Started           2m4s                 kubelet            Started container task5image
ox@ox:~/new$
```

Task 7: Using Kubernetes secrets
- Now modify the manifest in Task 6 and provide the input file using a secret this time.

secret.yaml

```
apiVersion: v1
kind: Secret
metadata:
   name: task7-secret
   type: Opaque
   data:
      username: dXNlcm5hbWU=
      password: cGFzc3dvcmQ=
```

Secrets are attached to the Pod via Environment variables (CONFIG_USERNAME, CONFIG_PASSWORD). Configmap from the task6 is attached to the Pod via Volume.

Task 8: Using kubernetes client-go library
- Write a small program that reads Kubernetes manifest files created in Task 6 and create the same container using the golang code, without using the kubectl.
- You can use the client-go library in golang for this purpose.

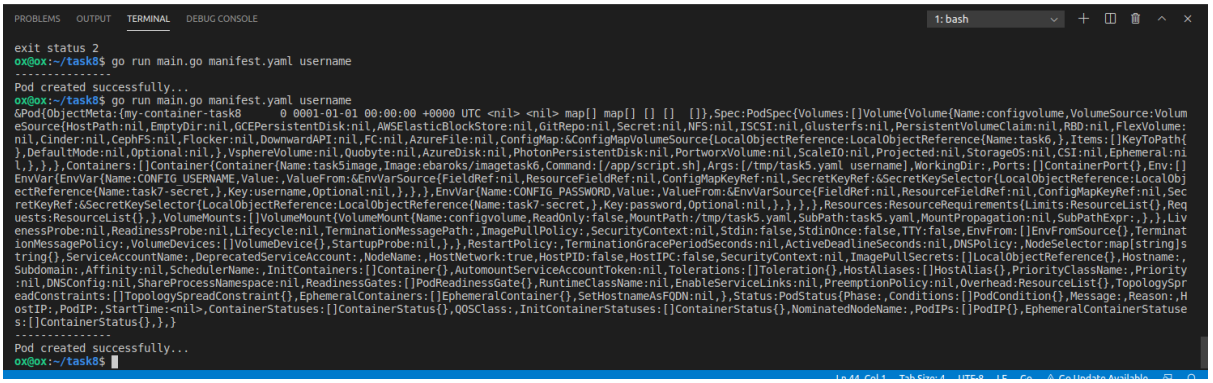
The following resources were used to write a program:
https://github.com/kubernetes/client-go/
https://pkg.go.dev/k8s.io/api/core/v1
https://v1-16.docs.kubernetes.io/docs/reference/generated/kubernetes-api/v1.16/#pod-v1-core
https://gist.github.com/dlorenc/2ac000a25656447a0c06e79150407b4c k8s yaml parse
https://github.com/hossainemruz/k8s-client-go-practice/blob/56eeb12f1ce54d3fe4d428e7546d70cd5bde3b50/main.go client go clientset

task5.go

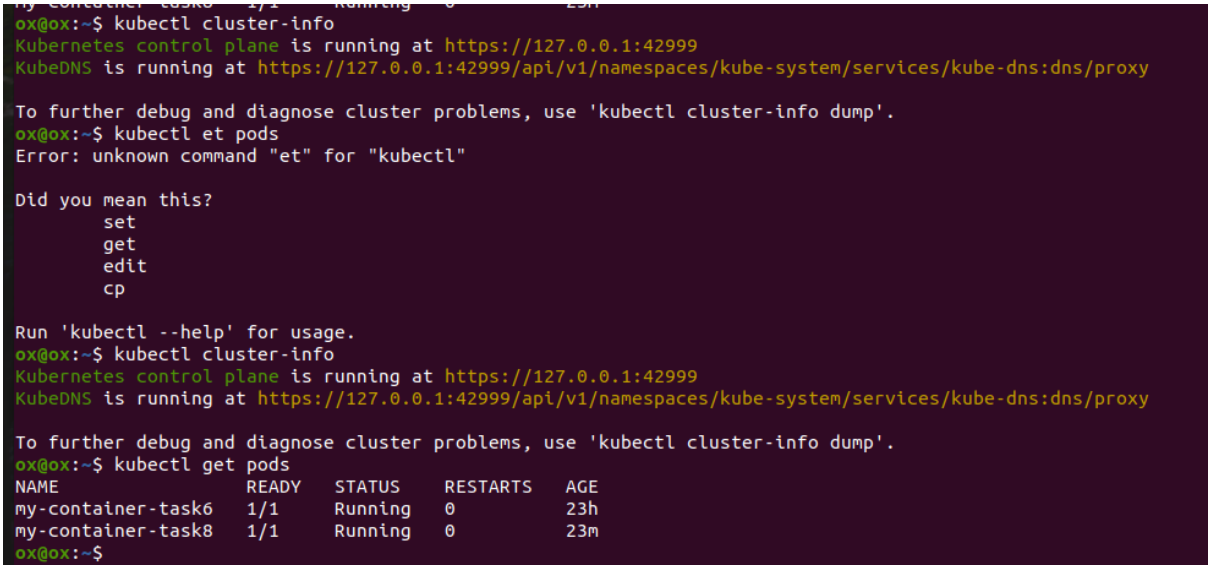
```
package cmd
import (
	"bufio"
	"context"
	"fmt"
	"io"
	"log"
	"os"
	"path/filepath"
	core "k8s.io/api/core/v1"
	metav1 "k8s.io/apimachinery/pkg/apis/meta/v1"
	"k8s.io/apimachinery/pkg/runtime"
	"k8s.io/apimachinery/pkg/util/yaml"
	"k8s.io/client-go/kubernetes"
	"k8s.io/client-go/kubernetes/scheme"
	"k8s.io/client-go/tools/clientcmd"
	"k8s.io/client-go/util/homedir"
)

func deployManifest(filename string, username string) {
	f, err := os.Open(filename)
	if err != nil {
		log.Fatalf("yamlFile.Get err   #%v ", err)
	}
	defer f.Close()
	b := bufio.NewReader(f)
```

```
	r := yaml.NewYAMLReader(b)

	doc, err := r.Read()
	if err == io.EOF {
		log.Fatalf("Empty Yaml file: %s\n%s", filename, err)
	}
	if err != nil {
		log.Fatal(err)
	}
	d := scheme.Codecs.UniversalDeserializer()
	obj, _, err := d.Decode(doc, nil, nil)
	if err != nil {
		log.Fatalf("could not decode yaml: %s\n%s", filename, err)
	}
	fmt.Println(obj)
	fmt.Println("---------------")
	clientset := createClientSet()
	deployPod(clientset, obj)
}
func createClientSet() *kubernetes.Clientset {
	// var kubeconfig *string
	// if home := homedir.HomeDir(); home != "" { // check if machine has home directory.
	//	// read kubeconfig flag. if not provided use config file $HOME/.kube/config
	//	kubeconfig = flag.String("kubeconfig", filepath.Join(home, ".kube", "config"), "(optional)
absolute path to the kubeconfig file")
	// } else {
	//	kubeconfig = flag.String("kubeconfig", "", "absolute path to the kubeconfig file")
	// }
	// flag.Parse()
	home := homedir.HomeDir()
	kubeconfig := filepath.Join(home, ".kube", "config")

	// build configuration from the config file.
	config, err := clientcmd.BuildConfigFromFlags("", kubeconfig)
	if err != nil {
		panic(err)
	}
	// create kubernetes clientset. this clientset can be used to create,delete,patch,list etc for the kubernetes
resources
	clientset, err := kubernetes.NewForConfig(config)
	if err != nil {
		panic(err)
	}
	return clientset
}

func deployPod(clientset *kubernetes.Clientset, obj runtime.Object) {
	// now create the pod in kubernetes cluster using the clientset
	podobj := obj.(*core.Pod)
	_, err := clientset.CoreV1().Pods("default").Create(context.Background(), podobj,
		metav1.CreateOptions{})
	if err != nil {
		panic(err)
	}
	fmt.Println("Pod created successfully...")
}
```

Output of the running program:



Check container creation:



The code written for the tasks can be found here:
https://github.com/oksanabaranova/Learning_tasks